



15th ICEEE-2024



ÓBUDA UNIVERSITY

REJTŐ SÁNDOR FACULTY OF LIGHT INDUSTRY
AND ENVIRONMENTAL ENGINEERING



15th ICEEE-2024

Proceedings Book
International Annual
Conference
on
“Global Environmental
Development & Sustainability:
Research, Engineering &
Management”

21 – 22 of November 2024

Obuda University
Budapest - Hungary



15th ICEEE-2024

**The 15th ICEEE-2024 Online
International Annual Conference on
“Global Environmental Development & Sustainability: Research, Engineering & Management”**



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**15th ICEEE-2024
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“Global Environmental Development & Sustainability: Research,
Engineering & Management”**



Considering the unprecedented circumstances, and the uncertainty due to the travel restrictions imposed by different countries, the Organizing Committee has made the decision to hold the Conference virtually.

Online

November 21st – 22nd, 2024
RKK – Obuda University
Budapest – Hungary



The 15th ICEEE-2024 Online
International Annual Conference on
“Global Environmental Development & Sustainability: Research, Engineering & Management”

2-DAY EVENT Online
International Annual Conference on
“Global Environmental Development & Sustainability:
Research, Engineering & Management”

PROCEEDINGS BOOK (PROGRAM, ABSTRACT & Full Papers)

Venue:
Obuda University
Budapest, Hungary

Date:
November 21 - 22, 2024

Editor-in-Chief
Prof. Dr. Hosam BAYOUMI Hamuda



The 15th ICEEE-2024 Online
International Annual Conference on
“Global Environmental Development & Sustainability: Research, Engineering & Management”

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Welcome Message

Dear Academics and Researchers!

Dear Friends!

Building on decades of work, in 2015 the United Nations (UN) Member States unanimously adopted the Sustainable Development Goals (SDGs), which identify areas with the most need within society. All 17 goals address key actions for improving health, reducing inequity, and working to challenge climate change and injustice. The 17 Sustainable Development Goals (SDGs) are:

- Goal 1: No Poverty
- Goal 2: Zero Hunger
- Goal 3: Good Health and Well-Being
- Goal 4: Quality Education
- Goal 5: Gender Equality
- Goal 6: Clean Water and Sanitation
- Goal 7: Affordable and Clean Energy
- Goal 8: Decent Work and Economic Growth
- Goal 9: Industry, Innovation and Infrastructure
- Goal 10: Reduced Inequalities
- Goal 11: Sustainable Cities and Communities
- Goal 12: Responsible Consumption and Production
- Goal 13: Climate Action
- Goal 14: Life Below Water
- Goal 15: Life on Land
- Goal 16: Peace, Justice and Strong Institutions
- Goal 17: Partnerships for the Goals

Sustainable Development Goals represent a global strategy for facing global instabilities within the realms of economic development, social inclusion, and environmental sustainability. Ensuring Sustainable Development Goal 6 of the UNs aims to ensure availability and sustainable management of water and sanitation for all. Clean water and sanitation are essential for human health and well-being, and critical for sustainable development.

Our planet earth is facing an unprecedented level of environmental crisis. Increasing human population demands more usage of consumable items thus causes more destruction to the environment by developing advanced materials and technologies. As innovations in worldwide



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face a variety of challenges arising from environmental changes, it has become a global concern to adopt a sustainable development strategy that ensures "harmonious symbiosis" between innovation and nature. "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". With the continuous increase in global population and the escalating impact of climate change, biosphere is facing unprecedented challenges.

At this critical juncture, achieving sustainable environment. Environmental sustainability is a significant global issue. It is commonly known that human activity affects public health, depletes non-renewable resources; damages plant habitat, growth, and development; and affects soil health in addition to creating environmental degradation.

The utilization of solar-powered electricity represents a highly effective strategy for enhancing renewable energy generation in worldwide. The abundant energy from solar radiation and the decreasing costs of PV modules have led to an increased demand for grid-tied PV power plants

Environmental degradation and its severe repercussions have brought renewable energy sources to global attention. Although renewable energy sources require a higher initial investment, their low operating costs and minimal pollution encourage increased adoption worldwide. As an outcome, several countries are starting to recognize wind and solar power as an attractive possibility for future electrical power generation.

Sustainable development can satisfy today's needs without endangering the capacity of future generations. It comprises four basic elements that must complement one another: environmental, economic, educational, and social sustainability. Accelerated urbanisation has resulted in the deterioration of the environment of cities and loss of quality of life. Energy-saving and eco-friendly building designs have become an important part of modern development. Clean water and sanitation are crucial for human development.

The world has been dealing with issues related to pollution and its effects on the environment. Amongst them one is the improper waste disposal and management of solid waste. This is a major challenge to sustainable development. Improper disposal of waste leads to health hazards for living beings as it worsens the quality of the environment.

There is lack of understanding of sustainability literacy of environmental engineers, economists and who working in healthcare and public health sectors and the extent their literacy level can contribute to sustainability performance in environment and human health in worldwide. The



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quality and stability of the environment are inevitable requirements of sustainable development, and previous studies have confirmed that digital economy and technological innovation have a positive enabling effect on the quality of worldwide environment.

The focus of the conference is to review the situation with respect to sustainable development strategies and examine the existing strategy processes adopted particularly by worldwide countries. In many countries, there is a range of past and current strategic planning approaches at both national levels. Some of these include National Development Plans, National Visions, Sub-National Strategies, and Plans, Sector and Cross Sectoral Plans and Strategies, such as National Environmental Action Plans, and Strategies Related to Conventions. In the developing countries, many of these, especially, the last two categories, have been externally conceived, motivated and promoted by multilateral development banks, developing cooperation agencies, UN organizations, international non-governmental organizations (NGOs), and other external organizations- often as planning mechanisms to implement international agreements or as conditions for securing financial assistance.

Few of these organizations have adopted or built on the systems, mechanisms and practices that were operating in the country for some time., such as national development plans, local plans and other community participation mechanisms. Furthermore, these approaches have been in developing countries as time-bound projects, rather than ongoing policy mechanisms, mainly by donors who have provided financial support and technical assistance, partly as a framework for planning aid support. Also, there has been limited emphasis placed by their sponsors on generating national ownership and establishing participatory processes for their elaboration.

The rapid population growth has led to the production of a substantial volume of municipal solid waste, and landfills which have led to an increase of emerging contaminants in the environment, and heavy metal contamination in soils, water, and food. This is a considerable civic health issue which has been extensively researched worldwide, but no definitive resolutions have yet been proposed. Amongst emerging contaminants, the contamination of pesticides, xenobiotics, microplastic pollution, artificial dye, cosmetic products, cleaning products, detergents, pharmacological products like antibiotics and hormones are particularly worrying in many regions globally.

Increased water pollution is closely linked to industrial, agricultural, and residential activities, which may have detrimental effects on the health of humans, animals, and/or other living things as well as biosphere. Organic pollutants found in water include pesticides, dyes, nitroarenes, chlorobenzene, and phenolic compounds, while inorganic contaminants include heavy metals



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and their salts and pathogens. Understanding the ecotoxicological aspects of substances is an important element in the sustainability of water/wastewater treatment.

Human health effects associated with e.g., healthy nutrition, food and clean water securities, air pollution are related to respiratory problems, mainly correlated with time exposure of people to particulate matter. Dramatic changes in the atmosphere due to a surge in acid substances have become one of the most serious environmental problems in the last century.

Due to climate change and extreme weather events, natural disasters are occurring more frequently, which makes the study of their effects, not only environmental but also economic and social, gain relevance. Climate change poses a serious risk to human life in the worldwide. Researchers are required towards supporting global vision to meet 50% of energy requirements and achieving net zero emissions by 2070.

The relation between economic development and environmental protection has gained widespread attention. Energy, economic, and environmental analyses, and technical analysis, are important requirements in all sectors of environmental projects. Further research is essential to gain an in-depth understanding of the complex links between career incentives and the environment in worldwide.

Under the climatic change and variations in the air quality which affect the productivity of the agriculture, the aim of the session of the 15th ICEEE-2024 issue is to enhance our understanding of how the organic food market operates. A better understanding of the drivers and mechanisms of the organic food market is crucial to understand how different trends and policies will affect market actors (producers, consumers, traders, etc.) in future. To this end, the proposed session will cover all stages from production, trade, retail to consumption. It would include analyses on the economic modelling of organic production systems, the flow of goods within the organic agri-food system, the role of trade of organic food, demand preferences for organic food (also vs. conventional food), the estimation of demand systems, as well as the impact and scenario analyses of policies designed to expand the share of organic food.

objectives of the 15th ICEEE-2024 event are to bring together world-class professional participants and young researchers looking for opportunities for exchanges the scientific knowledge that cross the traditional discipline boundaries and allows them to resolve multidisciplinary challenging problems that only a venue of this nature can offer. The 15th ICEEE-2024 annual international conference provides a platform of international standards



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where the participants can discuss and share persuasive key advances in *Global Environmental Development & Sustainability: Research, Engineering & Management*.

The 15th ICEEE-2024 conference on *Global Environmental Development & Sustainability: Research, Engineering & Management* is organized to bring together researchers, specialists and stakeholders from around the globe to share information and experience. The conference is designed to develop strategies around some of the core issues concerning how to develop strategies for a Sustainable Development and Environmental Protection all over the World.

to the Conference! This issue of this conference explores the understanding present situation our planet and highlights UN SDGs promoting sustainable practices and natural resource protection.

Yours sincerely

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ACKNOWLEDGMENT

Dear Guests and Colleagues

Thank you very much for your attendance in the 15th ICEEE-2024 International Annual Conference dealing with the Global Environmental Development & Sustainability: Research, Engineering & Management, which was in Budapest during 21st -22nd of November 2024, online in Budapest at Obuda University, Hungary.

15th ICEEE-2024 is a conference where researchers, environmentalists, scientists, scholars and students, share their ideas, experiences, advancements, and research results. There were plenty of opportunities for organisations, projects and consortia to hold side events (meetings, seminars and workshops) on the Conference site to draw insights and encourage collaboration from many topics, disciplines, and backgrounds, promoting research and education to build a fair global community and more sustainable societies.

The purpose of the 15th ICEEE-2024 Conference deals with „Global Environmental Development & Sustainability: Research, Engineering & Management”. Environmental Sustainability is projected to harm human health through adverse changes in security of the lifestyle.

The 15th ICEEE-2024 Conference bring together keynote, invited speakers and international researchers from academia, authorities and industry, to communicate and share a wide range of highlighting potential issues and paths towards the environmental health and the sustainable due to climate change at present and future. The following core conference themes reflect an integrated approach to identifying solutions to the complex global challenge of environmental quality.

As a part of the framework of the Hungarian Scientific Season in Budapest, Hungary and after a great successful of the last International Annual Conferences of ICEEE during the period between 2010 and 2020, which brought together the world's professions and practitioners from different fields of applied sciences and environmental engineering, the International Council of Environmental Engineering Education (ICEEE) with the cooperation with the Obuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering (RKK), Institute of Environmental Engineering and Natural Sciences had the great pleasure to welcome all of you as a speaker and contributor for our conference the 15th ICEEE-2024 International Annual Conference on “Global Environmental Development & Sustainability: Research, Engineering & Management” which is going online here in Budapest today November 21st to 22nd 2024 in Budapest, Hungary.



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The main goals of the conference are to promote research and developmental activities in Environmental Protection and different fields of Natural Science; and to promote scientific information interchange between researchers, developers, engineers, students, and practitioners working in and around the world.

This conference was provided the opportunities for the delegates to exchange new ideas and application experiences face to face, to establish business or research relations and to find global partners for future collaboration.

Here, the organizing committee of the conference identify opportunities for international, civil society, global partners, and researchers to contribute to a high quality of global effort towards environmental health systems. The organizing committee of the conference could thank the contributors and the reviewers for their activities and their work to review the manuscripts of the participants.

At the end, the organizing committee of the conference wish all the best for all the participants and thank their attendance.

We, the president of ICEEE and the chairman of the Conference, would like to thank the members of the organizing, scientific, and administrative committees and all the supporting staff for giving this opportunity.

We would also like to extend our sincere thanks to all the contributors and reviewers who have made this Program Book possible.

We hope that the papers in this Program Book will inspire further research and innovation in this important field.

Sincerely,

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IMPRESSUM

- For the Program, Abstracts and the Proceedings Book of the papers of the 15th ICEEE-2024 Conference titled: "Global Environmental Development & Sustainability: Research, Engineering & Management"
- – The Conference is: ONLINE, FREE OF CHARGE
- Dates of the Conference: November 21 - 22, 2024
- Host Place: Obuda University, Budapest – Hungary
- The languages of conference: English.
- *The program, abstracts and full papers will be published in Proceedings book with ISBN number after the conference.*
- *After the Conference, each participant who makes a presentation will be sent a "Participation Certificate" and to those selected, "The Best Presentation and Paper Award" document will be sent by e-mail.*
- The deadline for registration and submitting the abstract: 7th of November 2024.
- The deadline for submitting the Full paper: 30th of December 2024.
- *The Program, Abstracts and Full papers of the Conference is provided to all registered participants in online (electronic) form.*
- *All the received papers will be reviewed by two of the members of the International Committee of the Conference. – All reviewed papers for the 15th ICEEE-2024 International Annual Conference will be published in the Conference Proceedings Book with the ISBN 978-963-449-388-4. in CD-ROM format and online (electronic) on the website of ICEEE: www.iceee.hu*
- *The selected high-quality manuscripts will be also published in the online journal.*
- *The scientific information and quality of the manuscript is due to the corresponding author of the paper.*
- *Authors at their manuscripts will be responsible for any possible errors*
- *The Publisher of the Program, abstracts and the full Proceedings Book of the International Annual Conference is the ICEEE, Institute of Environmental*



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Engineering and Natural Sciences, Rejto Sandor Faculty of Light Industry and Environmental Engineering, Obuda University, Budapest, Hungary.

- *Publication year of the Proceedings is 2024.*
- *Important Website: www.iceee.hu*
- *The Conference is organised in the framework of the Hungarian Scientific Season (Hungarian Scientific Festival).*
- *The publication policy of the ICEEE offer you a chance to publish your full paper in Euro-Mediterranean Journal for Environmental Integration or which is related to Springer publishing house (<https://www.springer.com/journal/41207>) which is an indexed journal or Desalination and Water Treatment Journal (<https://www.deswater.com>)*
- *You can submit your paper (with max. 20% of similarity) to this journal and they well have a direct connection with you. But you must mention your wish to us.*
- *The 15th ICEEE-2024 will be held through Microsoft Teams.*
- *To join the Conference:*
 - a) *There is a short guide with useful information about how to use the Microsoft Teams during the Conference*
 - b) *The participants will have the link of the Conference.*
 - c) *The time of the Conference is related to the Hungarian time.*
 - *Please check the time with your time at home*
 - *Time of Presentations Online (Microsoft Teams)*

Presentation Type:

Total Allotted Time:

• Plenary speaker	25 min
• Keynote speaker	20 min
• Featured speaker	10 min
• Poster	5 min

Please note that:

- ✚ The time is very limited.



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✚ The official language of all the presentations including oral or poster speaker is English.

For Full paper:

The deadline to send the full paper is the end of December (30th of December 2024) in word document form.

November 2024.

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Statistical Analysis of the 15th International Annual ICEEE-2024 Conference

The International Council of Environmental Engineering Education (ICEEE) had the pleasure to announce about the 15th International Annual ICEEE-2024 Online (Microsoft Teams) Conference

Topic: *Global Environmental Development & Sustainability: Research, Engineering & Management*

Total presentations: 166

The participants in this Conference came from 29 countries covering as examples of Africa, Asia, Europe, N. and S. of America, Australia.

Nationalities: 43

Albania, Algeria, Australia, Bangladesh, Benin, Bulgaria, Canada, China, Czech Republic, Egypt, Ethiopia, Finland, France, Germany, Hungary, India, Italy, Iran, Iraq, Kazakhstan, Kuwait, Lebanon, Libya, Malaysia, Mexico, Morocco, Nepal, Netherlands, Nigeria, Philippines, Poland, Portugal, Pakistan, Rwanda, Slovakia, South Africa, Sweden, Syria, Tunisia, Turkey, Ukraine, Uzbekistan, and USA.

Total given scientific abstracts covering the following technical sessions were 166 classified as following:

Plenary Lectures: 7

Workshop Keynote Lecture: 1

Technical Sessions: 99 Lectures

- A. Sustainable Development & Environmental Protection
- B. Healthcare & Public Health Sustainability: Risk & Management
- C. Soil Biology & Agricultural Sustainability
- D. Sustainability of Water, Sediments & Waste Management
- E. Sustainability of Circular (Bio)Economy Strategy of Recycling, & Energy
- F. Air Pollution & Ecosystems & Landscape
- G. Applied & Natural Sciences
- H. Light Industry & Eco-design



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POSTER SESSION: 68 Posters

Before closing the 15th ICEEE-2024 Conference, a workshop was carried out to discuss the topic: IMPACTS OF CLIMATIC CHANGE AND THE FUTURE OF THE HEALTH OF BIOSPHERE.

The full articles of the given abstracts will be published in the form of ISBN Proceedings Book.

Organizers: 12

Chairs of the Sessions:

A. Sustainable Development & Environmental Protection

(A1)	<i>Chair of the Session:</i>	<i>Sándor J. ZSARNÓCZAI</i>
(A2)	<i>Chair of the Session:</i>	<i>Hosam BAYOUMI HAMUDA</i>
(A3)	<i>Chair of the Session:</i>	<i>Ágnes Bálint</i>

B. Healthcare & Public Health Sustainability: Risk & Management

(B1)	<i>Chair of the Session:</i>	<i>Salma LATIQUE</i>
(B2)	<i>Chair of the Session:</i>	<i>Ayan CHATTERJEE</i>

C. Soil Biology & Agricultural Sustainability

(C1)	<i>Chair of the Session:</i>	<i>Bhanu Singh PANWAR</i>

D. Sustainability of Water, Sediments & Waste Management

(D1)	<i>Chair of the Session:</i>	<i>Gábor KERTÉSZ</i>
(D2)	<i>Chair of the Session:</i>	<i>Zita ZRINYI</i>

E. Sustainability of Circular (Bio)Economy Strategy of Recycling, & Energy And

F. Air Pollution & Ecosystems & Landscape

(E&F)	<i>Chair of the Session:</i>	<i>Emoke IMRE</i>

G. Applied & Natural Sciences

(G1)	<i>Chair of the Session:</i>	<i>Ratnesh DAS</i>
(G2)	<i>Chair of the Session:</i>	<i>Giuseppe CIABURRO</i>

Poster Session-A

<i>Chair of the Session:</i>	<i>Hosam BAYOUMI HAMUDA</i>

Posters Session-B



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Chair of the Session:

Hosam BAYOUMI HAMUDA

Workshop Special Session: Environmental Health and Climatic Change

Chair of the Session:

Hosam BAYOUMI HAMUDA

Keynote Speaker:

Hosam E.A.F. BAYOUMI HAMUDA

**IMPACTS OF CLIMATIC CHANGE AND THE FUTURE OF THE
HEALTH OF BIOSPHERE**

12:30

Closing the Conference

Prof. Dr. Hosam E.A.F. Bayoumi Hamuda
President of ICEEE

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ORGANIZATION & COMMITTEES

The Conference is carrying out under the patronage of:

- *Prof. Dr. Levente KOVÁCS*
Rector, Obuda University
- *Dr. László KOLTAI*
Dean, Rejto Sandor Faculty of Light Industry & Environmental Engineering
- *Prof. Dr. Hosam BAYOUMI HAMUDA*
President, International Council of Environmental Engineering Education
Chairman of the Conference
- *Dr. Rita BODÁNÉ-KENDROVICS*
Vice Dean, Director, Institute of Environmental Engineering & Natural Sciences
- *Dr. Edit CSANÁK*
Vice Dean, Director of the Product Design Institute



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Organizers of the Conference

- *International Council of Environmental Engineering Education (ICEEE), Hungary*
- *Obuda University (OU), Hungary*
- *International Society of Waste Management, Air and Water (ISWMAW), India*
- *Azerbaijan Technological University, Azerbaijan*
- *Green India Clean Environment Society (GICES), India*
- *University of Coimbra, Coimbra, Portugal*
- *Uzhhorod National University, Uzhhorod, Ukraine*
- *Rejto Sandor Faculty of Light Industry and Environmental Engineering (RKK), Hungary*
- *Institute of Environmental Engineering and Natural Sciences (KTI), Hungary*
- *Soil Biology Session at the Hungarian Soil Science Society*
- *Sunwo Plc, Energy Expert, Hungary*
- *Sidi Mohamed Ben Abdellah University, Morocco*



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Organising Committees

NATIONAL ORGANISING COMMITTEE

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- Dr. Rita BODÁNE-KENDROVICS (Obuda University, Hungary)
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- Ms. Júlia KASZÁS (Obuda University, Hungary)

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- Prof. Dr. Faissal AZIZ (Cadi Ayyad University, Morocco)
- Dr. Nabil KHELIFI (Springer Nature, Germany)
- Dr. Enkhtuya OCHIRBAT (Mongolian Academy of Sciences, Mongolia)
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- Dr. Zoltán NAÁR (Tokaj-Hegyalja University, Hungary)
- Dr. Edit CSANÁK (Obuda University, Hungary)
- Dr. Tünde TAKÁCS (HAS, Institute for Soil Sciences & Agricultural Chemistry, Hungary)
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ICEEE-Cooperation

Our planet requires an array of scientific innovations, and it's time to look beyond the traditional problems and solve them. This is the critical and exciting time to be alive. The decisions and the actions we take in the next years will define the future for next generations to come. These solutions can be done from practical and not only excellent from theoretical point of view.

From our vision, the main task of the members of our International Council of Environmental Engineering Education board (ICEEE) and their voice, passion, and cooperation are critical to our success.

Please join us to create the future for the new generations free from environmental problems like climatic changes, pollutions, spread of epidemic diseases, reduction in the natural resources, etc., due to the continuous increasing in the global population and depending on the 17 points of sustainable development from United Nations. With your support, ICEEE can try and continue to solve problems from around the world and to find solutions, catalyse global impact, and create the future we envision.

*Prof. Dr. Hosam Bayoumi Hamuda
President of ICEEE
Obuda University
Budapest - Hungary*

*E-mail: bayoumi.hosam@uni-obuda.hu
WhatsApp/viber/messenger: +36303900813*



15th ICEEE-2024

**The 15th ICEEE-2024 Online
International Annual Conference on
“Global Environmental Development & Sustainability: Research, Engineering & Management”**



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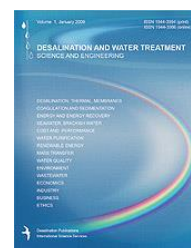
Publication:

All accepted and presented papers will be published in the **Proceedings Book of the Conference with ISBN: 978-963-449-388-4**.

Beyond the topics of the conference and received papers, we encourage submissions of innovative papers from the broad area of general environmental sciences and technologies what could be of interest to the academic scene of environmental engineering.

The Suggested Journals:

- Desalination and Water Treatment Journal: www.deswater.com



- Euro-Mediterranean Journal for Environmental Integration www.springer.com/journal



1. Selected papers by the Scientific Committee will be submitted for peer-reviewed publication in the above-mentioned journals:
2. The Journals publish papers of the highest scientific merit and widest possible scope of work in all areas related to the topics of the ICEEE-2024 Conference.
3. The responsible editor committee is responsible for arranging the first communication and relationship between the author and the journal.

15th ICEEE Responsible Editor:
Prof. Dr. Hosam Bayoumi Hamuda
(bayoumi.hosam@uni-obuda.hu)



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Objectives of the Conference:

The main approaches of the 15th ICEEE-2024 are:

- Provide a platform to exchange emerging ideas and investigate key issues such as air-, soil-, water-, nuclear pollution, waste recycling, wastewater, renewable energy technologies, public health issues, etc.*
- Work towards sustainable solutions within a team either personally or online, to identify problems to find solutions or to develop arguments.*
- Solve the problems with creative and innovative strategies and being conscious of global social, cultural and environmental issues in relation to engineering and technology.*
- Highlighting some of the main frameworks in this area and recommending directions for future research.*
- To assess status and future challenges towards environment sustainability*
- Environmental sustainability, Biotechnology and protection approaches for remediation of polluted soils, water and air as well as human healthcare*
- Use of Bio-Nanotechnologies for clean and sustainable environment*
- Management of wastewater and aquatic ecology in water ponds, canals and rivers*
- Circular (Bio)Economy Strategy and Sustainable Energy Research & Applications*

The Conference will cover a wide range of highlighting potential issues and paths towards a sustainable future such as:

- Global climate change and public health*
- Air, water and soil pollution*



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- *Agriculture and soil degradation, fertilizer, food production and nutrition*
- *Changes of biodiversity and depletion of natural resource*
- *Urbanization*
- *Energy and renewable energy sources*
- *Monitoring of the environmental state and management: protection and conservation*
- *Biogeochemical cycles, waste management and environmental engineering*
- *Biotechnology and food industry, Environmental biotechnology, nanotechnology and bioengineering*
- *Social, economic and demographic dislocation through effects on economy, infrastructure and resource supply as well as tourism and global environmental changes.*



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Main Sessions:

The conference program is planned to include two special sessions: one dedicated to strategies for environmental sustainability and another to replicating and strengthening integrated measures for the energy-climate transition through the international cooperation.

1. *Strategies for Environmental Sustainability*

The 15th ICEEE Conference covered 15 primary sub-sessions:

1. Biodiversity & Conservation
2. Climate Change & Atmosphere
3. Ecological Systems & Processes
4. Ecotoxicology & Pollution
5. Environmental Education & Communication
6. Environmental Impact Assessments
7. Environmental Justice & Equity
8. Environmental Sciences
9. Soil Pollution & Remediation
10. Sustainable Development & Environment
11. Sustainable Resource Management
12. Water Quality & Aquatic Biology & Chemistry
13. Simulation, Modelling, Applied Physics, Mathematics & Computer Sciences
14. Circular Economy Strategy & Sustainable, Energy Research & Applications
15. Sustainability of Public Health

These 15 sub-sessions are grouped into 7 main sessions

- A. Sustainable Development & Environmental Protection
- B. Healthcare & Public Health Sustainability: Risk & Management
- C. Soil Biology & Agricultural Sustainability
- D. Sustainability of Water, Sediments & Waste Management
- E. Sustainability of Circular (Bio)Economy Strategy of Recycling, & Energy
- F. Air Pollution & Ecosystems & Landscape
- G. Applied & Natural Sciences

2. *Workshop Special Session:*

Environmental Health & Climatic Change



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AWARDS CEREMONY

15th ICEEE-2024

15th ICEEE-2024 Excellence Awards for best papers: 15th ICEEE-2024 Excellence Awards for best papers and presentation was instituted since the year 2010 and have been given to the researchers for significant papers, to municipalities, temples, industries for their significant achievement in environmental management and sustainable development as well as the protection of the environment from pollution. The awards of the 15th ICEEE-2025 Annual International Conference were given to the most outstanding researchers of the conference under below four categories.

SELECTION PROCESS

CRITERIA FOR THE SESSION'S BEST PRESENTATION AWARD

Each presentation was evaluated by two evaluators, and the average mark of both evaluators was taken as the final mark. The best presentation from sessions was selected based on the final mark received from the evaluators and the final decision was given by the Conference Chair. Below criteria were taken into consideration for this award and marks are given out of 100.

- Value of the Content (30%)
- Clarity of Presentation (20%)
- Appropriate Audio-Visual Aids (20%)
- Ability to Connect with the Audience (10%)
- Proper Timing (20%)

CRITERIA FOR THE BEST POSTER PRESENTATION AWARD

Every poster presentation is evaluated by a special evaluator based on below criteria and the presentation with the highest mark was selected as the best poster presentation award. The final mark is given out of 100.

- Depth of Content (40%)
- Introduction and Abstract (15%)
- Content knowledge and organization (20%)
- Poster Design and Overall Visual Appeal (10%)
- Verbal Interaction (15%)



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CRITERIA FOR THE OVERALL BEST PRESENTATION AWARD AND BEST STUDENT PRESENTATION AWARD

Presentations of each technical session with the highest marks were recommended for these two awards. They were evaluated by a special committee headed by the Conference Chair according to the below criteria.

- Total Marks gained in the presentation (100%)
- Significance of the paper to the field (30%)
- Theoretical contribution (15%)
- The ability of practical implementation (20%)
- Use of appropriate methodological rigor (20%)
- Originality (15%)



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AWARDS CEREMONY

List of the Best Presentation on 15th ICEEE-2024 [*Global Environmental Development & Sustainability: Research, Engineering & Management*]

CONGRATULATIONS TO ALL OUR 15TH ICEEE-2024 INTERNATIONAL ANNUAL CONFERENCE AWARDS WINNERS

All the winners were presented with their awards during the awarding ceremony which was held on the second day of the conference along with the conference conclusion.

1 THE PROFESSIONAL BEST PRESENTATION AWARD

This award was provided for the most professional outstanding presentation:

1. **Ratnesh DAS** (Dr. Harisingh Gour Central University, Sagar, India) *in the presentation:*

NANO (MATERIALS, TECHNOLOGY, MEDICINE) AND HUMAN HEALTH

2. **Zakaria Fouad FAWZY, Shaymaa Ismaeel SHEDEED** (Agricultural and Biological Research Institute, National Research Centre, Egypt) *in the presentation:*

**CLIMATE SMART AGRICULTURE APPROACH FOR AGRICULTURAL
SUSTAINABILITY UNDER CLIMATE CHANGE**

3. **Karyna ANAPRIIUK, Larysa ANTONIUK** (Kyiv National Economic University, Kyiv, Ukraine) *in the presentation:*

**REALIZATION OF THE INNOVATIVE POTENTIAL OF THE EU SPACE SOLAR
ENERGY SECTOR IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT**



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4. **Lateefat Adeola BELLO** (Ahmadu Bello University Zaria, Nigeria) in the presentation:

GREEN FINANCING AND POLICY SUPPORT FOR SUSTAINABLE TOURISM INITIATIVES

5. **Igor DUKAY** (Institute for Wildlife Management and Nature Conservation, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary)

THE NEED AND POSSIBLE DIRECTIONS FOR SUSTAINABLE WATER MANAGEMENT ALONG THE BÜKKÖS STREAM (SZENTENDRE, HUNGARY)

6. **Svitlana ZHUKEVYCH¹, Natalia KARPYSHYN², Natalia ZHUK³**
(¹Department of Accounting and Taxation, West Ukrainian National University, Ternopil, ²Department of International Relations and Diplomacy, West Ukrainian National University, Ternopil, Ukraine, ³Department of Financial and Economic Security of the Educational and Scientific Humanitarian, Institute National Academy of the Security Service of Ukraine, Kyiv, Ukraine) in the presentation:

ANALYSIS OF THE FINANCIAL STATUS OF THE HEALTH CARE SYSTEM: A COMPREHENSIVE APPROACH BASED ON SECURITY

7. **Surendra Kumar YADAV** (Project Director (Environmental Conservation), SEHAT India, New Delhi, India)

PLASTIC POLLUTION IMPACTING ECOSYSTEM HEALTH: MAJOR THREAT IN DEVELOPING COUNTRIES LIKE INDIA



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8. **D. Jenina ANGELIN, R. PUGALENTHI** (*Department of Artificial Intelligence and Data Science, St. Joseph's College of Engineering, Chennai, India*) in the presentation:

THE HIDDEN COST OF INTELLIGENCE: AI'S CARBON FOOTPRINT AND STRATEGIC SOLUTIONS

2. THE BEST STUDENT PRESENTATION AWARD

The best student presentation award was given to the most outstanding presentation presented by a participant who has registered under the Ph.D. student.

1. **Rajnish YADAV, Shweta ANAND, Kavita SINGH** (*School of Management, Gautam Buddha University, Uttar Pradesh, India*) in the presentation:

HOW NET ENERGY IMPORTS, ENERGY INTENSITY & CARBON INTENSITY SHAPING ENERGY INTENSITY OF PRIMARY ENERGY: STUDY OF BRICS NATIONS

2. **Ikram KHABACH_{1,2}, Taha ELASSIMI_{2,3}, Jamal ARBOUI₁, Mounir KRIRAA₁** (*₁LMPEQ Safi, ₂IMED-LAB Marrakech, ₃UM6P Ben guérir, Morocco*) in the presentation:

SUSTAINABLE INSULATION SOLUTIONS: UTILIZING PET BOTTLE WASTE IN COMPOSITE MATERIALS

3. **Miranda IMERI** (*University of Florida, Gainesville, Florida, USA*) in the presentation:

ECOLOGICAL DYNAMICS OF TICK-HOST INTERACTIONS AND TICK BORNE DISEASE RISKS IN URBAN COYOTE HABITATS



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4. **Imane EL-BAGGAR₁, Mohammed ALAOUI MHAMDI₁, Jamila BAHHOUI₁, Salma LATIQUE_{1,2}** (*₁Laboratory of Biotechnology, Conservation and Valorization of Natural Resources, Faculty of Sciences Dhar El Mahraz, Sidi Mohamed Ben Abdellah University, Fez, ₂Biomedical and Translational Research Laboratory, Faculty of Medicine, Pharmacy and Dentistry of Fez, Sidi Mohamed Ben Abdellah University, Morocco*) in the presentation:

GROWTH KINETICS OF ₃ STRAINS OF MICROALGAE ISOLATED FROM FRESHWATER ECOSYSTEMS IN MOROCCO: THE FES-MEKNES REGION

5. **Eetizez KAROU, Mohammed Ali TRIK, Monia ENNOUR** (*Olive tree institute, Sfax, Tunisia*) in the presentation:

CHARACTERIZATION AND EVALUATION OF THE ANTIFUNGAL ACTIVITY OF POSIDONIA OCEANICA EXTRACTS AGAINST PATHOGENIC RHIZOCTONIA SPECIES

6. **Brunilda ÇUKO₁, Yllka LALA₁, Efigjeni KONGJIKI₂, Valbona SOTA_{1,2}** (*₁Department of Biotechnology, Faculty of Natural Sciences, Boulevard "Zogu I" Tirana, ₂Research Center of Biotechnology and Genetics, Academy of Sciences of Albania, "Murat Toptani" Promenade, Tirana, Albania*) in the presentation:

IN VITRO MICROPROPAGATION OF PUNICA GRANATUM VAR. DEVEDISHE: A COMPARATIVE STUDY OF CONVENTIONAL METHODS AND THE ELECTIS BIOREACTOR SYSTEM



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7. **Negar MOSALLANEJAD₁, Kateryna KHADUSKINA₂, Bhanu Singh PANWAR₃** (*₁Department of soil chemistry and fertility, Shiraz University, Iran, ₂V. N. Karazin Kharkiv National University, Kharkiv, Ukraine, ₃Green India Clean Environment Society (GICES), Hisar, India*)

DO YOU KNOW ADVERSE ASPECTS OF AGRICULTURE?

8. **Samaneh ANSARINIA** (*Molecular Cellular Department of the University Isfahan, Isfahan, Iran*) in the presentation:

THE EFFECT OF CHAMOMILE ESSENTIAL OIL ON BIOFILM PRODUCTION IN PSEUDOMONAS AERUGINOSA

9. **Mustafa HATHAL, Viola SOMOGYI₁** (*Sustainability Solutions Research Laboratory, University of Pannonia, Veszprém, Hungary*) in the presentation:

WASTEWATER RECYCLING FOR IRRIGATION USES IN ARID REGIONS

10. **Lara Rúbia BORGES-FORRÓ, Levente KARDOS** (*Hungarian University of Agriculture and Life Sciences, Institute of Environmental Sciences, Department of Agro-environmental Studies, Budapest, Hungary*) in the presentation:

EVALUATION OF GERMINATION PERFORMANCE IN COMPOST BLENDS OF PÁLINKA DISTILLATION MASH WITH DIVERSE CO-COMPOSTING MATERIALS



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3. SESSION'S BEST PRESENTATION OF YOUNG RESEARCHERS

These awards were provided to the presentations of young researchers. They were:

1. ***Dharmishtha TOLAMBIA, Dinesh PATIDAR*** (*Department of Physics, Mohanlal Sukhadia University, Udaipur, Rajasthan, India*) in the presentation:

**HYDROTHERMAL SYNTHESIZED CTS NANOMATERIAL FOR
PHOTOCATALYTIC DYE DEGRADATION OF METHYLENE BLUE**

2. ***Timea VERES, Júlia TOBAK, Georgina TÓTH-NAGY*** (*University of Pannonia, Faculty of Economics, Veszprém, Hungary*) in the presentation:

**THE FINE LINE BETWEEN TRANSPARENCY AND GREENWASHING:
NAVIGATING ESG REPORTING**

3. ***Azam ABOLHASANI¹, Valentina ANUFRIYEVA², Bhanu Singh PANWAR³*** (*¹Natural resources, University of Tehran, Iran, ²Health care management education coordinator, Ukrainian Swiss Project "Medical Education Development", Kyiv, Ukraine, ³Green India Clean Environment Society, Hisar, Haryana, India*) in the presentation:

HEAVY METALS, AND HUMAN HEALTH: THE DEATH ALARM

4. ***Clea Anne V. CORSIGA, Marciano D. TANGPOS*** (*Cebu Technological University-Barili, Cagay, Barili, Cebu*) in the presentation:

**INTEGRATED ASSESSMENT OF TILLAGE SYSTEMS AND NUTRIENT
MANAGEMENT SCHEMES ON GROWTH DYNAMICS AND YIELD
PERFORMANCE OF LOWLAND RICE (*Oryza sativa* var. NSIC RC222) IN BARILI,
CEBU**



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5. **Sonali RAJPUT** (Department of Seed Science and Technology, HN BGU-Srinagar, Uttarakhand, India) in the presentation:

LEVERAGING SOIL MICROBIOMES FOR SUSTAINABLE AGRICULTURE AND CLIMATE ADAPTATION

6. **Maru Zewdu KASSIE** (Assosa University, Assosa, Ethiopia) in the presentation:

DETERMINANTS OF PREGNANCY COMPLICATIONS AMONG THE WOMEN RECEIVING ANTENATAL CARE IN ETHIOPIA: A MULTI-LEVEL MIXED EFFECTS SPATIAL ANALYSIS

Budapest, 22nd of November 2024

Prof. Dr. Hosam Bayoumi Hamuda
President of ICEEE, Conference Chairman
Bayoumi.hosam@uni-obuda.hu

The certificates will be sent to all the awardees in email by 17th of December 2024. In case of non-receipt of the certificate, please write to us with your contact details to: Bayoumi.hosam@uni-obuda.hu



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The 15th ICEEE-2024

Scientific Program

**Online International Annual
Conference**

November 21 - 22, 2024

**Host Place: Obuda University, Budapest
– Hungary**

Theme of the Conference:

**“Global Environmental Development &
Sustainability: Research, Engineering &
Management”**

**with Workshop Special Session:
Environmental Health and Climatic Change**



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1st Day

Program of 21st of November 2024 (Thursday)



The 15th ICEEE-2024 Online
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Opening Ceremony

09:00 a.m. – 09:30 a.m.

Prof. Dr. Hosam BAYOUMI HAMUDA

*President, International Council of Environmental Engineering
Education
Chairman of the Conference*

Dr. Viktória SUGÁR

*Vice Rector for Sustainability and Priority Developments at Obuda
University*

Dr. Ragif HUSEYNOV

Vice Rector for Academic Affairs at Azerbaijan Technological University

Dr. László KOLTAI

*Dean, Rejto Sandor Faculty of Light Industry & Environmental
Engineering*

Dr. Rita BODÁNÉ-KENDROVICS

*Director, Institute of Environmental Engineering & Natural
Sciences*



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Plenary Session

Chair of the Session:

Hosam BAYOUMI HAMUDA

PL1 09:30 – 10:00

Bhanu Singh PANWAR¹, Olha A. KHLIESTOVA², Katarzyna Ewa BUCZKOWSKA³, Mariya KHMELYARCHUK⁴, Valentina ANUFRIYEVA⁵, S. Kh. YAKUBOV⁶, Hosam E.A.F. BAYOUMI HAMUDA⁷

¹Green India Clean Environment Society (GICES) Hisar, Haryana, India

²Department of Material Science, Faculty of Mechanical Engineering, Technical University of Liberec, Liberec, Czech Republic. Department of Primary Science Institute of Modern Technologies, Pryazovskyi State Technical University, Dnipro, Ukraine.

³Department of Material Science, Faculty of Mechanical Engineering, Technical University of Liberec, Liberec, Czech Republic, Department of Materials Technology and Production Systems, Faculty of Mechanical Engineering Lodz University of Technology, Poland.

⁴Department of Digital and International Economics -Ivan Franko National University of Lviv Ukraine

⁵Health care management education coordinator, Ukrainian-Swiss Project "Medical Education Development" (MED), Kyiv, Ukraine

⁶Institute of Military Aviation of the Republic of Uzbekistan, Karshi, Uzbekistan

⁷Obuda University, Rejto Sandor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering and Natural Sciences, Budapest, Hungary

SMOKE POLLUTION: THE CITY IN GAS CHAMBER??

PL2 10:00 – 10:30

Ratnesh DAS

Dr. Harisingh Gour Central University, Sagar, India

NANO (MATERIALS, TECHNOLOGY, MEDICINE) AND HUMAN HEALTH



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PL3 10:30 – 11:00

GIUSEPPE CIABURRO

Faculty of Engineering and Informatics, Pegaso University, Naples, Italy

**SUSTAINABLE ACOUSTIC METAMATERIALS: TUNABLE SOUND
ABSORPTION USING CORK MEMBRANES AND HONEYCOMB
STRUCTURES**

PL4 11:00 – 11:30

LYUDMYLA SYMOCHKO^{1,2}

¹University of Coimbra, Coimbra, Portugal,

²Institute of Agroecology and Environmental Management, National Academy of Agrarian
Sciences of Ukraine, Kyiv, Ukraine

**ESKAPE PATHOGENS IN THE ENVIRONMENT AND ONE-HEALTH
CONCEPT**

PL5 11:30 – 12:00

Zakaria Fouad FAWZY, Shaymaa Ismaeel SHEDEED

Agricultural and Biological Research Institute, National Research Centre, Egypt

**CLIMATE SMART AGRICULTURE APPROACH FOR AGRICULTURAL
SUSTAINABILITY UNDER CLIMATE CHANGE**

PL6 12:00 – 12:30

Gábor KERTÉSZ

International Business School, Budapest, Hungary

**ENSURING LONG-TERM HUMAN RESOURCES IN THE 21ST CENTURY
WHILE UPLOADING HUMAN RIGHTS STANDARDS**



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PL7 12:30 – 13:00

Amina MELIANI

Department of Biology, FSNV. University of Mustapha Stambouli, Mascara, Algeria

**HOW THE DEVELOPMENT OF BIOFILMS ON HOSPITAL SURFACES HAS
CATALYZED THE SEARCH FOR NEW TECHNOLOGIES**



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Oral Technical Sessions



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A. Sustainable Development & Environmental Protection Session (A1) 13:30 – 15:00

Chair of the Session: Sándor J. ZSARNÓCZAI

Surendra Kumar YADAV

Project Director (Environmental Conservation), SEHAT India, New Delhi, India

**FOREST MANAGEMENT USING SPATIAL TECHNOLOGY TOWARDS
SUSTAINABLE APPROACH: A CASE STUDY OF SIRSIYA BLOCK
(SHRAVASTI DISTRICT, UP, INDIA)**

Nitesh SINGH, Renuka SHARMA

SGT University, Gurugram, Haryana, India

**WILD EDIBLE PLANTS: A SUSTAINABLE SOLUTION FOR MEETING THE
NEEDS OF FUTURE GENERATIONS**

Abbas Ali GHEZELSOFLOO

Civil Engineering Department, The Islamic Azad University of Mashhad, Mashhad, Iran

**FROM DEGRADATION TO RESTORATION: REVITALIZING THE KASHAF-
ROUD RIVER ECOSYSTEM**

Neha Singh RAGHUVANSHI, Arpita JOHRI, Mudit SAXENA

ABES Engineering College, Ghaziabad, Uttar Pradesh, India

SUSTAINABLE TRANSPORTATION AND GREEN INFRASTRUCTURE

Rahat SIRAJ

Department of Zoology, Hazara University, Sub Campus Battagram, Pakistan

**A STUDY ON DIVERSITY OF ANTS (HYMENOPTERA: FORMICIDAE) IN
DISTRICT BATTAGRAM KP, PAKISTAN**



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Warda HUSSAINI

Department of Public Administration, University of Karachi, Pakistan

GLOBAL ENVIRONMENTAL DEVELOPMENT AND SUSTAINABILITY: ROLE OF DEVELOPING COUNTRIES”

Arvind BHATT

Tree Global, Riyadh, Saudi Arabia

ADAPTABLE GERMINATION STRATEGIES FOR THE RESTORATION OF THE ARABIAN DESERT: HARNESSING NATIVE SPECIES FOR ECOSYSTEM RESILIENCE

Medani BHANDARI

Akamai University, Hilo, Hawaii, USA

WHY IT IS HARD TO ACHIEVE SUSTAINABILITY AND MEASURES TO ACCELERATE SDG ACHIEVEMENTS

B. NDEH¹, S. O. OSHUNSANYA¹, B. OLASANMI², A. M. ODEBODE¹

¹Department of Soil Resource Management. University of Ibadan, Nigeria

²Department of Crop and Horticultural Sciences, University of Ibadan, Nigeria

CASSAVA (*Manihot esculenta* Crantz) GENOTYPE EFFECT ON SOIL LOSS DUE TO CROP HARVESTING



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Session (A2)

13:30 – 15:00

Chair of the Session:

Hosam BAYOUMI HAMUDA

Vijaya Kittu MANDA¹, Mallikharjuna Rao JITTA²

¹PBMEIT, Visakhapatnam, India

²GITAM (Deemed to be University), Visakhapatnam, India

RESEARCH THEMES ON GREEN INFRASTRUCTURE FOR SMART CITIES

Rajnish YADAV, Shweta ANAND, Kavita SINGH

School of Management, Gautam Buddha University, Uttar Pradesh

HOW NET ENERGY IMPORTS, ENERGY INTENSITY & CARBON

INTENSITY SHAPING ENERGY INTENSITY OF PRIMARY ENERGY: STUDY OF BRICS NATIONS

Bhanu Singh PANWAR¹, Mariya KHMELYARCHUK², Andrew PAVLYSHYN³

¹Green India clean Environment Society, Hisar, Haryana, India

²Ivan Franko National University of Lviv, Lviv, Ukraine, Poznan University of Technology, Poznan, Poland

³Ivan Franko National University of Lviv, Lviv, Ukraine

SOIL SICKNESS: BIOSPHERE UNDER THE FUMES OF WAR?

Odunayo James ROTOWA, Stanisław MAŁEK

Department of Ecology and Silviculture, Faculty of Forestry, University of Agriculture in Kraków. Kraków, Poland

SUSTAINABLE ALTERNATIVES TO PEAT IN FOREST NURSERIES:

IMPACTS ON GROWTH AND ROOT MORPHOLOGY OF FAGUS

SYLVATICA AND QUERCUS ROBUR SEEDLINGS



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Kokob Teshome WONDIMU¹, Abiyot Kelecha GELETU²

¹Department of Chemistry, College of Natural and Computational Sciences, Mattu University Bedele Campus, Bedele, Ethiopia

²Department of Chemistry, College of Natural and Computational Sciences, Mattu University, Mattu, Ethiopia

ANALYSIS OF SELECTED PESTICIDE RESIDUES IN COMMERCIAL TOMATO FRUITS

Ikram KHABACH^{1,2}, Taha ELASSIMI^{2,3}, Jamal ARBOUI¹, Mounir KRIRAA¹

¹LMPEQ Safi, Morocco

²IMED-LAB Marrakech, Morocco

³UM6P Ben guérir, Morocco

SUSTAINABLE INSULATION SOLUTIONS: UTILIZING ŐET BOTTLE WASTE IN COMPOSITE MATERIALS

Olunike Adedoyin BELLO

Osun State College of Education, Ila Orangun, Osun State, Nigeria

ETHNOBOTANICAL INVENTORY OF ERIN IJESA WATERFALL TOURISTS' CENTRE, OSUN STATE, NIGERIA: A SURE WAY TO CREATIVE EDUCATION

Dharmishtha TOLAMBIA, Dinesh PATIDAR

Department of Physics, Mohanlal Sukhadia University, Udaipur, Rajasthan, India

HYDROTHERMAL SYNTHESIZED CTS NANOMATERIAL FOR PHOTOCATALYTIC DYE DEGRADATION OF METHYLENE BLUE

M. FARHAOUI, C. SLIMANI

Law School, Sidi Mohamed Ben Abdellah University, ESSOR Lab, Fes, Morocco

REFLECTING SUSTAINABILITY IN REAL ESTATE VALUATION



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Suhail BASHIR

Ens Environmental Consultancy, India

ENVIRONMENTAL IMPACT ASSESSMENT AND SUSTAINABILITY

Emi RAMOSACAJ¹, Emira SHABANI², Anisa ALIU¹, Emily ELEUSIZOV¹

¹QSI International School of Kosovo, Kosovo.

²Obuda University, Budapest, Hungary

**HOW IS KOSOVO DEALING WITH THE CLIMATE CRISIS -WHAT HAS
BEEN DONE; WHAT IS BEING TAUGHT; WHAT ARE THE SOLUTIONS?**



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Session (A3)

15:00 – 16:50

Chair of the Session:

Ágnes Bálint

Sándor J. ZSARNÓCZAI

Obuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering,
Institute of Environmental Engineering and Natural Sciences, Budapest, Hungary

**AGRICULTURAL AND FOOD PRODUCTION IN INDIA
BETWEEN 2020-2022**

Rita Bodáné KENDROVICS, Sándor J. ZSARNÓCZAI

Obuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering,
Institute of Environmental Engineering and Natural Sciences, Budapest, Hungary

ECONOMIC DEVELOPMENT IN TURKEY BETWEEN 2010-2020

Timea VERES¹, Júlia TOBAK², Georgina TÓTH-NAGY³

¹University of Pannonia, Faculty of Economics, Department of Accounting and Finance
Institute, Veszprém, Hungary

²University of Pannonia, Faculty of Economics, Institute of Management, Veszprém, Hungary

³University of Pannonia, Faculty of Engineering, Sustainable Solutions Research Laboratory,
Veszprém, Hungary

**THE FINE LINE BETWEEN TRANSPARENCY AND
GREENWASHING: NAVIGATING ESG REPORTING**

Richard KOUKOU¹, Léocadie ODOULAMI²

¹Departement de Géographie et Aménagement de Territoire, Faculté des Sciences Humaines
et Sociales, Université d'Abomey-Calavi

²Laboratoire Pierre PAGNEY, Climat, Eau, Ecosystème et Développement, Université
d'Abomey-Calavi, Cotonou, République du Bénin

**SOCIO ENVIRONMENTAL EFFECTS OF MANAGEMENT METHODS FOR
RAINWATER DRAINAGE INFRASTRUCTURE IN THE 6TH DISTRICT OF
THE CITY OF COTONOU IN BENIN**



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Abire HULUKA

Mattu University, Mattu, Ethiopia

**ASSESSMENT OF NATURAL RADIOACTIVITY LEVELS AND
RADIOLOGICAL HAZARD IN SOIL SAMPLES: IN CASE OF BURE AND
BURRUSA MATTU UNIVERSITY AGRICULTURAL PROJECTS**

**Imane EL-BAGGAR¹, Mohammed ALAOUI MHAMDI¹, Jamila BAHHOU¹,
Salma LATIQUE^{1,2}**

¹Laboratory of Biotechnology, Conservation and Valorization of Natural Resources, Faculty of Sciences Dhar El Mahraz, Sidi Mohamed Ben Abdellah University, Fez, Morocco

²Biomedical and Translational Research Laboratory, Faculty of Medicine, Pharmacy and Dentistry of Fez, Sidi Mohamed Ben Abdellah University, Morocco

**GROWTH KINETICS OF 3 STRAINS OF MICROALGAE ISOLATED FROM
FRESHWATER ECOSYSTEMS IN MOROCCO: THE FES-MEKNES REGION**

Karyna ANAPRIIUK, Larysa ANTONIUK

Kyiv National Economic University, Kyiv, Ukraine

**REALIZATION OF THE INNOVATIVE POTENTIAL OF THE EU SPACE
SOLAR ENERGY SECTOR IN THE CONTEXT OF SUSTAINABLE
DEVELOPMENT**

Tarek DRIAS¹, Moufida BELLOULA², Abdelmajid BOUFEKKANE³

¹Laboratory of Mobilization and Water Resource Management. University of Batna 2. Algeria

²Laboratory of Natural Risks and Territory Development. University of Batna 2. Algeria

³FSTGAT. USTHB University, beb Azouar Algiers, Algeria

**A GIS-BASED DRASTIC MODEL FOR ASSESSING AQUIFER
VULNERABILITY. CASE STUDY OF TEBESSA PLAIN - (NORTH-EASTERN
ALGERIA)**



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Lateefat Adeola BELLO

Ahmadu Bello University Zaria, Nigeria

**GREEN FINANCING AND POLICY SUPPORT FOR SUSTAINABLE
TOURISM INITIATIVES**

DAWIT WAMI NEGERA

Mechanical Engineering Department, College of Engineering, Assosa University, Assosa,
Ethiopia

FABRICATION OF VEHICLE INTERIOR PARTS FROM NATURAL FIBERS



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B. Healthcare & Public Health Sustainability: Risk & Management

Session (B1) 13:30 – 15:00

Chair of the Session: Salma LATIQUE

Abrar HUSSAIN

International Center for Chemical and Biological Science, University of Karachi, Karachi, Pakistan

PATHOGENESIS AND EFFECT OF HOUSEHOLD MICROORGANISMS ON THE RESIDENTS

Ayan CHATTERJEE

School of Health Science and Technology, Medhavi Skills University, Sikkim, India

IMPACT OF CLIMATE CHANGE ON HUMAN PERFORMAVE

Surendra Kumar YADAV

Environmental Conservation Project, SEHAT India, New Delhi, India

PLASTIC POLLUTION IMPACTING ECOSYSTEM HEALTH: MAJOR THREAT IN DEVELOPING COUNTRIES LIKE INDIA

Titanilla EIDEH

Integral and Holistic HealthCreator, Member of the German Biochemic Association Budapest, Hungary

WHAT IS THE CONNECTION BETWEEN THE MAGICAL PERIODIC SYSTEM AND DR.W. SCHUESSLER BIOCHEMIC CELL SALTS?

Azam ABOLHASANI¹, Valentina ANUFRIYEVA², Bhanu Singh PANWAR³

¹Natural resources, University of Tehran, Iran

²Health care management education coordinator, Ukrainian Swiss Project "Medical Education Development", Kyiv, Ukraine

³Green India Clean Environment Society, Hisar, Haryana, India

HEAVY METALS, AND HUMAN HEALTH: THE DEATH ALARM



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Oleksandr PYVOVAROV

Kharkiv National Medical University, Kharkiv, Ukraine

SUSTAINABLE DEVELOPMENT GOALS AND EDUCATION

Titanilla EIDEH

Integral and Holistic HealthCreator, Member of the German Biochemic Association

Budapest, Hungary

WHY IS ESSENTIAL THE INTAKE OF CELL SALTS IN OUR INDUSTRIAL WORLD? STUDY CASES OF HEALTHCARE WITH SCHUESSLER CELL SALTS

Misrak Gebremariam ABERA¹, Adhena Ayaliew WERKNEH², Reda Shamie WELDE³, Aminul ISLAM⁴, Gebru Hailu REDAE⁵

^{1,2,5}Department of Environmental Health Sciences, Mekelle University, Mekelle, Ethiopia

²Faculty of Engineering and Environment, Northumbria University, Newcastle up on Tyne, NE1 8ST, United Kingdom

³Department of Reproductive Health, School of Public Health, College of Health Sciences, Mekelle University, Mekelle, Ethiopia

⁴Advanced Molecular Lab, Department of Microbiology, President Abdul Hamid Medical College, Karimganj, Kishoreganj-2310, Bangladesh

⁵COVID-19 Diagnostic Lab, Department of Microbiology, Noakhali Science and Technology University, Noakhali-3814, Bangladesh

ASSESSING THE ROLE OF WATER, SANITATION, AND HYGIENE (WASH) FACTORS IN THE HIGH PREVALENCE OF DIARRHEA AMONG INTERNALLY DISPLACED CHILDREN UNDER FIVE IN NORTHERN ETHIOPIA

Miranda IMERI

University of Florida, Gainesville, Florida, USA

ECOLOGICAL DYNAMICS OF TICK-HOST INTERCATIONS AND TICK BORNE DISEASE RISKS IN URBAN COYOTE HABITATS



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Session (B2)

15:00 – 16:00

Chair of the Session:

Ayan CHATTERJEE

Maru Zewdu KASSIE¹, Seyfemichael Amare YILMA²

¹Assosa University, Assosa; Ethiopia

²University of Pretoria, Pretoria; South Africa

DETERMINANT FACTORS OF THE LONGITUDINAL PULSE PRESSURE AMONG HYPERTENSIVE PATIENTS TREATED AT ASSOSA GENERAL HOSPITAL, WESTERN ETHIOPIA

Samuel Alemu BAMBORO

Arba Minch University, Arba Minch, Ethiopia

PREVALENCE OF STUNTING AND ASSOCIATED FACTORS AMONG CHILDREN AGED 6-59 MONTHS IN DROUGHT-AFFECTED PASTORALIST'S COMMUNITY IN TELTELE WOREDA BORANA ZONE OROMIA REGIONAL STATE ETHIOPIA: COMMUNITY-BASED CROSS-SECTIONAL STUDY

Avni DAHIYA¹, Namita SINGH², Suman SANGWAN³, Adhisha DAHIYA², Subhash KAJLA⁴

¹Crop Improvement Division, ICAR-CSSRI, Karnal, India,

²Lab No. 202 Dept. of Biotechnology, GJUS&T, Hisar, India,

³Animal Physiology Division, ICAR-CIRB, Hisar, India,

⁴Department of Botany and Plant Physiology CCSHAU Hisar, India

IN SILICO MULTITARGET SCREENING OF BACOPASIDE I FROM BACOPA MONNIERI FOR ANTIDIABETIC THERAPEUTIC POTENTIAL

Saima SALEEM, Mutaher ZIA, Farhatulain SIDDIQUI, Maham GHOURI, Ume KULSOOM, Sidra KAWAL, Fatima SEHRISH, Zehra SITWAT

Ziauddin University, Faculty of Engineering, Science, Technology and Management, Department of Biomedical Engineering, Karachi, Pakistan.

HYPERFUNCTION VARIANT RS708035 OF INTERLEUKIN 1 RECEPTOR-ASSOCIATED KINASES 2 GENE INVOLVED IN THE PREDISPOSITION OF LEPROSY INFECTION



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Salma LATIQUE^{1,2}, Imane EL-BAGGAR³; Karima SELMAOUI², Allal DOUIRA²

¹Biomedical and Translational Research Laboratory, Faculty of Medicine, Pharmacy and Dentistry of Fez, Sidi Mohamed Ben Abdellah University, Morocco

²Laboratory of Plant Productions, Animals and Agro-industry, Botanical Team, Biotechnology and Plant Protection, Department of Biology, Faculty of Sciences, Ibn Tofail University, Morocco

³Laboratory of Biotechnology, Conservation and Valorization of Natural Resources, Faculty of Sciences Dhar El Mahraz, Sidi Mohamed Ben Abdellah University, Fez, Morocco

**SUSTAINABLE SOURCE OF MOLECULE FARMING: MICROALGAE –
PROGRESS AND PROSPECTS IN AGRICULTURE AND PHARMACEUTICAL
APPLICATIONS**

Maru Zewdu KASSIE

Assosa University, Assosa, Ethiopia

**DETERMINANTS OF PREGNANCY COMPLICATIONS AMONG THE
WOMEN RECEIVING ANTENATAL CARE IN ETHIOPIA: A MULTI-LEVEL
MIXED EFFECTS SPATIAL ANALYSIS**



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C. Soil Biology & Agricultural Sustainability Session (C1) 13:30 – 15:20

Chair of the Session: **Bhanu Singh PANWAR**

**Vinod Kumar^{1,2}, Ritui, Sonu Maan¹, Kajal Kumari¹, Sunil¹, Sushil Nagar¹,
Punesh Sangwan¹, Neeraj Kharor¹**

¹Department of Biochemistry, CCS Haryana Agricultural University, Hisar, Haryana, India-125004

²Division of Biochemistry, Faculty of Basic Sciences, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, UT of J&K, India

IRON DEFICIENCY INDUCED PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES IN PEARL MILLET

Shivani SHARMA

School of Agriculture Science, LNCT University Bhopal, M.P.

EFFECT OF TILLAGE ON SOIL PROPERTIES, GROWTH AND PRODUCTIVITY OF MAIZE GROWN IN VERTISOLS OF WESTERN MADHYA PRADESH

Negar MOSALLANEJAD¹, Kateryna KHADUSKINA², Bhanu Singh PANWAR³

¹Department of soil chemistry and fertility, Shiraz University, Iran

²V. N. Karazin Kharkiv National University, Kharkiv, Ukraine

³Green India Clean Environment Society (GICES), Hisar, India

DO YOU KNOW ADVERSE ASPECTS OF AGRICULTURE?

Tofazzal ISLAM

Institute of Biotechnology and Genetic Engineering (IBGE), Bangabandhu Sheikh Mujibur Rahman Agricultural University, Bangladesh

COMBATING WHEAT BLAST DISEASE: HARNESSING CUTTING-EDGE TECHNOLOGIES FOR FOOD SECURITY



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Angel ALIZADEH¹, Bhanu Singh PANWAR²

¹ANGEL CAMPANY Tabriz, East Azerbaijan, Iran

²Green India Clean Environment Society, Hisar, Haryana, India

THE SOIL HEALTH PYRAMID

Éva KIRÁLY, Attila BOROVIČS

Forest Research Institute, University of Sopron, Várkerület Sárvár, Hungary

**INTRODUCTION OF THE COUNTINOUS COVER FORESTRY MODULE OF
THE FOREST INDUSTRY CARBON MODEL**

Shrouk Elgarihi EBRAHIM, Mohsen Elsayed IBAHIM, Ahmed Elsaid

ABDELAZIZ, Metwally Ramadan KOTTB

Faculty of science, Port Said University, Port Said, Egypt

**PENICILLIUM OXALICUM ISOLATED FROM ZEA MAYS RHIZOSPHERE AS
A PROMISING PLANT GROWTH PROMOTOR VIA MULTIPLE
MECHANISMS**

Clea Anne V. CORSIGA, Marciano D. TANGPOS

Cebu Technological University-Barili, Cagay, Barili, Cebu

**INTEGRATED ASSESSMENT OF TILLAGE SYSTEMS AND NUTRIENT
MANAGEMENT SCHEMES ON GROWTH DYNAMICS AND YIELD
PERFORMANCE OF LOWLAND RICE (*Oryza sativa* var. NSIC RC222) IN
BARILI, CEBU**

Komal JAT¹, Valentina Anufriyeva², Bhanu Singh PANWAR³

¹CAU Imphal, Imphal, Manipur, India

²Health care management education coordinator, Ukrainian-Swiss Project "Medical
Education Development" (MED), Kyiv, Ukraine

³GICES-Hisar, Haryana, India

GREEN APPROACH: PHYTOREMEDIATION



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Eetizez KAROU, Mohammed Ali TRIK, Monia ENNOUR

Olive tree institute, Sfax, Tunisia

**CHARACTERIZATION AND EVALUATION OF THE ANTIFUNGAL
ACTIVITY OF POSIDONIA OCEANICA EXTRACTS AGAINST PATHOGENIC
RHIZOCTONIA SPECIES**

Shreya BHOJANE¹, Bhanu Singh PANWAR²

¹Microbiologist, ICAR-National Research Centre on Meat, Rashtrasant Tukadoji Maharaj
Nagpur University (RTMNU), Hyderabad, Telangana, India

²Green India Clean Environment Society, Hisar, Haryana, India

PLASTIC POLLUTION: SOFT STONE IN THE SOIL BODY

CLEA ANNE V. CORSIGA

Cebu Technological University-Barili, Cagay, Barili, Cebu

cleaanne.corsiga@ctu.edu.ph, +63-946-566-6372

**EVALUATING SOIL COLOR AS A PREDICTOR OF FERTILITY
EVALUATING CHARACTERISTICS IN SUGARCANE-GROWN SOIL SERIES**



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D. Sustainability of Water, Sediments & Waste Management

Session (D1)

13:30 – 15:00

Chair of the Session:

Gábor KERTÉSZ

Abdul Aala Khurram

Water Care Services, Lahore, Pakistan

EXPLORING A CHEMICAL-FREE WASTEWATER TREATMENT SYSTEM FOR AGRICULTURAL REUSE: A PILOT STUDY ON INDUSTRIAL AND MUNICIPAL WASTEWATER

Ruqayah Ali GRMASHA^{1,2}, Csilla STENGER-KOVÁCS^{1,3}, Osamah J. AL-SAREJI^{2,4}, Mónika MEICZINGER⁴, Raed A. AL-JUBOORI^{5,6}

¹University of Pannonia, Faculty of Engineering, Center for Natural Science, Research Group of Limnology, Veszprem, Hungary

²Environmental Research and Studies Center, University of Babylon, Babylon, Al-Hillah, Iraq

³HUN-REN-PE Limnoecology Research Group, Veszprém, Hungary

⁴Sustainability Solutions Research Lab, Faculty of Engineering, University of Pannonia, Veszprem, Hungary

⁵NYUAD Water Research Center, New York University-Abu Dhabi Campus, Abu Dhabi, Abu Dhabi, United Arab Emirates

⁶Water and Environmental Engineering Research Group, Department of Built Environment, Aalto University, Aalto, Espoo, Finland

POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) LEVELS IN THREE DIFFERENT RIVERS



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Adhena Ayaliew WERKNEH

Mekelle University, Ethiopia

Northumbria University Newcastle, United Kingdom

**DECENTRALIZED CONSTRUCTED WETLANDS AS ALTERNATIVE
SOLUTION FOR WATER AND WASTEWATER TREATMENT IN
DEVELOPING COUNTRIES: OVERALL PERFORMANCE AND REMOVAL
MECHANISMS**

Fares BOUKHENISSA¹, Tarek DRIAS¹, Yacine AZIZI²

¹Department Of Geology, Mobilization and Water Resources Management Laboratory,
University Batna2, Algeria

²Department of Geology, Energy and Material Laboratory, University of Tamanrasset, Algeria

**GROUNDWATER MANAGEMENT AND SUSTAINABLE IN ARID
REGIONS A CASE STUDY OF KHANGUET SIDI NADJI, SOUTH-
EASTERN ALGERIA**

Moufida BELLOULA¹, Tarek DRIAS², Abdelmajid BOUFEKKANE³

¹Laboratory of mobilization and water resource management. University of Batna 2. Algeria

²Laboratory of natural risks and territory Development. University of Batna 2. Algeria

³FSTGAT. USTHB University, beb Azouar Algiers, Algeria

**CHARACTERISATION OF FLOW AND SEDIMENT TRANSPORT BY
MODELLING IN SEMI-ARID AREAS. EXAMPLE OF THE MESKIANA-
MELLEQUE UPSTREAM BASIN (CONFIN AIGERO-TUNISIA)**

**Zita ZRINYI, Renata GERENCSEK-BERTA, Nikoletta KOVACS, Gabor
MAASZ**

Soos Erno Research and Development Center, University of Pannonia, Nagykanizsa, Hungary

**WASTEWATER IMPACT ON SURFACE WATER: OCCURRENCE,
ATTENUATION, AND RISKS OF ORGANIC MICROPOLLUTANTS IN THE
MIRROR OF THE NEW EU URBAN WASTEWATER DIRECTIVE**



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Osamah J. AL-SAREJI^{1,2}, Mónika MEICZINGER¹, Viola SOMOGYI¹, Ruqayah Ali GRMASHA^{2,3}, Raed A. AL-JUBOORI^{4,5}

¹Sustainability Solutions Research Lab, Faculty of Engineering, University of Pannonia, Veszprem, Hungary

²Environmental Research and Studies Center, University of Babylon, Babylon, Al-Hillah, Iraq

³University of Pannonia, Faculty of Engineering, Center for Natural Science, Research Group of Limnology, Veszprem, Hungary

⁴NYUAD Water Research Center, New York University-Abu Dhabi Campus, Abu Dhabi, United Arab Emirates

⁵Water and Environmental Engineering Research Group, Department of Built Environment, Aalto University, Aalto, Espoo, Finland

THE APPLICATION OF DIFFERENT WASTES TO REMOVE ORGANIC MICROPOLLUTANTS

Imane HAYDARI^{1,2}, Jihen ELLEUCH³, Naaila OUZZANI^{1,2}, Faissal AZIZ^{1,2}

¹Laboratory of Water, Biodiversity, and Climate Change, Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco.

²National Center for Research and Studies on Water and Energy, Cadi Ayyad University, Marrakech, Morocco.

³Laboratory of Enzymatic Engineering and Microbiology, National Engineering School of Sfax, University of Sfax, Sfax, Tunisia.

INNOVATIVE ADSORBENT FOR ECO-FRIENDLY TREATMENT OF OLIVE MILL WASTEWATER

Mustafa HATHAL, Viola SOMOGYI

Sustainability Solutions Research Laboratory, University of Pannonia, Veszprém, Hungary

WASTEWATER RECYCLING FOR IRRIGATION USES IN ARID REGIONS



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Session (D2)

15:00 – 15:50

Chair of the Session:

Zita ZRINYI

Bekalu Melis ALEHEGN¹, Dagnenet Sultan ALEMU²

¹Assosa University, college of Agriculture, Department of Soil Resource and Watershed Management, Ethiopia,

²Bahir Dar university faculty of civil and Water Resource Engineering, Ethiopia

EFFECT OF DEFICIT IRRIGATION ON BARLEY YIELD AND WATER PRODUCTIVITY THROUGH FIELD EXPERIMENT AND MODELING AT KOGA IRRIGATION SCHEME, AMHARA REGION, ETHIOPIA

Yanina L. ROMERO¹, BESSEMBINDER², Van De GIESEN³, Van De VEN³

¹Beuningen, The Netherlands

²Climate Services, Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands

³Water Management of the Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, The Netherlands

A RELATION BETWEEN EXTREME DAILY PRECIPITATION AND EXTREME SHORT-TERM PRECIPITATION

Lema Kefyalew MULUBIRHAN

Ethiopian Electric Power (EEP), Addis Ababa, Ethiopia

URBAN WATER SUPPLY SYSTEM PERFORMANCE ASSESSMENT: THE CASE OF ALEM GENA TOWN

Tamás KLOKNICER^{1,2}, Dániel Benjámín SÁNDOR², Anita SZABÓ²

¹Obuda University, Budapest, Hungary

²Inno-Water Zrt, Budapest, Hungary

EFFECT OF MIXING ENERGY ON VARIOUS FRESHLY DEVELOPED MICROCARRIERS



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**Abdelmadjid BOUFEKANE¹, Moufida BELLOULA², Oussama SABROU¹,
Nawel CKIKH¹**

¹Geo-Environment Laboratory, Department of Geology, Faculty of Earth Sciences and
Country Planning, University of Sciences and Technology Houari Boumediene, Bab Ezzouar,
Algeria

²Natural Risks and Land Use Laboratory, Department of Geography and Regional Planning,
Batna 2 University, Fesdis, Batna, Algeria

**PREDICTION OF THE PIEZOMETRIC LEVEL IN THE EASTERN MITIDJA PLAIN USING
DEEP LEARNING MODEL - APPLICATION OF THE LONG-SHORT TERM
MEMORY MODEL**



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**E. Sustainability of Circular (Bio)Economy Strategy of
Recycling, & Energy
And
F. Air Pollution & Ecosystems & Landscape**

Session (E&F)

15:10 – 16:30

Chair of the Session:

Emoke IMRE

**Saeid Nasiri ZARE, Kamran JAFARPOUR, Amina MELIANI, Ahmed
BENSOLTANE**

Department of Biology, FSNV. University of Mustapha Stambouli, Mascara, Algeria

**THE USE OF THE PLANT GROWTH-PROMOTING RHIZOBACTERIUM
PSEUDOMONAS AS AGRICULTURE BIORESOURCE**

Karim ENNOURI

University of Sfax, Sfax, Tunisia

**CLIMATE CHANGE SIMULATION: UTILIZING REMOTE SENSING AS AN
EFFECTIVE TOOL**

I. B. ABRAHAM

Mekelle University, Mekelle, Ethiopia

**THE FIGHT FOR COEXISTENCE IN THE HARSH AFROALPINE
ECOSYSTEM: DIETARY NICHE PARTITIONING BETWEEN TWO
SYMPATRIC RODENT SPECIES IN THE GUASSA MENZ COMMUNITY
CONSERVATION AREA, ETHIOPIA**

Abdelkader HEMAIZIA

Laboratory of Energy Mechanics and Conversion Systems, University of Sciences and
Technology Houari Boumediene, Bab-Ezzouar, Algeria

**IMPACT OF HYDROGEN ENRICHMENT ON FLAME STABILIZATION AND
EMISSIONS IN PROPANE-AIR COMBUSTION: A NUMERICAL STUDY**



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Antoine KANTIZA

International Relations Policy, Centre of International Relations of Bujumbura,
Bujumbura, Burundi

EFFECTS OF OZONE LAYER SHORTAGE UPON LIVING BEINGS

Ágnes BÁLINT¹, Zoltán EISELT², Gábor BAKÓ², Xuechu WANG², Csaba MÉSZÁROS²

¹Obuda University, Budapest, Hungary

²MATE, Gödöllő, Hungary

**INVESTIGATION OF HEAVY METAL CONTAMINATION AT A FORMER
CANNERY IN HALÁSZTELEK**



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G. Applied & Natural Sciences

Session (G1)

13:30 – 15:30

Chair of the Session:

Ratnesh DAS

S. Kh. YAKUBOV

Institute of Military Aviation of the Republic of Uzbekistan, Karshi, Uzbekistan

ALGORITHMIZATION OF RESEARCH AND SOLVING OPTIMIZATION PROBLEMS

Amit Kumar MAURYA¹, Mahesh SINGH¹, Vinny JOHN²

¹Teerthankar Mahaveer University, Moradabad, Uttar Pradesh, India

²Department of Agriculture, Mangalayatan University, Jabalpur, Madhya Pradesh, India

OPTIMIZING SUBSTRATES FOR ENHANCED SPAWN AND YIELD OF OYSTER MUSHROOM (PLEUROTUS FLORIDA)

D. Jenina ANGELIN, R. PUGALENTHI

Department of Artificial Intelligence and Data Science, St. Joseph's College of Engineering, Chennai, India

LAND USE LAND COVER MAPPING IN BIODIVERSITY HOTSPOTS USING NEURAL-CELLULAR MODELS

Faruque HOSSAIN, S. Mosaddeq AHMED

American International University, Dhaka, Bangladesh

ORGANIC CARBON STORAGE MEASUREMENT OF SUNDARBAN MANGROVE FOREST SOILS OF BANGLADESH

Sahel HAGHIGHI¹, Frood SHARIFI², Reza TAMARTASH¹

¹Sari University of Agricultural Sciences and Natural Resources, Mazandaran, Iran

²Soil Conservation and Watershed Management Research Institute, Tehran, Iran

EVALUATION OF THE PERFORMANCE AND QUALITY OF VETIVER PLANT UNDER THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS (CASE STUDY: SIDE AREA OF SANGAR DAM RESERVOIR – IRAN)



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Gagan Preet Kour BALI

Department of Biosciences, UIBT, Chandigarh *University*, Mohali, Punjab, India

A TAXONOMICAL PUZZLE: GENUS GAZALINA WALKER

D. Jenina ANGELIN, R. PUGALENTHI

Department of Artificial Intelligence and Data Science, St. Joseph's College of Engineering, Chennai, India

THE HIDDEN COST OF INTELLIGENCE: AI'S CARBON FOOTPRINT AND STRATEGIC SOLUTIONS



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G. Applied & Natural Sciences
Session (G2) 15:30 – 17:30

Chair of the Session: Giuseppe CIABURRO

Lara Rúbia BORGES-FORRÓ, Levente KARDOS

Hungarian University of Agriculture and Life Sciences, Institute of Environmental Sciences,
Department of Agro-environmental Studies, Budapest, Hungary

**EVALUATION OF GERMINATION PERFORMANCE IN COMPOST BLENDS
OF PÁLINKA DISTILLATION MASH WITH DIVERSE CO-COMPOSTING
MATERIALS**

Maamar BOUKABCHA, Khaled EL MILOUDI

Hassiba BEN BOUALI University of Chlef, Chlef, Algeria

**STUDY OF THE BIOPHYSICAL PROPERTIES OF PLANT, SOIL, AND
WATER INTERACTION DURING THE ENTIRE GROWTH CYCLE OF THE
SUNFLOWER PLANT**

Ahmed RAMDANI, Fouad MALEK

Laboratory of Applied Chemistry and Environment – ECOMP, Faculty of Sciences,
Mohammed First University, Bd Mohamed VI, Morocco

COMPARATIVE STUDY OF CELLULOSE MICROFIBERS

Zoubir BELHIMER, Azzedine BOUZENOUNE, Abdelhakim BOUCHAIR

Geological Engineering Laboratory (LGG), Faculty of Natural and Life Sciences, University of
Jijel, Jijel, Algeria

**GITOLOGY OF TRIASSIC OPHITES-RELATED
MINERALIZATIONS OF EASTERN BABORS: A CASE STUDY OF
OUALIL OPHITES (JIJEL PROVINCE, NORTHEASTERN
ALGERIA)**



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Mekonen ASEFA

Budapest University of Technology and Economics, Budapest, Hungary

DEVELOPMENT OF ZNO/TIO₂ INVERSE OPAL NANOSTRUCTURED GAS SENSORS ON CHIP SUBSTRATES FOR ENHANCED DETECTION OF NO₂, CO₂, AND NH₃

Maamar BOUKABCHA, Khaled EL MILOUDI

Hassiba BEN BOUALI University of Chlef, Chlef, Algeria

MATHEMATICAL STUDY OF PLANT GROWTH PHENOMENA: STUDY OF THE SUNFLOWER PLANT GROWTH



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Poster Session-A

15:15 – 16:50

Chair of the Session: Hosam BAYOUMI HAMUDA

Swati MEHTA, Pankaj DAHIYA, Navjot RANA

Lovely Professional University, Phagwara, India

**CLIMATE-SPECIFIC FORAGE CROP PLANNING FOR CONTINUOUS
FODDER SUPPLY ROUND THE YEAR IN NORTHERN SUBTROPICS OF
INDIA**

Opeoluwa Aderemi AKINBOYEJE

College of Centre of Excellence in Agricultural Development and Sustainable Environment,
Department of Livestock Science and Sustainable Environment, Ogun State, Nigeria

**EFFECT OF PHYTOGENIC FEED ADDITIVE BLEND ON HAEMATO-
BIOCHEMISTRY INDICES AND CARCASS QUALITY OF BROILER
CHICKENS**

Kashif Raza SIDDIQUE

Goel Institute of Technology and Management, Lucknow, India

**STUDY ON MANAGEMENT OF ARSENIC-LADEN SPENT SLUDGE FROM
ELECTROCOAGULATION TREATMENT**

Pankaj DAHIYA, Swati MEHTA, Navjot RANA

Lovely Professional University, Phagwara, India

**ASSESSMENT OF PHENOLOGICAL DEVELOPMENT OF WHEAT CROP
UNDER VARYING SOWING DATES IN THE TRANSGANGETIC REGION OF
INDIAN SUBCONTINENT**



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Sushmita PAUDEL

Himalayan Whitehouse International College, Kathmandu, Nepal

**ASSESSMENT OF THE IMPACT OF BACILLUS MONOCULTURE
FERMENTATION ON TANNIN, PHENOL, FLAVONOID CONTENT, AND
PHARMACOLOGICAL PROPERTIES (ANTIMICROBIAL, ANTIOXIDANT
AND CYTOTOXICITY) OF PTEROCARPUS MARSUPIUM LEAVES: A
COMPARATIVE STUDY**

Mamata SONI, Bhavin SONI

Madhav University, Pindwara (Raj.), India

**RENEWABLE ENERGY FROM A PHYSICS AND BIOTECHNOLOGY
PERSPECTIVE: ADVANCES IN SOLAR, WIND, AND BIOENERGY SYSTEMS**

Abderrahim BEZAI¹, Nafaa BRINIS¹, Azzeddine REGHAIS², Samir DJENBA¹, Fares BOUKHENISSA¹

¹Mobilization and Water resources management Laboratory (MGRE), STU, Batna 2
university, Algeria

²Geological Engineering Laboratory (LGG), SNV, Jijel university, Algeria

**HYDROCHEMICAL EVOLUTION OF GROUNDWATER IN THE REMILA
PLAIN, NORTHEAST KHENCHELA, ALGERIA**

Olha. A. KHLIESTOVA^{1,2}, Katarzyna Ewa ŁOŚ², Bhanu Singh PANWAR³

¹Department of Primary Science Institute of Modern Technologies, Pryazovskyi State
Technical University, Dnipro, Ukraine.

²Department of Machine Parts and Mechanism, Faculty of Mechanical Engineering, Technical
University of Liberec, Czech Republic.

³Green India Clean Environment Society (GICES), Hisar, Haryana, India

**THE SOIL IS RICH, THEN SO IS THE NATION: A FARMER IS A MAGICIAN
WHO PRODUCES MONEY FROM THE MUD?**



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Ashish A. MAGDUM¹, N. M. KONDE², P. R. KADU³, Nilam KANASE⁴, G. V. THAKARE⁵

¹Department of Soil Science and Agricultural Chemistry, Dr PDKV Akola Maharashtra, India

²Department of Soil Science and Agricultural Chemistry, Dr PDKV Akola Maharashtra India

³College of Agriculture Nagpur Maharashtra, India

⁴Department of Soil Science and Agricultural Chemistry, Dr PDKV Akola Maharashtra, India

⁵Department of Agronomy, Dr PDKV Akola Maharashtra India

**EVALUATING THE INFLUENCE OF CONSERVATION AND
CONVENTIONAL TILLAGE REGIMES ON SOIL QUALITY DYNAMICS IN
COTTON AGROECOSYSTEMS**

Samaneh ANSARINIA

Molecular Cellular Department of the University Isfahan, Isfahan, Iran

**THE EFFECT OF CHAMOMILE ESSENTIAL OIL ON BIOFILM
PRODUCTION IN PSEUDOMONAS AERUGINOSA**

Sara Alia LAKHDARI¹, Boualem BOUSELSAL², Yasmine LAKHDARI³

^{1,2}Department of Earth Sciences, Kasdi Merbah University, Ouargla, Algeria

³Department of Agronomic Sciences, SNV Faculty, University of Gharda, Algeria

**GRAPHICAL, STATISTICAL AND INDEX-BASED TECHNIQUES
INTEGRATED FOR IDENTIFYING THE HYDROCHEMICAL FINGERPRINTS
AND GROUNDWATER QUALITY OF IN SALAH ALGERIAN SAHARA**

Visha JAIN¹, Chandra BHUSHAN¹, Ayushi JAIN², Shivam JANGRA³

¹Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, India

²Department of Horticulture, Maharana Pratap University of Agriculture and Technology, Udaipur, India

³Chaudhary Charan Singh Haryana Agricultural University, Hisar, India

**AUGMENTING YIELD OF MUNGBEAN (VIGNA RADIATA) THROUGH
FOLIAR NUTRITION UNDER GUAVA (*Psidium Guajava*) BASED
AGRIHORTI SYSTEM**



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Emoke IMRE¹, Giulia GUIDA², Shuyin FENG³, Maria DATCHEVA⁴, Wiebke BAILLE⁵, Ágnes BÁLINT⁶, Delphin KABEY MWINKEN⁷, Vijay Pal SINGH⁸

¹Bánki Donát Faculty of Mechanical and Safety Engineering and EKIK HBM Research Centers, Obuda University, Budapest Hungary

²Department of Civil Engineering and Informatics, Università degli studi di Roma Tor Vergata, Rome, Italy

³Department of Civil Engineering, Birmingham City University, UK

⁴Institute of Mechanics and Institute of Information and Communication Technologies, Bulgarian Academy of Sciences, Sofia, Bulgaria

⁵Ruhr-Universität Bochum, Bochum, Germany

⁶Obuda University, Institute of Environmental Engineering and Natural Sciences, Budapest, Hungary

⁷AIAM Doctoral School, Obuda University, Hungary

⁸Texas A & M University, USA

COMPARING THE HARMONIC MEAN DIAMETER FROM GRAIN SIZE DISTRIBUTION BY DRY MASS AND BY SURFACE AREA

Mohammed ER-RAJY, Menana ELHALLAOUI

LIMAS Laboratory, Faculty of Sciences Dhar El Mahraz, Sidi Mohamed Ben Abdellah University, Fez, Morocco

DESIGN OF NOVEL ANTI-CANCER AGENTS TARGETING COX-2 INHIBITORS BASED ON COMPUTATIONAL STUDIES

AANCHAL¹, Sanjay K SHARMA², Mitu KATOCH², Saurabh THAKUR¹

¹Department of Soil Science, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur, Himachal Pradesh, India

²Department of Agronomy, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur, Himachal Pradesh, India

SOIL MICROBIAL DYNAMICS AS INFLUENCED BY DIFFERENT NUTRIENT MANAGEMENT PRACTICES IN MAIZE-WHEAT CROPPING SYSTEM IN ACID HILL SOIL OF HIMACHAL PRADESH



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Sahar MALEKI¹, Bhanu Singh PANWAR²

¹Pars Exir Sepand, Shiraz University, Iran

²GICES-HISAR, India

HOW TO KEEP SOIL BODY HEALTHY AND FERTILE?



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Program of

2nd day

22nd of November 2024 (Friday)

Continuation of A, B, C, D, E, F, G and Poster sessions

09:00 – 11:00

I. Posters Session-B:

Chair of the Session: Hosam BAYOUMI HAMUDA

Saurabh THAKUR, Sanjeev K SANDAL, Richa JASWAL, AANCHAL

Department of Soil Science, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur,
Himachal Pradesh, India

**EVALUATING CAPSICUM PRODUCTIVITY THROUGH DRIP IRRIGATION
AND INM BASED FERTIGATION IN A NATURALLY VENTILATED
POLYHOUSE**

Sonali RAJPUT

Department of Seed Science and Technology, HNBGU-Srinagar, Uttarakhand, India

**LEVERAGING SOIL MICROBIOMES FOR SUSTAINABLE AGRICULTURE
AND CLIMATE ADAPTATION**

Shahnoor CHOWDHARY

Sher e Kashmir University of Agricultural Sciences and Technology, Jammu (Jammu &
Kashmir), Jammu, India

**INTRODUCING SILKWORM PUPAE AS AN INNOVATIVE MEDIUM FOR
MASS REARING THE BIOCONTROL PARASITOID TETRASTICHUS
HOWARDI (OLLIFF)**



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Sushma PAUDEL

Ecorevive Research and Innovation, Kathmandu, Nepal

STUDY OF ANTIMICROBIAL RESISTANT GRAM-NEGATIVE BACTERIA IN CHICKEN AND PORK MEAT IN KATHMANDU VALLEY

PANKAJ¹, K.K BHARDWAJ², M.K. SHARMA², R.S. BENIWAL³

¹Department of Soil Science, Guru Kashi University, Bathinda, India

²Department of Soil Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar, India

³Department of Forestry, Chaudhary Charan Singh Haryana Agricultural University, Hisar, India

SOIL NUTRIENT FRACTIONS UNDER DIFFERENT AGROFORESTRY SYSTEMS UNDER SEMI-ARID CONDITIONS OF HARYANA

Raghvendra Kumar KUSHWAHA¹, Drishty KATIYAR²

¹Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P., India

²CSAUA & T University, U.P., Kanpur, India

BIOSTIMULANTS-THE ALCHEMY OF THE FUTURE'S AGRICULTURE TECHNOLOGY

Galiya AKHMETOVA^{1,2}

¹Saniplant Biotechnological Research and Development Ltd, Gödöllo, Hungary

²A.I. Barayev Research and Production Centre for Grain Farming, Shortandy, Kazakhstan

TESTING THE PESTICIDE TOLERANCE OF BACTERIAL COMPONENTS FOR MICROBIAL SOIL INOCULANTS

Shashank SEN, Kapildev GOCHER

College of Agriculture Iroishemba, Central Agriculture University, Imphal, Manipur, India

CLIMATE SMART AGRICULTURE – A STEP TOWARDS SUSTAINABILITY TO REPLENISH THE EFFECT OF CLIMATE CHANGE



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Endalkachew ETANA

Mattu University, Mattu, Ethiopia

PHYSICOCHEMICAL PARAMETER ANALYSIS, LEVELS OF HEAVY METAL POLLUTION AND POTENTIAL HEALTH RISK ASSESSMENTS IN AGRICULTURAL SOILS FROM SOUTH-WEST REGION OF ETHIOPIA

Igor DUKAY

Institute for Wildlife Management and Nature Conservation, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

THE NEED AND POSSIBLE DIRECTIONS FOR SUSTAINABLE WATER MANAGEMENT ALONG THE BÜKKÖS STREAM (SZENTENDRE, HUNGARY)

Galiya AKHMETOVA¹, KIYAS ALDABERGEN¹, SYDYKOVA KAMILYA², SOLTABAYEVA AIGERIM²

¹A.I. Barayev Research and Production Centre for Grain Farming¹, Shortandy, Kazakhstan

²Nazarbayev University, Astana, Kazakhstan

FUNGAL COMMUNITY ISOLATED FROM THE ROOT OF AGRICULTURAL PLANTS AND SOIL IN A VARIETY OF TYPES CROP ROTATIONS IN THE AKMOLA REGION

Abdeldjabar NECER

University of Batna, Route de Constantine. Fesdis, Batna, Algeria

AMPHIBIAN AND REPTILE DIVERSITY IN THE BELEZMA BIOSPHERE RESERVE, BATNA PROVINCE, NORTH-EASTERN ALGERIA



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Ghalehtemouri^{1,2,3}, Taher PARIZADI¹

¹Department of Geographical Sciences, Faculty of Geography and Urban planning, Kharazmi University, Tehran, Iran

²Environmental Resilience and sustainability, Malaysia-Japan International of Technology, Universiti Teknologi Kuala Lumpur, Jalan Sultan Yahya Petra, Kuala Lumpur, Malaysia

³Disaster Preparedness & Prevention Centre, Malaysia-Japan International of Technology, Universiti Teknologi, Kuala Lumpur, Jalan Sultan Yahya Petra, Kuala Lumpur, Malaysia

**EXPLORING AND MAPPING THE DRIVERS OF SPATIAL INEQUALITY
AND REGIONAL ECONOMIC DISPARITIES IN IRAN: AN ANALYSIS OF
NATIONAL POLICIES**

**Olivier IRUMVA^{1,2}, Gratien TWAGIRAYEZU^{3,4}, Antong XIA³, Fasilate
UWIMPAYE⁵, Jean Claude NIZEYIMANA^{4,6}, Ildephonse NIZEYIMANA⁷**

¹Department of Civil and Environmental Engineering, University of Nebraska-Lincoln, Lincoln, Nebraska, United States

²College of Environmental Science and Engineering, Tongji University, Shanghai, China

³State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, Guizhou, China

⁴University of Chinese Academy of Sciences, Beijing, China

⁵Institute of Environmental Engineering and Building Installations, Faculty of Environmental Engineering and Energy, Poznan University of Technology, Berdychowo, Poznan, Poland

⁶CAS Key Laboratory of Urban Pollutant Conversion of Urban Environment, Institute of Urban Environment, Chinese Academy of Sciences, Xiamen, China

⁷Ministry of Infrastructure, Government of Rwanda, Kigali, Rwanda

**THE ENVIRONMENTAL FATE AND TRANSPORT, IMPACTS, AND FUTURE
PERSPECTIVES OF ENGINEERED NANOPARTICLES IN SURFACE WATERS**



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**Ayeh LOTFOLLAHI¹, Mohammad Amir DELAVAR¹, Asim BISWAS²,
Shahrokh FATEHI³, Ruhollah TAGHIZADEH-MEHRJARDI⁴, Mehdi
MOKHTARZADE⁵, Mohammad JAMSHIDI⁶**

¹Department of Soil Science, Faculty of Agriculture, University of Zanjan, Zanjan, Iran

²School of Environmental Sciences, University of Guelph, Guelph, Canada

³Soil and Water Research Department, Kermanshah Agricultural and Natural Resources
Research and Education Center, AREEO, Kermanshah, Iran

⁴Faculty of Agriculture and Natural Resources, Ardakan University, Ardakan, Iran

⁵Department of Photogrammetry and Remote Sensing, Faculty of Geodesy and Geomatics, K.
N. Toosi University of Technology, Tehran, Iran

⁶Scientific Staff of Soil and Water Research Institute, Agricultural Research, Education and
Extension Organization, Karaj, Iran

**IDENTIFICATION AND SPECTRAL ASSESSMENT OF CALCIUM
CARBONATE EQUIVALENT AND ORGANIC CARBON AT DIFFERENT
DEPTHS WITH THE MID-INFRARED SPECTRUM**

ASSIATAFROUNT, Tarek DRIAS

University of Batna 2, Fesdis, Algeria

**IDENTIFYING THE ORIGIN AND GEOCHEMICAL EVOLUTION OF
GROUNDWATER USING HYDROCHEMISTRY AND STABLE ISOTOPES IN
A SEMI-ARID SHALLOW AQUIFER: A CASE STUDY OF THE BARIKA AREA
IN NORTHEAST ALGERIA**

Kenza IRINISLIMANE

Mechanical Engineering Department, M'Hamed Bougara University, Boumerdes, Algeria

**ENVIRONMENTAL VULNERABILITY, NATURE'S PREDISPOSITIONS AND
RISK FACTORS**



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Safia SAOULI, Rabah KECHICHED

Laboratoire des Réservoirs Souterrains: Pétroliers, Gaziers et Aquifères, Université Kasdi Merbah Ouargla, Algeria

DISTRIBUTION AND ECOLOGICAL RISKS OF TRACE METALS IN GRAIN-SIZE FRACTIONS OF PHOSPHORITE DEPOSITS: A CASE STUDY FROM KEF ESSENOUN DEPOSIT (DJEBEL ONK, NE ALGERIA)

Asmaa HAJ KHLIFA^{1,2}, Halima GAMRANI^{1,2}, Najib KISSANI¹, Moulay Mustapha BOUYATAS^{1,3}

¹Neurosciences, Pharmacology and Environment Team, Laboratory of Clinical, Experimental and Environmental Neurosciences, Faculty of Medicine and Pharmacy, Cadi Ayyad University, Marrakech, Morocco

²Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakesh, Morocco

³Cadi Ayyad University, Multidisciplinary Faculty of Safi, Department of Biology, Morocco

AMELIORATIVE EFFECT OF ONONIS NATRIX AGAINST CHRONIC LEAD POISONING IN MICE: BIOCHEMICAL AND HISTOLOGICAL STUDY

Ayeh LOTFOLLAHI¹, Mohammad Amir DELAVAR¹, Asim BISWAS², Shahrokh FATEHI³, Ruhollah TAGHIZADEH-MEHRJARDI⁴, Mehdi MOKHTARZADE⁵, Mohammad JAMSHIDI⁶

¹Department of Soil Science, Faculty of Agriculture, University of Zanjan, Zanjan, Iran

²School of Environmental Sciences, University of Guelph, Guelph, Canada

³Soil and Water Research Department, Kermanshah Agricultural and Natural Resources Research and Education Center, AREEO, Kermanshah, Iran

⁴Faculty of Agriculture and Natural Resources, Ardakan University, Ardakan, Iran

⁵Department of Photogrammetry and Remote Sensing, Faculty of Geodesy and Geomatics, K. N. Toosi University of Technology, Tehran, Iran

⁶Scientific Staff of Soil and Water Research Institute, Agricultural Research, Education and Extension Organization, Karaj, Iran

DEVELOPING OF DIGITAL MAPS OF CARBONATE CALCIUM EQUIVALENT AND ORGANIC CARBON BY COMBINING SPECTROSCOPY AND GEOSTATISTICAL TECHNIQUES



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Pragati PANDEY

Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, India

PRODUCTION POTENTIAL OF RICE-BASED CROPPING SYSTEM UNDER IRRIGATED CONDITIONS

Adebayo-Adewunmi Raimot ADEJUMOKE

Department of Biology Education, School of Science Education, Federal College of Education (Technical) Akoka-Yaba, Lagos – State, Nigeria

ECOTOXICOLOGY AND POLLUTION: CAUSES, EFFECT AND PREVENTIVE MEASURE TO CONTROL THE TOXIC SUBSTANCES

Emőke IMRE¹, Péter FELKER¹, Zsolt HORTOBÁGYI², Gábor MILE³, Zoltán KAPROS⁴, Delphin K MWINKEN⁵, Ákos NEMCSICS⁶, Antal ÜRMÖS⁶, Ágnes BÁLINT⁷, Csaba KOLLÁR¹, Tibor GODA¹, Ervin RÁCZ¹, Tamás WEIDINGER⁸

¹Obuda University, Bánki Donát Faculty of Mechanical and Safety Engineering & HBM Research Centers, Budapest, Hungary

²Department of Structural Mechanics, Civil Engineering Faculty, Budapest University of Technology and Economics, Budapest, Hungary

³FKF Pvt Ltd, Budapest, Hungary

⁴Ministry of Construction and Transport, Hungary

⁵Obuda University, AIAM Doctoral School, Budapest, Hungary

⁶Kandó Kálmán Faculty, Obuda University, Budapest, Hungary

⁷Obuda University, Institute of Environmental Engineering and Natural Sciences, Budapest, Hungary

⁸Department of Meteorology, Institute of Geography and Earth Sciences, Faculty of Sciences, ELTE Eötvös Loránd University, Budapest, Hungary

WIND VELOCITY MEASUREMENTS: ASSESSING THE HILL EFFECT ON A TRUNCATED PYRAMID



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Adebayo-Adewunmi Raimot ADEJUMOKE

Biology Education Department, School of Science Education,
Federal College of Education (Technical) Akoka-Yaba, Lagos State, Nigeria

**HEALTH AWARENESS ON CAUSES AND PREVENTION OF DRUG
ADDICTION FOR BIOLOGY STUDENTS IN TERTIARY INSTITUTION IN
NIGERIA**



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II. Session

Poster without Presentation (ONLY Publication)

Svitlana ZHUKEVYCH¹, Natalia KARPYSHYN², Natalia ZHUK³

¹Department of Accounting and Taxation, West Ukrainian National University, Ternopil, Ukraine

²Department of International Relations and Diplomacy, West Ukrainian National University, Ternopil, Ukraine

³Department of Financial and Economic Security of the Educational and Scientific Humanitarian, Institute National Academy of the Security Service of Ukraine, Kyiv, Ukraine

ANALYSIS OF THE FINANCIAL STATUS OF THE HEALTH CARE SYSTEM: A COMPREHENSIVE APPROACH BASED ON SECURITY

Yara EzAl Deen SULTAN¹, Archana SHMA²

¹Department of Chemistry, School of Science & Humanities, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science & Technology, Chennai-600062, Tamil Nadu, India.

²Department of Agriculture, Marwadi University, Rajkot, Gujarat, India.

WILDFIRE RESISTANCE COATING MATERIAL IN VELLORE RESERVE FOREST

Martina SLÁMOVA¹, Zsolt BIRÓ², Csaba CENTERI²

¹UNESCO Department for Ecological Awareness and Sustainable Development, Technical University in Zvolen, Slovakia

²Institute for Wildlife Management and Nature Conservation, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

EFFECTS OF LAND USES ON SOIL PROPERTIES – A SLOVAKIAN CASE STUDY

Payal CHOUDHARY

Institute of Agriculture Science, Bundelkhand University, Jhansi (UP), India

SOIL BIOLOGY FOR SUSTAINABLE AGRICULTURE AND ENVIRONMENT PROTECTION



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Csaba CENTERI

Department of Nature Conservation and Landscape Management, Institute for Wildlife Management and Nature Conservation, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary

HETEROGENEITY OF NATURAL AREAS: A LANDSCAPE ECOLOGICAL ASPECT

Utam CHAND, Fizza BATOOL, Syeda Rahab Zahra BUKHARI

Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan, Pakistan

INNOVATIVE WASTE MANAGEMENT STRATEGIES TO REDUCE SOIL POLLUTION AND ENHANCE SOIL SUSTAINABILITY

Shreya SINGH¹, Sudhanand Prasad LAL²

¹Department of Agriculture, Ramlalit Singh Mahavidyalaya, Kailhat, Chunar, Mirzapur Uttar Pradesh, India

²Department of Agricultural Extension Education, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

AI-DRIVEN EXPERT SYSTEMS FOR CLIMATE-RESILIENT SOIL FERTILIZATION: ENHANCING DECISION SUPPORT FOR SUSTAINABLE AGRICULTURE

Fizza BATOOL, Syeda Rahab Zahra BHUKARI, Utam CHAND

Department of Soil and Environmental Sciences, MNS-University of Agriculture, Multan, Pakistan

RECYCLING INDUSTRIAL WASTE FOR SUSTAINABLE SOIL FERTILITY: A NATURAL ALTERNATIVE TO CHEMICAL FERTILIZERS

Oksana HNATIV

Ivan Franko National University of Lviv, Lviv, Ukraine

IMPACT OF FULL-SCALE WAR ON THE ENVIRONMENT: SOLUTIONS



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Sumit KUMAR¹, V P S PANGHAL²

¹Department of Vegetable Science, Maharana Pratap Horticultural University, Karnal, India

²Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, India

ROLE OF ORGANIC MANURES, JEEVAMRIT AND GHANAJEEVAMRIT ON THE YIELD OF CARROT

Olga DROBOTIUK¹, Valeriia OSADCHUK²

¹Kyiv National Economic University named after Vadym Hetman, A. Yu. Krymskyi Institute of Oriental Studies, National Academy of Sciences of Ukraine, Kyiv, Ukraine,

²Kyiv National Economic University named after Vadym Hetman, Kultura Marketing, a digital agency, Kyiv, Ukraine

DIGITALIZATION AS A DRIVER OF CIRCULAR ECONOMIC TRANSITION IN CHINA

Vera ALPÁR

Department of Applied Social Sciences, Orosháza, Kodolányi University, Hungary

LAW & ECONOMY OF CIRCULAR MODELS AND SUSTAINABLE STRATEGIES

Brunilda ÇUKO¹, Yllka LALA¹, Efigjeni KONGJIK², Valbona SOTA^{1,2}

¹Department of Biotechnology, Faculty of Natural Sciences, Boulevard “Zogu I” Tirana, Albania

²ResearchCenter of Biotechnology and Genetics, Academy of Sciences of Albania, “Murat Toptani” Promenade, Tirana, Albania

IN VITRO MICROPROPAGATION OF PUNICA GRANATUM VAR. DEVEDISHE: A COMPARATIVE STUDY OF CONVENTIONAL METHODS AND THE ELECTIS BIOREACTOR SYSTEM



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Shahrbanoo ABOUTALEBI¹, Nasser ZARE¹, Reza HAGHI², Parisa SHEIKHZADEH¹

¹Department of Plant Production and Genetics, Faculty of Agriculture and Natural Resources, University of Mohaghegh Ardabili, Ardabil, Iran

²Leibniz Institute of Plant Genetics and Crop Plant (IPK), Germany

REGULATORY MECHANISM OF BORAGO OFFICINALIS L. UNDER CADMIUM STRESS BASED ON TRANSCRIPTOME ANALYSIS

M. I. ABO-YOUSEF¹, E. H. ELSEIDY², I. A. TALHA¹, O. A. ELNAGAR¹, W. M. ELKHOBY¹

¹Rice Research Department, Field Crops Research Institute, Agriculture Research Center, Cairo, Egypt

²Agronomy Science Department, Faculty of Agriculture, Tanta University, Tanta, Egypt

GENETIC BEHAVIOR FOR RICE YIELD AND IT IS ATTRIBUTING USING TRIPLE ANALYSIS

Innocent Tayari MWIZERWA

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²Department of Botany at the University of Veterinary Medicine, Budapest, Hungary

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Chair of the Session: Hosam BAYOUMI HAMUDA

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Hosam E.A.F. BAYOUMI HAMUDA

Institute of Environmental Engineering and Natural Sciences, Rejto Sandor Faculty of Light
Industry and Environmental Engineering, Obuda University, Budapest, Hungary

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SMOKE POLLUTION: THE CITY IN GAS CHAMBER??

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To think about your surrounding of living and turn it in healthy breathing place is basic unit for global environmental development and sustainability. NASA (2023) satellites observed heavy smoke and haze darkening skies in northern India. The poor air quality is a seasonal occurrence —the product of smoke from crop fires mixing with urban pollution from traffic and industry, emissions from cooking and heating fires, windblown dust, and a range of other sources.

How fires affecting air quality in Punjab and Haryana?



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Many farmers, particularly in the states of Punjab and Haryana, use fire as a fast, cheap way to clean up and fertilize fields before planting winter wheat crops. However, the surge of fires in the heart of the densely populated Indo-Gangetic Plain often contributes to a sharp deterioration of air quality in November and December. Farmers realise this is unsustainable but say they don't have a choice because the government is not offering them effective solutions and alternatives in practical.

The smoke is likely to run as far as Delhi, about distance of 200 km away, adding to the national capital's toxic haze. It's not just Delhi that suffers. Stubble burning has created a massive public health crisis - its fumes pollute swathes of northern India and endanger the health of hundreds of millions of people of entire regions.

During the pandemic Covid-19 ravaging the country as pollution makes people more vulnerable to infection and slows their recovery. According to some estimates, farmers in northern India burn about 23 million tonnes of paddy stubble every year.

The efforts to reduce air pollution may help in rectify global warming and climate change. So, mitigating air pollution and climate should lead to integrated programs, especially in polluted cities of India.

India's capital Delhi recorded its worst November air in at least last six years. The city recorded 11 days of "severe" pollution, up from 10 days in November 2016. Delhi didn't experience even one "good" day of air quality through the month. It was blaming the burning of crop stubble in neighbouring states and the festival of Diwali for the alarming levels of pollution in November.

Satellite data from Nasa shows that there were 90,984 fires from stubble burning in three states - Punjab, Haryana and Uttar Pradesh - between 1 October and 28 November. Several studies have warned of the health risks of breathing such toxic air.

The flash out to high levels of air pollution can make children obese and put them at greater risk of developing asthma. The study was the first in India to establish a link between overweight children, asthma and air pollution.

Keywords: Smoke pollution, Northern India, crop stubble burning, poor governance

Biography



President, Green India Clean Environment Society (GICES), former Professor of Soils and Environmental Sciences, CCS Haryana Agricultural University, Hisar, India. Phytoremediation of heavy metals contaminated soils by brassica species. About 44 years experiences of teaching, research and extension.



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NANO (MATERIALS, TECHNOLOGY, MEDICINE) AND HUMAN HEALTH

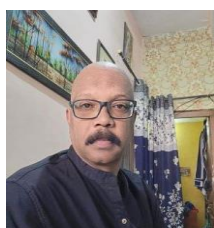
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Knowing the beneficial aspects of nanomedicine, scientists are trying to harness the applications of nanotechnology in diagnosis, treatment, and prevention of diseases. There are also potential uses in designing medical tools and processes for the new generation of medical scientists. The main objective for conducting this research review is to gather the widespread aspects of nanomedicine under one heading and to highlight standard research practices in the medical field. Comprehensive research has been conducted to incorporate the latest data related to nanotechnology in medicine and therapeutics derived from acknowledged scientific platforms. Nanotechnology is used to conduct sensitive medical procedures. Nanotechnology is showing successful and beneficial uses in the fields of diagnostics, disease treatment, regenerative medicine, gene therapy, dentistry, oncology, aesthetics industry, drug delivery, and therapeutics.

Keywords: Health care, nanotechnology, nanobiotechnology, nanomedicine, medical applications

Biography



Professor Ratnesh Das obtained M. Sc. degree in 1996 in Organic Chemistry from the Dr. Harisingh Gour University Sagar, India being placed first in the first class and Ph. D. degree in Synthetic Organic Chemistry from Dr. Harisingh Gour University Sagar, India in 2001. He joined the department of Chemistry, Dr. Harisingh Gour University, Sagar, India, as Assistant Professor in 2004. He has a rich experience in teaching and research for about 21 years during which he has supervised 11 Ph.D. students and completed many sponsored research projects. His active research areas include Heterocyclic synthesis, electrochemistry, synthesis of nano-catalysts, and green



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chemistry. He has authored about 80 research papers and 15 book chapters in Peer-reviewed national and international journals and refereed conferences organized by professional societies worldwide.



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SUSTAINABLE ACOUSTIC METAMATERIALS: TUNABLE SOUND ABSORPTION USING CORK MEMBRANES AND HONEYCOMB STRUCTURES

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This research work presents the development and characterization of sustainable acoustic metamaterials utilizing natural cork and honeycomb structures. Cork, a renewable and biodegradable material, offers unique properties such as low density, high elasticity, and excellent damping, making it an ideal candidate for sustainable sound absorption applications. By integrating cork membranes with lightweight honeycomb cores, the composite structure leverages the complementary properties of both materials to achieve enhanced acoustic performance while maintaining environmental sustainability. Cork, with its natural elasticity and high damping capacity, effectively dissipates sound energy, reducing noise levels. The honeycomb core, provides structural rigidity and lightweight characteristics, facilitating the creation of a robust yet easily deployable material. This synergy not only improves the sound absorption capabilities across a broad frequency range but also minimizes the environmental footprint by using renewable and recyclable materials. Additionally, the lightweight nature of the composite reduces transportation and installation costs, further promoting its use in sustainable construction and industrial noise control applications.

The study explores the tunability of the metamaterial by attaching discrete masses to the cork membranes. These masses modify the dynamic behaviour of the system, enabling control over the frequency range of maximum sound absorption. This tuneable design allows the metamaterial to target specific frequency bands, enhancing its applicability in diverse acoustic environments.

The sound absorption coefficient (SAC) of the composite materials was measured using the impedance tube method, also known as the Kundt's tube, to evaluate their performance across a wide frequency spectrum. Results demonstrate that the addition of masses significantly improves low-frequency absorption, a challenging area for traditional materials. The combination of cork and honeycomb structure, enhanced by mass tuning, achieves superior SAC performance while adhering to principles of sustainability. This work highlights the potential of integrating natural



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materials with advanced acoustic design strategies to develop efficient and environmentally friendly solutions for noise control applications.

Keywords: *sustainable acoustic metamaterials, natural cork and honeycomb structures, maintaining environmental sustainability*

Biography



Giuseppe Ciaburro holds a PhD in environmental technical physics a master's degree in chemical engineering, and a master's degree in acoustic and noise control. He works at the Built Environment Control Laboratory - Università degli Studi della Campania "Luigi Vanvitelli". He has over 20 years of work experience in programming, first in the field of combustion and then in acoustics and noise control. His core programming knowledge is in Python and R, and he has extensive experience of working with MATLAB. An expert in acoustics and noise control, Giuseppe has wide experience in teaching professional computer courses (about 20 years), dealing with e-learning as an author. He has several publications to his credit: monographs, scientific journals, and thematic conferences. He is currently researching machine learning applications in acoustics and noise control.



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ESKAPE PATHOGENS IN THE ENVIRONMENT AND ONE-HEALTH CONCEPT

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*The "One Health" concept aims to advance understanding of antimicrobial resistance (AMR) across human, animal, and environmental domains, recognizing the interconnectedness of these ecosystems in the AMR crisis. The ESKAPE group—comprising *Enterococcus faecium*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Enterobacter* spp.—is a major concern due to its significant resistance to key antibiotics like penicillin, vancomycin, and carbapenems. Unlike other pathogens, ESKAPE organisms exhibit enhanced resistance to commonly used antibiotics, increasing the urgency of understanding the resistome. In this study, multiple ecosystem types were analyzed for the presence of ESKAPE pathogens, including freshwater and agricultural environments. Results showed a substantial rise in ESKAPE populations within these ecosystems: in water ecosystem, ESKAPE counts increased by 1.65 times (from $n=35$ to $n=58$), while agricultural ecosystems saw a 2.21-fold rise (from $n=73$ to $n=162$). These findings underscore the rapid spread of ESKAPE pathogens in diverse environments, highlighting an urgent need for enhanced monitoring, targeted management practices, and integrated One Health strategies to limit the environmental reservoir of AMR and prevent further dissemination of resistant infections.*

Keywords: resistome, environment, soil, water, health, ESKAPE pathogens.

Biography

Lyudmyla Symochko is a specialist in environmental microbiology and ecology with a research focus since 2010 on the autecology and synecology of soil and water microbiota. Her work explores the environmental resistome and investigates how natural and human-



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impacted ecosystems serve as reservoirs for antibiotic-resistant microorganisms. She has pioneered studies in detecting antibiotic-resistant opportunistic pathogens in the environment and assessing their risks to human health. Dr. Symochko is the author of over 200 scientific publications, including five books, and serves as a guest editor for several prominent international journals.



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CLIMATE SMART AGRICULTURE APPROACH FOR AGRICULTURAL SUSTAINABILITY UNDER CLIMATE CHANGE

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Climate Smart Agriculture is a production system which or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. To the maximum extent feasible, Climate Smart Agriculture systems rely on crop rotations, crop residues and good agriculture practices. Climate-smart agriculture (CSA) is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. CSA aims to tackle three main objectives: sustainably increasing agricultural productivity and incomes; adapting and building resilience to climate change; and reducing and/or removing greenhouse gas emissions, where possible. CSA is an approach for developing agricultural strategies to secure sustainable food security under climate change. CSA provides the means to help stakeholders from local to national and international levels identify agricultural strategies suitable to their local conditions. CSA is one of the 11 Corporate Areas for Resource Mobilization under the FAO's Strategic Objectives. It is in line with FAO's vision for Sustainable Food and Agriculture and supports FAO's goal to make agriculture, forestry and fisheries more productive and more sustainable". Climate Smart Agriculture is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change. Widespread changes in rainfall and temperature patterns threaten agricultural production and increase the vulnerability of people dependent on agriculture for their livelihoods, which includes most of the world's poor. Climate change disrupts food markets, posing population-wide risks to food supply. Threats can be reduced by increasing the adaptive capacity of farmers as well as increasing resilience and resource use efficiency in agricultural production systems. CSA promotes coordinated actions by farmers, researchers, private sector, civil society and policymakers towards climate-resilient pathways through four main action areas: (A) building evidence; (B) increasing local institutional effectiveness; (C) fostering



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coherence between climate and agricultural policies; and (D) linking climate and agricultural financing. Climate Smart Agriculture differs from 'business-as-usual' approaches by emphasizing the capacity to implement flexible, context-specific solutions, supported by innovative policy and financing actions. To conclude, Climate Smart Agriculture is a productive agro-ecosystem which might be very resilient and adaptive to climate change scenarios.

Keywords: Climate Smart Agriculture – Sustainable of Agriculture – Climate Changes.

Biography



Zakaria Foad Fawzy – Professor Agricultural and Biological Research Division - National Research Centre and Assessor in Egyptian Accreditation Council about Organic Farming and Food Safety. He is coordinator of the Global Alliance for Climate Smart Agriculture " GACSA" in Food and Agriculture Organization " FAO" and also member of Chinese Arab Technology Transfer Centre. He is the first Egyptian researcher attended of the talented young scientist program in China. He got an opportunity for more than two international projects in Egypt as a principal investigator about Climate Changes Issues in China and Egypt. Dr Zakaria is professor in the Agriculture and Biological Division, National Research centre since 2013. Dr Zakaria is Former President of the Youth Scientific Research Association. He was attended many scholarships and fellowships such as, scholarship "PostDoctor" in China from 2011 to 2012 and fellowship " Talented Young Scientists Program" in China from 2014 to 2015 about Organic Farming sector. He created about four Memorandum of Understanding "MoU" and Memorandum of Agreement "MoA" between National Research Centre and other international scientific organization such as – Institute of Geographic Sciences and Natural Resources Research- Chinese Academy of Sciences and Beijing Institute of Technology- Ministry of Science and Technology – China. He is a member in many scientific organizations and acts as reviewer and referee as well as board member in the field of Organic Agriculture and climate changes issues for different national and international journals and organizations. Also, Dr. Zakaria won many awards, and he was attending a huge number of conferences, training and workshops in Egypt and other many countries in worldwide as well as he was published five scientific books such as " Organic Agriculture in Egypt and China" and more than 50 scientific research paper. Dr. Zakaria contributed significantly to the expansion of knowledge of organic agriculture and climate changes issues through public lectures on scientific



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research Centers and various Egyptian and Chinese universities, and because he is principal investigator of some international and national projects he contributed significantly in helping to learn Organic Agriculture and climate changes and using smart climate agriculture as a new trend in the field of agriculture. He has a Patent invention entitled "A new natural compound to increase productivity and immunity of horticultural and field crops" - 28729 - 2018 Advanced side - Academy of Scientific Research and Technology - Patent office.



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ENSURING LONG-TERM HUMAN RESOURCES IN THE 21st CENTURY WHILE UPLOADING HUMAN RIGHTS STANDARDS

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The longstanding debate persists: is the economy for the people, or are people for the economy? Technological advancements have increasingly reduced the need for physical human labour in economic activities. However, the demand for human resources is expected to persist at some level. Historically, the necessary human resources for national economies have been sustained through birth rates or immigration. This study explores whether maintaining a stable fertility rate of 2.1 in modern EU member states can be achieved over the long term while adhering to constitutional and human rights standards.

Keywords: HR, employee, increase the recruitment base

Biography



After completing university, he remained as a teaching assistant, and the following year he was appointed as an adjunct lecturer at an economic college. Simultaneously, he worked as a financial investigator for the police, focusing on tax fraud and bankruptcy crimes. After passing the bar exam, he helped small and medium-sized enterprises as a lawyer while continuing to teach. Upon earning his PhD, he was appointed as a professor and concluded his legal practice.



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HOW THE DEVELOPMENT OF BIOFILMS ON HOSPITAL SURFACES HAS CATALYZED THE SEARCH FOR NEW TECHNOLOGIES

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Use of plant growth promoting rhizobacteria (PGPR) as bioresources for the benefits of agriculture is gaining worldwide importance and acceptance and appears to be the trend for the future. These PGPR biofertilizer such as N₂ (nitrogen) fixing and phosphate solubilizing bacteria (PSB) can reduce chemical fertilizer applications and consequently preserve ecosystems biodiversity. The use of PSB as biofertilizers PGPR in order to increase the productivity may be a viable alternative to organic fertilizers and could decrease the environmental problems associated with conventional chemical fertilizers, which also helps in reducing the pollution and preserving the environment in the spirit of an ecological agriculture. In addition to biological nitrogen fixation, Phosphate solubilization is very important in enhancing the soil fertility. The use of phosphate solubilising Pseudomonas as inoculants have provided an alternative biotechnological solution in sustainable agriculture to meet the P demands of plants. The present study was carried out to isolate the PSB from the rhizosphere, to characterize indoleacetic acid (IAA) productivity and 1-aminocyclopropane-1-carboxylate (ACC) deaminase activity in some strains of fluorescent Pseudomonas for evaluating its capacity of the growth. The results showed that the isolates had shown capacities for siderophores production (maximum of 53.6 μM^{-1}) and Indole acetic acid (IAA) synthesis. Furthermore, all isolates were capable to solubilize PO₄ in PVK and PBRIP medium for 15 days, where PS6 and PS11 exhibited the greatest solubilization activity with a solubilization halo of 1.8 cm and 1.6 cm respectively. Interestingly, monitoring of ACC deaminase confirmed the production of α -ketobutyrate and ammonia.

Keywords: Bio-fertilizer, PGPR, PSB, IAA, Pseudomonas

Biography



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Prof MELIANI received her graduate degree in microbiology from the University of Es Senia, Oran, (Algeria) in 1995 and a Master in 2006 where she was recruited as an Assistant Professor. She subsequently had her Ph.D. in 2012 in Microbiological Sciences (Microbial ecology) from the same university of Oran, Algeria. She did her post-doc (HDR) in 2015, in the university of Mustapha Stambouli, Mascara, Algeria. In 2021, she promoted to full professor in microbial biotechnology. She has trained more than 140 graduates and postgraduate students in the faculty of science, University Mustapha Stambouli.

She has been chair of the Biotechnology Doctoral Committee since 2018. She is currently leading a research team of Microbial biotechnology of environment. She has authored many scientific publications, been invited to lecture at several international conferences. She is also an active reviewer for international committees or journals. In addition to her research, MELIANI has mentored many graduate researchers (more than 140).



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Abstracts of Oral Technical Sessions



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Session (A) Sustainable Development & Environmental Protection



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FOREST MANAGEMENT USING SPATIAL TECHNOLOGY TOWARDS SUSTAINABLE APPROACH: A CASE STUDY OF SIRSIYA BLOCK (SHRAVASTI DISTRICT, UP, INDIA)

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Spatial technology is a powerful technology in forest development, management and conservation. Environmental modelling using spatial technology (GIS, RS & GPS), as platform, can support many database queries tied to spatially referenced object and their associated attributes in waste land reclamation and management. Waste lands, which are marginally suitable area in open forest, found after analysis and modelling in GIS as 33.37 sq. km. This waste land area can be developed by considering basic needs like energy and biomass for local community members. Genesis of wasteland and their typologies into degraded forests, undulating land, gullied and ravinous land, degraded pastures, waterlogged, salt-affected and sand-affected areas etc. have been mapped and analysed with special reference to their relationship to natural environment, other land uses, human response and the problems and potentialities for reclamation. Action plan was developed for management and development of waste lands into forest cover to achieve sustainability.

Keywords: *Spatial Technology, GIS Modelling, Degraded Forest, Sustainable Development, Forest Management.*



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WILD EDIBLE PLANTS: A SUSTAINABLE SOLUTION FOR MEETING THE NEEDS OF FUTURE GENERATIONS

Nitesh SINGH, Renuka SHARMA

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The importance of biodiversity in sustaining ecosystem services is well recognized, the role of indigenous knowledge in the sustainable use and conservation of wild edible plants (WEPs) has often been overlooked. With global challenges like malnutrition, food insecurity, and crop shortages, WEPs offer a promising but underexplored solution. Although current research on WEPs is limited and often anecdotal, recent studies highlight their significant nutritional value. To maximize their potential, focused efforts on enhancing WEP farming, improving genetic traits, and optimizing storage and supply chains are needed. This presentation explores how conserving and sustainably managing WEPs—traditionally used by indigenous communities—can support multifunctional forestry, improve food security, and provide economic benefits to farmers and stakeholders.

Keywords: Wild Edible, Medicinal Plants, Food Insecurity, Nutritional Value.

Biography



Dr. Nitesh Singh

He had his PhD in Botany (2017-2022). Dr. Singh Presently serving as an Assistant Professor in the Department of Plant Pathology at SGT University, Delhi-NCR, India. A Junior Young



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Scientist Awardee – 2020 from the National Environmental Science Academy, India. Published 22 papers in reputed journals, 14 book chapters, 10 popular articles and 13 design and one utility patent.



Dr Renuka Sharma

Dr Renuka Sharma is working as a Deputy Dean Research at SGT University, Gurugram, Haryana, India. She worked as a Head government initiatives and business incubation, Noida Institute of Engineering and Technology, Greater Noida. She has a vast experience as program support professional, Ministry of Science and Technology, GoI.



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FROM DEGRADATION TO RESTORATION: REVITALIZING THE KASHAF-ROUD RIVER ECOSYSTEM

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Healthy and self-sustaining river systems provide important ecological and social goods and services on which human life depends. However, urban development and neglect of natural river courses have led to significant environmental issues. This article discusses how factors such as hydrological changes and pollution—from domestic sewage, agricultural runoff, and industrial waste—have contributed to environmental degradation. This phenomenon, termed "urban flow syndrome," results in detrimental morphological changes that compromise the ecological integrity of affected rivers.

Focusing on the Kashaf River in Mashhad City, Iran, the study evaluated water and soil quality by sampling from various zones—agricultural, industrial, residential, and less impacted areas—during both wet and dry seasons. The analysis included parameters like physicochemical properties, nutrients, heavy metals, and total and faecal coliform. Results indicated that industrial areas exhibited significantly poorer water quality, characterized by higher BOD₅ and nutrient concentrations, alongside lower pH and dissolved oxygen levels. Soil analyses showed increased heavy metal and nutrient levels in industrial regions, correlating with the water quality decline.

To address the pollution and degradation of the river, the study recommends a comprehensive restoration strategy. This includes restoring native riparian habitats to enhance biodiversity, sediment stabilization, and implementing integrated green infrastructure solutions like bioretention systems and constructed wetlands to filter urban runoff. An essential component of this strategy is promoting river auto-purification, which involves natural processes that enable rivers to cleanse themselves of pollutants. Enhancing these processes can be achieved by restoring natural flow regimes and establishing riparian buffers to improve filtration and habitat complexity. Additionally, innovative soil management practices, such as phytoremediation and the use of biochar, are suggested to improve the ecological function of surrounding landscapes. Crucially, engaging local stakeholders in the planning and execution of restoration efforts is deemed essential for ensuring the river ecosystem's long-term success and resilience.



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Keywords: *river restoration; anthropogenic; pollution; Environmental degradation*

Biography



I am associate professor of Civil Engineering Department, The Islamic Azad University of Mashhad, *I earned my PhD degree in Civil Eng. (Water Resources and Hydraulics) from Ferdowsi University of Mashhad, Iran. I joined the Department of Civil Engineering at Islamic Azad University of Mashhad in August 2007. My research interests lay in the following areas: Numerical Methods in water science, WRM, Dams and Hydraulic Structures and Water Related Disaster Management. And finally, I was founder and former director of Arid Environment Research Center in Iran from 2014 to 2022, which dealing with development aspects in arid and semi-arid environments.*



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SUSTAINABLE TRANSPORTATION AND GREEN INFRASTRUCTURE

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This chapter explores sustainable transportation and green infrastructure as vital components in achieving eco-friendly urban development. It examines the principles of sustainable transportation, including the promotion of energy-efficient public transit, electric vehicles, active transportation (walking, cycling), and low-emission freight systems. The chapter also discusses green infrastructure, highlighting urban design strategies that integrate natural elements, such as green roofs, permeable pavements, and urban green spaces, to enhance resilience against environmental impacts. Emphasis is placed on the environmental, economic, and social benefits of sustainable transport systems, including reduced greenhouse gas emissions, improved air quality, and enhanced urban livability. The chapter further investigates policy frameworks, technological innovations, and case studies from cities implementing green infrastructure and sustainable mobility solutions. Ultimately, it provides a comprehensive understanding of how integrating sustainable transportation with green infrastructure is essential for reducing urban carbon footprints and fostering sustainable urban ecosystems.



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A STUDY ON DIVERSITY OF ANTS (HYMENOPTERA: FORMICIDAE) IN DISTRICT BATTAGRAM KP, PAKISTAN

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Takes on challenging new role harnessing interpersonal skills, collaboration and problem solving. Driven to deliver high-quality service and consistent results. Hard-working conservation of Wildlife with strong organisational skills. Achieves company goals through exceptional planning and prioritisation. Enthusiastic conservation of Wildlife with knowledge of resolving customer problems. Works to increase success through effective work strategies and customer service. Passionate threats to Wildlife with experience in data accuracy and management. Independent problem-solver focused on customer service and product development. Works well under tight deadlines. Dedicated conservation of Wildlife highly effective in undertaking administrative and programme management tasks. Manages complex data with excellent organisation. Motivated to achieve outstanding success through prompt communication and helpful approaches.



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GLOBAL ENVIRONMENTAL DEVELOPMENT AND SUSTAINABILITY: ROLE OF DEVELOPING COUNTRIES”

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Billions of people in developing-countries continue to suffer from preventable diseases because of Environmental change, causing unnecessary suffering and increasing poverty. Whereas unorganized rapid economic development in developing countries proved as a gateway to many health and wellbeing problems which are potentially linked to environmental threats, from air pollution and physical deterioration to global climate change. Sustainable development seeks to reduce environmental impact and have less impact on environmental health than traditional practices. Carefully assessed “Green Economy” could serve solution to economic and environmental sustainability problems while taking key players on board like human and their relationships, including financial institutions, formal roles in the natural environment, and the performance of business and industry. This research aimed to drive the solutions against environmental and sustainability problem within developing countries like Pakistan to contribute to have sustainable future and making the World a better place to live.

Keywords: Environmental Health, Sustainable development, Climatic Changes

Biography

Research Fellow in dept of Public Administration, University of Karachi, Pakistan, thesis on Automation in Supply chain management, have worked on project like ‘PPP’, authors of many publications, Founder of ‘Economic Club Karachi’. Strong supporter of Future sustainability



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ADAPTABLE GERMINATION STRATEGIES FOR THE RESTORATION OF THE ARABIAN DESERT: HARNESSING NATIVE SPECIES FOR ECOSYSTEM RESILIENCE

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The restoration of the Arabian Desert demands a strategic selection of native species with specialized germination strategies that are adaptive to the region's extreme conditions, including high temperatures, erratic rainfall, and soil salinity. We examine the importance of opportunistic and cautious germination strategies observed in desert plants and their respective roles in fostering ecosystem resilience. Opportunistic germination enables plants to capitalize on brief rainfall events by germinating rapidly, whereas cautious germination involves dormancy mechanisms that delay germination until stable conditions are met. By balancing these strategies in species selection, restoration efforts can support a vegetation cover that withstands fluctuating moisture availability, stabilizes soil, and enhances biodiversity. Implementing a mix of species with varied germination strategies may significantly contribute to sustainable restoration practices in the Arabian Desert, aligning with the region's challenging environmental conditions.

Keywords: Desert, Restoration, germination, adaptation

Biography



Arvind Bhatt is a Seed Bank Manager affiliated with Tree Global. Previously, Dr. Bhatt worked as a Research Scientist with the Desert Agriculture and Ecosystems Program at the Environment and Life Sciences Research Center of the Kuwait Institute for Scientific Research. He completed his PhD in 2006 at H.N.B. Garhwal University, Uttarakhand, India. With over 17 years of global experience in plant science, He has worked with esteemed institutions and universities worldwide, including KwaZulu-Natal- South Africa, Universiti Sains Malaysia- Malaysia, Ghent University- Belgium, Gulf



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Organization for Research and Development - Qatar, Lushan Botanical Garden - China, and Kuwait Institute for Scientific Research- Kuwait. He scholarly contributions are proved by more than 138 Peer-reviewed research publications, which have amassed over 3200 citations. His remarkable achievements extend to receiving numerous awards and securing research grants from diverse countries.



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WHY IT IS HARD TO ACHIEVE SUSTAINABILITY AND MEASURES TO ACCELERATE SDG ACHIEVEMENTS

Medani BHANDARI

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Achieving sustainability remains challenging due to complex, interdependent issues like economic inequality, political constraints, resource overconsumption, and climate change. Many systems—economic, social, and environmental—are rooted in unsustainable practices, making it hard to transition to new, eco-friendly models. Rapid population growth and the demand for economic growth strain natural resources, often leading to environmental degradation. Additionally, limited awareness, lack of political will, and insufficient funding for sustainable initiatives create barriers to implementing meaningful change globally.

To accelerate the achievement of the Sustainable Development Goals (SDGs), we must prioritize policies promoting renewable energy, circular economies, and equitable resource distribution. Governments should establish regulatory frameworks that incentivize sustainable practices, including strict emissions limits and subsidies for green technology. Education plays a crucial role in fostering sustainable mindsets, encouraging individuals and communities to adopt sustainable lifestyles. Furthermore, public-private partnerships can mobilize resources and innovation to advance sustainable technologies and practices. Lastly, enhancing international collaboration and accountability among nations will ensure that sustainable development is pursued collectively, benefiting people and the planet. By integrating these measures, we can foster sustainable growth, minimize environmental impacts, and make substantial progress toward achieving the SDGs.



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CASSAVA (*Manihot esculenta* Crantz) GENOTYPE EFFECT ON SOIL LOSS DUE TO CROP HARVESTING

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Soil loss due to crop harvesting (SLCHcrop) has been recognized a soil degradation process in many countries of the world. A field experiment was therefore carried out at the Teaching and Research Farm, University of Ibadan, Nigeria, to investigate the effect of cassava genotype on soil loss due to crop harvesting. A total of twelve cassava genotypes (TMS01/1368, TMS30555, UIC-17-1200, UIC-17-1453, UIC-17-1713, UIC-17-2402, UIC-17-25, UIC-17-257, UIC-17-2610, UIC-17-444, UIC-17-707, and UIC-17-93), were laid out in Randomized Complete Block Design with three replications. Crop yield, SLCHcrop and nutrients losses were determined. Cassava genotype (UIC-17-1713, UIC-17-2610, UIC-17-257, and UIC-17-93) produced highest yield ($> 12.0 \text{ t ha}^{-1}$), followed by genotypes (UIC-17-1453, UIC-17-25, UIC-17-444, and TMS30555) with moderate yield ($5.0 - 12.0 \text{ t ha}^{-1}$), and the genotypes (TMS01/1368, UIC-17-1200, UIC-17-2402, and UIC-17-707) produced lowest yield ($< 5.0 \text{ t ha}^{-1}$). However, the UIC-17-93 had the highest SLCHcrop ($36.5 \text{ kg ha}^{-1} \text{ harvest}^{-1}$), followed by UIC-17-25, UIC-17-257, UIC-17-1453, UIC-17-2610, and UIC-17-444 ($18.9 - 11.5 \text{ kg ha}^{-1} \text{ harvest}^{-1}$) and least in UIC-17-1713, TMS30555, UIC-17-1200, TMS01/1368, UIC-17-707, and UIC-17-2402 ($9.3 - 0.4 \text{ kg ha}^{-1} \text{ harvest}^{-1}$). Similarly, soil nutrient losses (N, P, and K) exhibited the same trend as SLCHcrop. The differences in cassava genotypes resulted into variation in soil and nutrient losses during harvesting of cassava. Thus farmers, should consider cassava genotypes of high yield potentials with low soil loss due to harvesting for sustainable soil conservation

Keywords: Soil loss, nutrient loss, crop yield, cassava genotype.

Biography



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Ndeh Aniebiet Bassey was born on October 15th, 1995. He held from Ibiaku Osuk, Ibiono Ibom, Akwa Ibom State, Nigeria. He is a Soil Scientist and holds a bachelor's degree in Soil Science, University of Port Harcourt and a master's degree in Soil Resources Management, University of Ibadan, Nigeria. He is PhD candidate seeking opportunity for a PhD program in Environmental Sciences. He has a strong research interest in hydrology, environmental sustainability and soil physics.



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RESEARCH THEMES ON GREEN INFRASTRUCTURE FOR SMART CITIES

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This systematically examines the role of green infrastructure in smart city development through a structured review of recent literature. Smart cities aim to balance technological advancement with sustainable practices and attempts to address challenges such as climate change, resource consumption, and waste management. Green infrastructure, including green buildings and urban green spaces are vital for this objective. They promote energy efficiency, water conservation, and occupant well-being. This review identifies ten core research themes in green infrastructure. Using the PRISMA framework for systematic review and MaxQDA software for qualitative content analysis, the study reveals significant operational challenges, including high initial costs, technological limitations, and regulatory hurdles, that hinder the widespread adoption of green infrastructure. The review highlights the need for policy reforms, community engagement, and multidisciplinary collaboration to overcome these challenges. Future research direction proposed include the standardization of sustainability metrics and the exploration of integrated green technologies. This study's findings offer critical insights for policymakers and urban planners, advocating for incentives, clear regulations, and collaborative initiatives to advance green infrastructure in smart cities.

Keywords: green buildings, smart infrastructure, climate resilience, regulatory frameworks, water conservation, waste management

Biography



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Vijaya Kittu Manda has nearly 13+ years of experience in Business Management and Technology. He holds 11 University Postgraduate Degrees, a Ph.D. in Financial Management and is currently pursuing his second Ph.D., in Computer Science. He is an Editor, Peer Reviewer, and Peer Review Supervisor. He writes Research Papers, Case Studies, Book Chapters, and sits on Editorial Boards of various publishers.



Jitta Mallikharjuna Rao is a Ph.D. Research Scholar in Marketing stream. He is a BTech and MBA and is working with a renowned steel plant in India for the last 30 years in which he joined as a management trainee. He is currently working as Deputy General Manager in the Sales and Distribution (S&D) module on the ERP (SAP ECC 6.0) platform at RINL.



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HOW NET ENERGY IMPORTS, ENERGY INTENSITY & CARBON INTENSITY SHAPING ENERGY INTENSITY OF PRIMARY ENERGY: STUDY OF BRICS NATIONS

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On October 31, 2015, the United Nations General Assembly endorsed an agenda comprising 17 Sustainable Development Goals (SDGs) (UN, 2015). The energy transition is one of the dimensions of Sustainable Development and associates four SDGs with this transition - the 7th, 8th, 9th and 11th. Of these, the seventh goal emerges as relevant, dedicated to ensuring universal access to affordable, reliable, sustainable, and contemporary energy. This research paper provides a comprehensive analysis of the relationship between Energy Intensity of primary energy, Carbon Intensity (CI), Energy Efficiency (EE), and Net Energy Import (NEI) across BRICS, utilizing advanced econometric methods including the Phillips-Perron test and Fully Modified Ordinary Least Squares (FMOLS) regression. The study has used data from 2000 to 2021 (based on data availability) of BRICS nations.

The study results are as per descriptive results the highest mean of SDG 7.3 is in Russia and lowest in Brazil, whereas net energy import is negative in Russia and South Africa. All the series are stationery; researchers have used Phillips-person to check the stationarity of the series. The regression results based in FMOLS shows that Net Energy Intensity have a negative effect on SDG 7.3 in Brazil, Russia and India. Whereas it exhibits a positive result in China and South Africa. CI & EE have positive coefficient in Brazil, India, China and South Africa which shows the uniformity of Carbon and Energy Intensity in the four countries. Russia has negative coefficient with Energy Intensity of primary energy.

The diverse results suggest that policy interventions and strategic planning must be tailored to the specific energy, environmental, and economic contexts of each country. The research highlights the importance of considering both regional characteristics and global goals when designing policies aimed at improving sustainability and energy efficiency.

Keywords: Carbon Intensity, Energy Efficiency, and Net Energy Import, SDG-7, BRICS Biography



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I am pursuing Ph.D. from Gautam Buddha University with a focus on sustainable finance and SDG-7. I have (co) authored over 10 research papers, many of which have been presented at international conferences, including a recent presentation at Oxford University. Additionally, I have been recognized as an Emerging Scholar from Emerging Economies. I have 7+ certificate courses on green finance and ESG.



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SOIL SICKNESS: BIOSPHERE UNDER THE FUMES OF WAR?

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The World Environment Day is an annual global event observed on June 5 every year. The day encourages awareness and action for environmental protection by the global community. Many non-governmental organisations, businesses, and government entities back the cause. Moreover, World Environment Day is the United Nations outreach day for encouraging worldwide awareness and supporting the environment.

Look back:

The United Nations Environment Programme (UNEP), World Environment Day was first marked on June 5, 1973, during the Stockholm Conference on the Human Environment. At that time, the theme was 'Only One Earth'. World Environment Day aims to bring together millions of people from across the globe, engaging them in the effort to protect and restore soil fertility and productivity.

Go Green and No War: Save The Environment:

Today, as we come together to celebrate our beautiful planet, let's take a moment to reflect on the profound connection we share with nature. By recognizing that we are an integral part of this planet, we can change our approach and make a positive impact on the environment.

In our fast-paced lives, it's easy to forget that we rely on the Earth for our very existence. Our air, water, food, and resources all come from this incredible ecosystem we call home. Yet, we often overlook the impact of our actions on the environment. The time is remembered that we have the power to make a difference between peaceful restoration of environment or go for war-the chemical-biological war moreover, maybe atomic war?

By simply reconnecting with nature, embracing its beauty, and understanding our place within it, we can change our mindset and adopt sustainable practices.



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Start small by spending time outdoors, appreciating the wonders of the natural world. Take a walk in the park, go hiking, or simply sit beneath a tree and listen to the soothing sounds of nature. These moments of connection remind us of the importance of preserving our planet for future generations.

Let's also educate ourselves and others about environmental issues and the steps we can take to protect our planet. From reducing our carbon footprint to advocating for conservation efforts, every action counts. Together, we can bring about meaningful change. Let's embraces our role as stewards of the Earth and work towards a sustainable future. By connecting with nature and realizing that we are part of this planet, we can shape a better world for ourselves and generations to come.

War has a devastating effect on soil quality. Physical damage to land, pollution by heavy metals, mass mining and destruction of ecosystems lead to a decrease in soil fertility and a reduction in areas suitable for cultivation. The war in Ukraine had a negative impact on agricultural yields and exports, which in turn had global implications for food security. The restoration of lands and the agricultural sector of Ukraine will require significant efforts and time to ensure the restoration of soil fertility and the development of the agricultural sector.

Key words: soil, ecosystem, peace, world environment day, war, agricultural production, food security



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SUSTAINABLE ALTERNATIVES TO PEAT IN FOREST NURSERIES: IMPACTS ON GROWTH AND ROOT MORPHOLOGY OF FAGUS SYLVATICA AND QUERCUS ROBUR SEEDLINGS

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*This study investigates the effects of innovative peat-free substrates and liquid fertilizers on the growth dynamics and root morphology of *Fagus sylvatica* and *Quercus robur* seedlings, one year after forest establishment. The research compared traditional peat-based substrates and solid fertilizers to novel sustainable alternatives formulated by the University of Agriculture in Kraków, focusing on biometric parameters, root morphological traits and dimensional classifications. The field experiment was conducted using a randomized block design with eight treatments replicated across 24 subplots. Results revealed that while seedlings grown on traditional peat substrates exhibited superior growth metrics, those cultivated in innovative peat-free substrates demonstrated comparable survival rates. Solid fertilizers had a more significant effect on root morphology than novel liquid fertilizers, particularly in promoting fine and coarse root development. The study found strong correlations between total root length, surface area, and volume, suggesting the potential of fine roots to enhance seedling stability and resource uptake. The findings affirm that peat-free substrates can effectively replace peat in forest nurseries, contributing to sustainability without compromising seedling quality. However, further optimization of the liquid fertilizer formulations is recommended for enhanced root performance in long-term forest cultivation.*

Keywords: Sustainable forestry, Tree seedling, Forestry management, Root system architecture



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ANALYSIS OF SELECTED PESTICIDE RESIDUES IN COMMERCIAL TOMATO FRUITS

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In this study, analysis of some selected organophosphorus and organochlorine pesticides was carried out in tomato samples collected from the markets of Mattu town, Ilu Aba Bora Zone, Oromia, Ethiopia. The quick, Easy, Cheap, Effective, Rugged, and Safe (QuEChERS) method was used for the extraction of collected samples using acetonitrile with 1% acetic acid, anhydrous magnesium sulfate, and anhydrous sodium acetate, followed by dispersive solid-phase extraction (d-SPE). Chromatographic separation and quantitative determination of the pesticides were performed by gas chromatography equipped with a mass spectrometer. The calibration curves for each analyte constructed in tomato samples were linear in the concentration range of 2-200 µg/kg with $R^2 > 0.99$ and the LODs and LOQs of the method were in the range of 0.01-0.04 µg/kg and 0.04-0.13 µg/kg, respectively. The recovery and precision study results were within acceptable standard guidelines. Of the fourteen pesticides tested, chlordane, hexachlorobenzene, 4, 4'-DDE, 4, 4'-DDD, 4, 4'-DDT, and profenofos were detected at 0.15, 0.09, 0.17, 0.032, 1.24 and 0.062 µg/kg, respectively. Despite the concentrations of the detected pesticides being lower than the maximum residue limit recommended by FAO/WHO, the presence of these toxic chemicals in tomatoes indicates product contamination and requires extensive further investigation with the inclusion of other pesticides.



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SUSTAINABLE INSULATION SOLUTIONS: UTILIZING ŐET BOTTLE WASTE IN COMPOSITE MATERIALS

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As part of the Moroccan government's policy aiming to reduce urban energy consumption, thermal insulation in residential building sector is a key component of global effort to improve energy efficiency. Meanwhile, the non-biodegradation of plastic waste was positioned as one of the major 21st century's environmental issues. In fact, Polyethylene terephthalate (PET) waste is an example of the most important commercially consumed plastics in our daily life due to its good thermal, mechanical properties, low permeability, and chemical resistance. Unfortunately, waste of PET plastic bottles causes a significant environmental concern, such as ocean and arable land pollution affecting thus human health. To overcome the PET waste accumulation, recycling this polymer into high added value is one of the most attractive ways. In that regard, and having in view the low thermal

conductivity of PET, it has been reported that PET may ensure efficient insulation by retaining heat within confined spaces. The main objective of this contribution is the reuse of PET plastic bottle waste into composite materials for a thermal insulation application. Based on the experimental results obtained, PET could be reinforced by inorganic filler (perlite clay mineral) to reduce its thermal conductivity and improve its mechanical properties. Here in, after the composite material preparation and characterization, the effect of incorporating reinforcement agent into polymer matrix on the thermal properties was investigated. Indeed, it has been suggested that the dispersed perlite particles in the polymeric matrix could act as a barrier to heat transfer and providing nucleation sites for crystallization.

Keywords: Composite materials, PET plastic waste, thermal insulation, Perlite Clay

Biography



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Ikram KHABACH is PhD Student at Cadi Ayyad University-Marrakech, he is working on valorization of recycled plastics for sustainable applications. His research addresses structured polymer composite & insulator materials.

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ETHNOBOTANICAL INVENTORY OF ERIN IJESA WATERFALL TOURISTS' CENTRE, OSUN STATE, NIGERIA: A SURE WAY TO CREATIVE EDUCATION

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An eco-taxonomic study was carried out in Erin-Ijesa waterfall tourists' centre, Nigeria, to assess the plant species composition for the purpose of their identification and ethno botanical importance to add to state of plant biology students' knowledge and their deliberate conservation. A lot of information has been provided about Erin-Ijesa waterfall but there has not been any documentation on plants. The Inventory was carried out with the permission of the authority, led by one of the workers using oral interviews and direct counting. Attempts were made to identify the species present at the centre using descriptive statistics to categorize plants to their Botanical names, life span, families, growth habit and utilization/uses. In all, sixty-four (64) individuals belonging to 31 families were found growing at the centre. The families of these species were documented with their habits as Trees 23 (35.90%), herb 21 (32.81%) species followed by shrub 9 (14.93%), Grass 7 (10.94%), and climbers 4 (6.25%), 34 (53.12%) species were economical, 34 species were edible, medicine (19) species and, foods (34) species, dyes (2) and a coagulant (Calotropis procera). Most of the species were perennial (51 species) while 13 species were annual. Asteraceae and Poaceae families had the highest occurrence. This work will surely be of great assistance to students/researchers and tourists if the management of Erin-Ijesa waterfall tourists' centre which is richly endowed with flora resources will label the species found in the centre using this work.

Keywords: Ethnobotany, Creative Education, Inventory, Tourism, Waterfall

Biography



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Dr Olunike Adedoyin Bello is a distinguished Lecturer, Researcher, Ethnobotanist, Plant Biotechnologist and Conservationist, currently serving as the Dean of the School of Science at Osun State College of Education, Ila-Orangun, Nigeria. With deep expertise in alternative medicine for healthcare delivery, Dr Bello has made significant contributions to the study and application of medicinal plants. Her work emphasizes the conservation of biodiversity and the integration of plant-based remedies in modern healthcare, reflecting her dedication to sustainable and accessible healthcare solutions



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HYDROTHERMAL SYNTHESIZED CTS NANOMATERIAL FOR PHOTOCATALYTIC DYE DEGRADATION OF METHYLENE BLUE

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Due to various anthropogenic activities environmental pollution is increasing day by day. Several pertaining methods have been done to reduce the organic pollutants. Among the various techniques used, Photocatalytic degradation has gained much attention. In this present work we report the synthesis of Cu_2SnS_3 (CTS) nanomaterial employing an economical, eco-friendly method via hydrothermal process. The CTS nanomaterial synthesis was done using sulphur source of Thiourea. The morphology of prepared sample was characterized by X-ray diffraction (XRD). The photocatalytic activity of CTS was studied under the irradiation of visible light was evaluated by determining the degradation of methylene blue (MB). Degradation of the model pollutant methylene blue (MB) was used to study the photocatalytic activity of the sample. Results showed that CTS showed broad absorption in visible and IR region.

Keywords: Cu_2SnS_3 , Dye degradation, Hydrothermal, Nanomaterial, Photocatalytic

Biography



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REFLECTING SUSTAINABILITY IN REAL ESTATE VALUATION

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Real estate valuation is an issue of particular concern. It depends on many factors such as economic social and physical factors. Energy is one of the important factors which affects real estate value. In property appraisal, the energy can be considered as a price-setting factor in market price of real estate. Energy consumption depends on the construction methods, materials and the ambitions of the public authority to reduce energy consumption and mitigate the impact of constructions on the environment considering the effects of climate change. In Morocco, the authority approved the general regulations of construction setting the rules for energy performance of constructions (Decree N° 2-13-874, Oct 15, 2014). The application of this regulation has an impact on energy consumption but also an effect on real estate value as green value. Then, it is so difficult for real estate appraisers to determine why property prices differ and how much this difference can be attributed to distinguishing features such as green value, sustainable constructions and green building.

This study aims to assess the effects of constructions sustainability on real estate value and property prices. However, a systemic approach is applied considering technical, legal and environmental aspects of environment as factors of real estate value despite its great role in housing value determination.

This paper seeks to fill that void by examining the effects of application of construction's regulations related to energy efficiency, energy saving and water consumption on property values: design, materials, construction and monitoring. It presents many aspects related to the advantages of applying regulations on real estate valuation. It can be used to assess the market price and determine the influence of legal texts may have on the property's final market value.

Keywords: Energy, constructions, regulations, environment quality, real estate valuation, value's factors, appraiser, property price, sustainability.



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ENVIRONMENTAL IMPACT ASSESSMENT AND SUSTAINABILITY

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HOW IS KOSOVO DEALING WITH THE CLIMATE CRISIS -WHAT HAS BEEN DONE; WHAT IS BEING TAUGHT; WHAT ARE THE SOLUTIONS?

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Climate change is accepted worldwide as something detrimental to the health of the Earth and all species that live on it. Since the industrial revolution, fossil fuel emissions, waste, population, and pollution have experienced exponential growth. With that growth has come the greenhouse effect; insulating the atmosphere and destroying the world's habitats and the organisms that rely on them. Although much has been done to reverse the damages done by humans in more affluent countries, certain countries like Kosovo have not taken action to reduce environmentally destructive behaviors and consequently face the deterioration of the natural and public health. Adolescents, especially in Kosovo, know little about what is happening with the climate. Kosovo being a young country, there is inadequate research on Kosovo's climate status, action plans on mitigation and adaptation on climate change, what teenagers in Kosovo already know about climate change, and what existing strategies implemented in other countries may be compatible with Kosovo. The purpose of this research paper is to explore these topics and has thus been divided into four corresponding sections. Section One investigates the repercussions of Kosovo's lack of bureaucratic action on its environment. Analyzing the harmful practices of the country, specifically regarding energy usage, the section explains the results of said practices and how it is destructive to the environment. However, some action has been done in Kosovo on climate change. The second section explores the various strategies proposed or implemented in Kosovo by departments within the government as well as multitude of international organizations and treaties. Within Kosovo, a significant issue is the lack of awareness among citizens, but specifically adolescents. To gauge this lack of awareness, a survey was developed to quantify the level of knowledge about climate change in high school students in Kosovo. This survey is thoroughly analyzed in the third section. Section Four looks to the future for Kosovo by studying the steps other countries have already taken to combat climate change and determining each strategy's compatibility with Kosovo's individual traits.



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AGRICULTURAL AND FOOD PRODUCTION IN INDIA BETWEEN 2020-2022

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Case-study analyses main latest economic changes of agricultural and food production in India concerning agricultural gross value-added accompanying with food production, water use and population changes. India would like to decrease level of food dependence from the world market and mainly food import. Expanding employment in the agriculture cannot replace the need for agricultural technology developments for example advanced linear irrigation system, TESTING OF PLANT RESISTANT AGAINST DROUGHT CLIMATE, TERRASSE PLANT PRODUCTION FARMING IN SOIL EROSION CONTROL, USE OF FERTILIZERS, PESTICIDES, REGULAR VETERINARY SUPERVISION TO ENSURE THE HEALTH OF THE BREEDING ANIMAL, EXPERIMENTING WITH MORE PRODUCTIVE ANIMAL VARIETIES PER ANIMAL, MECHANIZATION, EXPANSION AND QUALITY FOOD PRODUCTION CONCERNING THE DEMANDS OF NATIONAL AND INTERNATIONAL MARKETS. Analyse is based on statistical program for social sciences, which emphasized corelations among economic variables and their economic features. INDIA HAS INCREASED ITS FOOD DEPENDENCE FROM THE WORLD MARKET, BECAUSE OF LESS FOOD PRODUCTION WAS BY SUPPLYING DOMESTIC MARKET FOR RESEARCHED PERIOD OF 2000-2020. Analyse corelations of share of agricultural gross value added produced by irrigated agriculture, with food availability average protein and value of food imports over total merchandise exports. Food dependence as value of food imports over total merchandise exports in India has increased from 5% in 2000 to 6% in 2020. Food consumption was depending on about two time more consumer food price indices increase in the same period. For the future in India green sustainable investment in agricultural and food production sectors should be realised to increase food supply.

Keywords: Domestic market, economic variables, gross value-added, population changes, statistical methods, technology developments



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Biography



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ECONOMIC DEVELOPMENT IN TURKEY BETWEEN 2010-2020

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From point of view of sustainability of development and social equity the main economic features of Turkey show serious economic results in direction to wide side economic prosperity. The study overviews economic conditions of Turkey for period of 2010-2020. The main goals of case-study are to analyse the general economic growth in fields of GDP and GDP per capita accompanying with gross value added based on the educational system at Doctoral level or its equivalent educational levels over 25-year-old aged populations. Research methodology is based on the statistical package for social sciences accompanying with collecting data from World Development Indicator in case of setting up each country. The economy of Turkey has realised a considerable economic development for researched period in direction to use more innovative advanced technology in manufacturing industry to strengthen the competition of the national economy. Researching analyses cleared the very strong correlations of GDP growth with GDP per capita, gross savings in percent of GDP, gross value added at basic prices, export volume index, import volume index, employment in agriculture in percent of total employment and number of population growth annually. In spite that inflation, consumer prices annually was between 8.6% and 12% in period of 2021-2020 and after that this was 20% in 2021, 72% in 2022, 54% in 2023, the economic developing trend was continuously increasing. This developing trend of educational attainment can contribute to GDP growth in the future as which increased by 6.5% between 2010-2020 and 1.8 % between 2020-2022.

Keywords: consumer prices, doctoral level, employment, gross value added, sustainability

Biography



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THE FINE LINE BETWEEN TRANSPARENCY AND GREENWASHING: NAVIGATING ESG REPORTING

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The rise of Environmental, Social, and Governance (ESG) reporting has become central to corporate transparency and sustainability. However, alongside its adoption, the phenomenon of greenwashing has raised concerns regarding the authenticity of ESG disclosures. Greenwashing refers to the practice of overstating or misrepresenting environmental efforts to enhance a company's image without meaningful impact. This article examines the dynamics between ESG reporting and greenwashing, focusing on drivers such as regulatory pressures, stakeholder expectations, and industry competition. Drawing from recent research, we analyze how companies may selectively disclose favorable information, employ vague terminology, or emphasize minor environmental initiatives to gain reputational benefits. Case studies from different industries highlight common greenwashing tactics and underscore the role of sector-specific challenges. Technological tools like machine learning and blockchain offer promising solutions for enhancing transparency and accountability in ESG reporting, though implementation remains limited. Finally, we discuss regulatory responses, including stricter disclosure standards and independent verification requirements, which aim to address greenwashing. This paper contributes to the growing discourse on corporate sustainability by proposing actionable strategies to improve the reliability of ESG reports and by calling for increased stakeholder engagement and standardized metrics to mitigate the risks of greenwashing.

Keywords: ESG reporting, Greenwashing, Corporate transparency, Sustainability, Environmental disclosure



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Biography



Dr. Georgina Tóth-Nagy (PhD) is a certified environmental engineer and science communicator specializing in environmental topics. Her research focuses on monitoring urban air quality changes, enhancing urban resilience, and developing sustainability strategies. She has several years of professional experience in environmental protection, with a strong focus on preparing and analyzing ESG and sustainability reports. Currently, she is involved in creating local climate strategies and sustainable climate and energy action plans, aiming to promote sustainability and resilience.



Dr. Júlia Tobak (PhD) is a certified economist with a professional background spanning academia and the private sector. Her expertise in entrepreneurship, business management, and practical experience in the food industry aligns with her active involvement in various projects and events. Her primary research areas include family business operations, social innovations, corporate sustainability and ESG. She has participated in projects focused on sustainability, social innovation, and climate change. Additionally, she is highly engaged in professional and project management activities, including curriculum developments, organizing adult education programs and managing an ESG e-learning course.



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***Tímea Veres** is a PhD student at the University of Pannonia. Her research focuses on the development of environmental accounting in both domestic and international contexts. Her research addresses the challenge of external environmental impacts, which often emerge outside the enterprise but are influenced by economic, social, and natural processes. In response, environmental protection is gaining importance in legal regulations, especially concerning corporate competitiveness and sustainability. Companies are increasingly held accountable by society for the environmental effects of their activities, requiring transparency towards stakeholders. While conventional accounting does not fully address environmental impacts, the field of environmental accounting seeks to bridge this gap by highlighting the financial implications of environmental protection and examining the impact of business activities on specific environmental factors.*



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SOCIO ENVIRONMENTAL EFFECTS OF MANAGEMENT METHODS FOR RAINWATER DRAINAGE INFRASTRUCTURE IN THE 6TH DISTRICT OF THE CITY OF COTONOU IN BENIN

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The management of Rainwater drainage infrastructure is a nuisance for people in the 6th district of the city of Cotonou. This research aims to analyze the socio-environmental effects of the Rainwater management mode in the 6th district of the city of Cotonou.

The field survey is conducted among 305 households out of 16,906 (elected or not drainage infrastructure), 19 local elected representatives and 05 resource persons from the Technical Services Department of the Cotonou City Council. The methodology used was used to collect rainfall data, observations and field surveys, research, documentaries, interviews, treatments and data analysis. Data processing was done with Word 2010, Excel 2010, Cs Pro 7.0 and SPSS.

Thus, we discovered that in the 6th district of the city of Cotonou, 15 out of 19 neighborhoods have at least one type of Rainwater drainage and more than half of these drainage structures are overflowed in season rainy at a rate of 54.46%. This is related to the way people manage their household waste. This study shows that 18.0% of households find their waste on wild dumps, 12.1% in the wild and 0.3% in the structures. What is easy is the proliferation of certain waterborne diseases such as cholera, diarrhea, malaria and infections with 80102 from 2012-2016, flooding and property damage.

Face to this situation, measures such as resizing the structures with the observed regular, raising awareness of the population and participatory management of all interested parties.

Keywords: 6th district of the city of Cotonou, waste, drainage works, Rainwater.



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ASSESSMENT OF NATURAL RADIOACTIVITY LEVELS AND RADIOLOGICAL HAZARD IN SOIL SAMPLES: IN CASE OF BURE AND BURRUSA MATTU UNIVERSITY AGRICULTURAL PROJECTS

Abire HULUKA

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In this study, the radioactivity concentrations of the natural radioactive nuclides ^{238}U , ^{232}Th and ^{40}K were measured in twelve (12) of soil samples collected at 20 cm deep of two areas of Mattu University agricultural project/lands. The samples were collected from two different agricultural projects/lands in Bure and Burussa. The measurements of the activity concentration of selected radionuclides in soil samples were effectuated from Mattu University agricultural lands/projects, Ethiopia by gamma-ray spectrometry using hyper-pure germanium (HPGGe) detector. The study's main aim is to assess the activity concentration of soil samples and their health impacts. Average activity concentrations (Bq kg^{-1}) for ^{238}U , ^{232}Th and ^{40}K in soil samples were obtained as 18.50 ± 1.05 , 61.12 ± 17.71 and 532.21 ± 25.27 , respectively for Bure, While the mean concentrations of ^{238}U , ^{232}Th and ^{40}K in soil samples were found to be 44.40 ± 3.88 , 31.15 ± 2.31 and 425.35 ± 30.81 , respectively for Burussa. The mean activity concentration of ^{238}U value in Burussa is slightly higher than the recommended global average value. It is observed that, for all soil samples, the Radium equivalent activity R_{eq} concentrations values for both studies sites are lower than the recommended limiting value of 370 Bq kg^{-1} . Furthermore, the corresponding radiological parameters, such as absorbed dose, annual effective dose equivalent, excess lifetime cancer risk (ELCR), internal (H_{in}) and external (H_{ex}) hazard indexes, gamma index (I_{γ}), and alpha index (I_{α}) were determined. Therefore, the levels of natural radioactivity of ^{238}U , ^{232}Th and ^{40}K in the two areas were found to be below the internationally recommended level. The NORM results showed that there are no major radiation consequences on workers or the population in the near term because the values of radiological parameters are less than the international recommended limit. This shows that the soil under consideration were safe for agricultural use and do not now represent any serious radioactive threats to the human population.



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Keywords: Soil Samples; activity concentration; natural radionuclides; HPGe detector;
Agricultural Projects/Lands; Ethiopia



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GROWTH KINETICS OF 3 STRAINS OF MICROALGAE ISOLATED FROM FRESHWATER ECOSYSTEMS IN MOROCCO: THE FES-MEKNES REGION

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Industrial and commercial interest in microalgae is growing all the time, thanks to their many advantages. Thus, microalgae play a significant role in mitigating climate change due to their ability to capture carbon dioxide (CO₂) during photosynthesis, such as reducing greenhouse gas emissions. Consequently, major importance is given to the study of species growth kinetics to adapt culture conditions according to the targeted microorganism species, which is particularly relevant in the fields of bioproduction and water treatment. This study examined the growth kinetics of 3 strains of microalgae isolated (Monoraphidium sp., Ankistrodesmus sp. and Chlamydomonas sp.) from freshwater ecosystems in Morocco's Fez- Meknes region, Zarrouka lake. Monoraphidium sp showed the highest biomass productivity of around (3.4 g L⁻¹), and a maximum density of around 10×10⁶ cells/mL, while Ankistrodesmus sp. showed limited growth, a biomass of around (1.8 g L⁻¹) and a maximum density reaching around 3×10⁶ cells/mL. These results underscore the importance of selecting species adapted to specific environmental conditions for each application. By tailoring culture conditions to meet the unique requirements of each microalgal type, it is possible to enhance productivity in biomass production and wastewater treatment processes. Furthermore, cultivating microalgae using wastewater not only treats the water but also recycles nutrients, aligning with circular economy principles. This approach converts waste into valuable biomass, supporting sustainable practices that reduce reliance on fossil fuels and minimize ecological footprints.

Keywords: Microalgae, Growth kinetics, biomass, wastewater, circular economy, ecological footprints



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Biography



I am Imane EL-BAGGAR, a first-year PhD student at Sidi Mohamed Ben Abdellah University, Faculty of Sciences, Dhar El Mahraz. My academic career was marked by a bachelor's degree in physical sciences at Lycée Al Massira in 2018, followed by a fundamental bachelor's degree in life sciences with an option in microbial biotechnologies at the Dhar El Mehraz Faculty of Sciences in Fez, completed in 2021. I then went on to obtain a master's degree in biotechnology, ecology and phytoresource development at the same institution from 2021 to 2023. During this period, I also had the opportunity to do an internship in a research laboratory where I worked on the identification, isolation and biochemical composition of microalgae. My passionate interest is particularly focused on microalgae biotechnology, with an emphasis on the field of phycoremediation. I am determined to explore the innovative solutions that microalgae offer to solve contemporary environmental challenges, particularly in the field of depollution and restoration of aquatic ecosystems.



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REALIZATION OF THE INNOVATIVE POTENTIAL OF THE EU SPACE SOLAR ENERGY SECTOR IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

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The purpose of this study is to analyze the realization of the innovative potential of space solar energy in the European Union in the context of sustainable development. Space solar energy involves the use of orbital solar stations to collect solar energy outside the Earth's atmosphere, which avoids atmospheric interference and increases the efficiency of energy production. This paper assesses how effectively the EU is integrating this technology, considering its environmental, economic and social impact in the light of the Sustainable Development Goals.

The paper analyses the impact of space solar power on the EU energy sector, as well as assesses the environmental benefits and possible risks. The main results show that the introduction of space solar energy has the potential to significantly reduce carbon emissions, increase the stability of energy supply and ensure EU energy security. In addition, the development of this industry can help stimulate other high-tech sectors, such as the production of satellites and automated energy transmission systems.

The main conclusion of the study is that the effective integration of space solar energy into the EU economy requires its coordination with existing sustainable development programs, as well as the creation of a regulatory framework that will facilitate investment and development of the necessary infrastructure. The use of space solar energy as a source of clean energy can significantly strengthen the EU's energy sustainability and reduce its environmental impact.

Keywords: space solar energy, sustainable development, environmental security, innovative potential

Biography



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Larysa Antoniuk, 01.06.1966 Ukraine is dynamic lady with
Current position: Doctor of Economic Sciences, Professor, Vice-
Rector for Research Work, Kyiv National Economic University named
Vadym Hetman, Kyiv, Ukraine

University studies: Lviv Polytechnic National University, Degree in
Economics

Scientific interest: international competitiveness of countries, world-
class universities, strategic planning of universities

Publications: more than 250 research papers/articles

Experience: Excellent performance of teaching and scientific activities
for more than three decades. Optimistic and innovative visions.



Karyna Anapriiuk, 24.09.1999 Ukraine is brilliant young girl with
Current position as Postgraduate (International economics) Kyiv
National Economic University named after Vadym Hetman

Scientific interest: international competitiveness of countries,
sustainable development, globalization

Publications: up to 10 publications

Experience: 6 years of scientific activity, keen interest in extra
curricular activities among students and youths.



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A GIS-BASED DRASTIC MODEL FOR ASSESSING AQUIFER VULNERABILITY. CASE STUDY OF TEBESSA PLAIN - (NORTH-EASTERN ALGERIA)

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It is considered that the DRASTIC method is the one of the most used methods to assess the vulnerability of aquifers to contamination. DRASTIC is an acronym for Depth to Water, Net Recharge, Aquifer Media, Soil Media, Topography, Impact of the Vadose Zone, and Hydraulic Conductivity of the aquifer. A new method was developed by adopting the same DRASTIC concept, but it includes only five of the seven parameters introduced in the DRASTIC method. The same parameter weighting was kept as proposed for DRASTIC method. For this purpose, it was proposed that only the parameters relating to the abbreviations DRIST are involved during the transmission of contaminants from the ground surface to the groundwater in the aquifers. This new method (DRIST) has been applied, to be compared with DRASTIC method, on the regional aquifer that covers an area of approximately 320 km². The results showed that the degree of vulnerability determined according to DRIST is similar to that determined according to the DRASTIC method. Accordingly, the proposed method can allow the assessment of the vulnerability of aquifers to contamination with less mobilization.

Keywords: Vulnerability, DRASTIC, DRIST, SIG, Tebessa aquifer

Biography





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GREEN FINANCING AND POLICY SUPPORT FOR SUSTAINABLE TOURISM INITIATIVES

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This study investigates how financial strategies, and supportive policies can convert tourism obstacles into chances for environmental and social progress. The main emphasis is on overseeing eco-friendly tourism practices that yield profit while also providing social benefits. The research seeks to assess funding mechanisms and policy frameworks that involve diverse stakeholders, including governments and local communities, to promote true sustainability to meet these goals, the research utilizes qualitative case studies from countries that have effectively applied green financing tools such as green bonds, grants, and public-private collaborations. It also analyses regulatory policies that promote sustainable practices in line with global sustainability objectives. The investigation indicates that sustainable development initiatives can be strengthened through innovative financing and supportive policies that address both environmental and social aspects. Nonetheless, the research highlights significant obstacles like policy fragmentation and the potential for "greenwashing." It calls for synchronized global policies and active local engagement to tackle these challenges. Economic incentives play a crucial role in attracting investments for sustainable initiatives, while policies act as fundamental frameworks for execution. Additionally, the participation of local communities is essential to ensure that tourism development honours cultural integrity and meets community requirements. The outcomes suggest strategic actions to encourage adaptive policies and enhanced green financing, facilitating collaboration among governments, financial organizations, and tourism projects. This cohesive approach can transition the tourism sector from being merely sustainable to becoming regenerative, promoting ecosystem vitality and community growth. The proposed model is versatile enough to be applied across various industries striving for both economic advancement and environmental sustainability.

Keywords: Green Financing, Tourism, Regulatory Policy, Sustainable, environment

Biography



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Dr. Lateefat Adeola Bello is a senior lecturer in Tourism Law. She holds a PhD in Commercial Law, focusing on the regulation of Nigeria's tourism and hospitality industry. Currently, she teaches at Ahmadu Bello University and chairs the International Federation of Women Lawyers in Nigeria. Dr. Bello has a background in Science Laboratory Technology and has worked as a legal adviser for a bank. She is married with three children, each excelling in their professions.



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FABRICATION OF VEHICLE INTERIOR PARTS FROM NATURAL FIBERS

DAWIT WAMI NEGERA

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The increasing concern over environmental issues and the demand for sustainable, eco-friendly materials are driving the search for viable alternatives to heavy metals in natural fiber-reinforced polymer composites. Lightweight materials are gaining significant attention as they can reduce vehicle weight, lower fuel consumption, and enhance both physical and mechanical properties— particularly in response to stricter environmental and safety regulations.

This thesis focuses on fabricating and characterizing composite materials, detailing the preparation methods, conducting experiments, and analyzing mechanical properties. False banana fiber (FBF) and sisal fiber (SF) were used to develop the composite, which was compressed using a general purpose (GP) resin mixed with a hardener, employing a simple hand lay-up technique. Mechanical tests, including density, water absorption, tensile strength, compression strength, and flexural strength, were carried out following ISO and ASTM standards.

The results revealed that the composite with a 1:3 fiber ratio exhibited the highest tensile strength at 69 MPa, outperforming both the 1:1 and 3:1 ratio. For compression strength, the 3:1 ratio provided the best performance, reaching 12.30 MPa. The water absorption tests (conducted using regular tap water and rainwater) showed lower absorption rates of 2.64% and 3.07%, respectively, for the 1:3 ratio compared to the other ratios tested. Additionally, bending strength tests confirmed the superiority of this ratio. The study also involved the preparation of a hybrid composite, characterization of its mechanical and physical properties, and the design of a car dashboard using SolidWorks 2017. A cost, weight, and fuel reduction analysis were conducted to compare the new composite with conventional materials. Finally, a prototype dashboard for a PEUGEOT model car, featuring improved mechanical and physical properties, was fabricated for demonstration purposes.



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Keywords: Dashboard, Flexural, Fuel consumption, Light material

Biography



Mr. Dawit Wami has been serving as a Senior Lecturer in the Mechanical Engineering Department at Assosa University since 2018 E.C. and is currently the Head of the Department. He earned a BSc in Mechanical Engineering from Arba Minch University, Ethiopia, in 2007 E.C., and an MSc in Automotive Engineering from Adama Science and Technology University, Ethiopia, in 2011 E.C. Additionally, he holds a BA in Management from Rehomed Business and Medical College, Assosa, Ethiopia, awarded in 2016 E.C. Mr. Dawit has published over five papers indexed in the Scopus database and has presented them at three national and two international conferences. He also serves as a board member and reviewer for two international journals. His research interests include mechanical design, energy systems, additive manufacturing, and composite materials.



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Session (B) Healthcare & Public Health Sustainability: Risk & Management



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PATHOGENESIS AND EFFECT OF HOUSEHOLD MICROORGANISMS ON THE RESIDENTS

Abrar HUSSAIN

International Center for Chemical and Biological Science, University of Karachi, Karachi, Pakistan

Microorganisms are found ubiquitously in the biosphere and play an important role. Air, soil, water, etc. all have a countless number of microorganisms. Microbes are comprised of bacteria, fungi, viruses, protozoans, and mites. These microbes can affect the quality of our lives, particularly when they have the potential for pathogenesis. A huge population of humans is living inside the houses and sharing common resources. Microorganisms in these indoor environments are found on walls, beds, and other accessories. The high prevalence of microbes is supported by the warm environment and dump places of the houses as they enter through air, people contacts, pets, water, and plantations. Bacteria are identified as the most common microbes in indoor environments. As it is well established, different types of microbes have the potential to produce and carry the pathogenic substances and thus contribute to the illness. In houses, all the family members live together, sharing common resources, and have limited access to open air, thus becoming more prone to the pathogenic effect of these microbes. Literature indicated different diseases like allergies, asthma, infections, etc. in the residents of indoor houses. Disease spreading is also more prevalent in such environments due to the favorable conditions and human activities. Isolation, using microbial nets, and proper sanitation systems can overcome the prevalence of these diseases.

Keywords: microorganisms, bacteria, fungi, virus, pathogenesis,

Biography



I have a strong educational background in biological sciences. I have obtained three degrees in biological sciences (B.Sc., M.Sc., and M.Phil.) and am currently pursuing my Ph.D. My career shows outstanding performance, devotion, timely completion of projects, and development of new



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ideas. I delivered numerous webinars and presented my work at different conferences. Participation in international events is my passion, and I have a good number of such certificates. I also published many articles in multidisciplinary fields and presented them in different symposiums. I have a keen interest in learning, engaging, and spreading knowledge.

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IMPACT OF CLIMATE CHANGE ON HUMAN PERFORMAVE

Ayan CHATTERJEE

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Background: On a global scale, there is an alarming trend of increase in ambient temperatures, erratic weather patterns, and the escalation of greenhouse gas emissions. In the Indian context, a nation highly susceptible to climate shifts, these effects are particularly pronounced due to its varied geography and dense population.

Objective: The present study has been undertaken to assess impact of climate change on cardiac performance among male agricultural workers occupationally engaged in different type of tasks during paddy cultivation time. On the other hand, rice cultivation is an important sector of earning opportunity for the human resources engaged in agricultural tasks.

Methodology: Thermal environmental condition was assessed in terms of Wet Bulb Globe Temperature Index, Corrected Effective Temperature, Discomfort Index and Physiological Strain Index. To assess the effect of workplace heat exposure, workload and posture being adopted in their likely impact on performance, cardiac strain indicators like net cardiac cost, estimated energy expenditure, absolute cardiac cost and human physical drudgery index were estimated in male paddy cultivators involved primarily in manual straight row paddy transplanting task in southern parts of West Bengal. **Result and Conclusion:** The result of the study indicated that human resources are indeed subjected to strains, albeit to different degrees, as adjudged by the indicators of cardiac strain.

Keywords: Thermal modelling, public health, mitigation, adaptation, mobility

Biography





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Dr. Ayan Chatterjee is currently working as Associate Professor and Associate Dean of School of Health Science and Technology, Medhavi Skill University, Sikkim, India. Dr. Ayan completed his PhD degree from University of Calcutta. He authored 102 full length research papers; among them 44 as first author in Peer Reviewed Journals, Conference Proceedings and as Book Chapters and also presented papers in International and National Conferences held at IIT Bombay, IIT Guwahati, ISI Kolkata, ISI Giridih, Jadavpur University, University of Calcutta, Vidyasagar University, Indian Institute of Social Welfare and Business Management Kolkata, NIT Jalandhar, Aligarh Muslim University, University of North Bengal, College of Engineering Trivandrum, Diamond Harbour Womens' University, University of Gour Banga



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PLASTIC POLLUTION IMPACTING ECOSYSTEM HEALTH: MAJOR THREAT IN DEVELOPING COUNTRIES LIKE INDIA

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Plastic pollution is a global problem affecting all ecosystems and life on earth. All people are not aware about plastic hazards and its impacts in developing countries like India and there is urgent need to spread awareness about plastic pollution impacts and its management. Microplastics (MPs), are found in all ecosystems, have been detected in human blood stream, stool, and placenta and in other body organs. Microplastics can interfere with genetic material and cell functions, and it is one major cause coupled with other environmental and health conditions for death of human and other species. More than 13,000 chemicals have been identified as associated with plastics pollution and plastic decomposition takes 20 to 500 years or more. The manufacture of plastics has become a major source of greenhouse gas emissions and driver of climate change. More than 300 million tons of plastic is produced every year and only about 9 % is recycled. Women, children, and senior citizens are more susceptible to these toxic chemicals released from plastic items, and exposures during fetal development and in children can cause, for example, neuro-developmental/ neuro-behavioural related disorders. Existing evidence calls for urgent action to address plastic pollution management strategies for effective policy to protect ecosystems, human health, and the environment for toxic-free and sustainable circular economy. Some strategies like stainless steel bottles for water and glass/ ceramic containers for food storage shall be good ideas to make life plastic-free. Strict implementation of rules for plastic pollution management coupled with effective laws like Environment (Protection) Act, 1986 in Indian situation can be good step for sustainability.

Keywords: plastic, pollution, chemicals, ecosystem, health, law.

Biography



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Dr Surendra Kumar Yadav, freelance Environmental Advocate & Project Director (Environmental Conservation) at SEHAT-India; did MSc, MPhil and PhD in Environmental Science (JNU, New Delhi, India); LLB from University of Delhi, and International Course on Climate Change Policy (SHRDC, Seoul, S. Korea). His credentials include 6 Awards, 80 research papers in Journals, completed 6 research projects, 9 books, 79 patents as joint Inventions (75 National & 4 International); about 260 research papers in Conferences; guided 29 Research Scholars, Membership of over a dozen International Scientific Professional bodies; provided expert inputs to WHO and UN Body; visited countries like Switzerland, Germany, France, Italy, Netherlands, South Korea etc for research & scientific activities.



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WHAT IS THE CONNECTION BETWEEN THE MAGICAL PERIODIC SYSTEM AND DR.W. SCHUESSLER BIOCHEMIC CELL SALTS?

Titanilla EIDEH

Founder and Owner of Integral and Holistic Health Creator, Member of the German Biochemic Association Budapest, Hungary, titanillanature@gmail.com, +36 30 354 7018

Living systems are made up of a small proportion of atomic elements, including essential macro-elements (C, H, N, O, P, S) and ions (Mg, K, Na, Ca), as well as small but variable amounts of trace elements (micronutrients). Here I provide an overview of how the chemical elements contribute to life. We define elements: essential for all life and essential or beneficial for many organisms. The ability of cells to maintain life in the absence or limiting effects of certain elements relies on complex physiological and evolutionary processes. An overview of element use in the tree of life is summarised in the periodic table that summarises the role of chemical elements in biology.

Nutrients are chemical substances required by the body to sustain basic functions and are optimally obtained by eating a balanced diet. There are six major classes of nutrients essential for human health: carbohydrates, lipids, proteins, vitamins, minerals, and water.

The German Society for Biochemistry according to Dr. Schuessler - Schuessler Salts and Face Analysis has set itself the task of promoting the public, especially in the sense of public health, by offering assistance for a healthy life in the sense of disease prevention and health care based on a comprehensive view of man.

In particular, the mineral theory founded by Dr. Schuessler is to be cultivated, the knowledge disseminated, and the face analysis founded by Kurt Hickethier further developed and promoted.



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2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne	
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	
6	55 Cs	56 Ba	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu		
7	87 Fr	88 Ra	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr		
			Lantanoidák:																
			Aktinoidák:																

Keywords: elements, macronutrients, micronutrients, Dr. Schuessler, periodic table, biochemistry

Conclusion: In the late 1800's Dr. Wilhelm Schuessler studied ash residue as a means of better understanding the human body. He discovered 12 minerals were found in the ash and in cells throughout the body. He thus concluded that these minerals were the foundation for the body structure and fundamental to the operation of all tissues and organs. Later researcher has developed further cell minerals all together we use 33 cell salts. The Cell Salts are critical to metabolic processes and they balance the biochemistry of the



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HEAVY METALS, AND HUMAN HEALTH: THE DEATH ALARM

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The soil with heavy metals has become a concern for agricultural scientists because of the progress made in agricultural product safety. Heavy metals are metalloids with biological toxicity even in minor quantity. The most common are arsenic (As), cadmium (Cd), chromium (Cr), mercury (Hg), and lead (Pb). These metals exist throughout the terrestrial environment and produce from anthropogenic and natural activities. The increasing quantity of heavy metals in our resources is currently an area of greater concern, especially since many industries are discharging their metal containing effluents into freshwater without any adequate treatment.

Among all the pollutants, heavy metals have received paramount attention to environmental scientists due to their toxic nature. However, no specific definition of heavy metal, literature has defined it as a naturally occurring element having a high atomic weight and high density which is five times greater than that of water. Heavy metals become toxic when they are not metabolized by the body and accumulate in the soft tissues. They may enter the human body through food, water, air or absorption through the skin when they come in contact with humans in agriculture, manufacturing, pharmaceutical, industrial or residential settings. Industrial exposure accounts for a common route of exposure for adults. Ingestion is the most common route of exposure in children. Natural and human activities are contaminating the environment and its resources, they are discharging more than what the environment can tolerantly handle the wastes. The studies have documented different natural sources of heavy metals. Under different and certain environmental conditions, natural emissions of heavy metals occur. The poisonous emissions include volcanic eruptions, sea-salt sprays, forest fires, rock weathering, biogenic sources and wind-borne soil particles. Natural weathering processes can lead to the release of metals from their endemic spheres to



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different environmental compartments. Although the heavy metals can be found in traces, they still cause serious health problems to human and other mammals. Agrochemicals, wastewater, mining and metallurgical processes and industrial runoffs also lead to the release of pollutants to different environmental compartments. Human activities have been found to contribute more to environmental pollution due to the everyday manufacturing of goods to meet the demands of the large population.

The presence of heavy metals in the environment leads to several adverse impacts. Such impacts affect all spheres of the environment, that is, hydrosphere, lithosphere, biosphere and atmosphere. Until the impacts are dealt with, health and mortality problems break out, as well as the disturbance of food chains of human, animals, birds, microbes and even of living beings-plants.

Keywords: Heavy metals, pollutions, human health, ecosystem, agriculture, industries wastes

Biography



I am a PhD graduate in natural resources with a thesis titled spatial modelling of land degradation in a semi-arid region of Iran using data mining techniques. My M.Sc. research projects focused mainly on the effects of reclaimed urban wastewater on soil properties as an approach for combating desertification. Totally, my skills include GIS (Geographic Information System), Machine learning, Statistical models, Remote sensing, and spatial modelling



Valentina Anufriyeva is dynamic lady with many folds' innovative visions in her mind. She performed health care management education coordinator at Ukrainian-Swiss Project "Medical Education Development" (MED) Ukraine. Experienced Quality Management Consultant/Auditor with a demonstrated history of working in health care. Academician with experience in research and in creating and teaching management in health care modules for adults. Writer of books for children.



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Professor Dr. B. S. Panwar has completed his PhD from CCS Haryana Agricultural University Hisar, India. He was the coordinator of Indo-Hungarian joint project entitled "Phytoremediation of potentially toxic heavy metals contaminated soils by agricultural crop genotypes" funded by DST New Delhi and HAS Budapest from the year 2005 to 2008 and "Fate of heavy metals in crop, soil and water ecosystem" funded by INSA and HAS from the year 1997 to 2001. He is visiting professor of ETHZ Zurich, Switzerland, PSTU, Mariupol Ukraine and MSU Moscow, Russia. He has published more than 110 peer reviewed research papers in national & International journals, 2 Books (Hungarian with summary in English) associated with Hungarian Professor, 10 Bulletins, 20 Book chapters, popular & Scientific articles in leading newspapers, magazines, Radio talks, farmers melas and has been serving as an editorial board member of reputed research journals. Professor Panwar Guiding many Post graduate students in Indian and abroad Universities. Since performing [one decade] as President of Green India Clean Environment Society-GICES, Hisar, Haryana, India. Besides his professional field, he is a proven writer - poet and published one flash drama, two books of Hindi poetry, and 12 E-booklets of poems in English literature.



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SUSTAINABLE DEVELOPMENT GOALS AND EDUCATION

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Introduction. The world faces a choice of the direction of global progress: deepening environmental crises, increasing climate disasters, widening inequality and conflicts or sustainable development, eradication of poverty, global peace and beneficial use of digital technologies. The UN has defined 17 Global Sustainable Development Goals (SDGs).

Objective. To establish the level of awareness and attitude of higher medical education applicants to the SDGs.

Methodology. At the Kharkiv National Medical University, a survey was conducted among students of higher medical education using an online form developed by the author using corporate e-mail to determine the prospects for the achievement and awareness of the Centers for Disease Control and Prevention. The questions related to the level of awareness of the SDGs, determining their quantitative composition, the choice of priority goals by the applicant, establishing the impact of the SDGs on ensuring a competency-based approach in higher education. Homogeneity of the interviewees by education and gender was ensured: men - 20%, women - 80%.

Results. Almost 90% of respondents answered the question about awareness of the SDGs. 17 noted 88.3%, 3 and 14 - 5% each. Regarding the selection of one priority goal from the list, the interviewees used the entire range of goals. Most of all, 18.6% chose the Goal 3 - To ensure a healthy lifestyle and promote well-being for everyone at any age. This corresponds to the direction of obtaining a medical profession. The second priority is Goal 11: Make cities and settlements open, safe, viable and sustainable - 14% of responses. In third place are the following goals: Goal 1 - to end poverty in all its forms throughout the world, Goal 2 - to end hunger, ensure food security and improve nutrition and promote sustainable development of agriculture; Goal 4 - Provide inclusive and equitable quality education and encourage lifelong learning opportunities for all. When asked about the priority among the educational development goals of ensuring that all students acquire the competencies necessary to promote sustainable development, 88% answered affirmatively, others refrained from answering, and no objections were noted. Regarding the need for the



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formation of health care competence, all respondents gave a positive answer. The existence of a connection between the goals of sustainable development and the provision of a healthy lifestyle and comprehensive and fair quality education was indicated by 90.7% of the respondents, which is noted by the composition of the respondents - students of higher medical education.

Conclusion. The conducted research indicates broad prospects for the realization of the goals of sustainable development. The survey established a high level of awareness among students of higher medical education and showed their positive perception.

Keywords: online survey, sustainable development goals, higher education seekers

Biography



Oleksandr Pyvovarov

Education: Kharkiv National Medical University, PhD of internal medicine.

Simon Kuznets Kharkiv National University of Economics Kharkiv Master of pedagogy.

Workplace: Department of Internal Medicine №3 and endocrinology Kharkiv National Medical University.

Academic Position: Assistant professor, Department of Internal Medicine №3 and endocrinology KhNMU.



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WHY IS ESSENTIAL THE INTAKE OF CELL SALTS IN OUR INDUSTRIAL WORLD? STUDY CASES OF HEALTHCARE WITH SCHUESSLER CELL SALTS

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Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.

Daily stress at work or in our private life, and the commonly resulting poor eating habits, put a strain on our body, make us sick and deplete our energy reserves.

What lifestyle habits will keep us fit? What can we actively do for our well-being, how can we support our body and our mind?

The attitude towards personal health has fundamentally changed in recent years. Preventive healthcare and striving for natural remedies for health complaints have become important issues. Small lifestyle changes can have great positive effects on our health.

Learn more about how you can strengthen your immune system and improve your energy balance. Get study cases for a better and healthy life with micro minerals and macro nutrients and how to reduce stress in your life.

Keywords: lifestyle, health, micro and macro minerals, industrial world



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ASSESSING THE ROLE OF WATER, SANITATION, AND HYGIENE (WASH) FACTORS IN THE HIGH PREVALENCE OF DIARRHEA AMONG INTERNALLY DISPLACED CHILDREN UNDER FIVE IN NORTHERN ETHIOPIA

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This study aimed to assess the prevalence of diarrhea and associated factors among internally displaced children under-five at school camps of Mekelle City, Northern Ethiopia. A descriptive cross-sectional study was conducted in Mekelle City (Ethiopia) from July 2021 to August 2021. Fifteen out of twenty-five IDP centers with 415 children under the age of five were randomly selected. A face-to-face interview with a pretested and administered questionnaire was used to collect data. Bivariate and multivariate logistic regressions were used to identify the predictor variables. The result of this study showed that the two-week prevalence of diarrhea among under-five children in Mekelle IDPs was 52.3 % (95 % Confidence Interval (CI): 47.5–56.9). The multivariate logistic regression model revealed that educational status (Adjusted Odds Ratio (AOR): 2.93, 95%CI: 1.637–5.269), children's faecal matter disposal practice (AOR: 0.49, 95%CI: 0.282–0.879), water storage period (5.53, 95%CI: 2.269–13.486), water treatment practice (AOR: 4.57, 95%CI: 2.435–8.609), cleaning practice of water storage material (AOR: 2.62, 95%CI: 1.550–4.431), water supply (AOR: 3.34, 95%CI: 1.007–11.113) and hand-washing practice (AOR: 2.50, 95%CI: 1.012–6.179) had a significant association with diarrhea prevalence. The prevalence



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of diarrhea among children under-five in the IDPs of Mekelle was significantly high, where educational status, disposal practices of children faecal matter, drinking water storage period, water treatment practice, and cleaning practice of drinking water storage materials were the associated factors. Therefore, improvements on the water, sanitation and hygiene (WASH) facilities in the IDP centers are essential for intervention in reducing the burden of diarrhea.

Keywords: Children under-five, Diarrhea, internally displaced persons, Water, sanitation, hygiene



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ECOLOGICAL DYNAMICS OF TICK-HOST INTERCATIONS AND TICK BORNE DISEASE RISKS IN URBAN COYOTE HABITATS

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Coyotes (Canis latrans) are prevalent in urban areas of Florida, potentially acting as reservoirs for tick-borne pathogens. This study aims to investigate tick-host interactions and disease risks in urban coyote habitats. Ectoparasites will be collected from coyotes in collaboration with USDA Wildlife Services, focusing on Cape Canaveral, Patrick, and Homestead airports. Morphological identification and DNA extraction techniques will be employed to characterize tick species and assess pathogen prevalence. Parasite burden calculations and correlation analyses will evaluate associations between host characteristics and tick infestation rates. Understanding the diversity of tick species associated with coyotes in urban habitats and their potential role as disease vectors is crucial for wildlife and public health management. This research will provide insights into tick-borne disease risks in urban coyote populations, informing targeted surveillance and control strategies to mitigate disease transmission. Through collaborative efforts with stakeholders and wildlife management agencies, this study seeks to address knowledge gaps in tick-host interactions and contribute to the conservation of urban wildlife and human health.

Keywords: Urban Coyotes, Tick Host Interactions, Pathogen Prevalence, Wildlife Health Management, Tick Borne Diseases

Biography



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Miranda Imeri holds a B.Sc. in Animal Science from the University of Prishtina and an M.Sc. in Wildlife Management Engineering from the Hungarian University of Agriculture and Life Sciences. She is currently pursuing a Ph.D. in Agronomy at the University of Florida, USA. Miranda has experience in carnivore investigation, genetic analysis, and zoonotic diseases, and has served as a lecturer and researcher at institutions including Goethe University. She has received awards from DBU, Erasmus+, and Visegrad, and has published research on topics such as Eurasian magpies and canid hybridization.



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DETERMINANT FACTORS OF THE LONGITUDINAL PULSE PRESSURE AMONG HYPERTENSIVE PATIENTS TREATED AT ASSOSA GENERAL HOSPITAL, WESTERN ETHIOPIA

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Background: Hypertension is a common, long-term condition that tends to be associated with age and can lead to significant cardiovascular complications. This study aimed to identify factors influencing the longitudinal Pulse Pressure of hypertensive patients treated at Assosa General Hospital, Western Ethiopia.

Methods: A retrospective study design was conducted from 325 randomly selected HTN patients in the outpatient department (OPD) clinic at AGH during the follow-up period from January 2022 to January 2024. The analysis included exploratory data analysis and the application of a linear mixed model. This model was used to analyze the longitudinally measured pulse pressure in patients with hypertension. The appropriate variance-covariance structure chosen for this analysis was the unstructured (UN) format.

Result: Among the 325 patients included in the study, 51.5% were female, and 54.2% were from urban areas. The variables: Age (p -value<0.0001), Urban (p -value=0.012), FHHTN (p -value<0.0238), Stage-I HTN (p -value=0.0403), Stage-II HTN (p -value=0.0022), DM (p -value<0.0001), CKD (p -value<0.0001), Smoking (p -value<0.0001), Enalapril + Nifedipine (p -value=0.0249), and follow-up time (p -value<0.0001) were significant factors for the progression of pulse pressure.

Conclusion: The profile plot showed that the patient's pulse pressure decreases slowly as follow-up time increases. Age, Residence, FHHTN, DM, CKD, Smoking status, and Stages of HTN were positively associated with pulse pressure, whereas Treatment type and follow-up time were negatively associated with pulse pressure. So, Healthcare providers should prioritize addressing the modifiable risk factors mentioned above to help mitigate the progression of blood pressure specifically pulse pressure in hypertensive patients.



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Keywords: Pulse Pressure, Cardiovascular disease, Hypertension, Linear mixed model, and Longitudinal data

Biography



Maru Zewdu Kassie is a Biostatistician, Lecturer, and Researcher with six years of experience in public health and statistical science. With degrees in Statistics and Biostatistics, Maru lectures at Assosa University and is skilled in SPSS, SAS, STATA, and R. His published work addresses diabetes, COVID-19, maternal health, and contraception. Currently, he is researching child mortality, advanced maternal age, and stroke risks using Ethiopian DHS data. Maru's research interests span spatial and longitudinal analysis, with a focus on health and socio-economic impacts. Outside academia, he enjoys music, reading, and community service.



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PREVALENCE OF STUNTING AND ASSOCIATED FACTORS AMONG CHILDREN AGED 6-59 MONTHS IN DROUGHT-AFFECTED PASTORALIST'S COMMUNITY IN TELTELE WOREDA BORANA ZONE OROMIA REGIONAL STATE ETHIOPIA: COMMUNITY-BASED CROSS-SECTIONAL STUDY

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Background: Stunting is one of the most serious public health problems in the world. In Ethiopia, stunting is the underlying cause of 270,000 under-five children's deaths each year. The prevalence and factors associated with children's stunting in pastoralist communities are all unknown. National estimates of stunting are not always comparable to local estimates. Therefore, this study aimed to assess the prevalence of Stunting and associated factors among children aged 6-59 months in drought-affected pastoralist communities in Teltele woreda Borena Zone, Oromia Regional State, Ethiopia, 2023.

Methods: A community-based cross-sectional study was conducted among randomly selected under-five children with their caregivers living in Teltele woreda Borena Zone, Oromia Regional State, Ethiopia, from April 20 to June 30, 2023. A multistage Cluster sampling technique was used to select 632 study participants. Kobo toolbox was used to collect data and exported to SPSS Version 25 for statistical analysis. Weight for height/length was calculated using WHO Anthro version 3.2.2 software. Descriptive statistics were done to summarize household characteristics. The analysis of factors associated with anemia was assessed by using logistic regression and significance was determined at p-value <0.05.

Results: The overall prevalence of stunting was 57.8% (95% CI: 53.4%–62.5%). Feeding other than breast milk in the first 48 hours (0.15, 95%CI: 0.072, 0.312), Vitamin A Supplementation (0.37, 95%CI: 0.18, 0.75), colostrum feeding (0.52, 95%CI: 0.34, 0.91), the duration of exclusive breastfeeding (0.66, 95%CI: 0.52, 0.84), attempts to purify drinking (0.20, 95%CI: 0.11, 0.36), and household food security status (2.01, 95%CI: 1.06, 3.80) were significantly associated with stunting.



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Conclusions and recommendations: Stunting in the study area was greater than regional and national averages, and factors associated with stunting in pastoralist children are different from those in agrarian communities. Thus, nutritional intervention and wash programs in the Teltele district should focus on these factors.

Keywords: Stunting, under-five children, drought, pastoralist region.

Biography



Samuel Alemu is an advocate for public health, with BSc and MPH in the field of Public Health Nutrition. He has expertise in disease prevention and health promotion with a focus on primary prevention. He is currently working on a malaria clinical trial, related to an important global health problem. Samuel sees hunger and malnutrition as impediments to progress in all nations and calls for collaboration across sectors and effective leadership in health. He has worked as a lecturer and researcher at Arba Minch University since 2020 with the goal of combating malnutrition and illness.



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IN SILICO MULTITARGET SCREENING OF BACOPASIDE I FROM BACOPA MONNIERI FOR ANTIDIABETIC THERAPEUTIC POTENTIAL

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A detailed molecular docking study was performed to evaluate the potential antidiabetic effects of five compounds from Bacopa manieri: Bacoside B, Bacoside A, Bacopaside I, Bacopaside II, and Bacopasaponin C. The docking analysis targeted six key antidiabetic proteins: Glucokinase (1V4S), PTP1B (2FWE), DPP-4 (2ONC), Alpha-glucosidase (3TOP), PPAR-γ (3DZY), and SGLT2 (3DH4). Docking scores and binding energies were evaluated to identify the most promising compounds for antidiabetic activity. Bacopaside, I emerged as the top candidate, demonstrating superior docking scores against multiple critical targets, including Glucosidase (1V4S), DPP-4 (2ONC), and PPAR-γ (3DZY), supporting its potential as a multitarget approach to diabetes management. Bacopaside I may enhance insulin sensitivity, improve glucose uptake, and prolong incretion hormone action. Bacoside A also demonstrated strong docking affinities, particularly against Alpha-glucosidase (3TOP) and PTP1B (2FWE), marking it as another promising compound for antidiabetic drug development. Bacopaside II showed favourable results, particularly in DPP-4 inhibition and PPAR-γ modulation. Overall, Bacopaside I and Bacoside A emerge as the leading candidates for antidiabetic therapy, with Bacopaside I demonstrate that the highest therapeutic potential across multiple targets, justifying further investigation and development.

Keywords: *Bacopa monnieri, Bacopaside I, Bacoside A, Antidiabetic, Glucokinase, DPP-4, PPAR-γ*



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HYPERFUNCTION VARIANT RS708035 OF INTERLEUKIN 1 RECEPTOR-ASSOCIATED KINASES 2 GENE INVOLVED IN THE PREDISPOSITION OF LEPROSY INFECTION

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Mycobacterium leprae (slow-growing bacteria) is the etiological agent for leprosy infection, which is a chronic granulomatous disease. Symptoms initiate with the loss of sensation in the affected areas, which can lead to severe injuries, cuts and burns. IRAK2 (interleukin-1 receptor-associated kinases 2) is reported to function in the regulation of the NF κ B pathway. The frequency of the IRAK2 polymorphism (rs708035) was unknown in the Pakistani population. Therefore, the study was designed to identify the role of the rs708035 SNP (single nucleotide polymorphism) in susceptibility to leprosy.

The case-control study was designed, and participants were selected by Ridley-Jopling Classification. Blood samples from healthy individuals and patients were collected after ethical approval. Genomic DNA was extracted for the amplification of selected polymorphisms by tetra-primer amplification refractory mutation system polymerase chain reaction. The desired products were observed via agarose gel (2.5%) electrophoresis followed by data analysis using bioinformatics tools (SNP Stats and SHEsis) and statistical tests (odds ratio, OR, and chi square). The study revealed that the mutant genotype (TT) was found to be frequent among cases (22.80%) in comparison with the controls (1.66%). The SNP rs708035 was significantly associated with the progression of leprosy ($\chi^2 = 17.62$, $p < 0.0001$). The targeted SNP significantly increases the risk of leprosy 2.3 times (OR = 2.3119, 95% CI 1.2729–4.1989, $p < 0.01$). The genetic model also confirms the significant association of the A/T genotype with leprosy in the over-dominant model (OR = 2.83, 95% CI 1.16–6.89, $p < 0.001$).

The study revealed a significant association of the targeted SNP with leprosy and provided baseline data regarding the association of rs708035. The current research could be utilized for the preparation of biomarkers by considering a larger sample size.



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Keywords: leprosy, NFκB pathway, Ridley–Jopling classification, rs708035, tetra-primer amplification refractory mutation system PCR.

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SUSTAINABLE SOURCE OF MOLECULE FARMING: MICROALGAE – PROGRESS AND PROSPECTS IN AGRICULTURE AND PHARMACEUTICAL APPLICATIONS

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Microalgae provide a wide range of bioactive compounds with potential application in novel therapeutic agents and nutraceuticals based on their health-promoting properties and safety profiles. They are known to produce different bioactive compounds (antioxidants, antimicrobials, and growth-promoting factors) that can act as biostimulants by improving crop yield and stress resistance while lowering chemical input.

The hope is that this exploration sheds light on the fields of integration of minimum mussels in agriculture practice and its significance in pharmaceutical development as sustainable exercises to move toward sustainable practices capable of addressing global challenges such as personal health and food security.

The future prospects will be towards the optimization of the cultivation and extraction procedures, genetic engineering to improve these natural production processes, and field trials on using microalgae bio-darkogout fractioned products to cure real-life problems. In our experience, we aim to leverage the unique properties of microalgae to develop innovative solutions for a more sustainable future.

Keywords: Microalgae, biostimulants, agriculture, pharmaceutical, sustainable practice, solutions

Biography



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I am an Assistant Professor at the Faculty of Medicine, Pharmacy and Dentistry of Fez, Sidi Mohamed Ben Abdellah University. I am also a Researcher in Marine Biotechnology, specializing in plant physiology and seaweed valorization. Additionally, I am an Engineer in Industry and Safety Food and an Engineer in Biotechnology Applied to Plant Improvement at the Faculty of Sciences and Techniques, Cadi Ayyad University.

My research expertise lies in seaweed and microalgae valorization, with a focus on unlocking the potential of algae biomass for various applications, including wastewater treatment, sustainable agriculture, and the development of bioactive compounds for the pharmaceutical industry. I investigate the use of seaweed liquid extracts to enhance the agronomic performance of crops, particularly beans and wheat. This includes exploring their effectiveness in both soil and hydroponic systems, as well as under abiotic stress conditions. My research also involves studying plant physiology and stress tolerance, with a focus on understanding the mechanisms of abiotic stress tolerance in plants and the potential of seaweed extracts to enhance stress tolerance.



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DETERMINANTS OF PREGNANCY COMPLICATIONS AMONG THE WOMEN RECEIVING ANTENATAL CARE IN ETHIOPIA: A MULTI-LEVEL MIXED EFFECTS SPATIAL ANALYSIS

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Background: Pregnancy complications pose significant challenges to maternal health globally, risking millions of women during pregnancy, childbirth, and the postpartum period. This study aims to conduct a spatial multilevel analysis to investigate factors influencing pregnancy complications in Ethiopia.

Methods: A cross-sectional study was conducted on 2923 women from the Ethiopian Mini Demographic and Health Survey (EMDHS) 2019 dataset. The data were cleaned, weighted using STATA version 17, and analyzed using ArcGIS 10.8 to map pregnancy complications. Global and local Moran's Index methods were used to assess clustering and a multilevel binary logistic regression model was fitted to identify predictors of pregnancy complications.

Results: The prevalence of pregnancy complications was 59.9%, and Global Moran's *I* for Pregnancy Complications was 0.5954, showing significant clustering across Ethiopian zones ($p=0.0000$). Significant individual-level variables: no education [AOR=4.99, 95% CI (2.78, 8.98)], primary education [AOR=2.77, 95% CI (1.59, 4.85)], aged 35-49 [AOR=1.21, 95% CI (1.05, 1.76)], richest wealth [AOR=0.76, 95% CI (0.59, 0.98)], no counselling on pregnancy complications [AOR=8.78, 95% CI (7.07, 10.90)], married [AOR=0.81, 95% CI (0.52, 0.80)], and previously delivered by caesarean section [AOR=1.48, 95% CI (1.02, 2.17)]. Community-level variables the women lived in Addis Ababa [AOR=1.39, 95% CI (1.37, 2.66)], Somalia [AOR=0.11, 95% CI (0.04, 0.29)], higher community wealth Index [AOR=0.63, 95% CI (0.41, 0.99)] and lower community education [AOR=1.13, 95% CI (1.09, 1.72)].

Conclusion: In this study, the high prevalence of pregnancy complications among women receiving ANC was spatially non-random with a positive Moran's Index. Individual and community-level factors like lower wealth index, education status, age 15-18 and 35-49, never married, previous Caesarean Section, no pregnancy counseling,



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lower community wealth Index, and media exposure were significantly associated with Pregnancy Complications. Strengthening women’s education, improving family wealth, providing media access, and paying attention to specific age groups and regions are recommended.

Keywords: Multilevel Analysis, Spatial Analysis, Pregnancy Complications, Logistic Regression

Biography



Maru Zewdu Kassie is a Biostatistician, Lecturer, and Researcher with six years of experience in public health and statistical science. With degrees in Statistics and Biostatistics, Maru lectures at Assosa University and is skilled in SPSS, SAS, STATA, and R. His published work addresses diabetes, COVID-19, maternal health, and contraception. Currently, he is researching child mortality, advanced maternal age, and stroke risks using Ethiopian DHS data. Maru’s research interests span spatial and longitudinal analysis, with a focus on health and socio-economic impacts. Outside academia, he enjoys music, reading, and community service.



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Session (C) Soil Biology & Agricultural Sustainability Session



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IRON DEFICIENCY INDUCED PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES IN PEARL MILLET

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Iron (Fe) is the most essential micronutrient for plant growth and development, being required as a redox active metal for various physiological and metabolic processes. About 1/3rd of world soil is deficient in Fe, affecting plant growth and development. It is difficult to manage Fe deficiency to plants through agronomic practices. Fe biofortified crop varieties with higher Fe uptake potential provides an attractive alternate for evaluation of performance under prevailing Fe deficiency. In this study, contrasting Fe containing genotypes including HHB-299 (biofortified) and HB-67(I) (non-biofortified) were evaluated under varied Fe supply (0-100 μ M Fe). It was observed that with increase in Fe deficiency under treatments T₁ to T₃, shoot length was decreased in the range of 0.92- 38.9% and 9.5- 41.7% at 5-leaf and panicle initiation stage, respectively, for genotype HHB-67(I), as compared to control (100 μ M Fe). In comparison, significantly, less decrease in shoot length was observed for biofortified genotype HHB-299. Results revealed better tolerance of HHB-299 to the Fe deficiency stress owing to its higher activity of SOD, lower decrease in catalase activity, Maximum MDA content at highest Fe deficiency, lower increase in proline content, low release of phytosiderophores, and higher uptake of Fe under Fe deficient conditions, as compared to genotype HHB-67(I). The study might have implications in development, evaluation and promotion of biofortified or Fe deficiency tolerant crops for cultivation in soils with prevailing Fe deficiency.

Keywords: Biofortified Pearl millet; Iron deficiency; Hydroponics; Phytosiderophore; Catalase

Biography



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Dr. Vinod Kumar is currently working as Associate Professor-cum-Senior Scientist at Division of Biochemistry, SKUAST-Jammu. After Ph.D. Biochemistry from GBPUA&T, Pantnagar, he has served at different positions at various institutions including Eternal University, Baru Sahib (H.P.); Agriculture University Jodhpur; and CCS Haryana Agricultural University, Hisar. He has done extensive research work on phytases including their study from different sources, purification, characterization, heterologous expression and in silico study of all four classes of phytases. His current research is focused on Biochemical & molecular assessment of biofortified crop varieties for quality traits and performance under varying nutrient and soil types. He has 98 publications with 5700 citations, iio-index 58, h-index 34. He has successfully completed two projects from DBT & DST, Govt. of India and filed 05 patent applications for innovations. He is life member of six scientific societies and received various awards, recognitions, including recent listing among world's top 2% scientists for 2024 by Stanford University, USA.



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EFFECT OF TILLAGE ON SOIL PROPERTIES, GROWTH AND PRODUCTIVITY OF MAIZE GROWN IN VERTISOLS OF WESTERN MADHYA PRADESH

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This study investigated the effects of various tillage practices on soil properties, maize growth, and productivity in Vertisols of Western Madhya Pradesh. The research was conducted during the 2019-20 growing season at the College of Agriculture, Indore, using four tillage treatments: T₁ (Sub-soiling), T₂ (Cultivator tillage twice), T₃ (Deep tillage by MB plough), and T₄ (Reduced tillage with crop residue). The primary objectives were to assess the impact of tillage on soil physical and chemical properties, maize growth and yield, nutrient uptake, and the economic, water, and energy efficiencies.

Key findings indicated that soil bulk density, mean weight diameter (MWD), and available potassium were influenced by reduced tillage with crop residue, while other chemical properties (pH, EC, SOC, N, P, S) showed minimal variation across treatments. Maize plant height and biomass were significantly affected by tillage methods, with sub-soiling (T₁) yielding the highest values in grain yield, water use efficiency (WUE), and energy use efficiency (EUE). Nutrient uptake, particularly of nitrogen, phosphorus, and potassium, was highest under sub-soiling and reduced tillage with residue. The economic analysis revealed that sub-soiling yielded the highest.

Sub-soiling and reduced tillage with residue proved optimal for maize production and resource efficiency, suggesting these as sustainable practices for Vertisols.

Keywords: Tillage, Vertisol, Maize,

Biography



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Miss Shivani Sharma Through an amazing academic path, a dedicated and motivated student is currently working as Assistant professor at School of Agriculture Science LNCT University, Bhopal. As part time serving as SMS in 360 Research foundation Organisation, Bihar, an NGO, working with many entrepreneurs to exploit their potential and my knowledge to build our Nation, Being curative made me to write and review many Articles of various Journal.



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DO YOU KNOW ADVERSE ASPECTS OF AGRICULTURE?

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Most prestigious old traditional profession of man the agriculture provides us with the food we all eat every day. But do you know how those agricultural practices impact on environment and global warming?

Well established, the positive aspects of agriculture, there are several negative effects of agriculture on the environment which are creating serious problems for a sustainable environment. One of the most important negative impacts, is the effect on earth warming. Greenhouse gases (GHGs) have different sources within agriculture. Dominant sources of agricultural greenhouse gases (GHGs) include carbon dioxide (CO₂) from tropical deforestation, methane (CH₄) from livestock and rice production, and nitrous oxide (N₂O) from fertilizing or burning croplands.

Agriculture is responsible for about half of global methane emissions. Methane is 26 times stronger as a GHG than CO₂. Ruminant livestock, including cows and sheep, digest their food through enteric fermentation, which produces methane. Burning biomass to prepare fields is another methane-maker, as is applying manure to fields.

Rice grown in paddies, where bacteria break down biomass submerged in the fields. Methane emissions from irrigated rice fields account for about 11 percent of emissions from agricultural management.

Sixty percent of all anthropogenic N₂O emissions are from agriculture. Nitrous oxide emitted into the atmosphere is a major GHG because it is 300 times more effective at warming than CO₂.

Most N₂O is produced after croplands are fertilized, when soil microbes convert some of the applied nitrogen from fertilizer and manure into N₂O. Nitrous oxide is also produced when crop residues are burned.

Land-use planning relating to agriculture have a far more significant impact on carbon cycling. Plants absorb CO₂ from the atmosphere, so plants, forests and many natural



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ecosystems that have developed over thousands of years store vast amounts of carbon. Changing the function of this uncultivated land from being a carbon sink and store to being a source of GHG emissions due to burning plant material or farming, has a negative impact on the emission balance. As greenhouse gas concentrations rise, so does the global surface temperature. And causes destructive impacts, there are a few effects below:

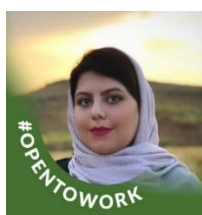
- i) More severe storms*
- ii) Increased drought*
- iii) Loss of species*
- iv) More health risks*
- v) Poverty and displacement*
- vi) Facing food shortages*

Suggested agronomic measurement?

Organic agriculture can remove from the air and sequester 7,000 pounds of carbon dioxide per acre per year. As a matter of fact, in drought years, it increases yield, since the additional carbon stored in soil helps it to hold more water. In wet years, the additional organic matter in the soil wicks water away from plant roots, limiting erosion and keeping plants in place. continue in comment.

Keywords: Agrochemicals, organic farming, global warming, pollution

Biography



Miss Negar Mosallanejad is a dynamic and brilliant Ph. D student of department of soil chemistry and fertility, Shiraz University, Iran.

Her passion for research and eagerness to acquire new concepts within agricultural and environmental contexts drive the professional pursuits. She is familiar with motivation with challenges and thrive in finding novel approaches to advanced research.



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COMBATING WHEAT BLAST DISEASE: HARNESSING CUTTING-EDGE TECHNOLOGIES FOR FOOD SECURITY

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*Wheat is a crucial food crop that accounts for 20% of global caloric intake and 25% of dietary protein. However, wheat blast, a severe disease caused by the filamentous fungus *Magnaporthe oryzae* pathotype *Triticum* (MoT), poses a significant threat to global food security. First identified in Brazil in 1985, this seed- and air-borne disease has rapidly spread to Argentina, Bolivia, and Paraguay. The urgency of addressing this threat was amplified by outbreaks in Bangladesh in 2016 and Zambia in 2018, raising alarm over the potential for a global pandemic. Our research harnesses advanced omics technologies alongside open data sharing and collaborative scientific initiatives to trace a clonal lineage of MoT in both Bangladesh and Zambia, revealing independent introductions from South America. We developed a rapid detection method using genome-specific markers and CRISPR-Cas12a technology to identify asymptomatic MoT in seeds and plants. Notably, we discovered the major blast resistance gene, *Rmg8*, which can be integrated into wheat varieties already possessing a blast-resistant chromosomal segment (2NS) to combat the prevalent pandemic lineage. Additionally, our transcriptomic analyses have identified key associations between specific susceptibility genes (S-genes) and the damage observed in wheat leaves infected by MoT, paving the way for utilizing CRISPR-Cas technology to edit these genes. This approach holds promise for developing durable blast-resistant wheat varieties. As we advance efforts to contain the wheat blast fungus, fostering global collaboration is essential for effectively tracing and managing this agricultural crisis.*

Keywords: Climate change, genomic surveillance, gene editing, molecular diagnostic, CRISPR technology

Biography



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Professor Tofazzal Islam, born on 20th of December 1966, is the Founding Director of the Institute of Biotechnology and Genetic Engineering (IBGE) at Bangabandhu Sheikh Mujibur Rahman Agricultural University in Bangladesh. Internationally recognized for molecular plant-microbe interactions and agrobiotechnology, he holds a Ph.D. in Applied Biosciences from Hokkaido University. With postdoctoral experience at prestigious institutions supported by JSPS, Alexander von Humboldt, Commonwealth, and Fulbright fellowships, Dr. Islam led an international team that rapidly identified the origin of the 2016 wheat blast epidemic in Bangladesh. Currently, he heads a large international team addressing wheat blast disease, utilizing genomics, genome editing, nanobiotechnology, biocontrol, and advanced molecular approaches. Their collaboration resulted in a rapid point-of-care diagnostic method. As Editor-in-Chief of two book series for Springer Nature and serving on editorial boards of *Physiologia Plantarum*, *Scientific Reports* and *Frontiers in Microbiology*, Prof. Islam is recognized as a Fellow of American Phytopathological Society, Bangladesh Academy of Sciences and The World Academy of Sciences, earning awards such as the Gold Medal of Bangladesh Academy of Sciences and the Commonwealth Innovation Award. With over 350 articles published with more than 10,800 total citations, his research has secured over \$10 million in global funding, reflecting his commitment to advancing agricultural research on a global scale.



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THE SOIL HEALTH PYRAMID

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"Food is only as healthy as the soil in which is grown" Anne Gibson. Bountiful, vibrant, healthy plants come from healthy soil—organic, living, and free from toxic chemicals or fertilizers. But how do you determine the health of your existing soil and how to improve it to maximize your growing efforts? For home gardeners, we've developed the Soil Health Pyramid™ to simplify this process. It focuses on the three most important aspects of soil health: Composition, Nutrients, and Microbiology.

1. Composition - Soil is made of air (25%), water (25%), minerals (45%), and organic matter (5%). Healthy, living soils have adequate air, water and nutrient holding capacity as well as sufficient porosity for air and water to move freely about.

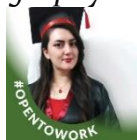
2. Nutrients - All macro and micronutrients contribute to plant growth and health and should be present in your soils. A standard soil test will indicate the presence of these important nutrients in your soil and identify deficiencies that need to be remedied.

3. Microbiology - Living soil contains diverse, rich microbial populations of bacteria, fungi, and microorganisms that consume and convert nutrients and minerals to highly plant available compounds. There are more soil microorganisms in a teaspoon of healthy soil than there are people on earth. Improving soil microbiology can increase yields and improve quality.

Soil health is the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals and humans, and connects agricultural and soil science to policy, stakeholder needs and sustainable supply-chain management.

Keywords: Soil health, Principle, constituents, Pyramid

Biography



Angel Alizadeh serves as an apprentice in central and soil lab in university of Maragheh. She worked as an expert agricultur Engineering in Agro-industry KeshtSanat since 2015 untill 2020 and



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studied lands and land use change in agricultural areas . She is expertidrd in the produce facial masks,cream and soaps from the clay. it is worth noting that her field of study was around wind erosion and physicochemical and mineralogical characteristics of soil having some of projects around water erosion. She is seeking chances for Advanced education in soil and environnement science,



President:Green India clean environment society, Hisar, Haryana,
India



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INTRODUCTION OF THE CONTINUOUS COVER FORESTRY MODULE OF THE FOREST INDUSTRY CARBON MODEL

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With the Paris Agreement and the EU Climate Law setting ambitious climate goals, land-based climate change mitigation solutions are gaining increased importance. The EU's recent Carbon Removal and Carbon Farming (CRCF) regulation underscores the dual priorities of enhancing biodiversity and increasing land-based carbon sequestration. Effective modelling tools are essential for planning and implementing climate change mitigation measures that target future carbon balances of these land-based approaches. One such tool, the Forest Industry Carbon Model (FICM), was developed at the University of Sopron's Forest Research Institute as a country-specific carbon balance calculation system. This model assesses future carbon balances in forests and harvested wood products while also accounting for material and energy substitution effects. Our current research focused on developing the Continuous Cover Forestry Module within the FICM, which was tested in a pilot forest stand. Findings suggest that transitioning from traditional rotation forestry to continuous cover forestry management can be an effective climate mitigation strategy. This approach allows for sustained carbon sequestration while promoting forest resilience and biodiversity. The results highlight the potential of continuous cover forestry as a valuable tool in achieving the EU's climate and biodiversity targets through improved land management practices.

Funding information

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PROJECT
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THE NRDI FUND

Keywords: Climate change mitigation; Carbon sequestration; Forest management system; Nature conservation; Carbon balance modelling; Continuous cover forestry

Biography



Éva Király is a PhD student and environmental engineer with over 10 years of experience in Greenhouse Gas Inventory and carbon balance calculations. She works at the University of Sopron's Forest Research Institute, where her research focuses on sustainable forestry and carbon management. She contributed to the development of the Forest Industry Carbon Model; a country-specific tool designed to enhance accuracy in carbon balance calculations within the forestry sector. Her work combines technical expertise with a commitment to advancing climate science, aiming to support sustainable forest management practices and contribute to national and global climate goals.



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PENICILLIUM OXALICUM ISOLATED FROM ZEA MAYS RHIZOSPHERE AS A PROMISING PLANT GROWTH PROMOTOR VIA MULTIPLE MECHANISMS

Shrouk Elgarihi EBRAHIM, Mohsen Elsayed IBAHIM, Ahmed Elsaid ABDELAZIZ, Metwally Ramadan KOTTB

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The use of synthetic fertilizers in agricultural production has harmful impacts on the ecosystem. Therefore, there is an emergent demand for using natural and sustainable practices to save the environment. Some of the soil microflorae are plant-growth-promoting fungi (PGPF) which promote plant growth and are considered potential biocontrol agents against phytopathogens. In the present investigation, more than 37 fungal species were isolated from the rhizosphere and rhizoplane of Zea mays and Vicia faba from AlRaswa Ferry of Port Said governorate and characterized for their potential as an Arabidopsis thaliana plant growth promotor. Four species of four genera namely Penicillium oxalicum, Fusarium oxysporum, Aspergillus niger, and Paecilomyces lilacinus revealed to have the highest capacity to enhance A. thaliana growth. The most observed effects on A. thaliana are a significant improvement in root length development and number of leaves due to multiple mechanisms, e.g., the fungal phytohormone, indole acetic acid production, volatile components and siderophore production, and phosphate solubilization. Fungal volatiles of Penicillium oxalicum increased the shoot length of seedlings by 11.8%, the root length by 250%, the number of leaves by 60%, and the indole acetic acid production by 110% compared to the controls. Obtained results suggest Penicillium oxalicum as a natural biological plant growth inducer whether individually applied or in mixed form with the other identified fungal species which may act as a practicable substitute for harmful chemicals in the agricultural field

Keywords: *Penicillium oxalicum*, plant growth promoters, siderophore, volatile compound, phosphate solubilization.



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INTEGRATED ASSESSMENT OF TILLAGE SYSTEMS AND NUTRIENT MANAGEMENT SCHEMES ON GROWTH DYNAMICS AND YIELD PERFORMANCE OF LOWLAND RICE (*Oryza sativa* var. NSIC RC222) IN BARILI, CEBU

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*A split-plot study was conducted on lowland rice (*Oryza sativa* var. NSIC RC222) under conventional (M₁) and minimum (M₂) tillage systems using different fertilizer treatments (T₁-control; T₂ - Organic fertilizer at 2 t ha⁻¹ (combination of rice straw compost, chicken manure dried, and carbonized rice hull at 1:1:1 ratio); T₃ - Organic fertilizer (same as T₂) + inorganic fertilizer at a rate of 60-30-30 kg/ha N-P₂O₅-K₂O; and T₄ - Inorganic fertilizer at the rate of 120-60-60 kg N-P₂O₅-K₂O) to compare the growth and yield performance of rice plant and evaluate the effects of organic fertilizers under different tillage systems.*

The study's findings have practical implications for rice cultivation. Both Conventional Tillage and Minimum Tillage systems were found to have similar effects on the growth and yield of lowland rice. The use of integrated inorganic and organic fertilizers was shown to be more effective than no fertilizer or organic fertilizer alone. However, the study also found that the use of inorganic fertilizer alone (T₄) produced comparable results. Therefore, the study recommends the use of integrated inorganic and organic fertilizers with Minimum Tillage for rice production to preserve soil health and quality, providing a practical strategy for rice farmers.

Keywords: Rice, Conventional Tillage, Minimum Tillage, Organic Fertilizers
Biography



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The primary author is a soil scientist, licensed agriculturist, professor, researcher, and extensionist with a strong academic background and technical skills in soil classification, land use, soil fertility, soil-crop suitability, and constraints assessment, soil characterization and sampling, soil analysis, soil mapping, pedology, soil-plant nutrition, environmental impact assessment, and other agriculture-related domains. She is currently the Director of the

Extension Services Office of Cebu Technological University-Barili, Cagay, Barili, Cebu. The primary author is a soil scientist, licensed agriculturist, professor, researcher, and extensionist with a strong academic background and technical skills in soil classification, land use, soil fertility, soil-crop suitability, and constraints assessment, soil characterization and sampling, soil analysis, soil mapping, pedology, soil-plant nutrition, environmental impact assessment, and other agriculture-related domains. She is currently the Director of the Extension Services Office of Cebu Technological University-Barili, Cagay, Barili, Cebu.



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GREEN APPROACH: PHYTOREMEDIATION

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Phytoremediation is a new technique employed for the remediation of contaminated soils. Brassica juncea (Indian mustard) accumulates high amounts of Pb, Cd, Cu, Ni and Zn in shoots. Metal uptake and accumulation in shoots of B. juncea is shown to be enhanced by application of chelators. Pollution of our environment with heavy metals because of industrialization and use of agrochemicals to boost agricultural production is continuing unabated and is affecting animal and human health.

Phytoremediation is the use of plants to repair contaminated soil. These plants are like a living vacuum that can take large amounts of pollutants from the soil. More than 400 plant species have been identified to have the potential for soil and water remediation. They can accumulate arsenic, nickel, cadmium, and other metals.

The plants will store the pollutant in their biomass while cleaning the soil. Although the process may be slow and the plant cannot be composted (need special disposal process as its biomass becomes hazardous waste), it's still a more economical and less invasive solution than removing all the contaminated soil layers.

Some universities have been studying the use of these plants to clean polluted wetlands and soils and how to increase their capacity. They are also investigating how teaming the plant with fungi or bacteria could help the plant speed the process.

Heavy metals uptake in Indian mustard is proportional to the amount of metals contained in a measurable fraction of the soil solution and plant capable to tolerate higher levels of heavy metals in soils and in shoot tissue also. The shoot/root ratios for Cd, Ni, Pb and Hg are much higher for these Brassica species. A greater portion of total metal in the plant is therefore, sequestered in harvestable tissues.

Areas under brassica crop also need to be identified and estimated to make potential use of this hyper accumulator plant. Remote Sensing Satellites provide a vantage point in



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space to get a synoptic view of the earth surface repetitively. This makes it possible to map and monitor crops. Such applications are growing day by day with the timely and in season availability of the satellite data

In view of this, the further research is planned with the following objectives: Relative efficiency of Brassica species to accumulate heavy metals (Cd, Hg, Pb and Ni) with and without application of chelating agents (EDTA) in soil. To investigate the accumulation factor (AF) for different heavy metals in some hyper accumulator plant genotypes. To investigate the heavy metals content and speciation of Cd, Hg, Pb and Ni in sewage sludge applied soils and decontamination with introducing hyper accumulator crops in local crop-rotation. Mapping of heavy metal contaminated soils using GIS. Mapping of area under Brassica species using satellite data. The heavy metal tolerant bacteria shall be identified, characterized and utilized for biosorption of heavy metals in the industrial effluents and wastewater.

Keywords: heavy metals, phytoremediation, soil-water pollution

Biography



Komal Jat is PG Student of Department of Soil Science, Central Agricultural University, Imphal, Manipur, India. She is Brilliant, dynamic, young girl with innovative mind and hard-working nature. Performing excellency in extracurricular activities and social welfare.



Valentina Anufriyeva is dynamic lady with many folds' innovative visions in her mind. She performed health care management education coordinator at Ukrainian-Swiss Project "Medical Education Development" (MED) Ukraine. Experienced Quality Management Consultant/Auditor with a demonstrated history of working in health care. Academician with experience in research and in creating and teaching management in health care modules for adults. Writer of books for children.



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Professor Dr. B. S. Panwar has completed his Ph.D from CCS Haryana Agricultural University Hisar, India. He was the coordinator of Indo-Hungarian joint project entitled "Phytoremediation of potentially toxic heavy metals contaminated soils by agricultural crop genotypes" funded by DST New Delhi and HAS Budapest from the year 2005 to 2008 and "Fate of heavy metals in crop, soil and water ecosystem" funded by INSA and HAS from the year 1997 to 2001. He is visiting professor of ETHZ Zurich, Switzerland, PSTU, Mariupol Ukraine and MSU Moscow, Russia. He has published more than 110 peer reviewed research papers in national & International journals, 2 Books (Hungarian with summary in English) associated with Hungarian Professor, 10 Bulletins, 20 Book chapters, popular & Scientific articles in leading newspapers, magazines, Radio talks, farmers melas and has been serving as an editorial board member of reputed research journals. Professor Panwar Guiding many Post graduate students in Indian and abroad Universities. Since performing [one decade] as President of Green India Clean Environment Society-GICES, Hisar, Haryana, India. Besides his professional field, he is a proven writer - poet and published one flash drama, two books of Hindi poetry, and 12 E-booklets of poems in English literature.



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CHARACTERIZATION AND EVALUATION OF THE ANTIFUNGAL ACTIVITY OF POSIDONIA OCEANICA EXTRACTS AGAINST PATHOGENIC RHIZOCTONIA SPECIES

Eetizez KAROU, Mohammed Ali TRIK, Monia ENNOUR

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Posidonia oceanica, a seagrass endemic to the Mediterranean Sea, is known for its ecological significance and potential bioactive properties. This study aimed to explore the physicochemical composition of *Posidonia oceanica* collected on the Mediterranean coasts of Tunisia (Kerkenah), and to test the antifungal activity of solvent extracts against the pathogenic fungi *Rhizoctonia solani* and *Rhizoctonia bataticola*.

Our findings revealed that *Posidonia oceanica* is rich in proteins (13.7 %), and in minerals (18%). The analysis of fatty acid methyl esters revealed a high amount of oleic acid (42.04 %) followed by palmitic acid (35.47 %) and palmitoleic acid (6 %). The effect of different extracting solvents on antifungal activity showed that the ethyl acetate extract was the most interesting inhibiting both tested pathogens.

These results showed that *Posidonia oceanica* is a promising source of natural antifungal, allowing it to be exploited for developing high value products for fighting pathogenic agent.

Keywords: *Posidonia oceanica*, characterization, antifungal activity, *Rhizoctonia*, extraction methods

Biography



S.

Student in the first year of doctoral studies in Biological Sciences at the Olive Genetic Resources Laboratory, of the Olive Tree Institute of Sfax (Tunisia).

Her research is focusing on the phytosanitary protection of olive tree with marine algae bioactive compound



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PLASTIC POLLUTION: SOFT STONE IN THE SOIL BODY

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While, we are now, bombarded by negative news that would lead us to believe we are fighting a losing battle in the protection of our natural environment? Climate change, loss of biodiversity, soil and waterway degradation, loss of agricultural productivity – the list goes on. But where do we think many countries are looking for solutions? Capital markets?

Fortunately, we have recognised that social capital will be vital in halting environmental decline. Landcare’s greatest strength is local people working on local problems. Grassroots communities work together to ensure actual remedial work is done where it is needed, to provide a solution for each, local environmental problem.

What do we think @ present?

The 90s, we were taught to use plastic instead of paper to save trees from deforestation. Now we are taught to use paper instead of plastic to save the Earth from Plastic Pollution. It took us more than three decades to realize our mistake. When we see the complete timeline, nearly all the economically beneficial development was directly and/or indirectly damaging the environment. Still, there is a long way to go before Homosapien learns to prioritize the environment over economic benefits. We are not advocating that it can’t have order. But to create some water retention potential and soil health we have to have shade. The cooling that occurs is required to maximize tree longevity. Absent of this we are planting on an island where a tree will always under perform.

Without a waste management system in place this is what happens. Ocean Integrity is actively addressing the issue of plastic waste dumping through a multifaceted approach. The organization recognizes the importance of implementing a waste management system as a primary means of reducing plastic waste. In addition, Ocean Integrity is also focused on collecting plastics from both rivers and oceans to prevent further pollution. By tackling both fronts simultaneously, the organization is taking a comprehensive approach to addressing the issue of plastic waste.



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To achieve its mission, Ocean Integrity is working to establish a waste management system that will effectively manage plastic waste. This approach is crucial, as without a proper waste management system in place, plastic waste will continue to accumulate and cause damage to the environment. By implementing an efficient waste management system, Ocean Integrity aims to reduce the amount of plastic waste that ends up in rivers and oceans, thereby improving the overall health of the marine ecosystem.

In addition to implementing a waste management system, Ocean Integrity recognizes the importance of collecting plastics from both rivers and oceans. This dual approach is critical to reducing plastic waste as it ensures that both sources of plastic pollution are addressed. By removing plastics from rivers and oceans, Ocean Integrity is preventing further pollution and helping to mitigate the damage that has already been done. Through these efforts, Ocean Integrity is working towards a future where plastic waste is no longer a significant threat to the environment.

Collections and recycling of the plastic is essential? if overruled it, everything else is meaningless??

Keywords: Plastic pollution, alarming danger, ecosystem, soil biosphere

Biography



Miss Shreya Bhojane is a dynamic lady having experience of working in NABL Laboratory, Expertise in microbiological and molecular biology lab. Technologies. I have an epistemological approach towards work and willingness to achieve my goal and contribute to the firm effectively.



Dr. B. S. Panwar President of GICES-Hisar, Haryana, India and Former Professor of CCS Haryana Agricultural University Hisar, India.



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EVALUATING SOIL COLOR AS A PREDICTOR OF FERTILITY EVALUATING CHARACTERISTICS IN SUGARCANE-GROWN SOIL SERIES

CLEA ANNE V. CORSIGA

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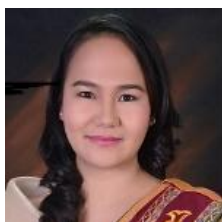
Soil color, shaped by pedo-chemical reactions, is one of the most immediately perceptible soil properties and is an essential indicator for farmers. Soil color often reflects underlying parent material, which influences specific soil characteristics. This study examined the relationship between soil color (value and chroma) and fertility parameters in soil samples collected from depths of 0–30 cm (topsoil) and 30–60 cm (subsoil) across different soil series (Guimbalaon, Isabela, Luisiana, San Manuel, and Silay) under sugarcane cultivation. Key fertility parameters assessed included organic carbon (%OC), pH (H₂O and CaCl₂), total nitrogen (N), available phosphorus (P), exchangeable cations (K, Na, Ca, Mg, and Al), extractable iron (Fe), cation exchange capacity (CEC), and particle size distribution (% sand, silt, and clay).

The results of this study are significant, as they indicate strong correlations between soil color and fertility parameters at both depths. In the topsoil (0–30 cm), %OC, exchangeable Mg, and K showed significant correlations with soil color value, while in the subsoil (30–60 cm), significant correlations were found for pH (CaCl₂), exchangeable Mg and K, and extractable Fe. Similarly, soil color chroma was significantly correlated in the topsoil with %OC, exchangeable Mg and Na, % clay, % sand, and pH (H₂O); in the subsoil, significant correlations were observed for %OC, exchangeable Mg, Na, and Ca, total N, CEC, % clay, and % sand. These findings underscore the potential of soil color as a valuable indicator of soil fertility status in sugarcane-cultivated soils.

Keywords: Soil Color, Soil Fertility, Correlation, Sugarcane
Biography



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The primary author is a soil scientist, licensed agriculturist, professor, researcher, and extensionist with a strong academic background and technical skills in soil classification, land use, soil fertility, soil-crop suitability, and constraints assessment, soil characterization and sampling, soil analysis, soil mapping, pedology, soil-plant nutrition, environmental impact assessment, and other agriculture-related domains. She is currently the Director of the Extension Services Office of Cebu Technological University-Barili, Cagay, Barili, Cebu.



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Session (D) Sustainability of Water, Sediments & Waste Management



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EXPLORING A CHEMICAL-FREE WASTEWATER TREATMENT SYSTEM FOR AGRICULTURAL REUSE: A PILOT STUDY ON INDUSTRIAL AND MUNICIPAL WASTEWATER

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Water scarcity remains one of the key challenges for sustainable agriculture in arid and semi-arid regions such as Pakistan, Iran, and India. Integrating waste management practices into agricultural systems offers a promising opportunity to enhance sustainability and resource efficiency. In this study, a survey was conducted across several neighborhoods in Lahore, near wastewater drains, to identify a suitable location for a pilot wastewater treatment project. Following consultations with local stakeholders, a site in Bhamma/Shadh Bagh was selected, where vegetables and fodder crops are already grown. A pilot effluent treatment plant (ETP) basing facultative microbes, was installed on-site, featuring anoxic, aerobic, and biosand filters designed to reduce the pollutant load in wastewater. Water samples were collected both before and after treatment, and soil analyses were performed at two points on the site. Radish and spinach seeds were sown in treated soil and irrigated daily with tap water, untreated wastewater, and treated wastewater according to a set protocol. As the plants matured, leaf samples were collected and analyzed for heavy metal concentrations. The results showed a significant reduction (90-100%) in total heavy metals, including chromium, copper, lead, and manganese, following treatment. These findings will be valuable in drawing the attention of policymakers and encouraging community involvement to promote sustainable agricultural practices, ultimately strengthening food security and resilience in water-scarce regions.

Keywords: Water scarcity, Sustainable agriculture, Resource efficiency, Agricultural resilience

Biography



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As the Technical Director of Water Care Services Pakistan, I am committed to advancing education and knowledge sharing in water and environmental sciences. Leading projects in water management and climate change, I bring a robust foundation in water policy, project management, and community engagement. My career is marked by a dedication to environmental advocacy



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POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) LEVELS IN THREE DIFFERENT RIVERS

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Mónika MEICZINGER⁴, Raed A. AL-JUBOORI^{5,6}

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³HUN-REN-PE Limnoecology Research Group, Veszprém, Hungary

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⁵NYUAD Water Research Center, New York University-Abu Dhabi Campus, Abu Dhabi, Abu Dhabi, United Arab Emirates

⁶Water and Environmental Engineering Research Group, Department of Built Environment, Aalto University, Aalto, Espoo, Finland

Effluents from industrial activities and wastewater treatment facilities negatively affect the aquatic ecosystems of rivers by degrading both water and sediment quality, posing a considerable threat to aquatic organisms. In this work, 16 Polycyclic Aromatic Hydrocarbons (PAHs) were analyzed at various sites along the Tigris and Euphrates rivers in Iraq, as well as the Danube River in Hungary, with the aim of investigating temporal and spatial variations in PAH concentrations within water and sediment. The findings indicated significant seasonal variation in PAH concentrations in the Danube, alongside elevated PAH levels in both the Tigris and Euphrates rivers. According to the European Drinking Water Directive, PAH concentrations in all three rivers exceeded the permissible threshold of 100 ng/L. The data suggests that most PAHs originated from anthropogenic sources, primarily pyrolytic and pyrogenic processes, with pyrogenic sources being more prevalent. Sediment Quality Guidelines (SQGs) showed that PAH levels in Danube sediments were below the Effect Range Low (ERL), whereas much higher concentrations were found in the Tigris and Euphrates. Moreover, the cumulative Individual Lifetime Cancer Risk (ILCR) exceeded $1/10^4$ for both adults and children in all rivers. These alarming PAH levels in the Tigris and Euphrates demand immediate intervention from Iraqi environmental authorities to mitigate the pollution.



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Keywords: PAHs, monitoring, rivers

Biography



Ruqayah is a scientist specializing in Environmental Engineering, with her research primarily focusing on several critical areas, including polycyclic aromatic hydrocarbons (PAHs), the removal of pollutants from water, health risk assessments, and dust contamination. She is also involved in studies related to adsorption processes, wastewater treatment, and the mitigation of particulate matter (PM) pollution. Ruqayah has made significant contributions to her field, having published over 35 peer-reviewed articles that address these environmental challenges.



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DECENTRALIZED CONSTRUCTED WETLANDS AS ALTERNATIVE SOLUTION FOR WATER AND WASTEWATER TREATMENT IN DEVELOPING COUNTRIES: OVERALL PERFORMANCE AND REMOVAL MECHANISMS

Adhena Ayaliew WERKNEH

Faculty of Engineering and Environment, Northumbria University, Newcastle up on Tyne, United Kingdom, Email: adhena.werkneh@northumbria.ac.

In most of the developing world, domestic wastewater is discharged into the aquatic environment prior to applying any treatment technologies, causing various public health concerns. In this regard, constructed wetlands (CWs) are alternative decentralized sanitation systems, to be applied as economically viable and most suitable for the climate conditions of developing nations. This paper describes a comprehensive review on the potential application of CWs for sustainable treatment of decentralized domestic wastewater in developing countries (2014–2023). In this paper, 17 single-stage CWs, 8 hybrid and 9 CWs integrated with other techniques that were operated in pilot and full- scale case studies were reviewed. Besides, the pollutants removal mechanisms, challenges and factors affecting the performance of CWs treatment are also illustrated. However, further study is required (i) in optimizing, the scale-up, long-term performance of CWs, (ii) the application of an innovative filtration media and (iii) searching for the new and suitable wetland plants that accomplishes higher efficiency for domestic wastewater treatment.

Keywords: Decentralized constructed wetlands, Pollutants removal mechanism, Case study Developing countries, Alternative sanitation

Biography



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Adhena Ayaliew Werkneh is a researcher with expertise in Applied Chemistry (B.Sc., Arba Minch University) and Environmental Science and Technology (M.Sc., UNESCO-IHE, Netherlands, and M.Sc. in Applied Chemistry, University of Gondar, Ethiopia). He has published 34 articles, many as the first author, in indexed journals and is an active peer reviewer for academic publications. Currently, he is pursuing a PhD focused on water purification for sub-Saharan Africa at Northumbria University Newcastle, UK.



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GROUNDWATER MANAGEMENT AND SUSTAINABLE IN ARID REGIONS A CASE STUDY OF KHANGUET SIDI NADJI, SOUTH-EASTERN ALGERIA

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The increasing demand for water in arid and semi-arid regions, coupled with climate change, poses significant challenges to groundwater management. This study focuses on the Khanguet Sidi Nadji watershed in Southeastern Algeria, an area characterized by limited surface water resources and over-reliance on groundwater. Using a combination of hydrological modelling, GIS-based mapping, and field data collection, the paper evaluates the potential of sustainable groundwater management strategies in the region. The research aims to identify areas of groundwater recharge, assess aquifer vulnerability, and recommend solutions for long-term groundwater sustainability in the face of rising water demands and climate variability.

Keywords: groundwater, khanguet sidi Nadji, Algeria, climate chang

Biography



Fares Boukhenissa was born in TOLGA Biskra, where he attended primary, middle, and high schools and transferred to the University of Batna, where he obtained a Master 2 in Water Resources Management and is completing his PhD in Hydrogeology, University of Batna 2, Algeria.



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*Interests in Groundwater Modelling, Geographic Information Systems (GIS), Hydrogeology,
Hydrogeology, Geostate.*



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CHARACTERISATION OF FLOW AND SEDIMENT TRANSPORT BY MODELLING IN SEMI-ARID AREAS. EXAMPLE OF THE MESKIANA-MELLEQUE UPSTREAM BASIN (CONFIN AIGERO-TUNISIA)

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The semi-arid areas are generally characterized by the irregularity of the pluviometric mode where the estimate of the flows and solid transport seems a relatively complex step. In addition, the evaluation of the flow property in these areas is dependent on many parameters whose quantification is not always easy. To overcome these problems, a mathematical modeling of the ratios liquid flow / solid flow appears as a reliable means of evaluation when the models are well validated. Our work presents a modest contribution in term of evaluation of the flows and transport, in the form of modeling of the ratios L_f / S_f on various scales in some catchment area of Medjerda. The correlations show variable values from one scale to another. They are rather significant with the annual and monthly step and less obvious with the seasonal step. In addition, a comparison with the results obtained by the various usual empirical methods applied in our areas, makes it possible to validate these models.

Keywords: Erosion- flow- catchment area- Medjerda- modeling- liquid flow - solid flow.

Biography

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WASTEWATER IMPACT ON SURFACE WATER: OCCURRENCE, ATTENUATION, AND RISKS OF ORGANIC MICROPOLLUTANTS IN THE MIRROR OF THE NEW EU URBAN WASTEWATER DIRECTIVE

Zita ZRINYI, Renata GERENCSEK-BERTA, Nikolett Kovács, Gábor MAASZ

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The occurrence, attenuation, and risks of 31 organic micropollutants (OMPs), including pharmaceutically active compounds (PhACs), pesticides, and bisphenols, were examined in the transboundary catchment of the lower River Mur. Monthly water samples collected over a year from the river and its tributaries in Croatia and Hungary revealed that Hungarian tributaries, receiving ~50% treated wastewater, exhibited the highest pollution levels for PhACs, herbicides, and neonicotinoids. Persistent pollutants like bezafibrate, carbamazepine, diclofenac, and atrazine were consistently detected in River Mur samples, indicating significant long-distance pollution. Photo- and biodegradation were identified as key attenuation factors in the river, reducing OMP concentrations during warmer seasons. However, these processes were less effective in tributaries due to limited space and time for in-stream attenuation. Despite being an agricultural catchment, risk assessments indicated PhACs, particularly diclofenac and estrone, posed the highest risks across all watercourses. This is likely due to extensive arable farming with shorter pesticide application periods. The findings suggest that even in rural settings dominated by arable land, urban stressors such as treated wastewater can significantly impact water quality. Will the new urban wastewater Directive solve these problems?

Acknowledgement: This research was supported by an Interreg Europe project (MonMur HUH/1901/2.2.1/0128), the National Laboratory for Water Science and Water Security (RRF-2.3.1-21-2022-00008). ZZ was supported by the Research scholarship program at University of Pannonia (2024-2.1.1-EKÖP-2024-00025 /130) with the funding of The Ministry for Culture and Innovation from the Source of The National Research, Development and Innovation Fund.

Keywords: micropollutants, wastewater, UWWTD, River Mur

Biography



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DRUG TESTING AND ANALYSIS 123-127.

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ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH 11630-11638



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THE APPLICATION OF DIFFERENT WASTES TO REMOVE ORGANIC MICROPOLLUTANTS

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Given the increasing concerns regarding organic micropollutants and their detrimental effects on human health, the environment, and the economy, developing effective methods for their removal has become critical. Adsorption has emerged as a cost-efficient solution for eliminating these contaminants. Various waste materials have been employed to synthesize activated carbon, specifically for removing pharmaceuticals from different water sources. The resulting activated carbons were characterized using techniques such as scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS), Fourier transform infrared spectroscopy (FTIR), Boehm titration, point of zero charge (pH_{PZC}), BET surface area analysis (S_{BET}), proximate and ultimate analyses, X-ray powder diffraction (XRD), and thermogravimetric analysis (TGA). The performance of these activated carbons in adsorbing pharmaceuticals was tested over six or more cycles, with adsorption isotherms evaluated using both Langmuir and Freundlich models. Additionally, adsorption kinetics were analyzed using pseudo-first-order and pseudo-second-order models. The findings underscore the potential of waste-derived activated carbon in mitigating organic micropollutants while promoting sustainable waste management practices.



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Keywords: Waste, adsorption, wastewater, activated carbon

Biography



Osamah is an academic and researcher in the field of Environmental Engineering, with a specific focus on the removal of emerging contaminants. His outstanding research contributions in this domain have earned him significant recognition at the University of Babylon, primarily demonstrated through his numerous scholarly publications.

In addition to his research, he has served as a peer reviewer for several prestigious journals. To date, he has authored more than 40 academic papers. He is currently affiliated with the University of Pannonia, where he continues to advance his expertise and research in Environmental Engineering.



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INNOVATIVE ADSORBENT FOR ECO-FRIENDLY TREATMENT OF OLIVE MILL WASTEWATER

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²National Center for Research and Studies on Water and Energy, Cadi Ayyad University, Marrakech, Morocco.

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*This study explores the possibility of using olive mill waste to remove phenol from aqueous effluents. The removal of phenol was investigated in both batch and continuous processes. This study presents an innovative approach to synthesizing nanoparticles and their application in environmental remediation. Copper oxide (CuO) nanoparticles were synthesized using the supernatant from *Chlorococcum* sp. microalgal cell lysate (microalgal CLS). These CuO nanoparticles were then cross-linked with sodium alginate (SA) to form CuO-SA beads. The properties of the CuO-SA beads were evaluated using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD). Batch and fixed-bed column adsorption tests for phenol were conducted to assess the sorption capacity of the CuO-SA beads. The findings indicated that the CuO-SA beads had a phenol adsorption capacity of 314 mg g⁻¹, achieved with an initial phenol concentration of 4000 mg L⁻¹.*

Keywords: Adsorption; CuO nanoparticles; phenol; olive mill wastewater.

Acknowledgments: This research was supported by the Morocco-Tunisian bilateral scientific cooperation, project “DEPHI” (ID: 20/PRD-02) and the National Center for Research and Studies on Water and Energy (CNEREE), Cadi Ayyad University, Morocco.

Biography



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Imane HAYDARI has registered in PhD in 2021 at Faculty of Sciences Semlalia, Cady Ayyad University Marrakech, Morocco. The theme of her work is industrial wastewater treatment and its recovery. Currently she is in internship in Mohammed VI Polytechnic University.



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WASTEWATER RECYCLING FOR IRRIGATION USES IN ARID REGIONS

Mustafa HATHAL, Viola SOMOGYI

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Global water scarcity, particularly in arid regions, presents a substantial challenge to sustainable agriculture. The agricultural sector, as the primary consumer of water in arid places, requires collaborative efforts to explore wastewater recycling and its influencing factors. This study addresses wastewater recycling for irrigation as a strategy to mitigate freshwater use in agriculture under changing climatic conditions in arid regions. The status of water consumption and wastewater reuse in dry zone countries is discussed, utilising the latest of the FAO AquaStat data. Various approaches to wastewater reuse for irrigation purposes, including current practices and proposed improvements, are demonstrated, and the associated needs, standards, processes, and techniques are explained. The findings offer guidance for designing wastewater processes tailored for recycling and reuse in dry environments, providing valuable insights for scientists and engineers based on a comprehensive literature review and FAO database analysis.

Keywords: Water Scarcity, Wastewater Recycling, Irrigation, Arid Regions, WWTP

Biography



Mustafa Hathal PhD student in Chemical Engineering and Material Science Doctoral School/ University of Pannonia, B.Sc. & M.sc Chemical Engineering/ Al-Nahrain University, Iraq, Senior Engineer in Iraqi Ministry of Industry and Mineral. He published more than 20 articles, and participated in more than 25 conferences, Google scholar h index is 7.



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EFFECT OF DEFICIT IRRIGATION ON BARLEY YIELD AND WATER PRODUCTIVITY THROUGH FIELD EXPERIMENT AND MODELING AT KOGA IRRIGATION SCHEME, AMHARA REGION, ETHIOPIA

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¹Assosa University, college of Agriculture, Department of Soil Resource and Watershed Management, Ethiopia,

²Bahir Dar university faculty of civil and Water Resource Engineering, Ethiopia

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The insufficiency of water is the most severe restraint for the expansion of agriculture in arid and semi-arid areas. An important strategy for increasing water productivity and improving water productivity deficit irrigation at different growth stages is important to advance the yield and Water Productivity of barley in water scarce areas. A field experiment was conducted at the Koga irrigation scheme in Ethiopia to examine barley yield response to different irrigation regimes and validate the aqua crop model. The experimental setup comprised six randomized treatments (T) with three replications for one irrigation season because of financial limitations. The irrigation regimes were selected 100%, 75%, and 50% application level in different growth stages of gross irrigation requirement using try and error in order to selecting the optimal water application level. The treatments were: no stress at all (T₁), 25% stressed during all crop stages (T₂), 50% stressed at all stages (T₃), 50% stressed at development stage (T₄), 50% stressed at mid-stage (T₅) and 50% stress at initial and late season (T₆). The agronomic parameters including canopy cover, biomass, and grain yield were collected to compare the ground-based crop yield and the aqua crop model. The results showed that the initial and late stages and stress 25% through the whole season were the right time for practice deficit irrigation without significant yield reduction. The highest (2.62kg/m³) and the lowest (2.03 kg/m³) water productivity were found under T₃ and T₄, respectively. The stress of 50% at the mid-growth stage and 50% of the full irrigation water requirement at all growth stages significantly ($\alpha=5\%$) affected the canopy expansion, biomass and yield production. The aqua Crop model performed well in simulating the yield of barley for most of the treatments ($R^2 = 0.84$ and $RMSE = 0.7 \text{ t ha}^{-1}$).



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Keywords: Aqua Crop, barley, deficit irrigation, irrigation regimes, water productivity,



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A RELATION BETWEEN EXTREME DAILY PRECIPITATION AND EXTREME SHORT-TERM PRECIPITATION

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³Water Management of the Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, The Netherlands

The Royal Netherlands Meteorological Institute (KNMI) published the KNMI'o6 Climate Scenarios in 2006. These scenarios give the possible state of the climate in The Netherlands for the next century. Projections of changes in precipitation were made for a time scale of one day. The urban drainage sector is, however, more interested in projections on shorter time scales. Specifically, time scales of one hour or less. The aim of this research is to provide projections of precipitation at these shorter time scales based on the available daily scenarios. This involves an analysis of climate variables and their relations to precipitation at different time scales. Because of this analysis, one can determine a numeric factor to translate daily projections into shorter time scale projections. Eventually, this synthetic data can be used as an input for an urban drainage model. With such a drainage model and synthetic data for design storms the effects of climate change on the systems' performance can be assessed and the efficiency of adaptive measures can be investigated.

Keywords: correlation, extreme, precipitation, ratio, urban, variables

Biography





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Eng. Yanina L. Romero has a MSc from Water Management at Delft University of Technology, The Netherlands. She is published in Climatic Change which has had numerous worldwide citations. Ms. Romero has worked as a software consultant, AutoCad drafter, advisor at diverse engineering firms and as a wastewater policy worker. She has reviewed papers for diverse journals including Theoretical and Applied Climatology. She currently attends online conferences and won the award for best young researcher at the 12th ICEEE conference. Ms. Romero resides with her husband in The Netherlands.



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URBAN WATER SUPPLY SYSTEM PERFORMANCE ASSESSMENT: THE CASE OF ALEM GENA TOWN

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Intermittent water distribution is the key problems of many water authorities in developing countries including Ethiopia. Water demand has been increasing significantly in most cities due to population growth and other factors. As a result, town water utilities are struggling to provide customers with adequate and reliable water supply service despite obstacles which hinder water utilities do not provide the required service. This study assesses the performance of Alem Gena town water supply sub-system based on main performance indicators namely Demand and supply, water loss, water quality, customers satisfaction and operation and maintenance. These indicators have been cited as the main factors which reflect the performance of many urban water supply systems. High water loss, customer complaints and operation and maintenance problems indicate that there are deficiencies in the quality of the service. To conduct this research, data of water production and consumption, water supply system data were obtained from the water utility records, other data not found in the water utility records is collected using instruments. Hydraulic performance of the system is also evaluated by modeling the system. Water quality tests were conducted and compared with the national and international standards. Household interviews were conducted to understand customers' satisfaction with the water supply. The result shows that water loss is 37.38% higher than the generally accepted value of 25%. There is frequent interruption of boreholes. The water quality test shows some parameters departed from the standard set on the Ethiopian and WHO water quality guidelines. In addition, there is customers' complaints about continuous access of water. The operation and maintenance in the town is identified to be poor. In conclusion, the town's water supply system is poor in managing water loss, water quality, operation and maintenance with the worst condition of continuous generation of water from sources continuously without interruption. It is recommended that the water utility develop a strategy and work hard on the indicated system deficiencies especially on operation and maintenance to improve the water supply system performance and provide customers with good quality service.



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Keywords: *water loss, operation and maintenance, hydraulic water CAD modelling, Oromia region, Ethiopia*

Biography



He is senior researcher, and he has PhD degree

Awards & Honours:

- Copyright – Engineering Surveying Software, Computer Program (2022), Ethiopian Intellectual Property Authority: EIPA
- Copyright – ExpressAfrica, Computer Program (2019), Ethiopian Intellectual Property Authority: EIPA

Ongoing Research/ project

- “Project performance assessment of Ethiopian electric Power”
- “Machine Learning approach to predict inflow to reservoir, G. Gibe III hydropower”

Publications/some

“Kefyalew L. Urban water supply system performance assessment: The case of Alem Gena town. National Digital Repository of Ethiopia (NADRE); 2018. DOI: 10.13140/RG.2.2.11851.82721

“Kefyalew, L., & Mengiste, Y. (2023, September). A review on artificial intelligence-based models to forecast factors affecting the availability of water in the reservoir. Global Scientific Journal. October 3, 2023. DOI: 10.13140/RG.2.2.22533.32484 <https://shorturl.at/vwPT6>



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EFFECT OF MIXING ENERGY ON VARIOUS FRESHLY DEVELOPED MICROCARRIERS

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In the development of biological wastewater cleaning moving bed biofilm reactors (MBBR) are one of the most efficient ways to remove pollutants from water. To have MBBR cleaning technology a biofilm carrying media required. Their key parameter is specific surface area (SSA), which is the available space for biofilm to develop colonies. The colonization rate and speed depend on many factors, such as microorganism type, nutrient forms and availability, temperature and flow velocity around the media. Traditional carriers have a massive, rigid construct, which is durable in almost any mixing condition applied in wastewater cleaning, however significantly smaller microcarriers are a different topic.

With laboratory scale experiments we measured different types of carriers under various mixing conditions to analyze if there is any harm to the structure of the media. We also studied hydrogels freshly after production and hydrogels that have been in use to determine if any activities change their size range. Calculations to determine the flow speeds around the carrier can predict their ability to be colonized by various types of microorganisms. In conclusion, all types of media can endure heavy mixing in laboratory scale, however freshly produced media shows a small degradation in diameter, which can be caused by sticking together during production.

Keywords: Biofilm, heterotroph/autotroph microorganisms, mixing energy

Biography



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My name is Tamás Kloknicher and I finished my bachelor in 2020 at Óbuda University, as an environmental engineer. My topic was freshwater qualification via macroinvertebrates. Next, I went to University of Debrecen to study Hydrobiology, and I continued my work field, to better understand the biological quantification system, and develop my knowledge in monitoring the urbanization effect on macroinvertebrates. During my studies I worked at Inno-Water Zrt, which is a R+D and consulting company on the fields of freshwater, wastewater. Now I'm on my PhD studies at Óbuda University, material sciences doctoral school. My work is about this new MICROBI technology, and to develop special kinetics for MBBR type systems.



Dániel Sándor Benjamin has a master's degree in environmental engineering since 2007 at Budapest University of Technology and Economics. He is also a professional engineer in the fields of water resource and sewage management (2012) at Budapest University of Technology and Economics. He has been working as an R&D CEO of Inno-Water Zrt since 2016.



Dr. Anita Szabó has more than 20 years of experience in the protection of environment and water quality. Her main research areas are urban water management, chemical and biological wastewater treatment, drinking water treatment technologies and protection of surface waters. As an expert and researcher of Inno-Water Inc., and previously as a member of the BME Department of Water Utility and Environmental Engineering research team, and by the Water Management Research Group of the Hungarian Academy of Sciences, she has previously worked on several research and environmental-technical consulting projects on the following topics: technologic and economic evaluation and development of drinking water-, industrial water- and wastewater treatment technologies, environmental impact assessments, pollutant emission impact assessment, investigation of water quality changes in pipelines (drinking water, industrial water supply, sewerage networks), water management and water quality surveys of surface waters, preparation of wetland rehabilitation projects. She was involved in several consulting and research projects in intensification of wastewater treatment technologies.



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PREDICTION OF THE PIEZOMETRIC LEVEL IN THE EASTERN MITIDJA PLAIN USING DEEP LEARNING MODEL - APPLICATION OF THE LONG-SHORT TERM MEMORY MODEL

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The prediction of the piezometric level of aquifers presents a great challenge for the preservation of these aquifers. In this work, we used a new method for predicting the piezometric level by applying the Deep learning approach. The LSTM (Long-Short Term Memory) model was proposed, tested and evaluated in seven areas of the Eastern Mitidja alluvial aquifer (northern Algeria) using data over a period of 10 years (2005-2015). The proposed model uses five (05) variables, composed of the approach of incoming volumes and outgoing volumes in the hydrological cycle (evaporation, precipitation, infiltration and temperature) and time as input data to predict the piezometric level of the aquifer. A standardization method was used to preprocess the data to obtain data at the same scale. 14 years of data are separated into two sets: the training set (2005-2013) and the validation set (2013-2015) in the experiment. As expected, the proposed model obtains very acceptable R^2 scores (0.937 to 0.994) in predicting the piezometric depth of the Eastern Mitidja alluvial aquifer, compared to the actual measurements, which proves that the proposed model can preserve and learn the previous data. In addition, the validity of the proposed Dropout method and model architecture are discussed. Through the experiment, the results show that the dropout method can prevent overfitting significantly, prove that the proposed model architecture is reasonable and can contribute to improving the data quality. Thus, it can be concluded that this proposed model can serve as an alternative approach, method



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and model to predict the piezometric level, especially in areas where hydrogeological data are difficult to obtain.

Keywords: Mitidja East, aquifer, piezometric level, LSTM (Long-Short Term Memory) model prediction, calibration, validation.



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Sessions (E and F)
**E. Sustainability of Circular (Bio)Economy
Strategy of Recycling, & Energy
And
F. Air Pollution & Ecosystems & Landscape**



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CLIMATE CHANGE SIMULATION: UTILIZING REMOTE SENSING AS AN EFFECTIVE TOOL

Karim ENNOURI

University of Sfax, Sfax, Tunisia

The swift progress in remote sensing technologies has rendered satellites crucial for various monitoring and mapping activities. The unique capability of polar-orbiting satellites to repeatedly observe the same geographical locations ensures continuous surveillance over long periods. This persistent observation is vital for recognizing, analysing, and regularly assessing land-based occurrences globally, which is essential for fields focused on risk assessment and climate change. The recent surge in interest in examining alterations through satellite images of identical sites captured at different times is noteworthy. This increasing curiosity stems from multiple sources. Numerous satellites are presently orbiting Earth, each outfitted with diverse sensing technologies, such as optical and synthetic aperture radar, delivering an array of geometric, spectral, and radiometric resolutions. Additionally, extensive climate models, which integrate various simulation approaches and emission scenarios, project forthcoming weather trends. These predictions are meticulously refined for more localized regions through both statistical and dynamic downscaling methodologies. A more profound comprehension of projected regional climate conditions would greatly assist researchers and policymakers, impacting their strategic choices. The enhancement of remote sensing methods for detecting changes will bolster our understanding of Earth's dynamics and the possible repercussions of climate change across different scales. The emergence of satellites featuring advanced sensors has revolutionized our ability to observe the planet's surface. These satellites, orbiting the poles, provide continuous visibility of Earth, enabling the monitoring of environmental shifts with unmatched accuracy. As a result, satellite imagery has become a crucial instrument in the ongoing assessment of surface processes, playing a key role in risk evaluation and investigating the impacts of climate change. The increasing interest in detecting changes through time-lapse satellite imagery underscores the growing importance of this technology.

Keywords: remote sensing, climate change, satellite



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THE FIGHT FOR COEXISTENCE IN THE HARSH AFROALPINE ECOSYSTEM: DIETARY NICHE PARTITIONING BETWEEN TWO SYMPATRIC RODENT SPECIES IN THE GUASSA MENZ COMMUNITY CONSERVATION AREA, ETHIOPIA

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*Unraveling the modes operandi of species coexistence in communities is a central theme in ecology. To this end, understanding the resource partitioning and diet of sympatric species is vital for conservation and management of biodiversity. Hitherto the coexistence mechanisms of all the sympatric Rodent species in the Guassa Menz community conservation area in Ethiopia are unknown. From April 2018 to March 2019, a study on the dietary consumption of *Lophuromys flavopunctatus* and *Stenocephalemys griseicauda* each 48 stomachs was conducted in the Guassa menz community conservation area. Rodent trapping was conducted in Shrubland, Festuka grass, and Swamp grass habitats during the dry and the wet seasons. Sherman live traps and snap traps were alternately placed in transect lines for three consecutive nights in each season. We calculated the percentage occurrence, percentage contribution of the dietary items, niche breadth, and niche overlap of the two species across the three habitats and the two seasons. Both species utilized all the examined food items in various frequencies. However, a significant difference was observed in the percentage occurrence of diet among food categories (Kruskal Wallis chi-square = 31.80, $df = 4$, $p < 0.001$). Vegetative plants were the most important food item in the diets of both rodent species across the habitats and between the seasons. Niche breadth differed significantly between seasons ($F = 9.41$, $df = 1$, $p = 0.02$). However, no statistically significant differences were found in niche breadth between species ($F = 1.73$, $df = 1$, $p = 0.23$) and habitats ($F = 1.90$, $df = 2$, $p = 0.22$). Furthermore, there was a significant difference in diet diversity between seasons ($F = 9.49$, $df = 1$, $p = 0.02$). However, no significant differences were observed between species ($F = 1.75$, $df = 1$, $p = 0.23$) and habitats ($F = 1.85$, $df = 2$, $p = 0.23$). There was a considerable niche overlap in diet (ranging from 0.84 to 0.98) between the two rodent species and was relatively higher in the dry season compared with the wet season. Despite the observed niche overlap, resource abundance in the environment, temporal variations in dietary consumption and*



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differential activity pattern between the two sympatric rodent species can serve as a mechanism of resource portioning enabling their sustainable coexistence in this harsh afroalpine ecosystem.

Keywords: Guassa Menz, Sympatric rodents, diet diversity, niche breadth, niche overlap. Seasons, habitats



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IMPACT OF HYDROGEN ENRICHMENT ON FLAME STABILIZATION AND EMISSIONS IN PROPANE-AIR COMBUSTION: A NUMERICAL STUDY

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Laboratory of Energy Mechanics and Conversion Systems, University of Sciences and Technology Houari Boumediene, Bab-Ezzouar, Algeria

Hydrogen (H_2) enrichment of hydrocarbon fuels, such as methane, has gained significant attention due to its potential to improve combustion efficiency and reduce harmful emissions. This study investigates the effects of hydrogen (H_2) addition to a swirling methane-air mixture on flame stabilization and emissions characteristics, specifically carbon monoxide (CO) and nitrogen oxides (NO_x). The simulations are performed using ANSYS-Fluent with a reduced reaction mechanism for propane (CH_4) and the Eddy Dissipation Model (EDM) for turbulent-chemical interaction. The $k-\omega$ Shear Stress Transport (SST) model is employed to accurately capture boundary layer behavior. A steady-state approach is used, with residuals set to 10^{-5} for all equations to ensure high computational precision. The study focuses on how varying levels of hydrogen enrichment (10%-60%) influence flame stability and emissions at a moderate swirl number ($Sn = 0.7s$). The results provide valuable insights into the potential benefits of hydrogen addition in reducing CO and NO_x emissions, while also identifying key factors that affect flame stabilization in premixed turbulent combustion systems.

Keywords: Hydrogen enrichment, Methane-air combustion, Flame stabilization, Emissions reduction
Biography



I am pursuing PhD studies in Numerical combustion.

My area of interest and research is an interdisciplinary study that combines heat transfer, fluid mechanics, mass transfer, chemical reaction, thermofluids, and molecular transport.



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I am currently working on a project that has the ambition to study the effect of hot gases on the stabilization of the premixed flame and reduction of pollutant emissions type NO_x



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EFFECTS OF OZONE LAYER SHORTAGE UPON LIVING BEINGS

Antoine KANTIZA

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Bujumbura, Burundi, E-mail: antoinekantiza@gmail.com

The ozone layer located in stratosphere protects any living beings of the planet Earth against ultraviolet sun radiation which is broken by the thin ozone layer. The ozone layer is not only the shield of living beings including human beings; animals; fishes and plants but also the ozone layer serves as a big tank of oxygen reserve allowing respiration and oxidation needed for bringing natural energy needed for activities of any living beings.

The current research is focused on the findings related to ozone layer depletion, the trend of ozone layer holes and the rational behaviours of human beings for preventing added holes of ozone layer.

Why is the ozone layer shrinking?

First, ozone molecule is in unstable configuration of three atoms of oxygen easily in reaction with many gases of Mendeliev table, available in the atmosphere area including Nitrogen and Hydrogen which transform ozone molecule in dioxide of oxygen.

Secondly, since the industrialisation era, the ozone layer is vulnerable to attacks of chemicals substances driven from the industries producing mostly the chlorofluorocarbons (CFCs) because the CFCs are fragmented in chloride once CFCs are intersected by UV sun radiation in the stratosphere and suddenly, chloride interacts with ozone molecule which is reversed in oxygen.

Why the ozone layer holes are being smaller?

The first hypothesis is that the chemistry reactions of atmospheric elements are done in open process making possible a lot of uncontrolled process, what means that the reverse reactions of big amount of dioxide of oxygen is easily retransformed in ozone whenever concentration of Nitrogen or Hydrogen is falling down what happen when temperatures are increasing, reason why ozone layer holes are smaller in the area of warming zones than in the area of cold zone, The second hypothesis is the outcomes of positive policies of reducing emissions of CFCs in the worldwide under the leadership of the United Nations Environment Program.

What human beings could do to prevent added holes of ozone layer?



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It is evident that ozone layer could be hampered by the misuse of space vehicles or the explosion of satellites inside the stratosphere reason why drivers of satellites have to think twice as soon as their vehicles are around the stratosphere.

Human beings are aware more about the consequences of their daily behaviours upon environment and more specifically on the reduction of ozone layer including the minimization of CFCs emissions; the prohibition of Nitrous oxide and pesticides; the promotion of vehicles with less carbon emission and the use of eco-friendly cleaning.

Conclusion

The major conclusion of the research proves that the ozone layer is vital for living beings on the Earth what the white egg is for the chick meaning that the natural or accidental depletion of ozone layer should endanger the tank of ozone as well as oxygen needed for safeguarding clean environment and the good health of any living beings on the Earth looking like fragile egg nowadays due of the potential use of nuclear vehicles in the stratosphere.

Keywords: not more than 6 words: CFCs; Holes of Ozone Layer; Living Beings; Oxygen; UV Sun Radiation; Stratosphere

Biography



Antoine KANTIZA is a Former Professor of International Relations Policy at the Centre of International Relations of Bujumbura and Journalist-Webmaster and Senior Adviser at the National Radio-Television of Burundi. He is holder of the Post-University Degree in European Studies from the University Catholique of Louvain where he earned the Diploma of Licence in International Relations and a Diploma of Candidate in Economic and Social Sciences.

Antoine KANTIZA is owner of the Diploma of Specialized and Superior Studies in Using Technologies of Information for Communication, Education and Formation.

He is legal representative of the not-for-profit association: "Promotion of Learning and Education in Distance, PLEAD in acronym.

He is holder of many professional qualifications in Intellectual Property Rights, smart Agriculture and Environment.

Antoine KANTIZA is owner of many scientific awards including his nomination of Featured Member of E-agriculture community. He is author of publications of varied topics including environment, intellectual propriety rights, economics and so on. He is Peace Ambassador Certificated from IEP as it is displayed at its online profile at <https://www.linkedin.com/in/antoine-kantiza-44660325>

It is worth quoting the information below:



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Antoine KANTIZA's training in Ecological and Environmental Transformation for Agriculture:

- United Nations Certificate in “**National Adaptation Plans: Building Climate Resilience in Agriculture**” granted by the United Nations Institute of Training and Research on December 19th, 2017.
- Certificate of Achievement in the Course “**Farm Data Management, Sharing and Services for Agriculture Development**” organized by FAO jointly by CTA and PAFO, awarded on November 10th, 2019
- edX Verified Certificate DAT 2001x of “**e-Learning on Digital Agriculture**” organized by WBGx, an online learning initiative of the World Bank Group
- Certificate of completion “**Transforming Agriculture and Food Systems through Data driven Digital Agriculture**” by October 2022 from the World Bank Group
- Certificate of “**Environmental Law Application in Protected Areas**”, delivered by December 2022 after successful exam of MOOC training organized during three months by the Programme on African Protected Areas and Conservation; PAPACO in short and the International Union for the Conservation of Nature, IUCN in acronym

Antoine KANTIZA's relevant Publications in Environment:

- **THE LAND'S DEGRADATION AS COUNTERPART OF TANGANYIKA BLUE ECONOMY**, Available at <http://www.springjournals.net/full-articles/springjournals.net/jarrarticles/index=11kantiza.pdf?view=inline>, accessed on November 21st, 2018
- **THE MYSTERY OF BURNERS OF GICUMBI's MOUNTAINS SOLVED**, Available at <https://www.linkedin.com/pulse/mystery-burners-gicumbi-mountain-solved-antoine-kantiza?articleId=6278516909038280704#comments-6278516909038280704&trk=prof-post>
- **ESSAY OF AN AUTHENTIC INTERNATIONAL CARBON MARKET** Available at <https://ieg.worldbankgroup.org/blog/building-next-generation-carbon-markets-climate-change-mitigation>
- **DIGITALIZATION OF INDIGENOUS KNOWLEDGE IN AFRICAN AGRICULTURE FOR FOSTERING FOOD SECURITY**, Available at <https://www.plan4all.eu/2020/11/covid-19-inspire-hackathon-2020-enters-its-final-stage/>
- **OPTIMIZATION OF AFRICAN LULC DATABASE FOR SUSTAINABLE DEVELOPMENT**, Available at <https://www.IST-Africa.org/Conference2022>
- **ENVIRONMENTAL IMPACTS OF URBANIZATION IN FLOODING ZONES, BURUNDI CASE**, Available at <https://www.researchgate.net/profile/AntoineKantiza>
- **EARTH OBSERVATION INSTITUTIONS SUSTAINING GLOBAL DEVELOPMENT IN AFRICA**, Available at https://bit.ly/JC2021_english, accessed on November 04th, 2021
- **EDUCATED WOMEN ARE EMPOWERED BY ICT DEVICES IN THE VIABLE PRODUCER ORGANIZATIONS**, Available at <http://www.e-agriculture.org/forumtopics/question-4-opens-20-nov>
- **THE EVALUATION OF MOBILE PHONE APPLICATION UPON THE SMALLHOLDER FARMER'S PRODUCTIVITY IN EAST AFRICA**, Available at <http://bit.ly/SwRwwg>, accessed on January 28th, 2012



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INVESTIGATION OF HEAVY METAL CONTAMINATION AT A FORMER CANNERY IN HALÁSZTELEK

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Today, pollution of our environment with heavy metals and other toxic elements is rising. These can enter the soil and, through plants, the food chain and, ultimately, the human body. Soils have limits to their filtering capacity, so it is necessary to know exactly what and how much contamination they contain. If soil becomes excessively contaminated, hazardous substances and heavy metals can accumulate and act as a source of pollution, accumulating in living organisms. The investigations aimed to assess the possible heavy metal contamination in the northern part of the municipality of Halásztelek and to assess the possible risks.

Sampling: The sampling points in the area were selected according to the standard MSZ 21470-1:1998.

The study area: The area investigated was formerly occupied by a canning plant. After its original activity had ceased, barrels and other materials were stored there. The plant was gradually dismantled and finally removed from the site in 2006, with part of the demolition waste buried in the ground. Following landscaping, the area was parcelled out, and several houses have since been built.

Measurements, tests: Measurements and sample preparation were carried out according to the standards MSZ 21470-1:1998, MSZ-08-0205:1978, and MSZ 21470-50:2006. The concentration of eight elements was determined in the samples: iron, manganese, copper, zinc, cadmium, chromium, lead and nickel, and these elements were analysed on a Jobin-Yvon 24 ICP-OES type apparatus; the values obtained were converted to dry matter content and expressed in mg/kg. Digestion was carried out with a Milestone 1200 mega microwave destructor.

Evaluation: For statistical evaluation, a two-factor analysis of variance was performed using SPSS 16.0 for Windows. The results were evaluated, and it was found that the concentration of heavy metals in all samples of the study area did not exceed the limits set in 6/2009 (IV. 14.) KvVM-EüM-FVM joint decree, so the area is not considered contaminated.



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Keywords: ICP, FAAS, heavy metals, pollution

Biography



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ALGORITHMIZATION OF RESEARCH AND SOLVING OPTIMIZATION PROBLEMS

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This study proposes a system approach to solving optimization problems based on algorithmic methods. Theoretical prerequisites and principles for constructing systems for solving classes of optimization problems are developed. Based on the system approach, issues of the internal organization of such systems, functions of individual blocks and modules, end-to-end automation of the process of solving optimization problems from formulation to obtaining numerical results are studied.

Keywords: automation, formalization, algorithms, algorithmization, optimization, system approach,

Biography



Yakubov Sabir Khalmuradovich - Doctor of Technical Sciences, Professor. Head of the Department of the Department of General Technical Disciplines of the Military Aviation Institute of the Republic of Uzbekistan. Author of 7 monographs, 9 textbooks and teaching aids and more than 200 scientific articles. Works were published in the CIS countries, as well as in Germany, Poland, India, Korea. Sphere of scientific (professional) interests: mechanics of deformable solids, materials science and technology of structural materials, automation and control of technological processes and production.



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OPTIMIZING SUBSTRATES FOR ENHANCED SPAWN AND YIELD OF OYSTER MUSHROOM (PLEUROTUS FLORIDA)

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Oyster mushrooms, Pleurotus florida, have a lot of promise for cultivation because of their nutritional content, flexibility, and rising consumer demand. The choice of suitable substrates for spawn growth and fruiting body yield is a critical component affecting its effective production. To determine the ideal circumstances for increased development and productivity, this study assesses the effects of different substrates on spawn generation and mushroom yield. An experiment was conducted in the Department of Plant Pathology, Teerthankar Mahaveer University, Moradabad U.P. in the year 2024. Five substrates, viz., maize grain, wheat grain, pearl millet, pea grain, and sorghum grain, were taken for evaluation to find out the best suitable substrate for spawn production of Pleurotus florida. After the evaluation of the above substrates, it was concluded that pearl millet grain was found to be the best spawn substrate for early spawn run, followed by sorghum grain, wheat grain, pea grain, and maize grain, respectively. Six locally available substrates, such as wheat straw, paddy straw, pea straw, maize straw, sawdust, and wheat straw in combination with paddy straws, were also evaluated for growth and yield parameters for the cultivation of oyster mushrooms. All the substrates were found effective to produce oyster mushrooms. However, the maximum number of fruiting bodies and yield were found in wheat straw, followed by combinations of wheat and paddy straw, paddy straw, sawdust dust, pea straw, and maize straw, respectively.

Keywords: *Pleurotus florida, mycelial growth, spawn production, different substrates*



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LAND USE LAND COVER MAPPING IN BIODIVERSITY HOTSPOTS USING NEURAL-CELLULAR MODELS

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Biodiversity hotspots are critical ecological zones vulnerable to land-use changes due to human activities. This research presents predictive results of Land Use and Land Cover (LULC) mapping across certain biodiversity hotspots using QGIS tool and the MOLUSCE (Modules for Land Use Change Evaluation) plugin. By leveraging neural-cellular models within MOLUSCE, this work integrates machine learning with spatial analysis to enhance the accuracy of predictions on land-use shifts. Multiple parameters, including Slope, Roughness, and Topographic Position Index (TPI), etc. are used to improve the precision of land cover predictions.

Initial results demonstrate significant accuracy in LULC classification and reveal distinct patterns in land-use transitions. Additionally, this hybrid model enables mapping and forecasting, allowing stakeholders to make informed conservation decisions and implement sustainable land management strategies to preserve biodiversity in these vital regions.

Keywords: Land Use and Land Cover (LULC) prediction – QGIS - (Modules for Land Use Change Evaluation) MOLUSCE - biodiversity hotspots – conservation

Biography:



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Jenina Angelin, Final-year BTech student in Artificial Intelligence and Data Science at St. Joseph's College of Engineering, Chennai, India; Data Engineer Trainee at Zeb (offshore branch), Chennai, India; Passionate about applying AI in environmental sustainability and space exploration.



Pugalenth, Head of Department and Professor, Department of Artificial Intelligence and Data Science, St. Joseph's College of Engineering, Chennai, India; Dr. Pugalenth has authored around 30 research papers in esteemed international journals and conferences, contributing extensively to the fields of artificial intelligence, data science, and machine learning.



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ORGANIC CARBON STORAGE MEASUREMENT OF SUNDARBAN MANGROVE FOREST SOILS OF BANGLADESH

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Background: Soil organic carbon (SOC) storage is a vital ecosystem service, resulting from interactions of ecological processes. Human activities affecting these processes can lead to carbon loss or improved storage. Organic carbon is a key component of soil that affects its physical, chemical, and biological properties, contributing greatly to its proper functioning on which human societies depend.

Objective: To identify the soil organic carbon storage measurement of Sundarban mangrove forest soils of Bangladesh.

Methodology: The composite soil samples were collected about a depth of 0-15 cm, 15-40 cm and 40-100 cm from ten different profiles in Sundarban South and Sundarban East within 1m depth because, worldwide, SOC in the top 1m of soil comprises about 3/4 of the earth's terrestrial carbon. The collected composite soil samples were air dried. Grounded samples were screened to pass through a 2 mm stainless steel sieve then further grounded and screened to pass through a 0.5 mm sieve for SOC analysis.

Findings: The values of SOC and organic matter (OM) ranges from 1.21 to 8.19 % and 2.09 to 14.12 %, respectively, which is higher than the mineral soils of Bangladesh. The concentration of aforementioned fractions ranges from 201.34 to 268.79 $\mu\text{g g}^{-1}$ (~0-2 %), 404.7 to 646.7 $\mu\text{g g}^{-1}$ (1-4 %), 250.2 to 473.3 $\mu\text{g g}^{-1}$ (2-3 %), 616.95 to 1515.37 $\mu\text{g g}^{-1}$ (2-10 %), 265.94 to 604.81 $\mu\text{g g}^{-1}$ (1-4 %), 612.0 to 1629 $\mu\text{g g}^{-1}$ (1-12 %) and 8862.61 to 78048.66 $\mu\text{g g}^{-1}$ (69-95 %), respectively and most fractions decrease from surface to substratum. On the other hand, most soils contain higher C in deeper layers. Soil organic C stock in the ten different locations of Sundarbans mangrove to 1m depth ranges from 16.75 to 135.12 kg C m^{-2} , with an average of 31.80 kg C m^{-2} that needs to include extensive data to get better representation of SOC of Sundarban mangrove forest soils.

Conclusion: The initial study revealed that Sundarbans mangrove forest soils are a good carbon sink and suggests that proper management plans must be taken and implemented in this area to ensure the role of Sundarbans as maximum carbon sink. An appropriate knowledge of the SOC stock measurements will help to increase carbon storage, enhance management practices, grow



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forest, which ultimately improve the forest and human health as well as economic condition of our society. However, limited sample studies have been conducted to assess their roles and potentials in carbon sequestration but destruction of Sundarbans mangrove which hold a significant amount of carbon in Bangladesh contributes significantly to rising atmospheric CO₂ levels and thus accelerates climate change that needs an extensive SOC analysis to estimate its societal benefits.

Keywords: Sundarban Mangrove Forest, Soil Organic Carbon Storage, Climate Change, Ecosystems.

Biography



Dr. Md. Faruque Hossain is currently the Professor of American International University - Bangladesh. Prior to this position, he was a Cropping System Scientist and a Country Manager of the CIMMYT-Mexico-USAID in Bangladesh, an Environmental Program Coordinator of Health Canada, an Environmental Scientist of Natural Resources Canada, a Soil Scientist of Agriculture and Agri-Food Canada, a Research Associate of Rothamsted-Research, UK, Sessional Professor of several Canadian Universities, and Research Fellow of Dhaka University. He has more than thirty-four years of teaching, research and project management experience in environmental and agricultural development in soil, water and plant biomass eco-systems. Much of his experience focused on researching the use of climate change and food security; soil C dynamics and accounting storages; environmental contamination and remediation; nutrient cycling, budgets and management in different farming and cropping systems; soil survey, classification, mapping and reporting to improve the environmental and agricultural production on Canadian and tropical countries ecosystems. He obtained his Doctorate Degree in Soil, Water and Environmental Sciences from Imperial College of Science, Technology and Medicine, University of London, UK under the British Government Scholarship. He also obtained his BSc (Honors) and MSc (Thesis Group) Degree from University of Dhaka (Department of Soil, Water and Environmental Science) in 1987 and 1988, respectively and secured First Class First Position. Prof. Dr. Hossain is a reviewer of minimum twenty-five international refereed journal publications and an internal reviewer at the Natural Resources Canada and National Science Foundation of USA. Dr. Hossain is affiliated with more than seventeen professional organizations in United Kingdom, USA and Canada. Dr. Hossain published more than 120 scientific articles in Elsevier, USA and Canadian journals and written more than 15 books/reports for the various governmental and non-governmental organizations. Dr. Hossain's scientific publication was included four times in the list of Top 25 Hottest Articles within the Journals (Elsevier, Science Direct, Website: <http://top25.sciencedirect.com>. Journal of Field Crops Research, Apr-Jun 2005, 12th place and Journal of Agriculture, Ecosystems and Environment, Oct-Dec 2005, 22nd place; Jan-Mar 2006, 3rd place; Apr-Jun 2006, 18th place; Jul-Sep 2006 20th place. In 2006, Dr. Hossain received Merit Award from Earth Science Sector Natural Resources Canada for exceptional achievement in the Arctic land use change and greenhouse gas monitoring and accounting project. In May 2014, Dr. Hossain received prestigious STEM Gold Medallion by Coppin State University, Baltimore,



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Maryland, USA for the research contribution in 2nd International Symposium on Sustainable Science, Technology, Human Health and Environment for a Global Society and in May 2017, he also received Sher-E-Bangla Shining Personality Award 2017 for significant contribution in higher education of Bangladesh. Dr. Hossain received Best Researcher Award 2019 in Environment Science by World Research Council.
<https://scholar.google.com/citations?hl=en&user=zLpC3WoAAAAJ>;

https://www.researchgate.net/profile/Mf_Hossain

Prof. Dr. MF Hossain's research priorities include: SOC and N Dynamics, Sequestration and Accounting Storages; Climate Change and Food Security; GHGs Emission and Measuring Flux; Nutrient Cycles, Budgets and Management in Different Farming Systems; Nutrient Use Efficiency; Soil Plant Relationship (Growth and Production); Soil and Water Quality; Soil Survey, Mapping, Genesis, Classification and Mineralogy (using TEM, SEM & X-RD); Environmental Chemistry (Organic & Inorganic Pollutants); Contaminated Site Assessment and Remediation; Arsenic Quantification and Remediation; Community Adaptation.



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EVALUATION OF THE PERFORMANCE AND QUALITY OF VETIVER PLANT UNDER THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS (CASE STUDY: SIDE AREA OF SANGAR DAM RESERVOIR – IRAN)

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Following the change of climatic conditions in recent decades and with the intensification of soil erosion and pollution, in many countries of the world, to protect the environment and natural resources, planting a large area of Vetiver plant under the title (soil bioengineering) has been considered. In this research, sampling of Vetiver plant roots and soil from the depth of 0-50 cm on the side of the dam wall with different slopes: the first level (30-40 degrees), the second level (40-50 degrees), The third level (60-70 degrees) was done in four repetitions. A total of 12 soil samples (untouched) and 12 soil samples along with Vetiver plant roots were sampled using a steel ring and 12 Vetiver plant samples. Soil characteristics from soil texture by hydrometric method, soil by weight method, acidity by saturated mud method, electrical conductivity by extraction method and soil salinity by EC meter, percentage of organic matter, lime and soil potassium by using film device. Photometers were measured in the laboratory. The results of this research show that the planting of Vetiver plant in the sloping slopes due to its high adaptability in different climates and conditions, the possibility of several meters of root growth, to stabilize the soil and prevent sliding and erosion in the sloping Lands.

Keywords: Slope, root weight, resistance, shear stress.

Biography



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Dr. Sahel Haghighi is the author of Vetiver book, inventor and researcher who has registered many herbal medicines in the fields of treatment and care. The year 2021, he entered Sari University of Agricultural Sciences and Natural Resources to get a PhD degree in pasture sciences and graduated in the August- year 2024. Currently, he is working as a researcher at the Research and Training National Soil Conservation and Watershed Management Research Institute - Education and Research Organization, Tehran, Iran.



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A TAXONOMICAL PUZZLE: GENUS GAZALINA WALKER

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Lepidoptera comprising of moths, butterflies and skippers is the second largest insect order and provides important model systems for studies on genetics, physiology, development, ecology and evolutionary biology (Mitter et al., 2016). The moths constitute a significant part of biodiversity as they play an important role in ecosystems such as herbivores, pollinators, bio-indicators etc. The subfamily *Lymantriinae* with 2500 known species is one of the most important families of order *Lepidoptera* (Holloway, 1999). This subfamily is composed of seven well defined and distinct tribes namely *Lymantriini* Hampson, *Orgyiini* Wallengren, *Nygmiini* Holloway, *Leucomini* Grote, *Arctornithini* Holloway, *Daplasini* Holloway & Wang and *Locharinini* Holloway & Wang (Wang et al., 2015). The placement of many tussock moth species is still ambiguous in these tribes. Genus *Gazalina* Walker is a taxonomic puzzle and needs attention.

Keywords: Biodiversity; *Gazalina*; *Lymantriinae*; *Notodontidae*; Puzzle; Taxonomy

Biography



Dr. Gagan Preet Kour Bali (Entomologist), Assistant Professor at Department of Biosciences, -UIBT, Chandigarh University has been working on the systematics of *Lepidoptera* especially moths since last 6-7 years from North -West Himalayas India. She has contributed a number of research publications in scientific Journals like *Oriental Insects*. She is associated with *Intech Open* as an author and has contributed three book chapters pertaining to insects (*Decline in Insect Populations*; *Larval Development and Moulting*); *Conservation ecology (Community Conservation)*.



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THE HIDDEN COST OF INTELLIGENCE: AI'S CARBON FOOTPRINT AND STRATEGIC SOLUTIONS

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This study investigates the carbon footprint associated with AI model development and deployment, focusing on the energy consumption of GPUs and computational resources required for large-scale AI training. Using predictive modelling and data-driven analysis, this research highlights the environmental impact of training state-of-the-art models and examine potential strategies for reducing emissions, including energy-efficient algorithms, hardware optimizations, and renewable energy sourcing. The findings underscore the need for sustainable AI practices, as data-driven approaches reveal the significant ecological footprint of current methods. This analysis aims to provide stakeholders, from AI developers to policymakers, with insights into minimizing the environmental cost of AI innovations, encouraging the adoption of green computing techniques, and promoting responsible AI usage in alignment with global sustainability goals.

Keywords: AI carbon footprint, environmental impact, energy efficiency, sustainable AI, green computing, AI emissions

Biography:



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Jenina Angelin, Final-year BTech student in Artificial Intelligence and Data Science at St. Joseph's College of Engineering, Chennai, India; Data Engineer Trainee at Zeb (offshore branch), Chennai, India; Passionate about applying AI in environmental sustainability and space exploration.



Pugalenthiraj, Head of Department and Professor, Department of Artificial Intelligence and Data Science, St. Joseph's College of Engineering, Chennai, India; Dr. Pugalenthiraj has authored around 30 research papers in esteemed international journals and conferences, contributing extensively to the fields of artificial intelligence, data science, and machine learning.



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EVALUATION OF GERMINATION PERFORMANCE IN COMPOST BLENDS OF PÁLINKA DISTILLATION MASH WITH DIVERSE CO-COMPOSTING MATERIALS

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This study evaluates the potential of composted Pálinka distillation mash, an acidic, high-organic by-product, as a sustainable soil amendment. Composting was conducted in breathable drum composters across three batches, each incorporating different co-composting materials to optimize pH, moisture, and nutrient levels. The first batch combined mature cow manure compost with wood chips and Pálinka mash; the second batch included coconut fiber, garden compost, vinasse, and Eisenia fetida (worms). The third batch integrated garden waste, cow manure, chicken manure, and natural white peat with wood chips and mash. Germination tests using lettuce, mustard, wheat, and corn seeds were conducted across soil-compost ratios of 100:0, 50:50, and 0:100. Key growth metrics—germination rate, seedling height, and biomass of above-ground and root components—were analyzed to assess each compost blend's effectiveness. Results demonstrated that blends containing mature cow manure, garden compost, and chicken manure notably improved germination rates and seedling growth by mitigating phytotoxicity and enhancing nutrient availability. The 50:50 soil-compost ratio consistently supported balanced growth conditions across most trials. This research underscores that targeted co-composting strategies can transform Pálinka distillation mash into a viable soil amendment. The findings highlight the advantages of integrating organic additives to advance sustainable waste valorization, aligning with circular economic principles and promoting agricultural sustainability. This approach offers a scalable model for regions facing similar distillery by-product challenges, contributing to improved soil health and sustainable agricultural practices.

The research was supported by the project ‘Preparation for the transition to circular economy in the case of agricultural and green waste’ of Environment and Energy Efficiency Operational



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Programme grant scheme of Ministry of Technology and Industry Hungary under grant no.: KEHOP-3.2.1-15-2021-00037.

Keywords: Pálinka distillation mash, Co-composting, Germination test, Sustainable waste valorization, Soil amendment, Circular economy

Biography



Sustainable Remediation and Valorization of Pálinka Spent Wash: Overcoming Environmental Challenges through Composting in Hungary (2024), ISBN: 978-963-8321-60-2

- *Mitigating environmental risk factors and promoting sustainable agriculture through Pálinka spent wash composting (2023), ISSN 3003-9908.*
- *Effect of Pálinka Mash Compost on Heavy Metal Accumulation by Letuce and Tomato Plants (2022), ISSN 1842-9815*
- *Characterization of different mash composts with culture vessel experiments (2021), ISBN: 9789638221827*



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STUDY OF THE BIOPHYSICAL PROPERTIES OF PLANT, SOIL, AND WATER INTERACTION DURING THE ENTIRE GROWTH CYCLE OF THE SUNFLOWER PLANT

Maamar BOUKABCHA, Khaled EL MILOUDI

Hassiba BEN BOUALI University of Chlef, Chlef, Algeria

The sunflower plant interacts with irrigation water, soil, and air under certain conditions to make the growth and development processes of this type of plant successful. The main objective of this study is to know and estimate the biophysical properties resulting from the interaction between sunflower plants and water, soil, and air. Planting 50 sunflower seeds in 50 small pots at a rate of one seed for each pot inside a plastic house provided with appropriate natural growth conditions, with continuous monitoring and care for them, and constant watering with drinking water coming from the Mediterranean desalination plant in the Chlef region with different concentrations of Sodium chloride. Twelve days after planting, they were transferred to large pots with the same distribution and conditions mentioned above, while continuing to follow a complete growth cycle. The results obtained during the period of the growth cycle of this type of sunflower plant, which exceeded one hundred days, show an increase in the growth rate for the length and diameter of the stem, the area of the leaves, the length and thickness of the roots, and the diameter of the flowers of this plant, in addition to the biophysical characteristics of each of the following: Irrigation water and soil used, taking into account weather changes affecting the growth of this plant during the study period. Growing sunflower plants requires us to provide the appropriate and necessary natural and environmental conditions to obtain a high-quality yield, whether as food or for other uses required by the modern era and the contemporary international community.

Keywords: sunflower plant, biophysical characteristics, irrigation water, soil, weather changes.

Biography



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Maamar BOUKABCHA studied Radiation Physics at HOUARI BOUMEDIENE University of Science and Technology in Algiers, Algeria. In 1996 began teaching in Physical sciences with all levels of students, from middle school and up to the university, at the level of Chlef region, Algeria. After receiving his Magister degree in Biophysics-Mathematics and simulation in 2010, he was Education Advisor, and after 2012 assistant professor in biophysics at Hassiba Benbouali University of Chlef (HBUC), Algeria.



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COMPARATIVE STUDY OF CELLULOSE MICROFIBERS

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Petro-based polymers are materials derived from non-renewable fossil resources that exhibit good physical properties. However, the high demand for petroleum-derived materials leads to resource depletion and environmental issues. Therefore, it is essential to find environmentally friendly alternatives. Furthermore, researchers have developed bio-based polymers that possess ecological, renewable, and biodegradable properties. Cellulose is the most abundant and renewable biopolymer on the planet. It is the primary target for developing an economically sustainable renewable fuel and bioproducts industry. It is extracted from plant biomass such as alfa and bamboo fibers, and is currently used in various industrial sectors, including food packaging, pharmaceuticals, cosmetics, and paper production. This study focuses on extracting of cellulose microfibrils (CMF) through an alkali treatment followed by a bleaching process. The extracted biopolymers underwent thorough characterization utilizing analytical techniques to determine the most efficient fiber.

Keywords: cellulose microfibrils, biodegradable, ecological, bio-based polymers, petro-based polymers

Biography



Ahmed Ramdani is a doctoral monitor enrolled in the PhD program in 2023 at Faculty of Science, Mohammed First University, Oujda, Morocco. Currently, he is doing an internship in the Materials Science, Energy, and Nano-engineering Department at Mohammed VI Polytechnic University, Morocco.



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GITOLOGY OF TRIASSIC OPHITES-RELATED MINERALIZATIONS OF EASTERN BABORS: A CASE STUDY OF OUALIL OPHITES (JIJEL PROVINCE, NORTHEASTERN ALGERIA)

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Despite their abundance and despite that most of them are mineralized, very few studies have been carried out on ophites packed in the Triassic mixture of eastern Babors and their related mineralizations. We hereby present the results of a study on ophites-related mineralizations of eastern Babors, taking those from Oualil region as a case study.

The Oualil region is located southwest of Jijel province in northeastern Algeria. This area belongs to the Erraguene unit of eastern Babors, which is part of the Tellian domain of the alpine chain of northern Algeria.

The Oualil ophites are packed in the Triassic mixture related to the NE-SW trending fault in the eastern part of Erraguene basin. This Triassic mixture consists mainly of marls that contain bipyramidal quartz crystals, large masses of cargneules and ophite blocks. The Triassic formations of the Oualil region are in contact with the Upper Cretaceous formations that fill the Erraguene basin. These formations are represented by marls, limestones and marly limestones.

The Oualil ophites are granular melanocratic rocks. They host an Fe-Ti mineralization represented mainly by ilmenite and magnetite with minor pyrite and rare chalcopyrite. Ilmenite is characterized by its strong anisotropy that allows its distinction from magnetite. It occurs mainly as large millimetric crystals of different shapes that are disseminated within the host rock. Magnetite occurs as subhedral to anhedral disseminated crystals. Pyrite occurs as disseminated grains within the host ophite. It can also be found as inclusion within oxides. Chalcopyrite is found as micrometric crystals disseminated in the rock or as inclusions within pyrite grains. The mineralization exhibits disseminated texture.



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The ophites packed in the Triassic mixture of eastern Babors are mineralized, of which those of the Oualil region represent a typical example. These ophites require further studies in terms of petrography, geochemistry and geology of their related mineralizations.

Keywords: Fe-Ti mineralization, ilmenite, magnetite, disseminated texture, Triassic mixture, Tellian domain.

Biography

Zoubir Belhimer is a Ph.D. student in geology (mineral resources, geomaterials and environment) at the Faculty of Natural and Life Sciences of Mohamed Seddik Benyahia University of Jijel, Algeria. Zoubir Belhimer is a Ph.D. student in geology (mineral resources, geomaterials and environment) at the Faculty of Natural and Life Sciences of Mohamed Seddik Benyahia University of Jijel, Algeria.



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DEVELOPMENT OF ZNO/TIO₂ INVERSE OPAL NANOSTRUCTURED GAS SENSORS ON CHIP SUBSTRATES FOR ENHANCED DETECTION OF NO₂, CO₂, AND NH₃

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The study aims to develop a high-performance gas sensor using ZnO/TiO₂ inverse opal structures on gas sensor chips with gold electrodes. The fabrication process begins with the deposition of a sacrificial polystyrene (PS) template on the chip surface. Atomic layer deposition (ALD) will then be employed to coat the template with sequential layers of ZnO and TiO₂. The PS template will be removed through thermal treatment, creating a porous inverse opal structure. To enhance the active surface area and gas sensing properties, ZnO nanorods will be grown hydrothermally on the inverse opal surface. The resulting sensor will be characterized using scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS) to analyze the morphology and composition, X-ray diffraction (XRD) to assess crystallinity, Raman spectroscopy to identify structural phases, UV-Vis spectroscopy to determine optical properties, and photoluminescence (PL) to study defect states. The gas sensing performance of the prepared devices will be evaluated for detecting NO₂, CO₂, and NH₃, focusing on sensitivity, selectivity, and response time. This research aims to advance the development of miniaturized gas sensors with potential applications in environmental monitoring, industrial safety, and air quality control.

Keywords: Opal Nanostructured, Nanorods, Sensor, Chips,



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MATHEMATICAL STUDY OF PLANT GROWTH PHENOMENA: STUDY OF THE SUNFLOWER PLANT GROWTH

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The sunflower plant interacts with irrigation water, soil, and air under certain conditions to make the growth and development processes of this type of plant successful. The main objective of this study is to know and estimate the biophysical properties resulting from the interaction between sunflower plants and water, soil, and air. Planting 50 sunflower seeds in 50 small pots at a rate of one seed for each pot inside a plastic house provided with appropriate natural growth conditions, with continuous monitoring and care for them, and constant watering with drinking water coming from the Mediterranean desalination plant in the Chlef region with different concentrations of Sodium chloride. Twelve days after planting, they were transferred to large pots with the same distribution and conditions mentioned above, while continuing to follow a complete growth cycle. The results obtained during the period of the growth cycle of this type of sunflower plant, which exceeded one hundred days, show an increase in the growth rate for the length and diameter of the stem, the area of the leaves, the length and thickness of the roots, and the diameter of the flowers of this plant, in addition to the biophysical characteristics of each of the following: Irrigation water and soil used, taking into account weather changes affecting the growth of this plant during the study period. Growing sunflower plants requires us to provide the appropriate and necessary natural and environmental conditions to obtain a high-quality yield, whether as food or for other uses required by the modern era and the contemporary international community.

Keywords: sunflower plant, biophysical characteristics, irrigation water, soil, weather changes.

Biography



Maamar BOUKABCHA studied Radiation Physics at HOUARI BOUMEDIENE University of Science and Technology in Algiers, Algeria. In 1996 began teaching in Physical sciences with all levels of students, from middle school and up to the university, at the level of Chlef region, Algeria. After receiving his Magister degree in Biophysics-Mathematics and simulation in 2010, he was Education Advisor, and after 2012 assistant



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Abstracts of Poster Session



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CLIMATE-SPECIFIC FORAGE CROP PLANNING FOR CONTINUOUS FODDER SUPPLY ROUND THE YEAR IN NORTHERN SUBTROPICS OF INDIA

Swati MEHTA, Pankaj DAHIYA, Navjot RANA

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Climate variability significantly affects the availability of forage crops leading to seasonal fodder shortages in the northern subtropical regions of India. This research aimed to develop a climate-specific forage crop planning model for ensuring continuous fodder supply throughout the year. The study focused on identifying appropriate fodder crops for each season, considering local climate conditions, soil types and water availability. The research analyzed meteorological data, crop growth patterns and nutritional content of different forage species integrating these factors into a dynamic crop rotation schedule. The results highlighted the optimal forage crops for different seasons: maize, cowpea, pearl millet and sorghum for the hot summer and monsoon seasons, oats, lucerne, barley and Egyptian clover for the winter season and perennial grasses like Napier and Setaria for year-round production. The inclusion of leguminous crops such as cowpea and lucerne improved soil fertility and fodder quality. Additionally, water-efficient crops were recommended for, and multiple cut practices were suggested to enhance productivity. Significantly higher system productivity was recorded with Multicut Pearl millet + Cowpea – Egyptian Clover + Oats with Root slips of Napier planted in July. The proposed crop plan demonstrated the potential to bridge the fodder gap during lean periods, ensuring a more reliable and nutritious fodder supply. Adoption of this climate-specific approach can significantly reduce dependence on external feed sources, improve livestock health and productivity, and support the economic stability of farmers. Overall, the study emphasizes the importance of strategic forage crop planning aligned with local climatic conditions for sustainable livestock farming in northern subtropical India.

Keywords: Climate variability, Crop rotation, lean period, system productivity and sustainable.



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Biography



Dr. Swati Mehta is presently working as an Assistant Professor in Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab. She has done her Ph.D. from Sher-e-Kashmir University of Agricultural Sciences and Technology - Jammu and qualified National Eligibility Test (NET-ASRB) in Agronomy in 2021. Dr. Swati Mehta has several Research papers, granted patents, book chapters and many popular articles which have been published in various reputed journals and magazines.



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EFFECT OF PHYTOGENIC FEED ADDITIVE BLEND ON HAEMATO- BIOCHEMISTRY INDICES AND CARCASS QUALITY OF BROILER CHICKENS

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Department of Livestock Science and Sustainable Environment, Ogun State, Nigeria

Phytogenic feed additives (PFA) have emerged as alternatives to antibiotics due to increased public and scientific concern regarding residual effects on birds, drug resistance in human and environmental issues. This study investigated the combined effect of these phytogenic feed additives (Lemon peel- LP, Curry leaf- CL, Lemon grass- LG and Orange peel- OP) on haemato-biochemical indices and carcass yield of broiler chickens. Two hundred (200) ARBOR ACRE broiler chicken were used in each experiment. Birds were allotted into 5 treatments (40 birds/treatments) with 4 replicates of 10 birds each using Completely Randomized Design (CRD). Diet supplementation containing T₁ (antibiotics), T₂ (LP: 50.0% + OP: 50.0%), T₃ (LP: 50.0% + LG: 50.0%), T₄ (LP: 50.0% + CL: 50.0%), T₅ (OP: 50.0% + LG: 50.0%) for experiment one and T₁ (antibiotics), T₂ (LP: 35.0% + OP: 30.5% + LG: 22.5% + CL: 12.0%), T₃ (LP: 32.5% + OP: 33.0% + LG: 23.5% + CL: 11.0%), T₄ (LP: 30.0% + OP: 35.5% + LG: 24.5% + CL: 10.0%), T₅ (LP: 27.5% + OP: 38.0% + LG: 25.5% + CL: 9.0%) for experiment two, were added to the feed. In both experiments, haemato-biochemical indices and carcass quality of the chicken were evaluated at 42 days of age. Data obtained was subjected to one-way Analysis of Variance. Result showed that packed cell volume (PCV), haemoglobin (Hb), white blood cell (WBC), heterophils (Het), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and platelet (PLAT) revealed were significantly ($p < 0.05$) influenced by phytogenic blends and control. Serum biochemical indices showed that total protein (TP), albumin (ALB), creatinine, uric acid, alkaline phosphate (ALP), superoxide dismutase (SOD), glutathione (GSH) and creatine kinase (CK) were not significantly ($p > 0.05$) influenced by the addition of phytogenic feed additives blends. Experiment two showed that heterophils and mean corpuscular haemoglobin concentration which were not significantly ($p > 0.05$) influenced by the addition of phytogenic additives blends in the diet. Serum biochemistry showed that parameters measured were significantly ($p < 0.05$) influenced by the addition of phytogenic feed additives except superoxide Dismutase. Antibiotics and phytogenic feed additives did not have any significant effect ($p > 0.05$) on the carcass weight, cut part yield and internal



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organs weight for both experiments. The study concluded that Phytogenic blend (lemon peel, orange peel, lemon grass and curry leaves) at varying supplementation in the diet used in this study could be incorporated into commercial broiler production to improve their health status.



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STUDY ON MANAGEMENT OF ARSENIC-LADEN SPENT SLUDGE FROM ELECTROCOAGULATION TREATMENT

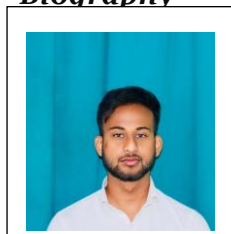
Kashif Raza SIDDIQUE

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This study examines the management of arsenic-laden sludge produced during water treatment processes, specifically from electrocoagulation, to mitigate environmental hazards and explore potential reuse. Electrocoagulation with aluminum hydroxide is highlighted as an effective method for arsenic removal, though disposal of the resulting sludge poses contamination risks. The study explores methods for extracting and repurposing arsenic, emphasizing alkaline pressure oxidative leaching (APOL) to separate arsenic from the sludge. Through experimental optimization of APOL parameters (NaOH concentration, oxygen pressure, temperature, and leaching time), arsenic is efficiently recovered, minimizing environmental impact. This report also proposes the potential re-utilization of arsenic in medical treatments and repurposing residual sludge in construction materials to immobilize arsenic, thereby reducing leaching risks.

Keywords: Arsenic Laden adsorbent, Water Treatment, APOL, Arsenic, Electrocoagulation, Arsenic toxicity

Biography



Kashif Raza Siddique is a dedicated biotechnology undergraduate at Abdul Kalam Technical University, India, specializing in bioinformatics, immunology, and nanotechnology. With extensive research experience, Kashif has held various internships focusing on bioinformatics and machine learning applications in healthcare, particularly in disease prediction and antimicrobial studies. His current projects include developing machine learning models to predict patient SOFA scores, exploring gut microbiome interactions with serotonin, and investigating the antimicrobial properties of natural compounds against drug-resistant pathogens. Kashif has contributed to multiple scientific studies and reviews, such as the potential of *Thymus vulgaris* compounds for MDR-TB treatment and



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bioinformatics analyses of H. pylori flagellar proteins. His technical expertise spans molecular docking, genomic analysis, and various laboratory techniques, further supported by skills in software like AutoDock, PyRx, and SPSS. Alongside research, Kashif is actively engaged in academic conferences, workshops, and cybersecurity seminars, showcasing his dedication to the intersection of biotechnology, AI, and computational modelling.



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ASSESSMENT OF PHENOLOGICAL DEVELOPMENT OF WHEAT CROP UNDER VARYING SOWING DATES IN THE TRANSGANGETIC REGION OF INDIAN SUBCONTINENT

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A crop's planting time can affect weather conditions during its whole growth and phasic stages since varied sowing times result in varying weather circumstances. A wheat crop's phenology is greatly impacted by the interplay between wheat genotypes and sowing timings. Because varied crop sowing times result in varying weather conditions, the timing of a crop's planting can affect the weather during all of its phases and growth stages. The relationship between sowing periods and wheat genotypes has a major impact on the phenology of the wheat crop. Wheat phenological events were tracked at 2- to 3-day intervals, and the results showed notable variations between the two cropping seasons depending on the types and dates of sowing. Following those sown in the second and final weeks of November (D₂ and D₃), the crop sown in the final week of October (D₁) came up the fastest. The crop that was planted in the final week of December (D₄), on the other hand, took the longest to sprout. Later planting dates resulted in a shorter reproductive phase duration. Key reproductive stages, including as anthesis, milking, and physiological maturity, were reached in a comparable amount of time throughout the 2020–21 season. Under comparable conditions, the crop that was sown in late October (D₁) took roughly 154 days to mature in the first season and 151 days in the second. Differences across varieties were also noteworthy. HD 2967 (V₂) took the longest to emerge and mature in both seasons, whereas HD 3086 (V₃) appeared first and matured more quickly than the other kinds. These results highlight how wheat phenology is influenced by varietal selection and planting dates.

Keywords: Climate variability, wheat, phenology, sowing window

Biography



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Dr. Pankaj Dahiya is presently working as an Assistant Professor in Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab. He has done his Ph.D. from CCS Haryana Agricultural University- Haryana and qualified National Eligibility Test (NET-ASRB) in Agricultural Meteorology in 2019. Dr. Pankaj Dahiya has several Research papers, book chapters and many popular articles which have been published in various reputed journals and magazines.



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ASSESSMENT OF THE IMPACT OF BACILLUS MONOCULTURE FERMENTATION ON TANNIN, PHENOL, FLAVONOID CONTENT, AND PHARMACOLOGICAL PROPERTIES (ANTIMICROBIAL, ANTIOXIDANT AND CYTOTOXICITY) OF PTEROCARPUS MARSUPIUM LEAVES: A COMPARATIVE STUDY

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The red-listed plant species Pterocarpus marsupium has been traditionally used in Ayurvedic medicine for its various pharmacological properties. However, the concept fermented traditional medicine for this plant is not well established. Thus, this study aims to assess the impact of Bacillus monoculture fermentation on the phytochemical and pharmacological properties of Pterocarpus marsupium.

Methodology involved the fermentation of Pterocarpus marsupium leaves using Bacillus species isolated from Juju Dhau. Phytoextracts from both the fermented and unfermented dried leaves of P. marsupium were isolated using soxhlet extraction using methanol as a solvent. Total flavonoid content, total phenolic content, total tannin content, and total carbohydrate content were determined using standard protocols and compared. Additionally, the pharmacological properties of antimicrobial, antioxidant, and cytotoxicity were compared between the two groups. The results reveal intriguing disparities between the two groups, revealing significant changes in their biochemical and pharmacological properties. Fermentation led to a substantial decrease in total carbohydrates (from 101.02 mg GE/g to 17.79 mg GE/g) and a decrease in total phenols (from 81.363 mg GAE/g to 38.623 mg GAE/g), tannins (from 39.701 mg tannic acid/g to 13.207 mg tannic acid/g), and flavonoids (from 13.89 mg QE/g to 7.542 mg QE/g). The fermented samples exhibited decreased antioxidant capacity, with a IC₅₀ value of 15160 µg/ml, compared to 1376.632 µg/ml for the unfermented samples. However, both fermented and unfermented samples showed no antimicrobial activity, and cytotoxicity



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assessments yielded similar results for both groups. These findings suggest that fermentation decreases flavonoid, tannin, and phenol content in Pterocarpus marsupium leaves, highlighting their intricate nature of plant-fermentation interactions, where the synthesis and degradation of compounds are influenced by microbial activity. By utilizing this capacity of microbes, certain compounds can be decreased and increased based on the nature of microbes. Hence, further exploration on suitable fermentation process is still in need for harnessing the therapeutic potential of this revered plant as the anticipated improvements in overall pharmacological properties were not realized by this study.

Keywords: *Ethno pharmacology, Pterocarpus marsupium, Fermented Traditional Medicine, cytotoxicity.*

Biography



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RENEWABLE ENERGY FROM A PHYSICS AND BIOTECHNOLOGY PERSPECTIVE: ADVANCES IN SOLAR, WIND, AND BIOENERGY SYSTEMS

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As communities look for sustainable solutions to deal with issues like climate change, energy security, and the environment, the demand for renewable energy is growing globally. The creation and optimization of bioenergy, solar, and wind energy systems are the main topics of this review, which examines advances in renewable energy from the combined viewpoints of physics and biology. In the field of bioenergy, physics helps to understand thermodynamic efficiency and scale production processes, while biotechnology has produced advances in microbial fuel cells, enzymatic biofuel synthesis, and genetic engineering to increase biofuel yield. Advances in semiconductor physics continue to support solar energy research, resulting in improved material properties, increased photovoltaic (PV) efficiency, and solar harvesting uses of nanotechnology. Complementary pathways to energy capture are provided by advances in biotechnological applications, such as photosynthetic organisms designed to create hydrogen. Aside from biotechnological insights into bioinspired designs that increase system performance, wind energy technology has witnessed significant advancements in physics-driven aerodynamic design, turbine materials, and energy conversion efficiency. This analysis demonstrates how interdisciplinary approaches can produce creative solutions for renewable energy systems that are both efficient and environmentally beneficial by fusing concepts from biology and physics. A viable route to a robust and sustainable energy future is provided by the combination of biotechnological developments with physics-based optimization in these systems.

Keywords: Renewable Energy, Bioenergy, Photovoltaics, Wind Turbines, Biotechnology, Physics



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HYDROCHEMICAL EVOLUTION OF GROUNDWATER IN THE REMILA PLAIN, NORTHEAST KHENCHELA, ALGERIA

Abderrahim BEZAI¹, Nafaa BRINIS¹, Azzeddine REGHAIS², Samir DJENBA¹,
Fares BOUKHENISSA¹

¹Mobilization and Water resources management Laboratory (MGRE), STU, Batna 2 university, Algeria

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The Remila plain, located to the northeast of the Khenchela wilaya in eastern Algeria, is a semi-arid zone. It covers 250 km² in a Mio-Plio-Quaternary filled synclinal basin. Its agricultural vocation has led to the development of a vast irrigation perimeter, mainly using groundwater from a battery of wells tapping the Mio-Plio-Quaternary aquifer.

The aim of this research is to monitor groundwater chemistry, with the results of chemical analyses of around thirty samples indicating that it is influenced by the dissolution of evaporitic and carbonate rocks, on the one hand, and contamination by saltwater from the Sabkha of Gareat and Tarf to the northeast, on the other. Mineralization values evolve in the direction of flow, are low, not exceeding 1000 $\mu\text{S}/\text{Cm}$ in the feeder zones, and can reach a maximum value of 2700 $\mu\text{S}/\text{Cm}$ at the outlet. These results were also used to draw up diagrams coupling the log of the concentration factor (CF) and the log of the moles of the major elements. This enabled us to highlight the evolution of these ions with overall mineralization and were then processed by the "Phreeci 2.8" thermodynamic software in terms of salt/solution equilibrium and simulation of the concentration of major ions under the effect of evaporation to get an idea of the state (saturation-sursaturation-equilibrium) of dissolved minerals in the waters studied.

Keywords: Remila plain, hydrogeochemistry, alluvial aquifer, mineralization, concentration factor, saturation index.



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THE SOIL IS RICH, THEN SO IS THE NATION: A FARMER IS A MAGICIAN WHO PRODUCES MONEY FROM THE MUD?

Olha. A. KHLIESTOVA^{1,2}, Katarzyna Ewa ŁOŚ², Bhanu Singh PANWAR³

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Soil is not only mother for the ecosystem, but it is real means of MOTHER for all organisms for their survival. Just a moment thinks out of soil. We will fell our existence is nothing means the end.

It is great to hear from soil lovers that we should take initiative to protect the soil communities and even through different ways we can welcome back to the migrated microbial communities in the soil for their health. Our aim is to introduce the new remedy-based projects for the farming communities. We must attract and engage the youth interest in agriculture for sustainable development, otherwise no one will leave for the agriculture innovation, on all living and non-living are based.

Population will keep growing, but soil productivity will help determine how much food and fibre can be provided for the world's increasing population of humans.

Some soils are naturally productive, others are not, some respond to cultural soil management practices and can be made more productive. Others will not respond, and it could be best to be left in their natural state. In any case, however, without proper knowledge of your soil nature, properties and management, it is not possible to predict or dictate your soil health or to know how your soil should be managed and conserved.

Research is demonstrating that proper soil management is a critical factor in agricultural productions, not only in underpinning good crop yields but also in sustaining long term productivity. The future of our planet is in our hands, and it is up to each and every one of us to take action to protect it. Let us remember that the choices we make today will have a lasting impact on the world we leave for future generation.



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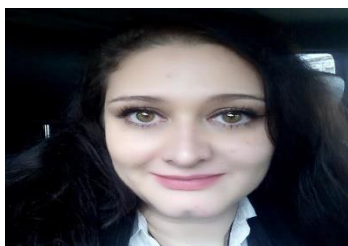
We, proudly say, who loves soils, nature, plants, birds, animals, agriculture, but we feel bad and defeated when realized "what we do to our soils". Yes, our duty is to fix it, but how can our leaders be so irresponsible as to contaminate good soil to pub of pollution. War all over world enriching chemicals, heavy metals and arms wastes in soil bodies. And then ask us what do you think? We just do not understand their egoism??

Keywords: soil. fertility, productivity, farmer

Biography



Olha. A. KHLIESTOVA



Katarzyna Ewa Łoś



B.S. PANWAR



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EVALUATING THE INFLUENCE OF CONSERVATION AND CONVENTIONAL TILLAGE REGIMES ON SOIL QUALITY DYNAMICS IN COTTON AGROECOSYSTEMS

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The research was conducted during year 2021-22 at the Research Farm of the Department of Soil Science, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experimental problem on impact of conservation (CNS) and conventional (CNV) tillage on soil quality in cotton cultivation. The field experiment encompassed two tillage systems, each with eight nutrient management strategies. CNS involved minimal disturbance with one harrowing and two hand weeding, while CNV employed more intensive practices, including biennial ploughing, annual harrowing, two hoeings, and two hand weeding. The nutrient management treatments varied from a control to 100% recommended dose of fertilizers (RDF), combining chemical fertilizers with organic amendments. Specifically, 50% of nitrogen was derived from organics (FYM, wheat straw (WS), green leaf manure (GLM), cotton straw (CS), vermicompost (VC), and 100% of phosphorus was supplied through phosphocompost (PHC), with the remaining nitrogen delivered via chemical fertilizers. Soil samples were collected at the experiment's onset and post-harvest to evaluate chemical properties. The results highlighted that integrating organic amendments like FYM, GLM, VC, and PHC with chemical fertilizers significantly improved soil organic carbon, available sulfur, and micronutrients such as zinc and iron under conservation tillage. Conversely, available phosphorus, potassium, and micronutrients like copper and manganese exhibited negligible changes. These findings underscore the benefits of incorporating PHC, FYM, and VC alongside RDF under conservation tillage to enhance soil health and maximize cotton yield in Vertisols.



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THE EFFECT OF CHAMOMILE ESSENTIAL OIL ON BIOFILM PRODUCTION IN PSEUDOMONAS AERUGINOSA

Samaneh ANSARINIA

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Background and Objectives: *Pseudomonas aeruginosa* is an important opportunistic pathogen. The mucoid strains of *P. aeruginosa* produce hyperviscous substances consisting mainly of alginate which have important roles in formation of BIOFILM. We investigated the effect of essential oil of *MATRICARIA CHAMOMILLA L.* on BIOFILM production in *P. aeruginosa*. *Material and Methods:* *P. aeruginosa* 8821M was used as standard strain for BIOFILM production. Antibacterial effects of essential oil of *M. chamomilla L.* (50% in DMSO) were tested by disk diffusion method. The effect of essential oil on BIOFILM formation of *P. aeruginosa* 8821M was evaluated following inoculation of bacteria in LB broth medium containing 0.5, 0.35 and 0.2 mg/ml of oil which were incubated for 24h at 37°C. The BIOFILM formation was measured by Fonseca method. Bacteria inoculated and uninoculated media without oil were used as positive and negative controls, respectively. *Results:* The results showed that the essential oil did not have any antibacterial effect or reduction in BIOFILM formation in the presence of 0.35 and 0.2 mg/ml of oil. On the other hand, bacteria BIOFILM formation was significantly reduced in the presence of 0.5 mg/ml of oil in comparison with positive control. *Conclusion:* This research showed that the essential oil of *MATRICARIA CHAMOMILLA L.* had no antibacterial effect, but caused reduced BIOFILM formation in *P. aeruginosa*. BIOFILM formation is an important virulence factor in mucoid strains and our results may suggest the possible use of essential oil in control of infections caused by *P. aeruginosa* or other related infections.

Keywords: *Pseudomonas aeruginosa*, biofilm, chamomile plant

Biography



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Samaneh Ansarinia, a PhD student in microbiology and working in the molecular cellular department of the university and an assistant of the academic staff and working in the private sector of pathobiology testing and interested in industrial and environmental fields and environmental and soil microbiology
"Our land, our future"



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GRAPHICAL, STATISTICAL AND INDEX-BASED TECHNIQUES INTEGRATED FOR IDENTIFYING THE HYDROCHEMICAL FINGERPRINTS AND GROUDWATER QUALITY OF IN SALAH ALGERIAN SAHARA

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Groundwater, a predominant reservoir freshwater, plays a critical role in providing a sustainable potable water and water for agricultural and industry uses in the In Salah desert region of Algeria. This research collected 82 underground water samples from Albian aquifers to assess water quality and identify hydrogeochemical processes influencing mineralization. To achieve this objective, various methods were employed to evaluate water quality based on its intended uses. The drinking water quality index utilized revealed the water potability status, while the indicators of irrigation potability were employed to evaluate its quality for agricultural purposes. The findings of this study revealed that the groundwater quality for consumption fell into four categories: good (2.44%), fair (29.27%), poor (65.85%), and non-potable (2.44%). Concerning agricultural irrigation, the indexical results indicated that 15.85% of the waters exhibited adequate quality, while 84.15% were questionable for irrigation. Calculations based on various corrosion and scaling evaluation indices showed that most wells were prone to corrosion, with a tendency for calcium bicarbonate deposit formation. Furthermore, the hydrochemical study identified three water types: Na-Cl (53.66%), Ca-Mg-Cl (37.80%), and Ca-Cl (8.54%) waters. Analyses of correlation matrices, R-type clustering, factor loadings, Gibbs diagrams, scatterplots, and chloro-alkaline indices highlighted that the chemistry of the Albian groundwater is fundamentally impacted by several processes such as silicate weathering, evaporite dissolution, ionic exchange, and anthropogenic inputs, that played impactful role in the aquifer's water chemistry.

Keywords: Geospatial map, Groundwater composition, Graphical plotting, In Salah Multivariate statistics Water quality evaluation.



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Biography

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AUGMENTING YIELD OF MUNGBEAN (*VIGNA RADIATA*) THROUGH FOLIAR NUTRITION UNDER GUAVA (*Psidium Guajava*) BASED AGRIHORTI SYSTEM

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A field experiment was carried out during the kharif season 2022 at Agroforestry Research farm, Rajiv Gandhi South Campus, Banaras Hindu University, Varanasi (Uttar Pradesh). The trial included 10 treatments; each reproduces three times in a Randomized Block Design. Result revealed that outcomes with characteristics i.e., yield parameters like length of pod (6.9), number of pods per plant (27.33), number of seeds per pod (8.13), 1000 grain weight (40.2 g), grain yield (1358 kg/ha), straw yield (3043 kg/ha), biological yield (4402 kg/ha) and fruit yield (71 kg/ha) showed by the treatment (T₁₀) RDF + Nano urea 4 ml per litre + 0.5% Zn + 0.2% B. This study focuses on optimizing the yield of mungbean in agroforestry systems by assessing the combined effects of nano urea, zinc, and boron. These treatments enhance crop productivity, contributing to more sustainable farming practices.

Keywords: Agroforestry system, Mungbean, Yield, Zinc, Boron

Biography



Currently pursuing a PhD in Silviculture and Agroforestry, I'm passionate about sustainable land management and integrating forestry with agriculture to support ecological resilience. I'm driven by a desire to contribute meaningfully to the field and am continuously working toward impactful research.



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COMPARING THE HARMONIC MEAN DIAMETER FROM GRAIN SIZE DISTRIBUTION BY DRY MASS AND BY SURFACE AREA

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The Trani & Indraratna, 2010 technical note suggests using the d_{hsa} (harmonic mean diameter of GSD by surface area) instead of d_{hm} (harmonic mean diameter of GSD by dry mass) for predicting saturated hydraulic conductivity k . It is assumed that d_{hsa} derived from GSDm incorporates the grains' size, shape and angularity. 26 grading curves are used to show that the ratio d_{hm} / d_{hsa} is increasing with C_u (for $3 < C_u < 10$, the d_{hm} / d_{hsa} is 1.75, for $10 < C_u < 20$, the ratio d_{hm} / d_{hsa} is 3), in the d_{10} range 0.074–2.75 mm. Two parts of the discussions are related to these statements and results. Theoretically, the concept of the hydraulic radius (rm), controlling the hydraulic conductivity k , was used to test the foregoing ideas. Assuming uniform spherical particles in every 'sieve range' (implied in the method suggested by Trani & Indraratna, 2010), it depends on $rm = ed_{hm}/6$. For other grain shapes, this result does not change significantly. Experimentally, a database of 102 samples is used. It is shown that both d_{hm} and d_{hsa} have the same kind of regression with the measured hydraulic conductivity data k , regarding R^2 and type of regression. The ratio



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d_{hm}/d_{hsa} increased with increasing Cu from 1.7 to 24, which is in agreement with the earlier results.

Keywords: Granular materials; Permeability & pore-related properties; Statistical analysis

Biography



Name: Dr. habil. Emőke Imre, Scientific degree: habilitation in 2015 at BUTE, Hungary, Budapest, Institution: Óbuda University, Hydro-Bio-Mechanical Systems Research Center and Bánki Donát Faculty of Safety Engineering, Phone: +36202892656; E-mail: imre.emoke@uni-obuda.hu, Position: Associate Professor. Specialty and publications: dikes, coupled consolidation models, applied math, unsaturated soils, grading entropy of granular matters, in situ -situ testing (e.g. CPT dissipation tests, evaluation methods and software preparation), laboratory experiments. ISSMGE TC102, TC106 and TC201 member.



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DESIGN OF NOVEL ANTI-CANCER AGENTS TARGETING COX-2 INHIBITORS BASED ON COMPUTATIONAL STUDIES

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The overexpress of COX-2 was clearly associated with carcinogenesis and COX-2 as a possible target has long been exploited for cancer therapy. A group of 29 derivatives of 1, 5-diarylpyrazole, was used to study its structural requirements using 3D-QSAR, the density functional theory method, molecular docking, and molecular dynamics. Four 3D-QSAR models were developed, and the predictive capability of the four selected models was also successfully tested using different validation methods. The contribution contours of the CoMFA and CoMSIA models effectively illustrate the relationships between the various chemical characteristics and their biological activities. Using the density functional theory method, with the 6-31G (d, p) basis set and the B3LYP function, to evaluate chemical reactivity properties, the results obtained from energy gaps of 3.431, 3.446 and 2.727 eV for molecules number 21, 22 and 23 indicate that these three molecules have good chemical stability and reactivity, and select the most reactive regions in the three molecules studied. Molecular docking results revealed that the active sites of COX-2 protein (PDB code: 3PGH) were residues ARG222, THR212, HIS386, HIS207, TYR148, and ASP382, in which the most active ligands and now ligands can inhibit the COX-2 enzyme. Based on the various results obtained by molecular modeling, four new compounds (N₁, N₂, N₃ and N₄) were proposed with significant predicted activity by different 3D-QSAR models. A molecular docking study and molecular dynamics simulations of the proposed new molecules (N₁ and N₂) and the most active molecule over 100 ns revealed that all three molecules establish multiple hydrogen interactions with several residues and also exhibit frequent stability throughout the simulation period. As a result, it is strongly recommended to consider the two newly proposed molecules, N₁ and N₄, as promising candidates for novel anti-cancer agents specifically designed to target COX-2 inhibition.



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Keywords: *Anti-cancer, COX-2 inhibitors, 3D-QSAR, DFT reactivity, Molecular dynamic.*

Biography



My name is Mohamed Er-rajy, and I have been a doctor in computational chemistry since 2023. I conduct research focused on the modelling of anticancer molecules. I have published over 20 scientific articles and participated in several national and international conferences.



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SOIL MICROBIAL DYNAMICS AS INFLUENCED BY DIFFERENT NUTRIENT MANAGEMENT PRACTICES IN MAIZE-WHEAT CROPPING SYSTEM IN ACID HILL SOIL OF HIMACHAL PRADESH

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Soil microbial dynamics play a crucial role in nutrient cycling, organic matter decomposition, and maintaining soil fertility, which collectively influence crop productivity and ecosystem stability. This study, conducted in 2022 at the experimental farm of the Department of Agronomy, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur, investigated the effects of various nutrient management strategies on soil microbial properties in an Alfisol. The experiment included chemical fertilizers, lime, organic farming, natural farming (with inputs from desi cows, crossbred cows, and buffalo), and integrated nutrient management, structured in a randomized block design with eleven treatments, each replicated three times. The microbial properties examined included bacterial, fungal, and actinomycetes counts, alongside dehydrogenase and phosphatase activities, measured at both surface (0-15 cm) and subsurface (15-30 cm) soil depths. Results revealed that integrating 25% NPK with organic farming yielded the highest microbial counts and enzymatic activity, followed by treatments combining 25% NPK with natural farming inputs from desi cows, crossbred cows, and buffalo, respectively. In contrast, the 100% NPK treatment exhibited the lowest bacterial and actinomycetes populations as well as enzymatic activities, while the 100% NPK + lime treatment had the lowest fungal count. Notably, integrated nutrient treatments (25% NPK + organic or natural farming treatments) consistently recorded higher microbial counts and enzymatic activities than pure organic practices across both soil depths. Although subsurface layers displayed a similar trend, microbial populations and



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enzymatic activities were comparatively lower than those in the surface layer which might be due to higher organic matter on the surface layer. These findings underscore the importance of balanced nutrient management approaches, highlighting that integrated nutrient practices can significantly enhance soil microbial activity. Such insights are essential for developing sustainable agricultural practices that improve crop productivity while preserving soil biological health.

Keywords: Soil health, microbial count, dehydrogenase, phosphatase, Alfisol

Biography



Aanchal is currently pursuing her Ph.D. in Soil Science at CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur, Himachal Pradesh, India, specializing in Soil Fertility and Agricultural Chemistry. Her research investigates the effects of diverse nutrient management practices viz. chemical, organic farming, natural farming, and integrated nutrient management practices on nutrient dynamics, soil properties and crop productivity in the acidic hill soils of Himachal Pradesh under Maize-Wheat cropping system. Her work aims to enhance soil health and productivity, supporting resilient agricultural systems in hill regions. She has contributed extensively to scholarly literature, including research articles, review articles, popular articles, and book chapters.



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HOW TO KEEP SOIL BODY HEALTHY AND FERTILE?

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Soil is a tiny particle of the earth which is smaller than 0.002 mm in diameter and has a large surface area compared to its volume. It is made up of organic and inorganic compounds, which hold water and nutrients, preventing them from leaching out of the soil with runoff water.

MAIN CONSTITUENTS OF SOIL:

I. Clay: It is the smallest soil colloid and has a high surface area, which makes it sticky and prone to clumping.

II. Humus: It is the decomposed organic matter in the soil that is rich in nutrients, which are available to plants.

III. Oxides: They are inorganic compounds that are rich in iron and aluminium, which help to stabilize soil particles, prevent erosion, and improve soil structure.

LIFE FOR THE PLANT GROWTH:

- i. Nutrient holding: Soil colloid holds water and nutrients in the soil, making it available to plants for a longer period.*
- ii. Absorption: Soil colloid can absorb water, which is essential for plant growth.*
- iii. Soil structure: Soil colloid helps to improve soil structure by keeping the soil particles together and preventing them from being washed away.*
- iv. Cation exchange capacity: Soil colloid's negative charge attracts positively charged nutrients or cations, which are essential for plant growth, and prevents them from being lost through leaching.*
- v. pH buffering: Soil colloid acts as a buffer and helps to regulate soil pH, which affects the availability of nutrients for plants.*

Soil plays a significant role in plant growth by providing nutrients and improving soil structure, which increases the plant's ability to absorb water and nutrients.

SOIL MANAGEMENT FOR BOOSTING FERTILITY AND ENHANCING CROP YIELD:



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1. *Collection of Agro-Industrial Wastes: Gather agricultural by-products such as plant residues, food processing waste, and other organic materials.*

2. *Processing into Fertilizers*

Process the collected wastes through composting or fermentation to convert them into nutrient-rich organic fertilizers.

3. *Formulation of Bio stimulants: Combine these organic fertilizers with bio stimulants, which include beneficial microorganisms, humic acids, and other bioactive compounds designed to promote plant growth and improve soil health.*

4. *Soil Application: Apply the formulated bio stimulants and fertilizers to the soil, either through direct mixing into the soil or as part of irrigation systems.*

5. *Improving Soil Structure and Nutrient Availability: The bio stimulants enhance microbial activity in the soil, improving nutrient availability, water retention, and overall soil structure.*

6. *Crop Growth and Yield Enhancement: As a result, crops grow more robustly with improved resistance to stress (drought, pests, etc.), leading to higher yields and sustainable productivity. This process promotes sustainable farming by turning waste into valuable resources while boosting crop performance.*

When life enters the picture, soils become enriched with all the exudates, glues, sugars, humus and living things that make up the soil ecosystem. These are what gives the soil the ability to form aggregates helping soil absorb water and exchange air, allowing roots, and soil organisms to respire.

Without organisms, soil would be a structureless and lifeless accumulation of small mineral particles.

Keywords: Soil Colloid, fertility, agronomic practices. Three-dimensional body

Biography



Sahar Maleki is dynamic Soil Engineer interested in soil chemistry and environmental pollutants. She is passionate about conducting risk assessments for environmental pollutants and remediation techniques. She works as a soil expert in the Pars Exit Spand company. Interested in soil- plant interaction.

She is researching the application of chitosan as a soil amendment. A soil science engineer interested in soil chemistry and environmental pollutants. She is passionate about conducting risk assessments for environmental pollutants and remediation techniques. She works as a soil expert in the Pars Exir Sepand company. Interested in soil- plant interaction. She is researching the application of chitosan as a soil amendment. Expertise in Environmental



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Professor Dr. B. S. Panwar has completed his Ph.D from CCS Haryana Agricultural University Hisar, India. He was the coordinator of Indo-Hungarian joint project entitled "Phytoremediation of potentially toxic heavy metals contaminated soils by agricultural crop genotypes" funded by DST New Delhi and HAS Budapest from the year 2005 to 2008 and "Fate of heavy metals in crop, soil and water ecosystem" funded by INSA and HAS from the year 1997 to 2001. He is visiting professor of ETHZ Zurich, Switzerland, PSTU, Mariupol Ukraine and MSU Moscow, Russia. He has published more than 110 peer reviewed research papers in national & International journals, 2 Books (Hungarian with summary in English) associated with Hungarian Professor, 10 Bulletins, 20 Book chapters, popular & Scientific articles in leading newspapers, magazines, Radio talks, farmers melas and has been serving as an editorial board member of repute research journals. Professor Panwar Guiding many Post graduate students in Indian and abroad Universities. Since performing [one decade] as President of Green India Clean Environment Society-GICES, Hisar, Haryana, India. Besides his professional field, he is a proven writer - poet and published one flash drama, two books of Hindi poetry, and 12 E-booklets of poems in English literature.



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EVALUATING CAPSICUM PRODUCTIVITY THROUGH DRIP IRRIGATION AND INM BASED FERTIGATION IN A NATURALLY VENTILATED POLYHOUSE

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An experiment was carried out in 2022 at CSK HPKV, Himachal Pradesh under a naturally ventilated polyhouse to evaluate the effect of drip irrigation and integrate nutrient management-based fertigation on the productivity of capsicum with the objective to determine optimal water and nutrient management practices that enhance capsicum growth and yield while ensuring efficient resource use. The experiment was laid out in a factorial randomized block design with a total of 10 treatments having two factors: drip irrigation (surface and subsurface) and integrated nutrient management-based fertigation. Each factor was assessed across three levels, alongside a control treatment. The results revealed that relative leaf water content and soil water content was comparatively higher under sub surface drip irrigation over surface irrigation and among nutrient schedules, 100% NPK + 7.5 t ha⁻¹ registered higher soil water content and relative leaf water content over other schedules. Further, the results also showed that highest plant height, number of fruits per plant and fruit yield was obtained from application of sub surface drip irrigation and also took least days to 50% flowering and days to first harvest over the surface irrigation. Among the nutrient regimes higher values of these parameters were found with the application of 150% NPK + 2.5 t ha⁻¹ of vermicompost followed by 125% NPK + 5 t ha⁻¹ of vermicompost and 100% NPK + 7.5 t ha⁻¹ of vermicompost. The lowest values of all the parameters were found under control which consisted of 100% NPK + 2.5 t ha⁻¹ vermicompost. The study concluded that sub surface drip irrigation and fertigation treatments consisting of 150% NPK + 2.5 t ha⁻¹ vermicompost improved crop productivity and can be helpful for sustainable and high yielding cultivation under controlled environment.

Keywords: Drip irrigation, Drip fertigation, naturally ventilated polyhouse, Vermicompost, Capsicum



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Biography



Currently, Saurabh Thakur is pursuing his Ph.D. in Soil Science at CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur, Himachal Pradesh, India with specializing in Soil Physics and Conservation. His research focuses on the impact of drip irrigation and fertigation on water productivity, soil-plant water relations, soil properties, and crop productivity in protected conditions. Saurabh has made significant contributions to the field through a variety of scholarly outputs, including research articles, review papers, popular science articles, and book chapters. His work aims to enhance the understanding of sustainable agricultural practices and improve water-use efficiency.



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LEVERAGING SOIL MICROBIOMES FOR SUSTAINABLE AGRICULTURE AND CLIMATE ADAPTATION

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This research investigates the role of soil microbiomes bacteria, fungi, and viruses in promoting sustainable agricultural practices and enhancing climate resilience. Soil microbiomes are critical for improving plant growth, nutrient cycling, and stress tolerance, offering a natural solution to reduce dependency on synthetic fertilizers and pesticides. Using advanced molecular techniques, including metagenomics, we explore how microbial communities interact with plant roots and how these interactions can be optimized to boost crop productivity and soil health. The study also examines the impact of climate change on microbial diversity and ecosystem functions, emphasizing the need for microbiome management to adapt to shifting environmental conditions. Our findings highlight strategies such as bioinoculants and agricultural practices favouring beneficial microbes, which can improve soil fertility, enhance plant resilience, and mitigate the negative effects of climate change. The research concludes that optimizing soil microbiomes is key to achieving sustainable agricultural systems that ensure food security and environmental sustainability in the face of global challenges.

Keywords: Soil microbiomes, sustainable agriculture, climate resilience, microbial diversity, metagenomics, bioinoculants

Biography



I am Sonali Rajput, a Research Scholar at Hemvati Nandan Bahuguna Garhwal University (HNBGU), Srinagar, Uttarakhand, India. I hold a B.Sc. in Agriculture and an M.Sc. in Seed Science and Technology from SKUAST-Jammu, India. My research focuses on crop improvement, particularly in developing strategies for adapting crops to changing environmental conditions. I am especially interested in soil and seed health to enhance agricultural productivity and sustainability. By exploring sustainable farming practices, I aim to contribute to resilient agricultural systems that



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*ensure food security while maintaining soil health and improving seed
quality for better crop yields.*



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INTRODUCING SILKWORM PUPAE AS AN INNOVATIVE MEDIUM FOR MASS REARING THE BIOCONTROL PARASITOID TETRASTICHUS HOWARDI (OLLIFF)

Shahnoor CHOWDHARY

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The research was carried out at the Division of Sericulture, Sher-e-kashmir university of Agricultural Sciences and technology, Jammu, focusing on repurposing waste from the sericulture industry, specifically the pupae of two silkworm species, Bombyx mori (Mulberry silkworm) and Philosamia ricini (Eri silkworm), to mass rear Tetrastichus howardi (Olliff), a valuable pupal parasitoid. The objective was to assess the effectiveness of three hosts: Spodoptera frugiperda (a natural host of T. howardi), B. mori and P. ricini in sustaining parasitoid populations and determining the optimal rate of parasitoid production at various host-parasitoid interaction densities. Densities ranging from 1:1 to 1:5 were evaluated to identify suitable dosages for mass rearing. The findings show that as the host-parasitoid density increased, the parasitization percentage, female-biased sex ratio of progeny and progeny production per host pupa also increased. However, the fecundity of female parasitoids and the rate of parasitization per day decreased with higher densities. The study indicates that the highest number of parasitoid progeny and maximum females were obtained at a density of 1:4 (5 host pupae: 20 parasitoids), particularly in P. ricini pupae, suggesting its potential to enhance the effectiveness of T. howardi in suppressing pest populations due to its superior female-biased sex ratio and nutritional content compared to the other two hosts.

Keywords: Biological control, parasitoid, Bombyx mori, Philosamia ricini, Spodoptera frugiperda

Biography



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Shahnoor Chowdhary holds a Bachelor of Science degree in Agriculture and a Master of Science degree in Sericulture from esteemed SKUAST-Jammu. With a strong background in agricultural sciences, achieved a Senior Research Fellowship (SRF) rank of 34, placing first in their category and successfully cleared the ICAR National Eligibility Test (NET) in 2023. She is aiming to contribute innovative solutions to sustainable pest management.



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STUDY OF ANTIMICROBIAL RESISTANT GRAM-NEGATIVE BACTERIA IN CHICKEN AND PORK MEAT IN KATHMANDU VALLEY

Sushma PAUDEL

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Antimicrobial resistance is associated with nearly 5 million deaths worldwide in 2019, according to a report released by CDC. Further, the increasing trend of multidrug resistance in Gram-negative bacteria (MDR-GNB) has been a major concern for the healthcare settings in Nepal and globally. In Nepal, previous studies on antimicrobial resistance (AMR) have received limited attention to animal-sourced food, which represents a significant route for the zoonotic transmission of antibiotic-resistant pathogens.

This study aimed to assess antibiotic resistance, multidrug resistance patterns of Gram-negative bacteria isolated from intestinal and cloacal samples of chicken and pork meat collected from 5 municipalities in Kathmandu district of Nepal. From a total of 36 samples collected, comprising 11 chicken meat samples and 2 pork meat samples, 136 gram negative bacteria were isolated. Subsequently, the isolated bacteria underwent susceptibility testing against 16 different antibiotics. Furthermore, for the selected isolates that exhibited resistance to tetracycline class, and aminoglycoside class. Polymerase Chain Reaction (PCR) analysis was performed on plasmid DNA to detect the presence of specific resistance genes, including tet-A, and aph-A1 gene. A total of 136 bacterial isolates, representing sixteen distinct types, were successfully identified. Notably, Escherichia coli and Shigella spp. were the predominant bacterial species followed closely by Yersinia spp., Citrobacter spp., Proteus spp., Klebsiella spp., and Plesiomonas spp., among others. Remarkably, the prevalence of multidrug-resistant bacteria was alarmingly high, with nearly half (49.9%) of the isolates exhibiting resistance to multiple classes antibiotics. The tet-A gene was found in just 6.06% of the isolates showing tetracycline resistance, and the aph-A1 1A gene was present in only 5.26% of cases, all of which were isolated from chicken meat samples. Our study discovered that the meat samples we tested were seriously contaminated with



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multidrug-resistant gram-negative bacteria. These findings are of significant concern and warrant future attention due to the potential implications for public health and food safety. There is a need for monitoring and mitigation strategies to address antibiotic resistance in our food supply to minimize the spread of multidrug-resistant bacteria within the food chain.

Keywords: Antimicrobials, AMR, Multidrug-resistant bacteria

Biography

Miss Sushma Paudel

Btech in Biotechnology, Purbanchal University, Nepal

Technology Head at Ecorevive Research and Innovation, Sushma Paudel is a fresh graduate with a B.Tech in Biotechnology from Purbanchal University, Nepal, and is currently the Technology Head at Ecorevive Research and Innovation. At Ecorevive, Sushma leads the development of natural hair care solutions by combining traditional herbal knowledge with modern biotechnology tools such as bioenzymes. She focuses on creating eco-friendly, sustainable cleaning solutions and utilizing underutilized herbs native to Nepal, such as Reetha (Soapnut), in hair care formulations.



In addition to her work in biotechnology, Sushma is actively engaged in the public health sector. She leads the project AMR Heroes: Understanding Antimicrobial Resistance, an initiative aimed at raising awareness about antimicrobial resistance (AMR) and promoting responsible antibiotic usage in Nepal. Through this project, she has conducted educational workshops for medical students, school children, and rural communities to emphasize the growing threat of AMR and the need for preventative actions.



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SOIL NUTRIENT FRACTIONS UNDER DIFFERENT AGROFORESTRY SYSTEMS UNDER SEMI-ARID CONDITIONS OF HARYANA

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Agroforestry systems are economically viable and provide diverse ecosystem services. We studied the long-term effects of tree-based systems on nitrogen, phosphorus, potassium and carbon fractions in Haryana, India. The selected systems were Poplar Cowpea-Wheat, Eucalyptus + Cowpea-Wheat, Melia + Cowpea-Wheat, Sisham + Cowpea-Wheat and sole cropping of Cowpea-Wheat. Water soluble and solid bound-P, Fe-P, total-P and organic P was significantly higher under tree-based systems as compared to sole cropping while Ca-P, Al-P and reductant-P were significantly higher under sole cropping. Total-N, organic-N and inorganic-N were significantly higher by 67.4, 68.1 and 12.5% under Poplar based agroforestry systems compared to control or sole cropping. Total-K, water soluble-K, exchangeable-K, non-exchangeable-K and lattice-K was significantly 1.26, 1.56, 1.21, 1.20 and 1.50 times higher under Melia + Cowpea-Wheat systems as compared to Cowpea-Wheat, respectively. Highest very labile-C, labile-C, less labile-C and recalcitrant-C was observed under Poplar + Cowpea-Wheat (2.08, 1.76, 2.27 and 2.02 g/kg) and lowest under Cowpea-Wheat (1.26, 0.97, 1.31 and 1.22 g/kg), respectively. Therefore, poplar- and Melia-based AFS with legume-wheat rotation was more efficient in improving nutrient cycling and nutrient status along with sustainability of the systems.

Keywords: Agroforestry, nitrogen, phosphorus, potassium and carbon fractions

Biography



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My name is Pankaj, born on 03 January 1995. Mother's name: Smt. Sunita and Father's name: Sh. Satyapal Singh, Permanent address: H.No. 3923 Defence Colony, Jind.

Mobile: +91-9466120148, E-mail: pankajsingroha95@gmail.com.

Academic qualifications:



Degree	University/ Board	Year of Passing	Percentage/ OGPA	Subjects
Matriculation	C.B.S.E	2011	87.4%	English, Hindi, Social Science, Mathematics, Science and Computer Science.
Intermediate	C.B.S.E	2013	87.2%	English, Hindi, Physics, Chemistry and Biology.
B. Sc. (Hons.) Ag.	CCS HAU, Hisar	2018	7.67/10	All Agricultural Subjects
M. Sc. (Ag.) Soil Science	PAU, Ludhiana	2020	7.69/10	Major: Soil Science Minor: Microbiology
Ph.D. (Soil Science)	CCS HAU, Hisar	2023	8.20/10	Major: Soil Science Minor: Chemistry



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BIOSTIMULANTS-THE ALCHEMY OF THE FUTURE'S AGRICULTURE TECHNOLOGY

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One important agricultural technology that provides innovative methods to increase crop output and resistance is biostimulants. An alternative to traditional chemical pesticides and fertilizers are biostimulants, which are defined as natural compounds or microorganisms that boost nutrient efficiency and encourage plant development. The many uses of biostimulants in modern agriculture are covered in this abstract, along with their benefits, mechanisms of action, and potential to address worries about global food security in the face of climate change. Higher agricultural output is required due to the growing global population, which degrades the environment and increases resource demand. By encouraging sustainable practices, improving soil health, and lowering reliance on artificial inputs, biostimulants can help alleviate these problems. These compounds, among others, improve nutrient intake, encourage root development, and trigger plant stress responses. Biostimulants also help to improve the soil's fertility and structure by encouraging the growth of beneficial microbial populations. The effectiveness of biostimulants derived from natural sources, including seaweed, humic chemicals, and beneficial microbes, has been shown in recent investigations. These substances not only promote plant growth but also make plants more resilient to biotic and abiotic stresses including drought, salt, and pest infestations. This resilience is crucial in the context of climate change, since unpredictable weather patterns pose a severe danger to agricultural systems. The economic benefits of biostimulants are substantial. These technologies have the potential to help farmers boost yields, reduce input costs, and improve product quality, all of which will make their products more marketable. Additionally, biostimulants promote sustainable agricultural practices, which greatly enhance the environment, by reducing chemical runoff and boosting biodiversity. Notwithstanding its potential, the biostimulant sector has several obstacles, such as lack of standardization, regulatory obstacles, and the requirement for more thorough field research to confirm effectiveness across various crops and settings. To overcome these obstacles, lawmakers, business, and academia must work together and never stop

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learning. To sum up, biostimulants are a practical farming technique that blends sustainability and innovation. They are positioned to have a significant impact on agriculture in the future due to their capacity to improve plant development and resistance while fostering environmental health. Consistent investment in research, development, and education is required for biostimulants to realize their full potential and revolutionize farming practices while guaranteeing food security for future generations. Biostimulants are revolutionizing agriculture by enhancing plant growth and resilience through natural means. They play a crucial role in sustainable farming, improving nutrient uptake, stress tolerance, and soil health while reducing reliance on chemical inputs. This innovative technology not only boosts crop yields but also fosters environmental stewardship. As farmers face challenges like climate change and soil degradation, biostimulants offer a viable solution for a sustainable future. Embracing these substances will be key to developing a resilient agricultural system that meets global food demands while protecting the planet for future generations.

Keyword: Sustainable farming, Soil health, Climate, Yield.

Biography



Raghvendra kumar Kushwaha, B.Sc. (Hons.) Agricultural Science. M.Sc. (Agri.) Soil Science at Department of Soil Science & Agricultural Chemistry, NAI, SHUATS, Prayagraj- 211007, Research area Nano fertilizer, member of 6 magazine/research organizations, completed 3 experiential learning program / project, Published 20 articles in different magazine, 1 book, 4 book chapters, 4 research paper, Participated in 26 Workshop and 13 National and International conference, 14 Training program and 8 Internship program, 1 Year experience in rural agriculture work experience. I have been awarded the best young professional award allied science (Soil science) 2023.



A dedicated and passionate scholar is currently embarked on a remarkable academic journey in pursuit of a Doctor of Philosophy (PhD) degree from CSAUA&T, Kanpur. I have always been driven by a profound curiosity and an unquenchable thirst for knowledge. My belongings are from Kanpur, Uttar Pradesh. I've completed my B.Sc. at CSIM University Kannur and furthered medication with an M Sc in Soil Science



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TESTING THE PESTICIDE TOLERANCE OF BACTERIAL COMPONENTS FOR MICROBIAL SOIL INOCULANTS

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Microbial inoculants play a crucial role for agricultural crops. They are more Efficient from the environmental point of view, and and are promisingly simple to use for farmers use for farmers to protect agricultural plants from pathogens.

The main goal of this research is to screen the effect of active ingredients from the most important synthetic pesticides on selected environmentally friendly bacterial strains. This work was done in Saniplant Biotechnological Research and Development Ltd, in Gődöllő, Hungary in 2023.

In the laboratory, eleven synthetic pesticides (Force, Glyphosate, Gladiator, Picassa, Priaxor, Scope, Topas, Wakiil, Rancona, Signal, Systiva, and Premise) were screened. The M9 media were prepared and each pesticide with five different doses were added to the M9 medium. Altogether, seventy-five environmentally friendly bacterial strains were tested. The bacterial strains were sub-cultured on each poison medium contained in the above-mentioned pesticides.

As a result, most bacterial strains revealed less tolerance to the high doses of tested pesticides. However, the lowest three doses of used pesticides indicated a better bacterial growth. On the other hand, the tested Scope insecticide showed a positive effect on bacterial strains' growth to all five used concentrations. To conclude, the tested bacterial strains showed little tolerance to the concentrated and half diluted different pesticides. Thanks to Dr. Zsolt Bereczky to provide the best conditions in the laboratory to complete my industrial placement in the Biotechnological Saniplant Company which is located in Gődöllő city, Hungary. This research was supported within the framework of the FEMS Industrial Placement Grant –ID 1851 in 2023.

Keywords: microbial inoculants, pesticides, bacterial strains, agriculture, active ingredients



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Biography



My name is Galiya Akhmetova, I completed my PhD degree in Microbiology at ELTE University in Budapest, Hungary in 2023. I was a Stipendium Hungaricum scholar. But originally, I am from Kazakhstan. During my PhD studies, I got FEMS Industrial Placement Grant for 3 months which I completed it in the Biotechnological Saniplant Company that is located in Gödöllő city, Hungary. Now I am working as Senior Scientific Fellow at A.I. Barayev „Research and Production Centre for Grain Farming”, in Kazakhstan. My research interests are mainly plant-fungal interactions, mainly endophytes (Ascomycota group) isolated from agricultural crops of Northern Kazakhstan.



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CLIMATE SMART AGRICULTURE – A STEP TOWARDS SUSTAINABILITY TO REPLENISH THE EFFECT OF CLIMATE CHANGE

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This study aims to provide a thorough understanding of the effects of implementing climate-smart agriculture (CSA) practices by reviewing the material that was published between 2013 and 2023. Based on the scope of climate-smart agriculture, we divide it into three categories: (a) sustainably raise agricultural incomes and productivity; (b) build agrifood systems' and people's resilience to climate change; and (c) minimize or completely avoid greenhouse gas emissions. The analysis shows that CSA adoption often results in higher farm incomes and productivity. Crop yields and productivity, revenue and profitability, and the efficiency of technical and resource usage all rise as a result of this growth. Moreover, by encouraging food consumption, dietary diversity, and food security while reducing production risks, CSA methods strengthen the resilience of farmers and agrifood systems. The natural equilibrium of the environment is being negatively impacted by climate change. Rising temperatures, intermittent famines and droughts, erratic dry spells, and erratic rains are all causing hardship for the population that depends on agriculture. A great way to reduce greenhouse gas emissions and increase crop yield for food security and climate change adaptation is to implement Climate Smart Agriculture (CSA). This study's main goal is to present a structured evaluation of recent developments in the field of climate-smart agriculture. 157 publications published between 2013 and 2022 were analysed for this study using the Scopus database. One of the most complicated environmental and socioeconomic problems affecting people's livelihoods worldwide is climate change (CC). CC is an additional burden for an agrarian and climate-sensitive emerging nation like India, whose ecological and socioeconomic systems are already under strain from industrialization, rapid population expansion, and resource depletion. In light of this, the study was conducted to learn more about the climate change (CC) scenario in Gujarat state's Aravalli district, its effects on smallholder farmers, the uptake of climate smart agriculture (CSA) practices, the available policies and programs at the moment, and the difficulties that CSA practices' sustainability faces.



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Keywords: *Climate change, Climate smart agriculture, Greenhouse gases, Smallholder farmer.*

Biography



Shashank Sen, Student of M.Sc. Soil science and agricultural chemistry at Central Agricultural University Imphal, Manipur, India.

My master's research is on Quantitative Evaluation of Pedological Development in Some Dominant Soils of Manipur State for Agricultural Land Use Planning.



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PHYSICOCHEMICAL PARAMETER ANALYSIS, LEVELS OF HEAVY METAL POLLUTION AND POTENTIAL HEALTH RISK ASSESSMENTS IN AGRICULTURAL SOILS FROM SOUTH-WEST REGION OF ETHIOPIA

Endalkachew ETANA

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In this study, soil samples collected from Burusa and Bure agricultural sectors were analyzed for their physicochemical parameters, and heavy metals level (Fe, Mn, Zn, Cu, Co, B, Se, Ni, Cr, Pb, Cd, As and Hg). Physicochemical parameters were analyzed according to AOAC methods. For quantification of heavy metals, the soil samples were digested by using aqua Regia (HCl: HNO₃; 3:1) and 5 mL of H₂O₂ (30%) at digestion temperature of 250°C for 3 hours prior to ICP-OES analysis. The analyzed mean values of physicochemical parameter including pH, temperature, electrical conductivity, moisture, organic matter and nitrogen content were found in the range of 4.85 – 6.47, 20.5 – 21.4°C, 101.6 -230.7 µS/cm, 8.7 – 20.7%, 0.677 – 1.81% and 5.81 -6.85%, respectively. The average amount of heavy metals found in the soil samples were ranged as 57072.9 - 81278.7, 1184.8 - 3255.5, 41.0 - 72.2, 12.6 - 29.2, 18.8 - 50.9, 25.0 - 40.5 , 42.2 - 60.8 , 13.6 - 34.5, 41.9 - 67.2, 25.0 - 59.4 , 9.9 - 13.3, 0.9 - 1.1 and 5 - 8.6 in mg/kg for Fe, Mn, Zn, Cu, Co, B, Se, Ni, Cr, Pb, Cd, As and Hg, respectively. The highest concentrations from all the heavy metals were recorded for Fe followed by Mn in the analyzed soil samples. All the studied metals are below the FAO/WHO permissible limit except Fe, Se, Cd and Hg for all analyzed soil samples and Mn for Bure soil sample. The target hazard quotient (THQ) and hazard index (HI) values are <1, suggesting that insignificant non-carcinogenic risk of the heavy metals to the adults via ingestion, inhalation and dermal contact exposure of agricultural soils. Likewise, the individual metal incremental lifetime cancer risk (ILCR) occurrence for all studied soil samples are below 1×10^{-4} . The total ILCR of heavy metals (Ni, Cr, Pb, Cd and As) resulting from ingestion, inhalation and dermal contact exposure of agricultural soil by an adult population indicate a slightly poses potential cancer risk ($> 1 \times 10^{-4}$) for soil samples obtained from Bure S₁, Bure S₂ and Bure S₃. Therefore, continuous monitoring of these harmful metals should be made by agricultural sectors and responsible government regulatory authorities are crucial to prevent heavy metals toxicity related with agricultural soils in Ethiopia.

Keywords: Soil samples, physicochemical parameter, heavy metals, ICP-OES, health risk assessments



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THE NEED AND POSSIBLE DIRECTIONS FOR SUSTAINABLE WATER MANAGEMENT ALONG THE BÜKKÖS STREAM (SZENTENDRE, HUNGARY)

Igor DUKAY

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Economic, social and environmental sustainability is of paramount importance in the field of water management. Water management interventions have a significant impact on the landscape character, wildlife, naturalness, water balance and benefits to society of the watershed, which until now have been judged almost exclusively in terms of direct economic and social benefits. This has led, among other things, to a drastic reduction in the natural value of the landscape, which has led to the outlining of sustainable water management guidelines and the setting of mandatory objectives. The study area is the 18 km long Bükkös stream, located in the central part of Hungary. It originates in the Visegrád Mountains and flows into the Danube at Szentendre. Along the stream, a landscape-historical study was carried out focusing on the bed morphology, the woody vegetation and the fish fauna. The stream has been regulated along a considerable length over the last 100 years: the bed has been straightened, deepened, sediment traps built in the riverbed and in some sections concreted over. Over the last 20 years, the stream has been subject to minor interventions, and its flora, fauna and riverbed have regenerated in the decades since the first major interventions. The natural value of the fish fauna, even in the urban stretch, is well illustrated by the fact that the number of species is over 20, and that there are also a large number of protected and specially protected species and individuals in the stream. However, maintenance and bank protection works are currently posing a local threat to fish fauna and flora, so it is very important to create a close to nature, based on sediment balance stream bed, create a fish passable sediment trap and use natural erosion control solutions.

Keywords: ecological state, stream rehabilitation, sustainable planning, sediment management, Bükkös stream (Hungary)



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Biography



Igor Dukay (born 15 September 1973) biology and geography teacher, nature conservation engineer. He has been working as independent nature conservation expert and environmental protection specialist since 2001. He worked also in the state, municipal and civil sphere. He is third year PhD Student. Study area is rehabilitation of wetland, primarily streams and associated habitats. He edited e.g. one-one methodological handbook of field study of streams and sources and a Hungarian standard for rehabilitation and managing of ecological restored streams.



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FUNGAL COMMUNITY ISOLATED FROM THE ROOT OF AGRICULTURAL PLANTS AND SOIL IN A VARIETY OF TYPES CROP ROTATIONS IN THE AKMOLA REGION

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One of the main agricultural centres in Kazakhstan for the production of agricultural crops is based in the Akmola region. However, plant pathogens affect crops yields and productivity. Thus, studying fungal members of root of plants and soil is important for this region. Our research aimed to isolate fungal strains from the roots of agricultural plants and soil within a variety of types of crop rotations in the steppe ecosystem of the Akmola region. Root and soil samples were taken from eight agricultural crops were carried out from the eight agricultural crops: wheat, barley, maize, sunflower, flax, lentil, pea, mustard from varied types of crop rotations in summer, 2024. The soil samples under sterile conditions were sifted and a dilution series was made by suspending soil on the Chapek-Doksa medium. The surface sterilization of plant roots was conducted further and the hyphae growing out were sub-cultured to a new PDA medium.

Overall, 137 isolates were collected from roots of different agricultural plants and soil samples from a variety of types of crop rotations. The obtained isolates represented the variety of fungal species.

To conclude, the presence of diverse fungal strains isolated from roots of plants and soil might indicate their importance in the ecology of plants and soil in the conditions of Northern Kazakhstan.

Thanks to my colleagues to Oblasov Sergey and Vorobiev Vladislav to carrying out soil and plant samples. Thanks to Sydykova Kamilya and Soltabayeva Aigerim for helping me with the medium preparation work.

This research was supported within the framework of the scientific program BR22885719 “Develop and implement sustainable farming systems for profitable agricultural production in a changing climate for various soil and climatic zones of Kazakhstan”.



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Keywords: *agricultural crops, soil, fungi, ecosystem, crop rotations*

Biography



My name is Galiya Akhmetova, and I am from Kazakhstan. I am working as Senior Scientific Fellow at A.I. Barayev „Research and Production Centre for Grain Farming”. My research interests are mainly plant-fungal interactions. In both my previous degrees I majored in Biotechnology. In my PhD topic I decided to broaden my knowledge in mycology, mainly endophytes (Ascomycota group) isolated from agricultural and non-agricultural crops of Northern Kazakhstan.



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AMPHIBIAN AND REPTILE DIVERSITY IN THE BELEZMA BIOSPHERE RESERVE, BATNA PROVINCE, NORTH-EASTERN ALGERIA

Abdeldjabar NECER

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This study presents the first herpetological survey conducted in the Belezma Biosphere Reserve, located in Batna Province, Algeria. Fieldwork took place from April to October in both 2015 and 2016, documenting a total of 4 amphibians and 16 reptile species across 12 families. Notably, two amphibian species and one chelonian species were recorded in the province for the first time. This survey provides a comprehensive checklist of herpetofauna in the reserve, along with their associated habitats. The findings offer valuable baseline data to guide future research and inform conservation management efforts within the Belezma Biosphere Reserve. These insights are crucial for understanding the region's biodiversity and supporting sustainable strategies to protect its unique herpetofauna. The survey emphasizes the ecological importance of the area and serves as an essential resource for herpetologists and conservationists working to preserve Algeria's diverse reptile and amphibian populations.

Keywords: Amphibians; Reptiles; Checklist; Belezma; Algeria

Biography



Dr. NECER Abdeldjabar, an ecologist from Batna, Algeria, is a university lecturer and researcher specializing in biodiversity, particularly in the Aurès region and Belezma National Park. With a focus on herpetofauna and forest ecosystems, his work highlights Algeria's ecological diversity. He also teaches



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communication techniques and supervises research on medicinal plants and microbiology, contributing significantly to conservation efforts and environmental awareness in northeastern Algeria.



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EXPLORING AND MAPPING THE DRIVERS OF SPATIAL INEQUALITY AND REGIONAL ECONOMIC DISPARITIES IN IRAN: AN ANALYSIS OF NATIONAL POLICIES

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³Disaster Preparedness & Prevention Centre, Malaysia-Japan International of Technology, Universiti Teknologi, Kuala Lumpur, Jalan Sultan Yahya Petra, Kuala Lumpur, Malaysia

Regional disparities in economic development and living standards persist between urban and rural areas in Iran. Urban centers generally have better infrastructure, economic opportunities, and access to essential services compared to rural regions, which often face limited economic activity and inadequate infrastructure. Regional disparities within the country are also influenced by variations in industrial and agricultural development. This study examines factors contributing to regional inequality across five dimensions and 23 indicators, including economic development, by analyzing the intermediate consumption and output of each economic activity. Following the political revolution of 1979, Iran implemented significant policy changes to promote development centers and support enterprise growth. However, a lack of comprehensive planning and centralized decision-making processes has perpetuated regional disparities. The research highlights the importance of the agricultural sector as a key driver of economic growth in developing countries. In the regional assessment, public services rank highest with a score of 1.128, followed by finance and business at 1.048, industry at 0.981, infrastructure and services at 0.891, agriculture at 0.858, and mining at 0.187. The study underscores the strong correlation between sectoral development and regional disparities, emphasizing the need for targeted policies and interventions to address regional imbalances and promote a more equitable distribution of opportunities and resources across Iran.

Keywords: Spatial inequality, planning system, unequal distribution, regional account, Iran.

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Biography



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Dr. Kamran Jafarpour Ghalehtemouri

I am a bachelor's holder in urban planning geography, master's in urban regional geography, and PhD in environmental ecosystem assessment. He has been involved in several national and international projects. Reviewer and journal editor for over 40 journals in English and 10 journals in Persian.



Dr. Taher Parizadi

I have studied in the best universities in Iran and in the field of planning. Planning has two main branches: planning with and for people (social planning) and planning for places (spatial-physical planning); These two types of planning are complementary. Throughout my research and teaching career at top universities in Iran, I have tried to excel in both areas of planning with a strategic and scenario-based approach. And to carry out various projects at the national, regional, and local spatial levels (city and village), considering the specific socio-cultural conditions of each planning place, to experience operation.



Mr. Saeid Nasiri Zare

Phd. Candidate in rural planning and geography in Khazarmi university of Iran



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THE ENVIRONMENTAL FATE AND TRANSPORT, IMPACTS, AND FUTURE PERSPECTIVES OF ENGINEERED NANOPARTICLES IN SURFACE WATERS

Olivier IRUMVA^{1,2}, Gratien TWAGIRAYEZU^{3,4}, Antong XIA³, Fasilate UWIMPAYE⁵, Jean Claude NIZEYIMANA^{4,6}, Ildephonse NIZEYIMANA⁷

¹Department of Civil and Environmental Engineering, University of Nebraska-Lincoln, Lincoln, Nebraska, United States

²College of Environmental Science and Engineering, Tongji University, Shanghai, China

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⁷Ministry of Infrastructure, Government of Rwanda, Kigali, Rwanda

Technological advancements have sparked concerns about the release of engineered nanoparticles (ENPs) into the environment. They could be implicated in dynamic transformation processes after being released through various point and diffuse sources. However, recent studies have demonstrated the detrimental effects of ENPs on numerous organisms, prompting queries concerning the behavior and fate of the nanoparticles in the various environmental compartments. ENPs' environmental fate, fundamental mechanisms, and potential effects still need to be widely recognized in aquatic environments. This paper reviews the processes of transformation that govern ENPs' occurrence and path in water systems, including physical, chemical, and biological processes such as agglomeration, dissolution, sedimentation, and adsorption. The degree to which these processes occur is influenced by the physicochemical characteristics of ENPs and environmental conditions, which are the most crucial variables governing the environmental changes of the ENP and controlling its cytotoxicity and behavioural traits. The study also illustrated the applications and future challenges of ENPs. The future perspective, including the long-term exposure and the trans-generational effects, the fate of



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transformed by-products in water systems, and the implementation of specific international laws for treating and disposing of wastewater containing ENPs, have been suggested for further research.

Keywords: Bioavailability; Ecotoxicity; Physicochemical characteristics; By-products; Dynamic transformation

Biography

Olivier Irumva, I am an environmental science researcher and engineer specializing in micro- and nanoplastic pollution, sustainability, and environmental engineering. I have an extensive research background, contributing to various academic publications, including co-authoring chapters in ecological science books and publishing in reputable scientific journals. My work delves into the environmental and health impacts of plastics, specifically focusing on plastic pollution in drinking water and the release of microplastics from food containers, which has critical implications for public health and environmental policy.

As a graduate research assistant, I am committed to advancing scientific understanding in environmental health and finding sustainable solutions to plastic pollution. In addition to my research, I serve as a reviewer for Peer-reviewed journals and actively participate in international conferences. I have presented my research at respected events like the International Conference on the Environment and Sustainability, where I share my findings on environmental health and sustainability.



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IDENTIFICATION AND SPECTRAL ASSESSMENT OF CALCIUM CARBONATE EQUIVALENT AND ORGANIC CARBON AT DIFFERENT DEPTHS WITH THE MID-INFRARED SPECTRUM

Ayeh LOTFOLLAHI¹, Mohammad Amir DELAVAR¹, Asim BISWAS², Shahrokh FATEHI³, Ruhollah TAGHIZADEH-MEHRJARDI⁴, Mehdi MOKHTARZADE⁵, Mohammad JAMSHIDI⁶

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Soil spectroscopy is a growing method for assessing soil properties, challenging traditional methods. The remarkable expansion of spectroscopic models, instruments, and technologies confirms the instrumental and fundamental nature of this approach. Therefore, we applied this technique to estimate organic carbon and calcium carbonate equivalent in the form of a global framework (preparation of samples, spectral preprocessing, spectra processing, and validation of processing results) in the Chardowli Plain in western Iran. For this purpose, samples were collected at two standard depths of 0–5 and 5–15 cm and 30 sites identified by the Conditioned Latin Hypercube Sampling method. The results show that when the key wavelengths of calcium carbonate equivalent corresponding to the partial least squares regression model are identified, the intensity of peaks at the depth of 5–15 cm is greater than at the depth of 0–5 cm. The reason



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for this is the greater amount of calcium carbonate equivalent at a depth of 5–15 cm compared to a depth of 0–5 cm. For the same reason, when identifying the main wavelengths of organic carbon, the intensity of the peaks with the partial least squares regression model is higher for the 5–0 cm depth than for the 5–15 cm depth. The results showed that the values of a feature in the soil have an impact on the accuracy of the estimates, and the higher the percentage of a feature in the soil, the higher the accuracy. Thus, a small difference between certain features at different depths led to a significant difference in the intensity of the spectra. It is suggested to use this technique to assess the spectroscopy of one or more features at different land uses.

Keywords: FTIR, Organic carbon, Partial least squares regression, Spectroscopy.



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IDENTIFYING THE ORIGIN AND GEOCHEMICAL EVOLUTION OF GROUNDWATER USING HYDROCHEMISTRY AND STABLE ISOTOPES IN A SEMI-ARID SHALLOW AQUIFER: A CASE STUDY OF THE BARIKA AREA IN NORTHEAST ALGERIA

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As is the case for the region of arid and semi-arid regions, is likely to be at high risk of water scarcity due to climate change. The Barika-Bitam plain, which is the subject of this study, is located on the Hodna Bassin northeast Algeria. It is characterized by a semi-arid climate with annual rainfall s approximately 290 mm with a high evaporation rate of 975.7 mm/year. The average temperature is around 18°C, but during the summer, temperatures can soar up to 32°C, leading to a significant increase in water demand for irrigation and domestic use. The research aims to identify the origin and geochemical evolution of groundwater in the semi-arid shallow aquifer of the Barika region. Water samples were collected, and major ions and stable isotopes ($\delta^{18}\text{O}$, $\delta^2\text{H}$)) from various locations in the Barika-Bitam region. were analyzed. In terms of hydrogeological conditions and the analytical results of hydrochemical data, groundwater can be classified as mio-plio Quaternary groundwater. The dominant water types for groundwater were chloride and sulphate calcium and magnesium type. The groundwater chemistry is mainly controlled by the dissolution of evaporated minerals, precipitation of carbonates, evapotranspiration, and ion exchange reactions. The stable isotopic values of oxygen and hydrogen in groundwater are close to the Global meteoric water line, indicating that groundwater is of meteoric origin. This study provides decision-makers with crucial hydrochemical and isotopic information for sustainable groundwater management.

Keywords: semi-arid, Barika, Groundwater, isotopes, Global meteoric, Hydrochemical. Biography



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Degree:

PhD student in Hydrogeology (7th year): Hydrogeological study of an aquifer system in semi-arid zones. Optimized resource management. Case of Barika plain (Batna wilaya).

July 2017: Master's degree in Geology. Specialty Water Resource Management. University of Batna02.Algeria.

September 2015: Licensees Degree in Geology at Department of earth sciences and Universe, Faculty of Science University of Batna02.Algeria.

Work completed:

- Master Level Completion Project: on integrated water resources management: case of the Thniet El Abed watershed (Les Aurés).
- Licence Level Completion Project: on geological monitoring in an oil drilling.

Professional experience:

- Teaching as a Teacher of Applied Works at the University of Batna 2 Department of Geology:
- General geology and computer science. (2017-2018).
- General geology and tectonics. (2018-2019).
- Tectonics and paleontology. (2019-2020).
- Hydrogeological. (2022-2023)
- Teaching as a teacher of Applied Works in the Department of Geography and Land Management of the University of Batna 2,
 - General geology. (2020-2021/2022-2023).
 - Geomorphology. (2020.2021/ 2022-2023)
- Intensive training on 22,23 and 24 December 2019 in Hammamet-TUNISIA:
 - Research, communication, writing and publishing techniques.
 - Geographic Information System.
 - Numerical Method

Publications:

-Tafrount, A., Drias, T., Chenaf, D., Nafaa, B. (2023). Hydrogeochemical evolution and mineralization origin in a semi-arid shallow aquifer: a case study of the Barika area in northeast Algeria. *Acque Sotterranee - Italian Journal of Groundwater*, 12(2), 19 - 34 <https://doi.org/10.7343/as-2023-624>.

Scientific communication:

-TAFROUNT ASSIA (2018), DRIAS TAREK: Management integrates water resources: case of the catchment area of thniet el Abed (les Aurès)- Poster. 4Th International Symposium. The Geosciences For Sustainable Development - Tebessa 21-22 November 2018.

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Eastern Algeria-Poster. the 4th International Congress: Treatment of Liquid Effluents and Environmental Protection TELPE 2019: 20, 21, 22 December Hammamet, Tunisia.

- TAFROUNT ASSIA (2020), DRIAS TAREK: Hydrogeochemical characterisation of groundwater in the Barika region. Is Algerian. GIRE3. Batna on 15 and 16/12/2020. Poster. (Online). The 3rd International Conference on Integrated Water Resources Management AAH and MGRE Laboratory.

-TAFROUNT ASSIA (2021), DRIAS TAREK: Study of the physical and chemical quality of the groundwater of the Mio Plio-Qauternaire in the Barika region. (Is Algerian). (CMEEZASA 2021). Biskra on 22-23 March 2021 (Online).



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ENVIRONMTAL VULNERABILITY, NATURE’S PREDISPOSITIONS AND RISK FACTORS

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Environmental problems have direct negative impacts on activity and efficiency economic, on the health and quality of life of the population, on the productivity and sustainability of the natural heritage. The aim of my work is to develop an approach aimed at minimizing risks and creating a new mapping of laboratory risks to protect our environment. We carried out an in-depth functional analysis of a process, using the identity sheet to highlight the potential risks associated with the main activity and the resources used. By carefully examining the different stages of the process and the tasks involved. We drew up a detailed plan for the various stages of the research methodology, including data collection, analysis and method implementation

Keywords: protection, environment, accident, risk, safety



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DISTRIBUTION AND ECOLOGICAL RISKS OF TRACE METALS IN GRAIN-SIZE FRACTIONS OF PHOSPHORITE DEPOSITS: A CASE STUDY FROM KEF ESSENOUN DEPOSIT (DJEBEL ONK, NE ALGERIA)

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This study investigates the distribution and environmental implications of trace metal elements (TMs) in various grain size fractions ($f < 45\mu\text{m}$, $45\mu\text{m}$, $f_{125\mu\text{m}}$, $250\mu\text{m}$, and $f > 500\mu\text{m}$) from phosphorite deposits in the Kef Essenoun region (Djebel Onk), northeastern Algeria. Scanning Electron Microscopy (SEM), Inductively Coupled Plasma Mass Spectrometry (ICP-MS), and Laser Ablation ICP-MS (LA-ICP-MS), were used along with Robust Principal Component Analysis (PCA) of centered log-transformed data to assess TM concentrations across grain size fractions. The results show significant variation in major element compositions, with P_2O_5 ranging from 20.27 wt% to 35.59 wt%, and CaO as the dominant element (32.91–48.87 wt%). The coarse fractions ($f_{125-250\mu\text{m}}$, $f_{250-500\mu\text{m}}$, $f > 500\mu\text{m}$) show higher CaO and P_2O_5 concentrations. In contrast, the finer fraction ($f < 125\mu\text{m}$) contain lower contents (CaO < 45 wt% and P_2O_5 < 27 wt%) but higher MgO (1.15–3.81 wt%) and Al_2O_3 (1.33–3.60 wt%). Among trace elements analysed, Sr levels exceeded 1000 ppm in all fractions, followed by V, Zn, Y, and Cr (100–1000 ppm). Cu, Cd, Ni, Zr, Ba, and U were found at concentrations of 10–100 ppm, while other elements, including Ta, W, Hf, Cs, Co, Nb, Sc, Li, Mo, Pb, Tl, Rb, As, and Th, were < 10 ppm. The Potential Ecological Risk Index (PERI) for each fraction yielded Ecological Risk Index (RI) values from 727 to 37,398, indicating significant ecological risk ($\text{RI} \geq 600$). Cd was the primary contributor to the ecological risk, followed by U and Tl. The $f < 45\mu\text{m}$ fraction, particularly in samples from the upper sub-layer, exhibited the highest PERI values, underscoring the elevated ecological risks associated with finer grain sizes. These findings highlight the urgent need for sustained monitoring and comprehensive mitigation strategies to address trace metal contamination in phosphorite mining areas.



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Keywords: Trace Metals (TMs), Grain Size Fractions, Phosphorite Deposits, Ecological Risk Assessment, Potential Ecological Risk Index (PERI), Environmental Contamination.



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AMELIORATIVE EFFECT OF ONONIS NATRIX AGAINST CHRONIC LEAD POISONING IN MICE: BIOCHEMICAL AND HISTOLOGICAL STUDY

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Lead (Pb) is one of the most common heavy metals with toxicological effects on many tissues in humans as well as animals. In order to counteract the toxic effects of this metal, the administration of synthetic or natural antioxidants is thus required. The aim of this study was to examine the beneficial effect of the aqueous extract of Ononis natrix (AEON) against lead acetate-induced damage from a biochemical and histological point of view. Forty-eight male mice were divided into four equal groups: Ctr (control); Pb (lead acetate 1g/l); Pb + On 100 mg/kg (lead acetate 1 g/l + AEON 100 mg/kg); Pb + On 500 mg/kg (lead acetate 1 g/l + AEON 500 mg/kg). AEON was administered orally from day 21 after the start of lead exposure up to the end of the experiment. The results revealed that lead induced increased serum levels of liver markers (AST, ALT, and bilirubin), as well as kidney markers (urea and creatinine). At the same time, levels of thiobarbituric acid reactive substances (TBARS) and glutathione peroxidase (GPx) increased significantly. Moreover, Pb caused structural changes in the liver and kidneys of Pb-exposed mice. However, AEON administration significantly improved all lead-induced liver and kidney dysfunctions. Our results suggest that AEON could be a source of molecules with therapeutic potential against liver, and kidney abnormalities caused by lead exposure.



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DEVELOPING OF DIGITAL MAPS OF CARBONATE CALCIUM EQUIVALENT AND ORGANIC CARBON BY COMBINING SPECTROSCOPY AND GEOSTATISTICAL TECHNIQUES

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Soil carbon in the global cycle is in two forms, organic and inorganic. Calcium carbonate equivalent constitutes an important part of inorganic carbon. In Iran, there are many areas with low organic carbon and high equivalent calcium carbonate. The Chahardowli Plain in the west of Iran is one of these areas. In recent years, pedometric techniques have been successfully used in soil mapping, but the integration of spectroscopic techniques and geostatistical methods to prepare soil maps is very limited. In this research, we used normal kriging and block kriging based on normal kriging for interpolation. The results showed that the more important the peak and the higher the average, the more area it occupies in the digital map. Also, there is a direct relationship between the importance of a peak and the average frequency of that peak. If a peak has a high importance in identifying a feature, the average frequency of that peak causes it to



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occupy a larger percentage of the area, and vice versa. Based on the obtained results, the important peaks that are identified in wavelengths close to each other have the same digital map, so it seems that the wavelength range has a special effect on the spatial prediction digital map. The results show that factors such as the importance of the peak, the frequency of a certain peak, and the wavelength range all affect the digital map. In this study, the highest kappa index was the basis of model selection for all peaks. The contribution of the Mathern, M. Stein semi-variable model was more than other models. In the end, it is suggested that using the data from the database that is being collected is a good opportunity to prepare spectral maps. It is also suggested to investigate the relationship between important land use and peak abundance in future studies.

Keywords: *Fourier transform, Mathern, M. Stein, Partial least squares regression, Spectroscopy.*



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PRODUCTION POTENTIAL OF RICE-BASED CROPPING SYSTEM UNDER IRRIGATED CONDITIONS

Pragati PANDEY

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An experiment on rice-based cropping systems to monitor the soil properties was conducted at Agronomy Research Farm in Acharya Narendra Deva University of Agriculture and Technology, Kumarganj (Ayodhya, U.P.) during 2020-21 in Complete Randomized Block Design with seven treatments and three replications. Seven cropping patterns viz; rice-wheat-fallow, rice-wheat-green gram, rice-french bean-green gram, rice-berseem-sudan chari, rice-cauliflower-okra, rice-potato-cowpea and rice-mustard-green gram were compared with rice-rice cropping pattern. The cropping systems were evaluated to assess their effect on the soil properties like soil pH, EC, organic carbon contents, soil organic matter, and available soil NPK. The results further indicated that the introduction of green manuring or leguminous crops in the existing rice-wheat system increased grain yields and improved the physio-chemical properties, organic matter contents and nutrient availability in the soil. Soil pH lowered from 8.3 to 7.97 and organic carbon increased from 0.38 % to 0.39 %. The effect of green manure are shown in the availability of N and P hence it proves by the experiment on rice-based cropping systems, if the use of green manure crops under the rice-based cropping increases the availability of the nutrients in the soil which play vital role in increasing the productivity of the soil and the crop production.

Keywords: Cropping pattern, green manuring, leguminous, productivity and yield.



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ECOTOXICOLOGY AND POLLUTION: CAUSES, EFFECT AND PREVENTIVE MEASURE TO CONTROL THE TOXIC SUBSTANCES

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It was observed that most of the health problem is caused by toxic substances such as 'Ecotoxicology and Pollution' which is affecting human body and the environment. While the harmful substance that causes pollution in the environment is called 'pollutant'. The objective of this paper tends to enlighten people about the effects and preventive measures to control toxic substances. The presentation of the paper involved concept meaning of ecotoxicology and pollution, types of ecotoxicology and pollution, sources of pollution, effect of ecotoxicology and pollution, preventive measures to control ecotoxicology and pollution. This paper also recommended that the government must develop stringent regulations to control pollution of water, soil, land and air. Also, the existing laws must be enforced at all levels. More so, government should ensure that frequent environment monitoring at least twice a year must be carried out to know the level of environmental contamination. Also, health clubs should be organized in schools to educate the students on pollution and others related health topics. Both the educational, environmental and health sector should also play a vital role in educating the youth on pollution effects through seminars, workshops or conferences on health programs.

Keywords: ecotoxicology and pollution, causes, effect and preventive measure



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WIND VELOCITY MEASUREMENTS: ASSESSING THE HILL EFFECT ON A TRUNCATED PYRAMID

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This wind velocity is measured on an 18-meter-high pole at the top of a 60-meter pyramid shaped hill to measure and a meteorological station at the hill bottom, at the Puszta Zamor municipal solid waste (MSW) landfill area. The results showed an 30% increase compared to the reference station's average. The correlation coefficient between the two datasets was 0.87, supporting the accuracy of the measurements. The type of distributions was different, and this was supported by openFoam simulations, indicating a significant increase in horizontal wind velocity above the hill. These findings suggest significant potential for integrating wind energy with other renewable sources at MSW landfill sites, projecting that such systems could meet 5-10% of Hungary's electrical energy needs.



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Keywords: *Hill effect, Meteorological measurements, Renewable energy, Pusztázámor, Truncated pyramid, Wind energy*

Biography



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HEALTH AWARENESS ON CAUSES AND PREVENTION OF DRUG ADDICTION FOR BIOLOGY STUDENTS IN TERTIARY INSTITUTION IN NIGERIA

Adebayo-Adewunmi Raimot ADEJUMOKE

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It was observed that drug addiction has gone a long way to create several health problems and dangers in our societies., also students in Nigeria like many other countries of the world are developing addiction to psychoactive substances. This paper tends to create health awareness on causes and prevention of drug addiction for Biology Students in Tertiary Institution in Nigeria. The Presentation involved the conceptual framework which includes meaning of drug, concept of drug addiction, classification/ kinds of drug addiction, factors that increase the risk of addiction, symptoms of drug addiction, causes of drug addiction, effects /consequences of drug addiction, prevention of drug addiction. While the theoretical framework includes theory of addiction, self-esteem theory, Psychosocial Theory, an ego/self-theory of substance dependence, somatosensory affectional deprivation (SAD) Theory of Drug Bad-habit theory, educational implication of drug addiction. Several recommendations were made among which are Parent should educate their children on effects of drug addiction on their health, society and human dignity, tertiary institution management, including the school counsellor should be involved in awareness program that will prevent drug addiction in school, also government should set up rehabilitation centers to aid victims of drug addiction.

Keywords: health awareness, causes and prevention, drug addiction.

Biography



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Mrs. Adebayo-Adewunmi Raimol Adejumoke a lecturer at the department of Biology Education, School of Science Education, Federal College of Education (Technical) Akoka-Yaba, Lagos- State, Nigeria My area of specialization includes biology courses and botany (plant pathology, mycology, plant physiology, plant taxonomy and biotechnology(Agricultural Biotechnology)My Educational Qualification includes: Master of Science in Botany (University of Lagos) Akoka-Yaba, Lagos State, Bachelor of Science in Education Biology (University of Nigeria, Nsukka) Enugu State , Nigeria Certificate in Education (NCE) in Integrated Science/Biology (Federal College of Education Technical (Akoka), Yaba- Lagos State.

More so, I have published in both local, national and international journals, also attended many conferences, seminars and workshops. I have received several certificate awards, and appreciation letters both from religious leaders and education sectors. Also, contribute to Book Chapters at International level. Also act as blind reviewers for International Journal and Members of local and international professional bodies. I ensure I played a positive impart to my community through my Aradeb foundation with the aim of educating the females on the importance of education and enlighten students on health, science and education.



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ANALYSIS OF THE FINANCIAL STATUS OF THE HEALTH CARE SYSTEM: A COMPREHENSIVE APPROACH BASED ON SECURITY

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An indicator of the safety of the health care system in the market, competitive space is a certain level of financial condition, which is determined by the productivity of economic, financial and economic activities, effective attraction and use of resources, especially financial, risk management. It is summarized that the financial state of the health care system is a complex management category that reflects the availability of resource potential at a certain point in time, which is necessary for functioning and effective management of activities; is measured by a set of indicators that characterize the efficiency of activity, sustainability, liquidity, business activity, the probability of a crisis state (or not) and, accordingly, are determinants of the economic security of the health care system. The following levels of financial condition are distinguished: absolute, normal, unstable, crisis. Determining the level of financial condition is possible using qualitative and quantitative economic and mathematical methods. The proposed method of determining the financial condition, as the main indicator of determining economic security in a competitive market space, is systematic and complex and covers the following stages: a) determination of the overall assessment; б) a comprehensive (in-depth) assessment of the financial condition, which includes the study of financial stability, liquidity and solvency, efficiency and turnover of assets, etc. It has been proven that the choice of methodology and methods of financial state research (general, complex, local analysis) depends on the needs and requests of information users: owners, managers, staff and stakeholders. The internal and external factors that affect the financial condition and safety of health care systems are outlined. Internal factors are formalized by algorithms that show their relationship and interdependence. However, protracted crises, instability, variability of socio-



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economic conditions and the presence of threats and risks to financial and economic activity require monitoring and assessment of factors of the external environment, for the analysis of which methodological triangulation is proposed. It was concluded that the analysis of the financial condition is relevant and in demand for the management system of health care, as an indicator of the safety of their development in the market space.

Keywords: financial analysis, management, financial condition, indicators, security.

Biography



Svitlana Zhukevych - Associate Professor of the Department of Accounting and Taxation, has significant experience in scientific and pedagogical activities. Field of interests and scientific research: strategic analysis, financial analysis, economic and business analysis of various business entities, as well as public procurement in the public sector of the economy. Author of more than 120 scientific works.
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Natalia KARPYSHYN - Associate Professor of the Department of International Relations and Diplomacy, has significant experience in scientific and pedagogical activities. Field of interests and research: sustainable development, behavioral finance, public finance, diplomacy, international relations, international financial relations. He is the author of a significant number of scientific works, training manuals and textbooks.
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Natalia Zhuk - Senior lecturer of the Department of Financial and Economic Security of the Educational and Scientific Humanitarian Institute. I recently defended my dissertation on the financial security of enterprises, which is my area of interest. He is the author of more than 25 scientific works on the financial and economic security of enterprises in the food industry.
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WILDFIRE RESISTANCE COATING MATERIAL IN VELLORE RESERVE FOREST

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Global calamities, such as wildfires, place a threat to all countries and ecosystems. In the light of the many human-made and natural causes of forest fires, precautions should be considered to reduce their adverse consequences. The preventative approaches were made clearer using the experimental method, which was used to document all experimental steps. The author of this article suggested using Adobe material as a remedy for this destructive problem since it decelerates the fire spread. Growth Triangles, an engineering method that assistance in distributing the Adobe material in a systematic and scientific manner, are also used. In this study, Indian forests are underlined as a case study with potential worldwide application. The present article recommends using eco-friendly materials to protect the environment as well as being economical because doing so makes it smooth to apply Adobe Construction everywhere.

Keywords: Wildfires, adobe construction, growth triangle, stem. tree trunks.

Biography



Yara EzAl Deen Sultan from Syria, I'm a volunteer in the Scout of Syria. I got a bachelor's degree in Geography and Education Habilitation Diploma degree – from Tishreen University-Syria. I got a master's degree in environmental science from Marwadi University Rajkot- India and I'm about to complete Ph.D. degree, which I'm studying in- the Chemistry department- at Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology Chennai- India, my specialty is Environmental Science, my research work is about wildfire modelling using remote sensing and GIS technologies. I participated before in The V. International Symposium on



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Environmental Quality and Public Health and VIIth International Symposium-2023 on Environmental Health and Biosecurity Strategy. I'm interested in all Environmental issues like climate change, wildfires, renewable energy, Wildlife.... Etc



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EFFECTS OF LAND USES ON SOIL PROPERTIES – A SLOVAKIAN CASE STUDY

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Rural areas in Slovakia had small parcels for family use. Rock walls were used to mark the boundaries of the parcels, so they were easy to distinguish on the field. The rocks were collected from the parcels. Some parcels were used for meadows, some for pastures and/or meadows, and some for arable use. Two parcels were compared. One of them is a grassland, the other one is an arable field. Soil samples were taken in five replicates from the 0–20 cm depths. This depth is the maximum depth of the soil, below 20 cm there is a high proportion of rocks (80<%). We aimed to compare the arable area with the grassland, assuming that there were differences in the soil properties and the degradation caused by arable use can be proven. The soils were analyzed by the Near Infrared Scanner of Agrocates Ltd. (the Netherlands). Statistical analyses started with the Shapiro-Wilk test normality test. The results with Levene's test for normal distribution data show that there are significant differences for soil organic matter, P and K in favor of the grassland while the soil moisture was higher under arable use. The non-normal distribution data was analysed with the Mann-Whitney U-test and proved that the total N content is higher on the grassland, while pH values did not differ.

Keywords: arable field, grassland, near-infrared spectroscopy, soil organic matter, climate resilience

Biography*



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Csaba Centeri is an associate professor (Dept. of Nature Conservation and Landscape Management, Szent István Campus, Hungarian University of Agriculture and Life Sciences, Gödöllő). He has published 6 papers in D1 and 26 papers in Q1 and Q2 journals and has been serving as a chief editor in the Hungarian Journal of Landscape Ecology, guest editor of special issues in the journals of Water, Sustainability, Forest and Remote Sensing. His main research interest is soil water erosion, erosion modelling, land-use change, ecosystem services, soil-plant, soil-wildlife and other soil-zoology interactions, with special emphasis on nature conservation and landscape-related issues.



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SOIL BIOLOGY FOR SUSTAINABLE AGRICULTURE AND ENVIRONMENT PROTECTION

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Soil is a natural ecosystem with functionally and taxonomically different biological body. An intensive agricultural production system has mostly detracted the soil ecosystem services, health, and biology. Soil Biology is the study of microbial and faunal activities and agroecology in soil. The study by (Wang et al.) observed that an ex-situ addition of decomposed organic carbon increases the biomass of gram-negative bacteria, gram-positive bacteria, fungi, and actinomyces. However, the entire microbial community composition remained unchanged. Decomposed organic carbon was assimilated by specific bacterial groups present in the topsoil. (Wakelin et al.). Studied the effects of various plant species and their diversity on rhizodeposition of nutrients, primarily carbon, nitrogen, and phosphorus. They found comparable nutrient deposition in the rhizosphere, categorical of the plant species. Soil microorganisms affect the decomposition of organic residues and nutrient availability. Agricultural practices use beneficiary properties of soil microorganisms, inclusive of nitrogen fixation, macro/micronutrient solubilization, phytohormone production, and biocontrol activities in creating a sustainable cropping system. The various agronomic practices, including crop rotation, intercropping, conservation tillage, green manure, biofertilizer, and agroforestry, establish a healthy soil and ecosystem.

Keywords: Soil, Biology, Sustainable, Microorganisms, Decomposition etc.



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HETEROGENEITY OF NATURAL AREAS: A LANDSCAPE ECOLOGICAL ASPECT

Csaba CENTERI

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Climate sensitivity due to anthropogenic effects is (literally) a hot topic. Meanwhile, some individuals are already getting ready to move a part of the population to Mars, while there is a tremendous lack of information about our natural environment. This information can help solve our most recent problems about carbon sequestration, climate change, land use intensity growth, etc. The recent paper describes a smaller portion of the Bükk National Park in Hungary. While most of the soil forming factors are very similar (e.g. climate, parent rock (limestone), slope steepness (high), land cover (forest), etc.), the heterogeneity of the soil parameters is considerably high. A good example is soil acidity which is assumed to be above 7.2 as the parent rock is limestone so we might expect even higher values between 7.5 and 8.5, it was found to be between 6 and 8.5. The other parameter that has a quite high difference compared to the average is the exchangeable Ca which is expected to be high, due to the Ca-rich parent rock and the highest value proves the hypothesis to be good, being 475.8 mmol/kg, however, the minimum value is "only" 99.2 mmol/kg. It raises the question of the assumption that finding a high amount of Ca all over the national park was erratic. Still, soil organic matter, which is also expected to be high, due to the soil forming factors is following our assumptions, the average value is 7.3% with a 13.4 % maximum and a 4% minimum value. The values leave more questions than answers, and more samples to be taken and more analyses to be done. Some of the findings can be explained by some of the local forming factors but some cannot. The minimum and maximum values guide further analyses. Natural areas provide good examples of how heterogeneous our natural environments are and what we can learn from these differences concerning our future on Earth.



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Keywords: *nature conservation, national park, Hungary, land use, land cover, comparative analyses*

Biography



Csaba Centeri is an associate professor at the Dept. of Nature Conservation and Landscape Management at the Szent István Campus of the Hungarian University of Agriculture and Life Sciences in Gödöllő. He has published over 23 papers in D1, Q1 and Q2 journals. He has been serving as a chief editor in the Hungarian Journal of Landscape Ecology, and guest editor of special issues in the journals of Water, Sustainability, Forest and Remote Sensing. His main research interest is soil water erosion, soil erosion modelling, land-use change, ecosystem services, soil-plant, soil-wildlife and other soil-zoology interactions, with special emphasis on nature conservation and landscape-related issues.



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INNOVATIVE WASTE MANAGEMENT STRATEGIES TO REDUCE SOIL POLLUTION AND ENHANCE SOIL SUSTAINABILITY

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Soil pollution is a major issue worldwide it has significant effects on food production and environmental health, primarily caused by improper waste management practices, that lead to pollution, and loss of soil fertility. To address these challenges, innovative waste management approaches have become important in mitigating soil pollution and promoting sustainability. This paper emphasizes the integrated strategies used to resolve these problems. Integrated approaches like recycling waste, utilization of bio-waste, and use of organic waste techniques such as composting for agricultural materials, food waste, animal waste, green waste, and biochar have proven effective in improving soil fertility, and environmental protection. Additionally, recycling of industrial and urban wastes like degradable materials convert into organic fertilizer, and other non-degradable substances while improving soil carbon. The applications of waste-to-energy technologies also offer a sustainable solution to decrease the volume of waste and promote the regenerating energy that can be used for sustainability. Bioremediation and phytoremediation techniques are important in removing harmful pollutants from the soil and improving soil health. Adoption of these techniques can lead to a significant improvement in soil degradation, increasing soil fertility, enhancing agricultural productivity, and ensuring environmental sustainability for future generations.

Keywords: Soil pollution, food security, environmental protection, and waste recycling.

Biography



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AI-DRIVEN EXPERT SYSTEMS FOR CLIMATE-RESILIENT SOIL FERTILIZATION: ENHANCING DECISION SUPPORT FOR SUSTAINABLE AGRICULTURE

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The unpredictable nature of climate change offers considerable difficulties to soil health and crop yield, demanding the use of advanced decision-making techniques for successful soil fertilization schemes. This work investigates the creation and implementation of an expert system-enabled decision support system (DSS) aimed at optimizing soil fertilization in climate-affected agricultural settings. Farmer needs specific tools to monitor soil nutrition flow, balance, depletion, prevention and optimizing fertilizer application using NUTMON (Nutrient Monitoring). Utilizing real-time environmental data, soil profiles, and crop requirements, this system integrates machine learning algorithms with expert agricultural knowledge to generate site-specific, climate-resilient fertilization recommendations. Field experiments in various climatic zones showed that the CropNutrient DSS (Crop Nutrient Management Decision Support System) effectively improved soil nutrient management, reducing reliance on the environment by lowering chemical inputs while increasing crop yield, profitability, and soil quality. Advances in digital technology encourage the use of AI-driven precision agriculture tools such as CropSmart, TerraNIS - Agri Yield by TerraNIS, Nutrient Expert, SOILIN (Soil Information System), and DSSAT (Decision Support System for Agrotechnology Transfer), which play an important role in promoting sustainable soil health and nutrient management practices, thereby contributing to global food security and environmental sustainability. The results suggest that using AI-powered expert systems in agriculture can equip farmers with actionable information to adjust to climate-induced soil issues, improving sustainability and resilience farming practices.

Keywords: Climate Resilience, Decision Support System, Expert System, Soil Fertilization, Sustainable Agriculture

Biography



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Shreya Singh is passionate agricultural enthusiast who belongs to small village Mirzapur, Uttar Pradesh. Currently pursuing her B.Sc. (Hons.) in Agriculture at Ramlalit Singh Mahavidyalaya, she has been at the forefront of exploring innovative and sustainable agricultural practices. She has actively participated in many workshops, seminars, and technical sessions and contributed to several esteemed national and international conferences and published 7+ book chapters in prominent publications. She likewise effectively runs a blog and LinkedIn newsletter on practical cultivating, where she imparts experiences to a wide crowd, acquiring over 950k impressions. As a supporter for strengthening in farming, she is engaged with drives pointed toward sustaining female business visionaries in the agricultural area. Her all-encompassing way to deal with cultivating future in agriculture, consolidating conventional insight with technological innovation, makes her an idea chief in the arising field of smart cultivating.

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Dr. Sudhanand Prasad Lal is currently an Assistant Professor cum Scientist, Department of Agricultural Extension Education, PG College of Agriculture, RPCAU, Pusa, MoA&FW, Govt. of India. He pursued his B.Sc. Ag. (Hons.) from CSA University, Kanpur in 2012 and received Chancellor gold medallist. He did his MSc from, ICAR- National Dairy Research Institute, Karnal-132001, (Haryana) in 2014 & was awarded a merit certificate in Social Science & Management group. He did his Ph.D. Agricultural Extension Education on 12 th March 2018 and received Ph.D. best thesis Director&39;s gold medal at ICAR-NDRI, Karnal from Dr. Trilochan Mohapatra, Secretary (DARE) & Director General (ICAR) Krishi Bhavan, New Delhi. He is the recipient of NTS in B.Sc., JRF in M.Sc., and SRF in Ph.D. He is the recipient of Certificate of Excellence Award from Elsevier Researcher Academy, Amsterdam, Netherlands. He has written 81 Research articles, 04 Review articles, 03 Short communication, 07 Books, 26 Book chapters and 52 popular articles. He was invited as an expert by The Times Higher Education Academic Reputation Survey in partnership with Elsevier for the 2023 Times Higher Education World Reputation Rankings and the 2023 World University Rankings, supported by UNICEF. Dr. Lal has received citations from DRDO, IIT-Delhi, CAB Direct, ETH Zurich, USDA and FAO. He is currently subject matter expert at Tata Consultancy Services (TCS) Tata



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RECYCLING INDUSTRIAL WASTE FOR SUSTAINABLE SOIL FERTILITY: A NATURAL ALTERNATIVE TO CHEMICAL FERTILIZERS

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Soil degradation is a serious threat to global agriculture, which is the main food production unit for all human beings. Soil degrades due to many causes in which floods, desertification, and environmental hazards but the main cause is overuse of chemical fertilizer. According to researchers 200 million metric tons of chemical fertilizer are produced annually. Due to chemical fertilizer quality of soil is disturbed and its Biological, Physical, and Chemical properties are affected. Availability of essential nutrients such as Nitrogen, Phosphorus, and Potassium is affected. Hence the sustainable management of degraded soil is of paramount importance to meet the demand of food grain production for an ever-raising population in the World. Recently our industries have produced too much waste that contains organic amendments, and compost that improves soil biological, and chemical properties and stabilizes the microbial community. After treating the industrial waste properly, we produce fertilizer in granular and pellet forms. Organic fertilizer in which solid-organic fertilizers, Nutrient rich fertilizer, and vermicompost include act as a soil health booster. The fertility of soil increases, which helps to mitigate hunger. Therefore, industrial waste could be an alternative to costly chemical fertilizers as well as reduce the reliance on chemical fertilizers for enhancement production.

Keywords: Soil degradation, chemical fertilizer, industrial waste, organic fertilizer



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IMPACT OF FULL-SCALE WAR ON THE ENVIRONMENT: SOLUTIONS

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The full-scale war in Ukraine significantly affected the ecological security not only of Ukraine, but of the world in general. We are talking about the damage caused to the ecosystems of the Azov and Black seas, the destruction of soils, and therefore the reduction of arable land, the pollution of rivers and groundwater, as well as the air. Cases of destruction of natural parks, nature reserves, reserves, rare and red-listed animals are not isolated. At the same time, unique natural monuments are concentrated on the territory of Ukraine. The impact of full-scale wars, as well as armed conflicts, affects not only migration, economic, and security policies, but also environmental ones. This situation requires taking adequate measures. Conventional regulation of damages can be one of such measures.

Keywords: environmental safety, environment, damage caused, convention regulation.

Biography



Oksana Hnativ, LL.M, PhD, Associate Professor of the Department of Civil Law and Procedure of Ivan Franko National University of Lviv, Lviv, Ukraine.

Ivan Franko National University of Lviv - 2001-2006.

Attorney-at - law-2008.

PhD in law- 2014.

Academic title "Docent" – 2023.

The author of more than 120 scientific works



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ROLE OF ORGANIC MANURES, JEEVAMRIT AND GHANAJEEVAMRIT ON THE YIELD OF CARROT

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Carrot is one of the important and major root vegetable members of the family Umbelliferae, used as salad and cooked vegetable besides. In India, it is grown as a cool-season vegetable crop as most favourable temperature range is 15 to 20°C. The experiment was conducted at Research farm of Deen Dayal Upadhyaya Centre of Excellence for Organic Farming (DDUCOE-OF) of CCS Haryana Agricultural University, Hisar during the rabi season 2022-23 by adopting cultivation system without using any chemicals. The experiment was laid out in RBD with eight treatments and three replications. Three different organic manures treatments i.e., FYM, vermicompost, poultry manure alone and with combinations of biofertilizers (Azotobacter and PSB) was applied and cow-based bio-formulations (as a component of natural farming i.e., Ghanajeevamrit and Jeevamrit) and control was also included (from T₁ to T₈) respectively. Yield attributes and total yield (q/ha) were recorded maximum in treatment T₅ which was significantly superior over T₇ and T₈. The maximum CGR (5.53 g m² day⁻¹) between 31- 60 DAS and AGR (0.94 cm day⁻¹) from 31- 60 DAS were recorded in treatment T₅. Root and shoot yields (283.4 and 138.0 q ha⁻¹, respectively) were recorded the maximum in treatment T₅ which showed an increase of 28.35 and 39.39 % over control (220.8 and 99.0 q ha⁻¹, respectively) and 17.25 % and 24.77 % over cow-based bio-formulations (241.7 and 110.6 q ha⁻¹, respectively), respectively.

Keywords: Organic farming, Azotobacter, bio-formulations

Biography



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DIGITALIZATION AS A DRIVER OF CIRCULAR ECONOMIC TRANSITION IN CHINA

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The transition to a circular economy is critical for sustainable development, particularly in resource-intensive economies like China. Emerging digital technologies have the potential to serve as key enabling factors for this transition. China's policy frameworks, including the 14th Five-Year Plan and net-zero commitments, strongly support this digitalized transition, offering a regulatory foundation for innovation. The paper explores the transformative role of digitalization in advancing China's transition to a circular economy, a model that emphasizes resource efficiency, waste reduction, and sustainable growth. By analysing the synergies between digitalization and circularity, the study explores how digital technologies can enable and support a circular economy in China. The research provides insights into the opportunities and challenges of leveraging digitalization to drive China's circular economy transition through a comprehensive literature review, SWOT and case study analysis. The findings indicate that digitalization promotes a circular economy and sustainable development, it also advances China's economic goals by fostering innovation and international competitiveness.
Keywords: China, circular economy, digitalization, economic transition, sustainable development.

Biography



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Dr. Olga Drobotiuk is a senior research fellow at the A. Yu. Krymskyi Institute of Oriental Studies, National Academy of Sciences of Ukraine, a doctoral candidate at the Kyiv National Economic University named after Vadym Hetman, and a board member of the Ukrainian Association of Sinologists. Her research focuses on Chinese economic development and Sino-Ukrainian economic cooperation.



Valeriia Osachuk is a PhD candidate at Kyiv National Economic University named after Vadym Hetman and the Chief Marketing Officer at Kultura Marketing, a digital agency. Her dissertation research centers on the digital imperative in the development of international trade



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LAW & ECONOMY OF CIRCULAR MODELS AND SUSTAINABLE STRATEGIES

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This research explores the legal and economic frameworks essential for advancing circular economy models and sustainable strategies within the global environmental development and sustainability sector. The study examines how policy, legal guidelines, and economic incentives can support or hinder the adoption of circular models that prioritize resource efficiency, waste reduction, and long-term environmental resilience. The principal aim is to assess the role of law in facilitating sustainable business practices and how economic strategies, including taxation and subsidies, impact the transition to circular economies.

Key findings reveal that clear, enforceable regulations and incentives are critical for the successful implementation of sustainable strategies. Economically, tax breaks and subsidies for eco-friendly practices show significant promise in encouraging sustainable investments. The research concludes that an integrated approach—leveraging both legal mandates and economic policies—provides a stronger foundation for sustainable environmental development. This study contributes insights that can inform policies at both national and international levels, providing a roadmap for governments, businesses, and stakeholders to collaborate effectively for a sustainable future.

Keywords: Circular economy, sustainability, environmental policy resource efficiency, economic incentives, legal frameworks

Biography



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Vera Alpár, with three doctoral degrees, is currently the Head of the Department of Applied Social Sciences and an Associate Professor at Kodolányi János University. She earned her Juris Doctorate in 2022 from Károli Gáspár University, Summa Cum Laude, along with a Doctorate in Educational Science from the Faculty of Psychology and Education in 2021. Additionally, she holds a PhD in Social Work. Her areas of expertise include organizational development, strategic HR, and interdisciplinary approaches to societal challenges. With extensive international experience and a commitment to academic excellence, she leads her department with a focus on talent development and impactful research.



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IN VITRO MICROPROPAGATION OF PUNICA GRANATUM VAR. DEVEDISHE: A COMPARATIVE STUDY OF CONVENTIONAL METHODS AND THE ELECTIS BIOREACTOR SYSTEM

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This research evaluated the possibility of effectively applying the ElecTIS prototype bioreactor for mass production of Punica granatum L. var Devedishe, an autochthonous fruit species in Albania. In vitro cultures were established using zygotic embryos as initial explants, cultivated in WPM nutrient medium (Woody Plant Medium) supplemented with 1 mg/l of 6-benzylaminopurine (BAP), 0.1 mg/l of 1-naphthaleneacetic acid (NAA). Shoot and root organogenesis were observed 3 – 5 days after embryo inoculation. The plantlets were subcultured in the same nutrient medium, and the shoots obtained after 2 subcultures were used for further micropropagation in the ElecTIS bioreactor, a novel prototype of the TIS systems. The plantlets cultivated in the traditional semi-solid medium cultivation system were used as a control group. Morphometric parameters, rate of tissue hyperhydration, and shoot tip necrosis were observed for both cultivation techniques. The ElecTIS bioreactor showed better results, including higher relative growth rates (RGR), more significant shoot proliferation, and increased shoot length. Moreover, it resulted in a lower production cost by eliminating the need for agar in the liquid medium and decreasing labor time for culture vessels' preparation and explants' inoculation in the laminar flow hood. Given these preliminary data on the effectiveness of pomegranate micropropagation in ElecTIS bioreactor, scientific research should continue to further optimize this micropropagation protocol as a potential possibility of applying this type of TIS system in large-scale production of this valuable plant species.

Keywords: pomegranate, temporary immersion system, micropropagation costs, proliferation rate
Biography



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Brunilda ÇUKO is a Ph.D. student at the University of Tirana, Albania. She graduated in 2014 with a bachelor's degree in biotechnology and earned a master's degree in molecular and industrial biotechnology in 2016 from the Faculty of Natural Sciences, Department of Biotechnology.

From 2016 to 2023, Brunilda worked as a lecturer and researcher assistant and at the Laboratory of In Vitro Tissue Culture, Department of Biotechnology, UT. She has been working and gaining good experience in plant micropropagation, in vitro sanitation of plants and in vitro conservation methods. Her current PhD study is focused on micropropagation of fruit species of Albania by using innovative temporary immersion system bioreactors such as SETIS, Plantform and ElecTIS.

Author and co-author of the following scientific papers:

- Çuko B., Shkëmbi L., Kongjika E., Sota., "Overcoming challenges for micropropagation of *Prunus domestica* cv. Tropojane in various TIS bioreactor systems" Book of Proceedings of the 2nd conference of Cost Action CA21157 COPYTREE, 2024.
- Çuko B. "Patenting transgenic plants: legal framework and statistics in the last 10 years in Europe", 4th International Conference on Applied Biotechnology (4th ICAB) – Proceedings Book, ISBN: 978-960-233-276-4, 2022
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- Grazhdani M., Sota V., Çuko B., Kongjika E., "Micropropagation of some albanian cultivar of *Malus domestica* borkh. via direct organogenesis" *Journal of Natural and Technical Sciences (JNTS)*, 2016



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- *Sota V., Çuko B., Bacu A., Kongjika E., August 2015 "Seed culture – a successful method for avoiding polyphenolic oxidation of Malus domestica L. explants during micropropagation" Poster session presented at 8th EURO Biotechnology Congress, Frankfurt, Germany*



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REGULATORY MECHANISM OF BORAGO OFFICINALIS L. UNDER CADMIUM STRESS BASED ON TRANSCRIPTOME ANALYSIS

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Cadmium is recognized as one of the most widespread and detrimental heavy metal contaminants, inhibiting plant growth and development by disrupting various physiological processes. The current study was conducted with the aim of investigating the accumulation of Cd and the adapting genes to metal stress in the roots of the medicinal plant borage. The impact of varying Cd concentrations on metal buildup and alterations in gene expression profiles was assessed after 24 and 48 h of Cd exposure. Total root RNA samples were sequenced using the Illumina HiSeq 2000 platform. Bioinformatics analysis encompassing reference transcriptome assembly, functional annotation of the transcripts, and differential gene expression analysis was conducted. The current study demonstrated that elevating the concentration of Cd in the culture medium resulted in increased Cd accumulation in the roots of borage. According to the results, the roots exposed to 324 µM Cd showed the highest response to Cd by changing the expression of 14,778 and 15,852 transcripts at 24 and 48 h, respectively. The present study exhibited that many NRAMP family members were expressed, with NRAMP3 showing the highest expression under all stress conditions. HMA8 is a gene associated with heavy metals that enhanced its expression in reaction to Cd stress. In addition, the accumulation of Cd in the root intensified with the decrease in aquaporin (PIP) gene expression. This expression pattern induces the segregation and compartmentalization of Cd inside the vacuole, tonoplast, and cellular storage compartments. Consequently, it may be concluded that this approach functions as a regulatory mechanism in borage to alleviate the harmful impacts of Cd on cellular processes and restrict its translocation to the shoot, thereby protecting the plant.

Keywords: Borage, Heavy metal, Protective mechanism, Root



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GENETIC BEHAVIOR FOR RICE YIELD AND IT IS ATTRIBUTING USING TRIPLE ANALYSIS

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A triple test cross was conducted to assess genetic variance in rice yield traits, examining epistasis, additive, and dominance effects using testers Giza 177, Grain Super Rice IR2-9-L1-L3R2, their F1 hybrid, and 15 promising lines across three seasons. Results showed significant total epistasis, especially type i for traits like flag leaf area and grain yield, while j + l types were beneficial for all traits under recurrent selection. Line MJ5460-4 contributed notably to epistasis. Additive and dominance variances were high, suggesting early selection for additive traits (filled grains, flag leaf area) and late selection for traits with partial or over-dominance effects.



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POTENTIAL OF ELECTRIC VEHICLES FOR CLIMATE CHANGE MITIGATION AND ENVIRONMENTAL SUSTAINABILITY

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Electric cars have become famous and commonly used worldwide. This study is focused on introducing and using electric cars to help to improve their healthy lifestyle by providing air pollution free and use of electricity friendly cars. This paper therefore presents the potential of offering electric vehicles (EVs) as an arrangement to reduce environmental contamination and associated benefits. The transportation means could be a critical support to discuss contamination compared with conventional fossil fuel vehicles being a source of pollution. By conducting a comprehensive examination of the current state of quality, the impacts of conventional vehicles on the environment, and the benefits of transitioning to EVs. This involved the intensive focus on micro and macro competitor factors from the electric vehicle companies and reviewing related literature. These focusses on points to supply bits of knowledge into the potential of EVs in lessening environmental contamination. Moreover, the study further looked at the challenges and openings related to advancing and offering EVs foundation advancement, buyer mind set, and government arrangements in decision making. This investigation revealed that expanding EV appropriation is viable thus leading to a critical diminishment in contamination and a cleaner, more advantageous environment for all citizens and environmental integrity promotion. EVs deliver zero greenhouse gases emissions, meaning they don't emit toxic waste such as nitrogen oxides, particulate matter, and carbon monoxide like conventional gasoline-powered vehicles. Embracing EVs by nations can as well diminish their general unnecessary gas outflows and move forward discussing quality for citizens. Furthermore, EVs have lower working costs and can help thus diminish reliance on fossil powers, advancing vitality, freedom and supportability. Generally, the appropriation of EVs presents a promising arrangement to address the natural challenges postured by transportation outflows. Lastly, highlight recommendations for start-up businesses that promote improving public health and environmental sustainability.

Keywords: Electric cars; Transportation; Air pollution; environmental sustainability; Start up business.



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Biography



Innocent Tayari Mwizerwa is a Ugandan PhD researcher at Donghua University college of environmental science and engineering- shanghai-PR China. He obtained Master of Environmental Engineering, Donghua University (2020), Bachelor of Environmental Science, Technology and Management (Kyambogo University-Uganda (2016) and a Diploma in Fisheries Management and Technologies from Fisheries Training Institute Entebbe-Uganda-(2008). He has published scientific journal articles, conferences, and presentations in the same field and has received several awards for the contributions to the scientific community. Innocent has worked and is active with different industries, associations and academies around the world. He is interested in biological testing, materials chemistry for water pollution remediation. My recent research focuses on optimization carbon nitride heterogeneous catalysis with N-porphyrins complexion and single atom 3d transition metals.



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GRAPHENE, A GAME-CHANGER IN SCIENCE AND TECHNOLOGY

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Science and technology are about to undergo a revolution thanks to graphene's extraordinary characteristics and adaptability. It leads in many industries thanks to its remarkable strength, high electrical and thermal conductivity, flexibility, and transparency. It has been shown via intensive research that graphene-based materials have great potential for use in energy storage, electronics, biomedical devices, and environmental applications. The results of this study highlight graphene's promise as a revolutionary material that outperforms conventional materials in terms of efficiency and performance. With continuous research and development, graphene is opening the door to ground-breaking ideas, establishing itself as a catalyst for revolutionary change throughout industries, and tackling important global issues.

Moreover, graphene's adaptability goes beyond its physical characteristics because of its atomic structure, which permits nanoscale manipulation and opens up new possibilities for specialized applications. Because of its biocompatibility and impermeability, it has great promise for applications in biomedicine, including drug delivery systems and biosensors. Graphene-based materials promise faster charging times and longer battery life in energy storage applications such as batteries and super capacitors. Moreover, graphene's potential for environmental remediation—such as pollution management and water purification, illustrates its ability to meet urgent sustainability issues. Graphene continues to be a source of innovation, pushing the boundaries of science and technology with never-before-seen impact as research opens up new possibilities.

Keywords: Graphene, Derivatives of Graphene, Innovative Technology

Biography



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My name is Asad Ullah, a dedicated researcher exploring the potential of graphene. Pursuing a bachelor's degree with last year in Chemistry at University of Central Punjab, Lahore, Pakistan, my fascination with the material began during undergraduate studies. I am known for my innovative approach and rigorous experimentation. I am making significant contributions to graphene synthesis and applications. With a passion for pushing the boundaries of scientific knowledge, I collaborate across disciplines to unlock graphene's potential in electronics, energy, biomedicine, and environmental sustainability. My commitment to excellence drives me to shape a future where graphene revolutionizes technology and address pressing global challenges.



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FACTORS AFFECTING CONSUMERS ATTITUDE TOWARDS LOCAL RICE PRODUCTION AND CONSUMPTION IN OGUN STATE, NIGERIA

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Rice is a staple food in many parts of the world, including Nigeria. The demand for rice in Nigeria is increasing due to population growth and urbanization but the local rice popularly known as 'Ofada rice' is less preferred among consumers for imported rice, so the study identified the factors affecting consumers' attitude towards local rice production and consumption in Ogun state. A multi-stage random sampling was employed to generate primary data with the aid of well-structured questionnaire, and a total of 108 respondents were selected for the study. Data were analysed using descriptive statistics such as frequency, percentage, mean statistics etc.

The major factors influencing the attitudes were low price of local rice ($\bar{x}$ = 3.72), its rich quality ($\bar{x}$ = 3.70) and its freshness ($\bar{x}$ = 3.17). It was also discovered that the respondents have positive perception ($\bar{x}$ = 2.89) towards local rice because its freshness and nutritious quality. Further results also showed that there is a moderate level of consumption (66.0%) of local rice in the study areas due to its taste compared to the imported rice, suggesting that it is already a staple food in the study area. Issues like stones in local rice ($\bar{x}$ = 3.65) and negative experience such as lower flavour ($\bar{x}$ = 3.37) were the major issues that affects the consumption of local rice. In conclusion, it was recommended that quality control mechanisms should be put in place to ensure that local rice meets high standards for texture, taste, and cooking consistency.

Keywords: Local Rice, Attitudes, Barriers, Perception

Biography



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Wole-Alo Felicia Itunu born on 23rd of August 1980 and is a researcher in the field of Gender and Agricultural extension and Rural Development at the Federal University of Technology. She received her master's degree and doctorate degree from the Federal University of Technology. She currently lives in Akure city and some of her notable works includes Small-scale farmers' perception on organic farming status in Ondo state, Nigeria Assessing the future of agriculture in the hands of rural youth in Oriade local government area of osun state, Nigeria Utilization of modern cassava processing techniques among small holder rural women processor in Ondo State, Nigeria, etc.



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FACTORS AFFECTING MARKET ORIENTATION OF RICE FARMERS IN EKITI STATE, NIGERIA

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Rice became a critical component of the Nigerian household diet and on the other side, a major consumer of the country's foreign exchange as the imported rice is preferred to the local rice. We have different types of rice that grow very well in different states in Nigeria and yet, Nigeria government has yet to harness these potentials to boost local rice production despite its nutritious quality, so this study examined the factors affecting market orientation of 110 rice farmers in Ekiti state, Nigeria. A total number of 110 rice farmers was purposively selected for the study using the multi-stage sampling technique. Data were analysed using descriptive statistics such as frequency, percentage, mean statistics etc. Result showed that only 6.3% of the respondents attempted and completed tertiary education. The major factors that affect market orientation were price fixing ($\bar{x}= 1.95$), financial performance ($\bar{x}= 1.94$), customer's preferences ($\bar{x}= 1.89$), distribution channels ($\bar{x}= 1.88$) and variety selection ($\bar{x}= 1.81$). It was concluded the market orientation of the farmers is very low and this is due to the low educational level as it takes a certain level of educational exposure and knowledge to make business decisions that would guide an individual in meeting different consumer's needs and demands to help build strong relationship with consumers, ensuring repeat business and market loyalty. Hence, it was recommended that the rice farmers need to be educated on business marketing.

Keywords: Rice Farmers, Market Orientation, Consumers

Biography



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Wole-Alo Felicia Itunu born on 23rd of August 1980 and is a researcher in the field of Gender and Agricultural extension and Rural Development at the Federal University of Technology. She received her master's degree and doctorate degree from the Federal University of Technology. She currently lives in Akure city and some of her notable works includes Small-scale farmers' perception on organic farming status in Ondo state, Nigeria Assessing the future of agriculture in the hands of rural youth in Oriade local government area of osun state, Nigeria Utilization of modern cassava processing techniques among small holder rural women processor in Ondo State, Nigeria, etc.



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IMPROVING THE PERFORMANCE OF BANDWIDTH EFFICIENT ACKNOWLEDGEMENT BASED MULTICAST (BEAM) PROTOCOL IN VANET FOR URBAN ENVIRONMENT

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Vehicular Ad-hoc Network (VANET) is part of Mobile Ad-hoc Network (MANET) that facilitates communication between group of vehicles to provide safety of vehicles and road, traffic updates, entertainment, data sharing and to increase the comfort to both drivers and passengers. Due to the high mobility and dynamism, routing the messages/disseminate the data to their destination in VANETs is a challenging task. There are number of protocols that disseminate data to appropriate destination in VANET but to preserve limited bandwidth and to disseminate maximum data over networks during emergency makes it more challenging. These protocols are relegated as broadcasting, multicasting and geo-casting-based protocols. Multicasting based protocols are found to be best for conserving the bandwidth. The one and best desired protocol named as Bandwidth Efficient Acknowledgment Based Multicasting Protocol (BEAM) exists that improve the performance of VANETS by repressing the number of in-network message transactions and thereby efficiently using the bandwidth during an emergency. But this protocol may lead to multicar chain collision as there is no V2V communication. So, to overcome the problem of BEAM protocol we proposed algorithm by considering the concept of clustering. Clustering is a way of grouping of vehicles based upon some predefined metrics such as density, velocity, and geographical locations of the vehicles. Clustering in vehicular ad hoc networks (VANET) is one of the control means for dynamic topology. We established clustering based on speed, density and direction of vehicles to provide stability, which in turn enhance cluster lifetime and minimize communication barriers and installation cost of RSU. The proposed approach make use of multi-agent interaction method consists of static and mobile agents to establish the



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communication between vehicles and RSU. RSU for multicast groups whereas CH (in MG) for non-multicast group agents are responsible to decide the cluster size and select suitable primary and secondary cluster head based on vehicle speed and connectivity with neighbouring nodes. The second cluster head used as backup when the first cluster head is failed and act as main cluster head to prevent re-clustering in high mobility and dynamism of vehicles over the network. The cluster size is vary depending upon vehicle speed, which in turn increases the cluster lifetime and reduces the routing overhead. Simulation results show the improved performance of new proposed algorithm in terms of Throughput, PDR and end to end delay when compared with BEAM protocol.

Keywords: vanet, manet, beam, ch, rsu, mg, emergency

Biography



Alehegn Minale Chanie has MSc in Computer Networking, BSc in Information Technology from Jimma university. He is working as Lecturer, Faculty of Computing & Informatics, Jimma Institute of Technology, Jimma University



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ASSESSMENT OF THE NEUROPROTECTIVE EFFECT OF ONONIS NATRIX EXTRACT IN AN ACUTE MODEL OF LEAD EXPOSURE

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Lead (Pb) is a toxic metal naturally occurring in the earth's crust. It is not essential for the human body, and exposure to this metal through the various routes (digestive, respiratory or dermal) is dangerous and can subsequently induce adverse health effects. Poisoning can be acute, resulting from brief exposure to Pb in high amounts, or chronic, due to repeated exposure to very small amounts. Our study aims firstly to elucidate the effect of acute lead exposition by an intraperitoneal injection (50 mg / kg) for three successive days in mice on the functioning of the central nervous system. On the other hand, we evaluate the preventive effect of the aqueous extract of Ononis matrix administered by oral gavage. We have noticed that acute lead exposure induced behavioral alterations like a deficiency in short term memory and expression of anxiety behavior. Weight monitoring also showed significant weight loss in intoxicated mice, associated with increased cerebral-body ratios. The study of the rate of cerebral edema revealed an increase in the latter in the group intoxicated with Pb, which proves a dysfunction of these organs following lead exposure. However, the use of Ononis matrix as a natural pretreatment has shown a significant preventive effect by preventing the anxiogenic effect of lead and by inhibiting the alteration of the state of short-term memory in mice poisoned by Pb and pretreated with this plant. In addition, the extract of Ononis matrix has shown remarkable preventive potential against brain morphometry, without forgetting its contribution to the reduction of cerebral edema.

Keywords: lead acetate, Ononis matrix, central nervous system, anxiety, memory, cerebral edema.



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PARENTAL INTEREST, INVOLVEMENT, AND OCCUPATIONAL IMPACT ON BASIC SCIENCE OUTCOMES IN PRIMARY EDUCATION

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This study investigates the impact of parental factors on the academic performance of lower primary pupils in Basic Science within Ibadan North Local Government Area, Oyo State, Nigeria. Employing an ex-post facto research design, the study examines three key variables: parental interest in science, parental involvement, and parents’ job specialization. Data were collected from 96 pupils across five randomly selected public primary schools and were analyzed using descriptive statistics and multiple regression analysis. Findings reveal that while parents showed a high level of interest and involvement in their children’s science education, the relative contribution of the examined parental factors on pupils’ performance in Basic Science was not statistically significant. These results indicate that other school or learner-related factors may have a stronger influence on pupil outcomes in science. Recommendations include enhancing educational programs to raise awareness of the importance of parental involvement and broadening future research to include other influential factors.

Keywords: Parental involvement, primary education, Basic Science, academic performance, science education



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CHALLENGES AND SOLUTIONS FOR PHOSPHORUS MANAGEMENT IN CALCAREOUS SOILS: IMPACTS ON CROP YIELD, FOOD SECURITY, AND SUSTAINABILITY

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Phosphorus (P) is an essential nutrient for plant growth, significantly influencing energy storage and genetic functions. Additionally, phosphorus is a finite resource, making its effective management essential for long-term agricultural sustainability. Phosphorus fixation occurs due to chemical reactions with soil minerals, including aluminum, iron, and calcium, depending on soil pH. These reactions trap phosphorus in insoluble forms, particularly in calcareous soils with high pH. Phosphorus (P) management in calcareous soils poses significant challenges due to high soil pH and calcium carbonate content, which restricts P availability to crops. This reduced P availability impedes plant growth, limiting crop yields and affecting food security, especially in regions dependent on calcareous soils for agriculture. Key strategies to improve P availability in calcareous soils include soil amendments, optimized fertilizer application methods, and the use of P-efficient crop varieties. Soil amendments, such as sulfur or organic matter, can help acidify the rhizosphere, enhancing P solubility and uptake by plants. Precision agriculture techniques, including localized fertilizer applications and controlled-release P fertilizers, can increase P use efficiency by targeting the nutrient directly to the crop's root zone, reducing losses to fixation. Integrating these practices can improve crop yields on calcareous soils, contributing to enhanced food security. This paper explores these challenges and solutions, emphasizing the need for holistic and adaptive phosphorus management strategies to maximize agricultural productivity, mitigate environmental impacts, and support sustainable food systems on calcareous soils.

Keywords: Phosphorus management in calcareous soil, Crop yield optimization, Sustainable agriculture, Phosphorus use efficiency

Biography



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I am an undergraduate student of BSc (hons) Agri. (Soil sciences) at MNS university multan,



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DETERMINATION OF THE WATER QUALITY OF THE SMALL RIVERS OF THE SIVERSKYI DONETS BASIN

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The quality of the surface waters of the rivers of the Siverskyi Donets basin is one of the decisive conditions for ensuring the water management needs of the population of the eastern region of Ukraine. The aggravation of this problem occurred due to the beginning of hostilities in the east, taking place within the basin of the Siverskyi Donets. Possible water pollution caused by munitions ruptures and, as a result, entering water bodies with surface runoff of chemicals.

Our research, conducted in the riverbeds flowing through the city of Druzhkivka in the Donetsk region, is of utmost importance. On this territory is the right tributary of Siverskyi Donets - Kazennyi Torets and its tributary Kryvyy Torets. From these two rivers, we took five water samples in the channels of the Kryvyy Torets River and the Kazennyi Torets River. The results of our laboratory studies, conducted in accordance with the 'Hygienic standards...' [1], revealed that the water exceeded the standards for nitrate concentrations by 1.9 - 3.6 times in the Kazennyi Torets River (within the city limits) at the confluence of the Kryvyy Torets. In all water samples, nitrites are within normal limits. Concentrations of chlorides in the water of Kazennyi Torets are 8 times higher (at the confluence of Kryvyy Torets) and 4 times higher along the channel (within the city limits). The results of the analyses did not show exceeding the norms for the concentration of heavy metals Zn, Cu, Mn, Cd, Cr6+ in the water of both rivers. The source of pollution that has led to increased concentrations of chlorides and nitrates in water samples is likely to be surface runoff from the city and agricultural lands. The potential for poisoning and intoxication of the human body from using and consuming water with high concentrations of chlorides and nitrates is a serious concern that cannot be overlooked.

1. Hygienic water quality standards of water bodies to meet drinking, household and other needs of the population: Ministry of Health of Ukraine May 2, 2022, No. 721.



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Keywords: *water quality, chemical analysis, regulations, water use.*

Biography



Professor Alla Nekos is performing as head of the Department of Environmental Safety and Environmental Education. The experience of scientific and pedagogical activity is 40 years. Field of interests and scientific research: Plant food safety, environmental education, remote methods of research in ecology, author of about 500 Scientific Publications.

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Kateryna Khaduskina is student at V. N. Karazin Kharkiv National University, Kharkiv, Ukraine



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THE POTENTIAL ROLE OF WILD GAME FEEDING IN THE SPREAD OF INVASIVE ALIEN SPECIES BASED ON RELATED INTERNATIONAL AND HUNGARIAN LITERATURE

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Wild game feeding is a widespread but very controversial practice all over the world. Most studies focused on the effect of supplementary feeding on animal populations or tree damage. At feeding sites, a large amount of fodder is used, and since these are typically contaminated with weed seeds, alien species can easily enter the natural environment. We conducted a literature review of studies investigating the effects of game feeding on herbaceous vegetation. Related studies are very sporadic in both international and national literature. Most of the papers was conducted in America and Europe and they examined the effects of winter supplementary feeding. In this case, the forage is mainly hay and silage, and almost no invasive species were found. However, in some Central European countries, where hunting feeding grounds operated with mixed feeds are the most common, the occurrence of invasive species proved to be higher. In Hungary, for example, many studies showed a significant number of invasive species at feeding sites, in many regions of the country. At some sites, up to 8-9 invasive species may appear. Review of botanical data reports showed similar results. Authors mention almost only weed species, primarily alien species, in the surroundings of hunting establishments, and in addition, among the sources found, they also name foreign species in connection with feeders that are taxa newly appearing in the Hungarian flora. Based on the overview, it can be said that a total of 21 invasive species of plants are mentioned in the country in connection with game feeders. Consequently, the type of feeding and the quality of feed could be important factors in the spread of invasive species. Considering that game feeding is very



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intensive in European countries, in addition to the effects of climate change, these can even be focal points for biological invasion.

Keywords: supplementary feeding, bait sites, degradation, weed species

Biography



I was born in 1993 in Hungary. I graduated in 2015 (BA) and in 2018 (MA) at Hungarian University of Agriculture and Life Sciences as nature conservation engineer. I started Ph.D. in 2018 (Doctoral School of Environmental Sciences) and finished it in 2022. I currently work as a university lecturer at Department of Nature Conservation and Landscape Management, in Hungarian University of Agriculture and Life Sciences.

Other work experiences: 2018: environmental educational tasks at a composting company (few months). 2015: forest surveyor in the project SH/4/13 Multipurpose assesment serving forest biodiversity conservation in the Carpathian Region of Hungary (6 months).

Language skills: intermediate English, basic German language exams. Others: I established an educational trail to the highest mountain peak of Hungary, and I often lead tours. Research interests: plant invasion, forest ecology, soil seed bank.



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EXAMINATION OF SOIL DEGRADATION IN A HUNTING GROUND LOCATED IN A CONSTRUCTION WASTE LANDFILL SITE IN HUNGARY

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Wild boar is increasingly present in periurban and urban areas, which makes wild game management necessary in these areas as well. In Hungary, especially bait sites used for wild boar hunting are widespread, they are found in all parts of the country. Since feed is usually placed directly on the soil surface at these sites, this can significantly affect soil properties. We examined soil characteristics of a bait site located in a construction waste landfill site in the capital agglomeration of Hungary. Soil samples were collected from the 0–10cm layer of the soil at a wild boar bait site. We also designated two nearby control areas (within approx. 50 m), a grassland and a forest site. Soil properties were measured by a near-infrared device (Agrocares Ltd., The Netherlands). Soil characteristics were compared. We hypothesized that the soil nutrients (e.g. N, P, K, Ca, Mg) are the highest at the bait site due to the continuous supply of food plus the manure produced by the animals. However, according to the results, this proved to be true only in relation to the grassland site. The amount of soil organic matter, organic carbon, Ca, cation exchange capacity and total and potentially mineralizable nitrogen were the highest at forest site. Results show that feeding can cause changes in soil properties, but such anthropogenic habitats like landfill sites, there are other soil-degrading effects on a much larger scale. Thus, further research in similar habitats is needed to better understand the effects.

Keywords: supplementary feeding, bait sites, degraded habitats, nutrient enrichment

Biography



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I graduated in 2015 (BA) and in 2018 (MA) at Hungarian University of Agriculture and Life Sciences as nature conservation engineer. I started Ph.D. in 2018 (Doctoral School of Environmental Sciences) and finished it in 2022. I currently work as a university lecturer at Department of Nature Conservation and Landscape Management, in Hungarian University of Agriculture and Life Sciences.

Other work experiences: 2015: forest surveyor in the project SH/4/13 Multipurpose assessment serving forest biodiversity conservation in the Carpathian Region of Hungary (6 months).

Language skills: intermediate English, basic German language exams.

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CHARACTERIZATION OF COPPER OXIDE–JATROPHA OIL NANOFLUID AS A SECONDARY REFRIGERANT

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Nanofluid is a new fluid with special characteristics that can be used in various industrial heat transfer applications. The nanofluid was created using the two-step approach of dispersing nanoparticles into Jatropha oil. The experiments were conducted for four samples of mixture nanofluid at four different volume concentrations of 0.5%, 1.0%, 1.5%, and 2%. The nanoparticles were characterized by X-ray diffractometric analysis, X-ray fluorescence spectroscopy, and scanning electron microscopy. The greatest increase in thermal conductivity for CuO–Jatropha oil nanofluids was made possible by 0.5%, 1.0%, 1.5%, and 2% mixture was 4.5%, 6.01%, 7.6, and 9.1%. The study observed that a mixture achieved the highest thermal conductivity for nanofluid at 2%. At a mixture of 0.5%, the lowest value of thermal conductivity within the range under consideration, a “deeding” effect was seen. To determine the thermal conductivity of CuO–Jatropha oil nanofluids based on temperature, volume concentration, and nanoparticle mixture volume concentrations, the study suggested and compared four sample models. The effect of nanoparticles on the rise of thermal conductivity and viscosity was investigated at temperatures ranging from 298 to 323 K. The X-ray diffractometer is used to characterize nanoparticles. Viscosity and thermal conductivity have been tested in the lab. The findings show that the copper oxide nanoparticles improved the base fluid’s thermophysical abilities more than Jatropha oil alone. For the evaluation of the thermal conductivity and viscosity of nanofluid, new empirical correlations were presented based on experimental data. The thermal conductivity of the nanofluids increases as the temperature rises, while the viscosity of the nanofluids decreases.



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A STUDY ON RAIL FREIGHT TRANSPORT EMISSIONS AND POSSIBLE WAYS TO REDUCE THEM

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The rail sector, although often seen as environmentally friendly, faces significant challenges in terms of emissions, especially for diesel locomotives. This article examines the current emissions situation in rail freight, with a particular focus on the impact of diesel engines and possible solutions. The impact of nitrogen oxides (NO_x) is analysed by reviewing key studies and case studies. The primary aim of the article is to show how emissions from rail transport have changed since 1990 and the causes of the changes. In addition, from a rail transport perspective, technical proposals are given to help railways to really reduce emissions of air pollutants from rail, since if we want to increase the share of rail transport, these solutions are essential to avoid a drastic increase in the emission of chemicals that are harmful to the environment

Keywords: rail freight, NO_x reduction, EGR system, AdBlue AU 32 system, diesel locomotives



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III. Session:

Workshop Special Session:

Environmental Health and Climatic Change



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IMPACTS OF CLIMATIC CHANGE AND THE FUTURE OF THE HEALTH OF BIOSPHERE

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ABSTRACT

Climate change poses significant challenges to global stability, despite contributing minimally to global emissions, facing disproportionate climate impacts. The Earth's temperature is rising rapidly due to human driven greenhouse gas (GHG) emissions, primarily from burning. This has led to significant changes in the world's climate and consequently intensified hydro-climatic extremes such as heavy rainfall, droughts, floods, sea level rise, and cyclones around the world fossil fuels. Climate change profoundly impacts the biosphere and human health, disrupting ecosystems, causing species migration and extinction, and increasing disease outbreaks through shifting weather patterns and habitat destruction. Achieving sustainability requires protecting the biosphere by reducing GHG emissions, preserving natural habitats like forests and wetlands that act as carbon sinks, and fostering ecosystem-based strategies to adapt to changing conditions. These actions are essential for maintaining the delicate balance of life on Earth and ensuring human well-being by safeguarding food and water security and reducing health risks. Climate change severely harms the biosphere by disrupting ecosystems, threatening biodiversity, and creating conditions for new and intensified disease outbreaks. Impacts include shifting species' geographic ranges, altered life cycles, the loss of vital habitats like coral reefs, and an increase in extreme weather events that devastate ecosystems and livelihoods. Environmental change poses a serious threat to well established frameworks of the ecosystem, while the increase in the average temperature of the Earth's atmosphere, known as global warming, is a primary driver of these ecological disruptions. In 2017, human-caused warming increased by around 1 C (between 0.8 C and 1.2°C) over pre-industrial levels, with an increase of 0.2°C (between 0.1 C and 0.3°C) per 10 years. Climate change and variability limit farmers' capacity to make strategic agricultural decisions. Local knowledge plays a crucial role in establishing climate change mitigation and adaptation strategies in areas with limited hydrometeorological data. Subsistence farmers are sensitive to climate change but also have extensive knowledge of local weather patterns and past extremes. Climate change poses significant challenges to



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global stability, which, despite contributing minimally to global emissions, face disproportionate climate impacts. Climate change is one of the most urgent and complex global challenges, affecting nearly every aspect of life including health, ecosystems, infrastructure, food systems, and economic stability. In the era of climate change, optimizing both photosynthesis and radiation use efficiency is essential to meet the growing global food demand and minimizing environmental impacts. Climate change poses significant challenges to photosynthesis and radiation use efficiency through increased temperatures, altered precipitation patterns, and elevated atmospheric CO₂ levels. These changes can disrupt plant metabolic processes, reduce water availability, and increase the frequency of extreme weather events, thereby affecting crop productivity. However, there is a lack of comprehensive documentation on the understanding of relationship between photosynthesis and radiation use efficiency in this era of climate change. Changes in the frequency and intensity of drought and floods could be a threat to food security. All features of the environment are affected by climate changes. For instance, ecological alteration causes temperatures to rise on certain parts of the planet. This results to more decrease in temperature during colder months. The production of plants and animals are directly affected by variations in weather conditions, such as temperature and precipitation, as well as by the frequency and severity of extreme occurrences, such as droughts, floods, and storms. Therefore, it is imperative to address the threat and effects of climate change, as they have a significant impact on crop productivity and production. There is an urgent need to assess how well global society is doing at increasing agricultural production while simultaneously conserving biodiversity and associated ecosystem services in an era of climate change, energy costs and financial instability.

Keywords: Climatic variations, biosphere health, biodiversity, land degradation, sustainability of life on earth

Biography



Currently, Prof. Dr. Hosam Bayoumi Hamuda is working at Óbuda University, Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering and Natural Sciences (Budapest, Hungary). He was Senior Researcher and Deputy Director of Research Group for Environmental Microbiology of Hungarian Academy of Sciences (Gödöllő University of Agricultural Sciences, Faculty of Agricultural Sciences, Szent István University (Budapest). Briefly, He received the degrees of B.Sc. (Chemistry and Botany), M.Sc. (Biological Sciences), University Doctor (Agricultural Sciences-Soil Microbiology) and C.Sc. in Biological Sciences from Garyounis University, Benghazi, Libya, Gödöllő. University of Agricultural Sciences and Hungarian Academy of Sciences, Budapest, Hungary, respectively. Also, he received the PhD in Biological Sciences, Doctor Habilitation Degree in Environmental Sciences as well as the Professor degree from Szent István University (Gödöllő, Hungary). Also,



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University Doctor Degree in Natural Sciences from Eötvös Loránd University (Budapest). Prof. Hamuda was awarded many times from different organisations, e.g., the Society of Hungarian Microbiologists (MMT), the Hungarian Professors Council, etc. and he is a member of many Hungarian and International Organisations. Prof. Hamuda was the general secretary and now is the president of International Council of Environmental Engineering Education (ICEEE) originated since 2010 (Budapest, Hungary) and Member of the International Society of Development and Sustainability (Japan), Society of MMT, Soil Science and Agrochemistry Committee of the Agricultural Sciences Department of IV of the Hungarian Academy of Sciences (Budapest) and Association of Hungarian Medical Societies (MOTESZ) and others. He was the director of MSc program titled: Microbial Science and Biotechnology (Szent István University, Gödöllő, Hungary) from 2000 to 2008 and Director of PhD Program titled: Agricultural-, Environmental Microbiology and Soil Biotechnology until from 2007 to 2015 and now a member of the Environmental Sciences Doctor's School at Szent István University and Doctoral School on Materials Sciences and Technologies at Óbuda University. Prof. Dr. Bayoumi Hamuda is acting as editorial member, reviewer of many international journals, and he organize many international conferences and symposiums. He delivered more than 120 plenary and keynote lectures in international events and a member of scientific committee of more than 100 conferences. He is the editor and chair of more than 20 Proceedings Books of International Symposium and Conferences.

Research Interest: Prof. Dr. Bayoumi Hamuda is an Environmental Microbiologist and Soil Biotechnologist dealing with waste and wastewater management. Rhizosphere index, soil microbial biomass and enzymatic activities. Soil Biotechnology, soil health and soil biodiversity. Soil Biosecurity, biocontrol and biofertilizers. microbial inoculants. Colonization of Plant Growth-Promoting Rhizomicrobiomes (PGPR). PGPR microbial inoculants in rhizosphere. Nitrification inhibitors and crop quality. Monitoring of soil organic matter. Econanotoxicology. Roles of engineered metal oxide nanoparticles in soi. Public health and health care. Bioengineering and Environmental Health. Probiotics, antibiotics, xenobiotics, and human gut microbiotas. Impacts of xenobiotics: pesticides and other pollutants on soil bioactivities. Climatic changes and global security.



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MANUSCRIPTS OF FULL PAPERS



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SMOKE POLLUTION: THE CITY IN GAS CHAMBER??

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ABSTRACT

To think about your surrounding of living and turn it in healthy breathing place is basic unit for global environmental development and sustainability. NASA (2023) satellites observed heavy smoke and haze darkening skies in northern India. The poor air quality is a seasonal occurrence —the product of smoke from crop fires mixing with urban pollution from traffic and industry, emissions from cooking and heating fires, windblown dust, and a range of other sources. How fires affecting air quality in Punjab and Haryana? Many farmers, particularly in the states of Punjab and Haryana, use fire as a fast, cheap way to clean up and fertilize fields before planting winter wheat crops. However, the surge of fires in the heart of the densely populated Indo-Gangetic Plain often contributes to a sharp deterioration of air quality in



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November and December. Farmers realise this is unsustainable but say they don't have a choice because the government is not offering them effective solutions and alternatives in practical.

The smoke is likely to run as far as Delhi, about distance of 200 km away, adding to the national capital's toxic haze. It's not just Delhi that suffers. Stubble burning has created a massive public health crisis - its fumes pollute swathes of northern India and endanger the health of hundreds of millions of people of entire regions. During the pandemic Covid-19 ravaging the country as pollution makes people more vulnerable to infection and slows their recovery. According to some estimates, farmers in northern India burn about 23 million tonnes of paddy stubble every year.

The efforts to reduce air pollution may help in rectify global warming and climate change. So, mitigating air pollution and climate should lead to integrated programs, especially in polluted cities of India. India's capital Delhi recorded its worst November air in at least last six years. The city recorded 11 days of "severe" pollution, up from 10 days in November 2016. Delhi didn't experience even one "good" day of air quality through the month. It was blaming the burning of crop stubble in neighbouring states and the festival of Diwali for the alarming levels of pollution in November.

Satellite data from Nasa shows that there were 90,984 fires from stubble burning in three states - Punjab, Haryana and Uttar Pradesh - between 1 October and 28 November. Several studies have warned of the health risks of breathing such toxic air. The flash out to high levels of air pollution can make children obese and put them at greater risk of developing asthma. The study was the first in India to establish a link between overweight children, asthma and air pollution.

Keywords: smoke pollution, Northern India, crop stubble burning, poor governance



INTRODUCTION

For much of November 2023, NASA satellites observed heavy smoke and haze darkening skies in northern India. The poor air quality is a seasonal occurrence the product of smoke from crop fires



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mixing with urban pollution from traffic and industry, emissions from cooking and heating fires, windblown dust, and a range of other sources.

WHY ARE FIRES AFFECTING AIR QUALITY IN PUNJAB & HARYANA?

- Many farmers, particularly in the states of Punjab and Haryana, use fire as a fast, cheap way to clean up and fertilize fields before planting winter wheat crops. However, the surge of fires in the heart of the densely populated Indo-Gangetic Plain often contributes to a sharp deterioration of air quality in the months of November and December.

किसान को बदनाम करना बंद करो..!!



फैक्टरी और वाहनों का प्रदूषण 76% और खेती से प्रदूषण केवल 8%

AIR QUALITY: DELHI RECORDS WORST NOVEMBER AIR IN YEARS 1 DECEMBER 2021?

- India's capital Delhi recorded its worst November air in at least six years, according to official data. The city recorded 11 days of "severe" pollution, up from 10 days in November 2016.



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- Data revealed that the residents of Delhi didn't experience even one "good" day of air quality through the month.
- Officials blame the burning of crop stubble in neighbouring states and the festival of Diwali for the alarming levels of pollution in November. The numbers are the worst Delhi has seen since 2015, when the Central Pollution Control Board started recording air quality status.
- The prolonged monsoon pushed the stubble burning and Diwali into November, Dr Gufran Beig, founder of air quality forecast agency SAFAR, told local media. Delhi pollution: What's causing poor air quality? Delhi air pollution 'killing our children' "This is the major reason why November saw poorer air quality this year as compared to the last few years," he said. Delhi is the world's most polluted capital.
- Satellite data from Nasa shows that there were 90,984 fires from stubble burning in three states - Punjab, Haryana and Uttar Pradesh - between 1 October and 28 November.

This was the highest number in five years, according to a report from the Council on Energy, Environment and Water (CEEW).

- Air quality in Delhi had also dipped to hazardous levels the day after Diwali as people defied a ban to burst firecrackers for hours.
- Stubble burning - where crop residue is burnt every year to make way for planting wheat - turns the city's air toxic every year. It's banned but enforcement has been weak.
- NASA Smoke from crop fires in northern India on 18 November 2021 NASA. Smoke from crop fires in northern India on 11 November 2021. The problem looks set to worsen as the federal government has agreed to decriminalise stubble burning in a bid to assuage protesting farmers at Delhi's borders.
- The levels of PM 2.5 - tiny particles that can clog people's lungs - are far higher in Delhi than the World Health Organization's (WHO) safety limit. Several studies have warned of the health risks of breathing such toxic air.
- Recently, a joint study by the Lung Care Foundation and Pulmocare Research and Education found that exposure to high levels of air pollution can make children obese and put them at greater risk of developing *asthma*. The study was the first in India to establish a link between overweight children, asthma and air pollution
- Every November, satellites detect large plumes of smoke and heightened fire activity in northwestern India as farmers burn off excess paddy straw after the rice harvest. Many farmers, particularly in the states of Punjab and Haryana, use fire as a fast, cheap way to clean up and fertilize fields before planting winter wheat crops. However, the surge of fires in the heart of the densely populated Indo-Gangetic Plain often contributes to a sharp deterioration of air quality in November and December.
- Though lingering monsoon rains this year kept fire activity at low levels for a few weeks longer than usual, satellites observed elevated fire activity in November as the pace of burning accelerated. On November 11, 2021, the Visible Infrared Imaging Radiometer Suite (VIIRS) on



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the Suomi NPP satellite acquired this natural-colour image of a river of smoke streaming from fires in Punjab and Haryana toward Delhi,

- Use the image comparison slider to see the locations of hotspots observed by VIIRS that afternoon. Fires in northern Pakistan likely contributed some of the smoke as well.
- “Looking at the size of the plume on November 11 and the population density in this area, We can say that a conservative estimate is that at least 22 million people were affected by smoke on this one day,” said Pawan Gupta, a Universities Space Research Association (USRA) scientist at NASA’s Marshall Space Flight Center.
- As in years past, sensors in Delhi and elsewhere in northern India have recorded soaring levels of air pollution. Sensors in the capital area—including one at the U.S. Embassy—recorded concentrations of fine particulate matter (PM_{2.5}) and coarse particulate matter (PM₁₀) well above 400 micrograms per cubic meter on several occasions in November.
- Since particulate matter is linked to a range of respiratory, cardiovascular, and other health problems, World Health Organization guidelines recommend that 24-hour mean PM_{2.5} concentrations be kept below 15 micrograms per cubic meter. The high pollution levels led to partial lockdowns, school closures, and halts in construction in Delhi and other cities.
- Smoke from crop fires is not the only contributor to the hazy skies. Influxes of dust sometimes arrive from the Thar Desert to the west—as they did on November 12, 2021 (see image below). An array of other human-caused sources of air pollution in cities, including motor vehicle fumes, industrial and construction activity, fireworks, and fires for heating and cooking also produces particulate matter and other pollutants.



November 12, 2021 JPEG

November 20, 2023 JPEG

- ✚ Geography and weather also exacerbate the region’s air quality problems. Temperature inversions are common in November and December as air rolls off the Tibetan Plateau and mixes with smoky air from the Indo-Gangetic plain.



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- ✚ An inversion can function like a lid, with the warm air trapping pollutants near the surface and helping hem pollutants in between the Himalayan Mountains to the north and the Vindhya Mountains to the south.
- ✚ Hiren Jethva, a Universities Space Research Association (USRA) scientist based at NASA's Goddard Space Flight Center, uses measures of the "greenness," or Normalized Difference Vegetation Index (NDVI) to anticipate fire activity each year. The data he uses comes from the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite.
- ✚ "Earlier in the summer, observed the largest NDVI values in the 20-plus year record. Which was predicted that one of the most active fire seasons on record, and that is exactly what was seen,"
- ✚ "We still have a few weeks of burning to go, but already Aqua MODIS has detected more than 17,000 hotspots in Punjab and Haryana—making this the most active fire season on record." Aqua MODIS began collecting data in 2002 (Jethva).
- ✚ While total fire counts have remained consistently high in Punjab, satellite data indicate that campaigns to get farmers to clear fields without using fire have proven more successful in Haryana. "Over nine years of VIIRS observation, we don't see much of a trend in Punjab.
- ✚ However, in Haryana, we saw a 45 percent decrease in the total number of fires in 2020 compared to the 2012-2019 (Gupta) "But fire counts seem to be on the higher end in Haryana again this year."

NASA Earth Observatory images by Lauren Dauphin, using MODIS data from NASA EOSDIS LANCE and GIBS/Worldview. Story by Adam Voiland

THE HAZY NOVEMBER IN NORTHERN INDIA

- ❖ The November 2023, NASA satellites observed heavy smoke and haze darkening skies in northern India. The poor air quality is a seasonal occurrence—the product of smoke from crop fires mixing with urban pollution from traffic and industry, emissions from cooking and heating fires, windblown dust, and a range of other sources. The timing is also important: all this particle pollution enters the atmosphere when seasonal weather patterns tend to trap air pollution near the ground.
- ❖ The MODIS (Moderate Resolution Imaging Spectroradiometer) on NASA's Aqua satellite captured this image of haze blanketing the region on November 20, 2023. Ground-based air quality monitors, managed by India's Central Pollution Control Board, the Delhi Pollution Control Committee, the U.S. State Department, and Nepal's Department of Environment, reported unhealthy to hazardous levels of airborne particulate matter that day. From above, satellites detected widespread crop fires in northern Pakistan and the Indian states of Punjab, Haryana, and Uttar Pradesh on November 20.
- ❖ The World Health Organization considers 15 micrograms per cubic meter of PM_{2.5} to be a safe limit. But ground-based air quality monitors routinely measured levels that exceeded 300 and, at times, 500 micrograms per cubic meter in November. As air quality deteriorated, doctors



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urged people to limit outdoor activity and reported increases in respiratory problems. The haze also led to pauses in construction, restrictions on vehicle use, and school closures.

- ❖ Hiren Jethva, a Morgan State University researcher based at NASA's Goddard Space Flight Centre, uses satellites to observe vegetation and track fire activity in the region each fall. "In terms of satellite-detected fire counts, the fires in Punjab and Haryana have been less severe this year—about 40% less than the five-year average detected by Aqua's MODIS—but they're still numerous enough to cause poor air quality in Delhi," he said. One analysis of the contribution of crop fires to the overall air pollution problem conducted by India's Ministry of the Environment attributed about a fifth of Delhi's PM_{2.5} to fires in early November.
- ❖ Ritesh Gautam, previously an atmospheric scientist at NASA and now with the Environmental Defence Fund, has been taking a longer-term look at trends in fire activity, haze, and atmospheric stability in the region. Gautam, Jethva, and several other colleagues recently found that increasing numbers of fires since the early 2000s have coincided with a 90% increase in the amount of aerosol-laden haze that satellites observe in November and increased stability of the lower troposphere. Their analysis of the radiative effects of aerosol particles found that as smoke from crop fires builds up, it likely warms the atmosphere and cools the ground. This increases the likelihood of temperature inversions—a meteorological condition that traps pollution near the surface, further intensifying the haze.
- ❖ "It's a double whammy. It's not just the smoke itself, but likely the way that the increasing smoke is changing the meteorology that makes this such an intense problem," Gautam said. "On the other hand, our results suggest that reducing late autumn burning and other anthropogenic emissions during the winter might have an even greater effect in reducing the haze than previously thought."

❖ *NASA Earth Observatory image by Michala Garrison, using MODIS data from NASA EOSDIS LANCE and GIBS/Worldview. Story by Adam Voiland.*



[View this area in EO Explorer](#)

Even with fewer fires than normal in fall 2023, poor air quality plagued the region.

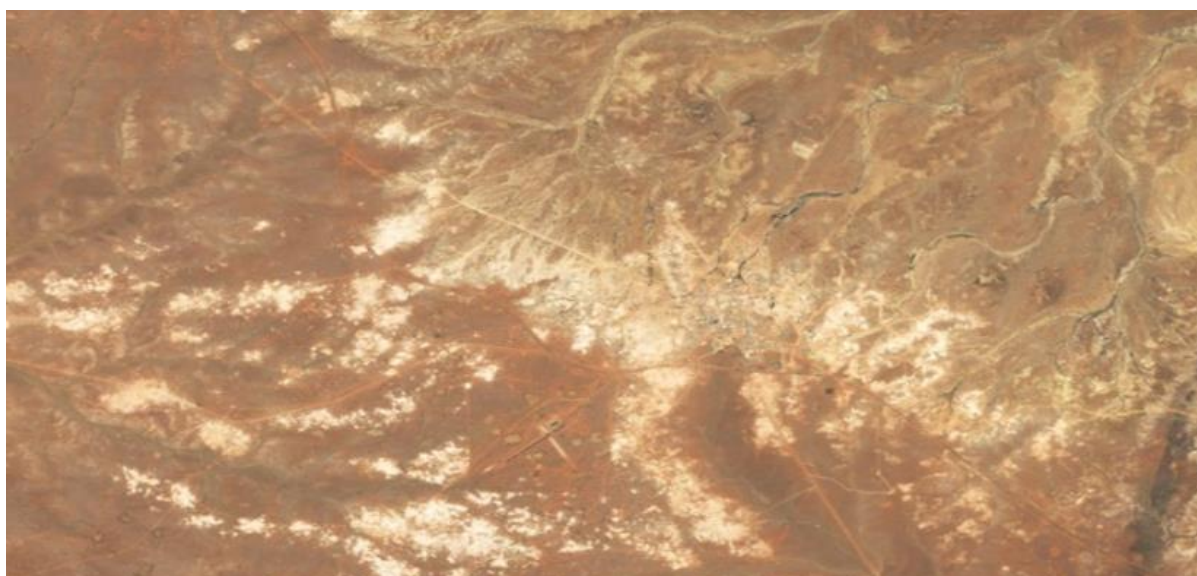
Image of the Day for November 21, 2023



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Instrument:
Aqua — MODIS

APPEARS IN THIS COLLECTION:
Air Quality



Nov 20, 2023



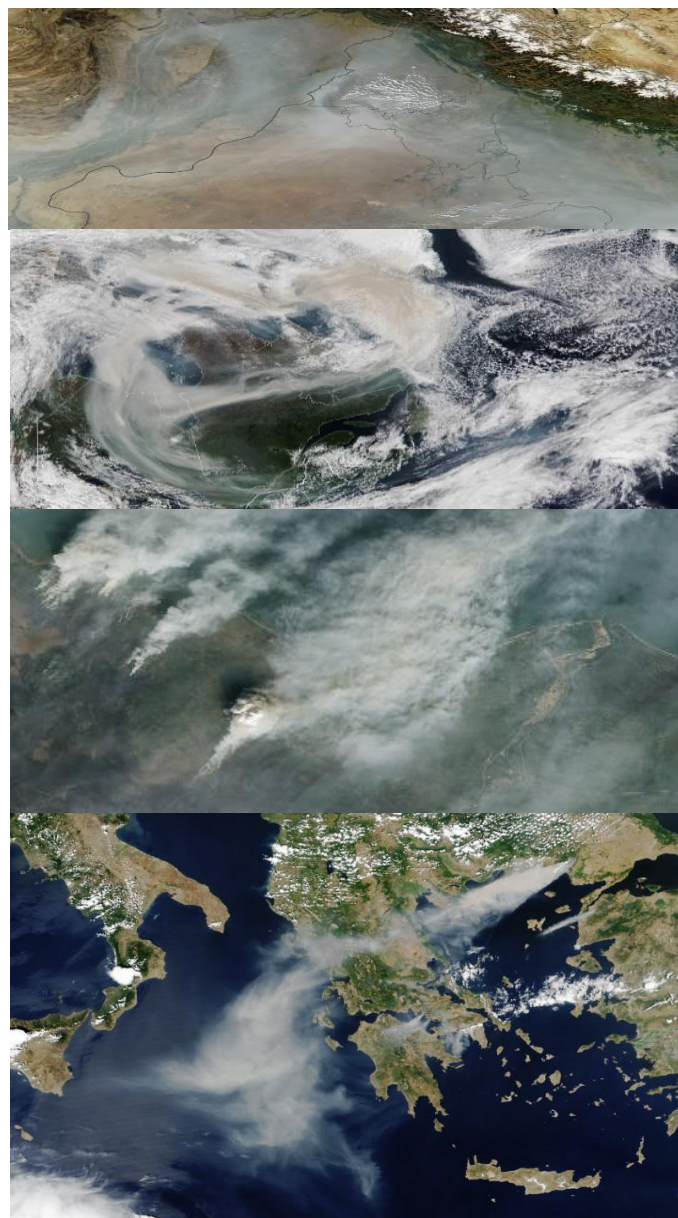
Nov 22, 2023

FIRE SEASON IN THE NORTHERN HEMISPHERE (2023)

Whether sparked by lightning, intentional land-clearing, or human-caused accidents, wildland fires are burning longer and more often in some northern latitudes as the world warms.



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- ❖ It is that time of the year again when North India gets engulfed in a thick gloomy greyish-brown of doom called ‘smog’ that makes people living in this region earnestly yearn for those bright sunlit winter days of the past. Air quality in Delhi and surrounding areas have turned ‘severe’ and people are grasping for breath in the first week of November.



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- ❖ Over the last few years, smog has increasingly impacted the North Indian states of Punjab, Haryana, Delhi and Uttar Pradesh. While most of the blame falls on the 'stubble burning' and 'Diwali celebrations' for the worsening quality of ambient air in these states, it needs to be highlighted that India's smog problem is also part of the larger climate change issue.

VEHICLES ARE A MAJOR CONTRIBUTOR

- According to a recent investigation by the Centre for Science and Environment, among local sources, vehicles may have contributed the most to air pollution in Delhi for the week of October 21 to October 26.
- From October 21 to October 26, the national capital's own contribution to PM_{2.5} levels was roughly 51%, or about half, according to the data. Vehicles contributed about 17% of Delhi's PM_{2.5} concentration when the impact of other NCR districts and biomass burning were considered.
- Over the course of the week, the daily percentage of emissions from vehicles varied between 49.3% and 53%. Residential sources came in second with 13%, followed by industrial sources with 11%, and construction with 7%. This is a significant find as it is well known that vehicular emissions due to the burning of fossil fuels is one of the major contributors to global warming at present.

TWO SIDES OF THE SAME COIN: AIR POLLUTION AND CLIMATE CHANGE

- The UNEP says that they are two sides of the same coin. In India, air pollution seems to get highlighted only when 'smog' like cases surface every year during the winter. But the fact remains that during this time of the year, multiple factors like 'stubble burning' and 'winter conditions' only amplify an already worsening air quality in the region that is silently contributing to global warming and vice versa.
- There is an intrinsic connection between air pollution and climate change. "The relationship between air pollution and climate change in the Indian context is obvious. The most important air pollutants like CO₂, CO, black carbon and methane are either greenhouse gases or other forcings having high global warming potential or direct GHGs, contributing to global warming," said Dr Partha J Das, Senior Climate and Environment Scientist who heads the 'Water, Climate and Hazard Division' of Aaranyak "On the other hand, the major contributors to global warming like CO₂, Methane, O₃, PM_{2.5}, etc. constitute some of the main air pollutants in India."

THE INFAMOUS DELHI SMOG BEYOND 'STUBBLE BURNING'

- Smog issues in India, including the infamous Delhi smog that covers New Delhi and its environs in the winter, are mostly caused by severe air pollution. The inherent air pollution brought on by businesses and factories, coal-fired power plants, road dust, vehicle traffic, the widespread



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usage of firecrackers during Diwali, and crop stubble burning in western India are the main sources of the 'Delhi Smog'.

- While much has been written and spoken about the stubble burning in states like Punjab contributing to the poor air quality in North India, primarily Delhi, there are other factors at play here and these have a connection with the larger climate change issue.
- "The stubble burning's role in Delhi's air pollution varies from 10% to 50% on average. The Delhi smog constitutes mainly of CO₂, CO, Particulate Matter 10 (PM 10), Particulate Matter 2.5 (PM 2.5), SO₂, NO₂, O₃ and NH₃. Out of these, CO₂ and O₃ are GHGs, whereas CO indirectly enhances the GWP (Global Warming Potential) of other gases and therefore is also a climate forcing," Dr Das said. "PM 2.5 consists of mainly black carbon or carbon soot that is emitted during the process of burning fossil fuels such as coal, petrol, and diesel as well as biomass and biofuels. It is the second major source of global warming after CO₂ and is a short-lived climate pollutant (SLCP) responsible for nearly 50% of global warming to date," Dr Das explained.
- He added, "Black carbon is not considered a GHG as it comprises particulate matter. But it has a high global warming potential, almost 460-1,500 times that of CO₂. Therefore, it warms up the atmosphere by absorbing solar radiation and converting it to thermal radiation. Thus, it acts as a climate forcing."
- "Black carbon or soot is majorly responsible for the accelerated melting of snow and ice and therefore glaciers in the Arctic and Himalayas as deposition of the soot particles result in a decrease of albedo increasing in warming of the snow-ice surfaces," Dr Das further said. On the other hand, the repeated extension given to the coal-powered thermal power plants within 10km of the national capital region in terms of meeting SO₂ and other pollution norms is only making matters worse.
- In a recent notification, the environment ministry extended the timeline to meet SO₂ norms to December 31, 2027, for units that are scheduled to retire, and December 31, 2026, for plants that will continue operations beyond that period. It is well-known that SO₂ through sulphate formation makes a significant part of PM_{2.5} and results in huge public health and economic damage.

BURNING STUBBLE IN A CHANGING CLIMATE

- ✚ The Indian Monsoon seems to have got extended to late October in recent years because of climate change. This has been witnessed as a growing trend over the last few years. Rainfall till mid-October delays the harvesting process in North India and when the rain finally ends it leaves farmers racing against time to finish harvesting and prepare the field for the next crop. What follows is a sudden increase in farm fires as the farmers set fire to the stubble in a bid to quickly get rid of them in a cost-effective manner.
- ✚ The government has tried to help by introducing harvesters and SEEDERS but multiple ground issues that need to be addressed exist. "I had a discussion with a farmer and he told me that



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Paddy variety 1121 is not properly shredded by a combine harvester and they are resorting to the manual cutting of Paddy and paying about Rs 500 per day to farm labourers,” Dr M S Bhatti, Professor at the Department of Botanical & Environmental Sciences – Guru Nanak Dev University in Amritsar, said in an email to CFC India.

✚ Dr Bhatti also said that whether ‘HAPPY SEEDER and other baler machines’ are easily available is another aspect that needs to be investigated. “In my opinion, the solution lies in the total record of emission inventory (fuel to be burned) in a city daily. This may put light on their own contribution first. Pareto principle says first look out for 80% contribution as Punjab fires have contribution in the range of 3-30% (best guess). Cordon-type survey must be done, and all fuel/burning material inventory should be maintained,” Dr Bhatti further said. Late monsoon withdrawal is also not good in terms of stagnant weather conditions that lead to low wind speeds, descending air, and compressed boundary layer which favour rapid fine particulate matter formation and accumulation of pollutants, according to SAFAR.

SOLUTION:

Recent studies suggest that global action on carbon dioxide and SLCPs together is needed to meet the temperature goals in the Paris Agreement.

“Any attempt to reduce air pollution also helps in mitigating global warming and climate change. Therefore, mitigating air pollution and climate should lead to integrated programs, especially in polluted cities of India. Reducing ambient and household air pollution can also reduce emissions of carbon dioxide (CO₂) and short-lived climate pollutants (SLCP), such as black carbon particles and methane, therefore contributing to the near- and long-term mitigation of climate change,” said Dr Das. Tags

WHAT'S BEHIND NORTH INDIA'S WINTER SMOG? IT'S NOT JUST STUBBLE BURNING.

09/01/2024

- As for improving air quality and quality of life during winter in north India, reassessing agricultural practices, irrigation, handling of crop residue and prevention of open fires could be a win-win.



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Credit: (Vinayak Sinha and Abhishek Mishra)

Every January millions of people across India's Ganges plain find themselves caught in fog – cloud at ground level.

This cloud then mixes with smoke from open fires lit for heating and cooking and vehicle exhaust, turning the fog into a toxic smog that shrouds the country for weeks.

Besides air quality deterioration, it also reduces visibility, disrupts travel as well as the transportation of goods and can even lead to loss of life. The livelihood of millions of people is affected.

The Indian meteorological department defines a fog event to have occurred when visibility reduces to 1000 metres or less.

In the last 40 years, there has been a five-fold increase in the number of poor visibility days in the Indo-Gangetic Plain.

Like all clouds, the main ingredient of fog is water vapour.

Pollutants in the air in the form of microscopic aerosol particles soak up the water vapour and grow to larger droplets blocking solar light by scattering and absorption.

The high aerosol load reduces radiation from reaching the surface, thereby cooling the ground. At the same time, it warms the layers of the atmosphere above the ground, which in turn lowers the “boundary layer height”.

The “boundary layer height” is like a lid over the lower atmospheric layer into which surface-emitted and chemically formed pollutants accumulate.

During summer, the height of this lid over the Indo-Gangetic Plain reaches 2000m or more during the daytime and is still several hundreds of metres high at night.



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By winter, however, the height of this lid drops several hundred metres. The same air pollution emissions then accumulate and build up within a much smaller container (that is reduced in volume by as much as five times compared to summer), resulting in higher air pollutant concentrations.

These further aggravate the duration and intensity of the fog.

This is what causes the visibility to decrease, preventing airplanes from landing and slowing down cars and trains.

Economic losses due to these disruptions easily exceed several hundred million rupees every year.

During November, paddy stubble burning adds significantly to the aerosol burden and pollution.

In the late December and early January, the extra open fires for cooking and heating by the vast population who cannot afford cleaner technologies, become the major sources of air pollutants.

The lower temperatures that accompany fog episodes trigger more open burning for heating, people huddled around these small fires are a common sight across the region's cities and villages during winter.

These open fires end up releasing more aerosol particles, which can prolong the fog event by providing additional particles that can soak up the water vapour and swell to produce more fog droplets.

Such open fire emissions release copious amounts of both gaseous and aerosol pollutants into the air, a noxious cocktail that, when combined with the aerosol-radiation feedback, strengthens the spread of the thick blanket of smog over the region.

Several toxic chemicals like isocyanic acid and benzene, a human carcinogen, are also released.

While these factors significantly affect the fog lifecycle, without large scale regional availability of moisture, they would only result in air pollution aggravation, as in the November cycle.

What distinguishes the late December and early January periods from November, is the influx of water vapour near the ground through the rainfall induced by the extra-tropical weather system known as.

This moistens the ground. The irrigation of the winter wheat crop provides even more water for evaporation, in addition to the existing natural water bodies (ponds, rivers and canals) present in the region.

Further, the occurrence of “atmospheric rivers” as a result of moisture transported from the Arabian Sea, also adds to the water vapour in the air during winter.

Over the past few decades, there has been a documented increase in fog frequency, persistence and intensity over the region.

The most intense fog events predominantly occur from midnight to 8am.

This is when wind speeds are low, promoting stagnant conditions for accumulation. Surface water vapour easily condenses through the night-time cooling of the ground. The ground air cools to its dew point – thereby condensing the water vapour in it to liquid droplets.

Dissipation of the fog occurs during daytime due to surface warming and when wind speeds pick up. However, this may not happen for prolonged periods.

This is the most common type of fog that occurs over the Indo-Gangetic Plain and in scientific parlance is referred to as “radiation-fog”.



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Research such as the winter fog experiments program led by the Indian Institute of Tropical Meteorology and several other national research institutes in India, are attempting to find out more about the phenomenon.

Right now, there are still more “unknowns” than “knowns”.

Further scientific efforts are needed to design focused regional field studies with comprehensive chemical and meteorological observations to unravel the chemistry of fog. This will help with improved fog forecasts that can alert citizens with more accurate and timely warnings.

As for improving air quality and minimising fog, a serious investigation of prevalent agricultural practices, for irrigation and handling of crop residue, and preventing open fires will help. This can be done by providing access to cleaner energy technologies for heating and cooking along with better waste disposal.

This would be a win-win for air quality and improved quality of life for the millions that inhabit this dynamic developing region of the world.

Vinayak Sinha is Professor at the Indian Institute of Science Education and Research Mohali, India.

Abhishek Mishra is Scientific Officer with the Bihar Mausam Sewa Kendra.

Dr Vinayak Sinha’s research projects have received funding from the Ministry of Earth Sciences India.

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**Who Is Accountable for the Disease and Death India’s Deadly Air Pollution Triggers?
Environment**

Air Crisis: India’s Toothless Pollution Response, Delhi-Centric Discourse to Blame



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Pollution: Delhi Ordered to Shut Schools, Colleges, 6 Thermal Plants Credit: (Environment)



WHAT'S INSIDE NORTHERN INDIA'S WINTER SMOG?

Reassessing agricultural practices, irrigation, handling of crop residue, and prevention of open fires could be a win-win for air quality and quality of life. (Vinayak Sinha and Abhishek Mishra, 2024)



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Credit: [Varshesh Joshi on Unsplash](#)

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This would be a win-win for air quality and improved quality of life for the millions that inhabit this dynamic developing region of the world. [Originally published under Creative Commons by 360infoTM

STUBBLE BURNING: WHY IT CONTINUES TO SMOTHER NORTH INDIA:

*Avtar Singh surveys stubble burning on his land in Punjab state's Patiala district, **Stubble burning in northern India has long been a major cause of air pollution, but efforts to stop it fail every year. The BBC's Krutika Pathi and Arvind Chhabra find out why.***

Plumes of smoke from Avtar Singh's paddy fields envelop his village in Punjab state's Patiala district. Mr Singh has just finished burning left-over straw - known as stubble - to clear the soil for the next crop.

The smoke is likely to travel as far as Delhi, some 250km (155 miles) away, adding to the national capital's toxic haze. It's not just Delhi that suffers. Stubble burning has created a massive public health crisis - its fumes pollute swathes of northern India and endanger the health of hundreds of millions of people.

And it's more dangerous this year with Covid-19 ravaging the country as pollution makes people more vulnerable to infection and slows their recovery. According to some estimates, farmers in northern India burn about 23 million tonnes of paddy stubble every year.

Governments have tried to stop the practice. They've pitched alternatives, they've banned it, they've fined farmers for continuing to do it and they've even thrown a few of them in jail.

They've also tried to reward good behaviour - in 2019, the Supreme Court ordered a clutch of northern states to give 2,400 rupees (\$32; £24) per acre to every farmer who didn't burn stubble.

Mr Singh, who didn't do it last year, was hoping to get this reward. "We waited a whole year, but we got nothing," he says. "So, like many others, I decided to burn the stubble this year."

In August, the Punjab government admitted they couldn't afford to pay so many farmers. "I don't know any farmer who has been paid this," says Charandeep Grewal, a farmer.

Every winter, capital Delhi and surrounding areas battle a haze of pollution

As pollution levels grow, so has the chasm between the country's farmers and policymakers, who are trying to fix a broken system that has incentivised bulk production over the decades.



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Experts say it's partly due to policies that encourage farmers to grow more and not less. A spate of farmer-friendly decisions and cheap subsidies in the 1960s turned Punjab and Haryana into India's biggest contributors of food grains.

But unlike then, India's granaries are no longer empty and the system, which has changed little, is now at loggerheads with strained efforts to clean up the air.

The solutions that haven't stuck

What complicates matters is that farmers are a crucial vote bank. That's why court orders like bans and heavy fines often remain unenforced. "The politicians who need to enforce it would have to risk the ire of thousands of farmers - which they won't do," says agricultural economist Avinash Kishore.

Meanwhile, farmers continue to avail free electricity and heavy subsidies on paddy fertiliser.

"The behaviour of farmers depends on the policies you put into place. Things like free electricity and cheap fertilisers are causing havoc," says agricultural economist Ashok Gulati.

But farmers say they get the lion's share of the blame, although their stubble is only one of many sources of Delhi's air pollution. Others include dust, industrial and vehicular emissions, and incineration.

Weather plays a role too. Farmers burn stubble twice a year - in summer and at the onset of winter. The first time they do it, the warm breeze disperses it quickly. But the second time, in September or October, plummeting temperatures and low wind speed spread the smoke far and wide.

Farmers in northern India burn paddy stubble to clear the soil for their next crop

"The share of stubble burning in Delhi's pollution can range from 1% to 42%, depending on wind speed and direction," says Dr Gulati.

But a new environment ministry report says the average contribution has grown from 10% in 2019 to 15% this year.

The government has tried offering alternative technology, but that comes with its own share of problems.

For instance, take the HAPPY SEEDER - a machine mounted on a tractor which removes the paddy straw while simultaneously sowing wheat for the next harvest. It was touted as eco-friendly, fast and effective. The government picked up 50 to 80% of the bill, depending on whether it was an individual farmer or a group.

Inderjit Singh, a wealthy farmer in Punjab, says he didn't burn any stubble this harvest because he got a HAPPY SEEDER last year.

But it doesn't come cheap - the machine needs a tractor to work and the two combined can cost up to \$15,000 (£11,229). "This explains why many farmers burn stubble - they can't afford not to," Mr Singh adds. And even for those who can, getting their hands on the machine has proved difficult due to long wait times and dwindling stock.

Another potential game-changer, a bio-decomposer developed by the Indian Agricultural Research Institute, turns crop residue into manure in 15 to 20 days. But some farmers say they don't have so much time between crops.

"We aren't allowed to plant paddy in the summer since the crop requires a lot of water and the logic is to conserve water during the heat," says Mr Grewal. "If we were allowed to sow earlier, we would have more time between crops to get rid of the residue."

Does India need another farming revolution?



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But some experts, like Dr Gulati, say all these efforts are "irrelevant" to a degree. Instead, he suggests tackling it at the root - subsidise crops other than paddy, the source of most stubble burning. "Policy and money should incentivise farmers in the region to plant more fruits and vegetables," he says. "India needs more vitamins and protein rather than wheat and rice." This, he adds, will create more greenery and since vegetable and fruit crops don't leave stubble, it'll bring down the number of open fires. Farmer Inderjit Singh says many can't afford to use the Happy Seeder. But to move forward, India may need to start from the beginning. Or at least 1966, when Punjab, Haryana and Uttar Pradesh were chosen to lead the country's Green Revolution, which turbo-charged crop production by adopting modern technology and high-yielding varieties of seeds. "Growing so much paddy in northern India was always going to cause issues - its topography isn't suited for the crop," says Dr Gulati. Paddy is incredibly water-hungry, making it easier to grow in regions with high groundwater, which Punjab doesn't have. More than 50 years on, experts say such intensive farming has not only led to air pollution but is likely to spark other devastating consequences. "Water tables in these states are depleting rapidly - future generations are staring at a water crisis," Dr Gulati adds (BBC30 NOVEMBER 2020).

FARMERS REALISE THIS IS UNSUSTAINABLE BUT SAY THEY DON'T HAVE A CHOICE BECAUSE THE GOVERNMENT IS NOT OFFERING THEM EFFECTIVE SOLUTIONS.

"The way we farm has deeply affected the health of millions across states, but the effects are felt first-hand by the farmer before they reach the people of Delhi," says Mr Grewal. "We're literally in the eye of the smoke, but nobody is concerned about that."



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ENSURING LONG-TERM HUMAN RESOURCES IN THE 21ST CENTURY WITH ADHERENCE TO HUMAN RIGHTS STANDARDS

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ABSTRACT

The longstanding debate persists: is the economy for the people, or are people for the economy? Technological advancements have increasingly reduced the need for physical human labour in economic activities. However, the demand for human resources is expected to persist at some level. Historically, the necessary human resources for national economies have been sustained through birth rates or immigration. This study explores whether maintaining a stable fertility rate of 2.1 in modern EU member states can be achieved in the long term while adhering to constitutional and human rights standards.

Keywords: HR, Employee, Increase the recruitment base

INTRODUCTION

Based on its title, this conference investigates topics of international economic development and sustainability, while also exploring the fields of economics, management, engineering, and natural sciences, as well as life sciences. For the global economy, humans play multiple roles: as owners on one hand, consumers on another, and, moreover, as the human resources that drive and sustain the economy. In today's global society, a significant portion of the population simultaneously fulfill all three of these roles.

Nowadays, we hear and talk a lot about "revolutions" and "crises"—the new industrial revolution, the ecological crisis due to global warming—but there are also phenomena where one side experiences an effect and another country experience the opposite of it; such an example can be population growth. While at global level, population continues to grow—as it has been since the beginning of recorded history, with only a few interruptions—in most EU member states, it is declining [1]. In the following, using Hungary's data as an example, I will examine how it is possible to ensure the human resources



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necessary for the functioning of the national economy while adhering to universal human rights standards.

It is a macroeconomic fact that in addition to other necessary resources, human resources, that is, people who work, are also needed for the functioning of the economy. It is also a well-known fact that, at a societal and national economic level, to maintain the population size—which, from a macroeconomic perspective, is considered human resources—in the long term, women of childbearing age are needed to give birth to an average of 2.1 children. According to long-term statistical data from the Hungarian Central Statistical Office (KSH), this value was last achieved in Hungary in 1978, and since then it has consistently been below this level, with fluctuations. According to the most recent data from 2023, the fertility rate is 1.51 [2]. This means that ensuring the long-term viability of the national economy requires the continuous provision of a sufficient number of human resources. However, we must not forget that all human resources, as people, have fundamental human rights guaranteed by the Constitution. Looking at the long-term data, we see that despite small fluctuations, the trend has not changed: population decline and a decrease in birth rates have continued. In the past 40 years, the government has launched several programs to reverse this trend, but despite significant national expenditures on these programs, they have only temporarily slowed or halted the decline. The "low point" in the fertility rate was in 2002-2003, with a value of 1.27, but considering the decline in the number of people of childbearing age, the 94,647 newborns of that time meant that by 2023, a rate of 1.51 corresponded to the birth of 85,200 children [3]. Due to the natural population decline over the past twenty years, this higher fertility rate reflects a smaller overall population and fewer women.

In other words, based on the data, additional human resources must be 'acquired' from somewhere to ensure the long-term stable functioning of the national economy. This issue arises in most of the Union's countries. In most member states, the problem is primarily solved by the immigration of guest workers. Western member states have experience from the 20th century in integrating larger working communities into society, and in many countries, there is experience with living together or side by side due to old colonial ties. In the following, I will examine whether, apart from immigration, there are other constitutional and nationally viable solutions.

THE ANCIENT ROMANS

As lawyers, we studied Roman law at university, and in our daily work, we often encounter situations like those faced by the Romans, where legal development, with minor modifications, continues to apply the old Roman solution.

A legal entity—in this case, a human—has the right to abandon ownership of a thing (applying dereliction), making the thing "ownerless," which can then be freely appropriated [4]. In the case of abortion, the human legal entity decides to "derelict" the fetus, and for this dereliction,



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the individual (and in most cases, considering their health insurance status, the insurer) even pays.

If we start from the premise that the aborted fetus could eventually become a human resource valuable to the national economy, which, since it is currently not (or not yet) a legal subject but an object, and the pregnant woman intends to apply dereliction through her lawful decision, the question arises: Can the state lawfully take action, while fully respecting the rights of the pregnant woman, to acquire this potentially macroeconomically beneficial human resource in the long term?

According to the current state of science and technology, which even the Romans knew, the fetus needs to grow in the maternal body for a maximum of 300 days to fully develop. It is widely known that during pregnancy, the female body functions differently from the "usual," which in many cases leads to a significant reduction in her work capacity and efficiency. Consequently, in most cases, the pregnant woman's income decreases, and she incurs additional expenses. The state addresses these financial downsides through the social security system, typically compensating in percentages but with an upper limit.

COLLISION OF RIGHTS – CONTRACT

According to Article XIII (1) of the Hungarian Fundamental Act (Constitution), everyone has the right to property, a right known and recognised by all legal systems in the world. We have known since Roman law that no one can be considered the owner of the parts of his body, but if something is separated from the body, it becomes a thing, and the owner of which becomes the person from whose body it is separated. According to the last clause of Article II, sentence 2 of the Constitution, the fetus is entitled to protection from the moment of conception. According to consistent practice, this does not affect the legal practice of abortion for decades, since 'protection' is not the same as 'recognition of legal personality'.

In this paper, I will not address the library of international pro and con debates on abortion but only examine whether it is economically profitable and legal to operate a program that immediately takes aborted children into state care, thus increasing the long-term workforce and taxpayer numbers.

Article II, sentence 1 of the Constitution states that human dignity is inviolable. Fraud, deception, threats and coercion are sanctioned by the legal system not only in criminal law but also in other branches of law. In other words, if we accept the mathematically and demographically based hypothesis that the fetus destroyed by abortion - in the sense of the law of property - which is a legal 'thing' under Hungarian and most other legal systems, is 'appropriated' by the state in the



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interests of ensuring the long-term (meaning several decades) - stability of the national economy, all the rights of the pregnant woman - personal and property - must be respected to the maximum. In a functioning free market society, this can be solved in individual cases by means of a contract, by 'persuading' the pregnant woman, with a commercially advantageous offer, to carry and give birth to a child, whose future upbringing and education will be provided by the state, as the child's guardian. The 'bargain' is nowadays typically made on a monetary basis. In addition, the State is obliged to compensate the woman who is expecting for the loss of income in connection with the case and for the necessary and justified costs incurred, since they incurred in her interest.

It is important to note that a child born as a result of such a transaction will have the same legal personality from birth as everyone else. In Hungarian law, as in all modern legal systems, the legal personality of everyone is complete, unconditional and unlimited from the moment of a person's live birth (Hungarian Civil Code, § 2:1 - § 2:2). I know, it is "strange" or "heretical" to use the aforementioned concepts of property law in relation to human beings, but Hungarian health law has been using concepts known from property law such as "embryo deposit" and "embryo donation" in connection with artificial insemination for decades. It is important to note that nowhere in the world are different rules applied to different people depending on the way in which they were conceived or born, including the uniform practice in most jurisdictions that the fetus is a child of the deceased father and that an embryo conceived through rape can be aborted under the law of almost all states.

The purpose of the legal act, from the State's side is to ensure that the fetus is carried by the woman and, by increasing the population, to ensure the long-term functioning of the national economy. This is a very long-term investment, since the first two decades are almost entirely costly and it is only at the end of the second decade, or rather in the middle of the third one when the young citizen begins to contribute to the production of the national economy.

The legal transaction is a special engagement contract where the woman gives birth to the child, and the state pays a fee. The rules of an engagement contract are laid down in the Hungarian Civil Code. § 6:272. - § 6:280. which may be amended by the parties in accordance with the principle of freedom of contract.

It can be proved with invoices - and most likely estimated before the agreement - how much income the woman loses and how much extra cost incurs at her because of the change of condition. The loss of income is typically the full cost of the loss of work due to the change of condition, as under the relevant legislation, social security benefits for pregnancy are subject to a fixed or insured earnings cap.

COSTS TO THE STATE



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In addition to the one-off payment and the reimbursement of costs to the pregnant woman, the State bears the cost of maintaining the child protection system as a public service. At some level, the system has centuries of history and experience.

The number of abortions has been steadily declining; it was 21,200 in 2023 [5]. In the child protection institutional system there are currently approximately 26. 000 children. If the State, in order to increase the available human resources in the long term in terms of numbers, offers all those concerned the opportunity to cover the costs of pregnancy and loss of income at the mandatory pre-abortion counselling, and 25% of those concerned accept it, this would mean that the number of people served in the child protection system would suddenly increase by nearly a quarter, based on 2023 data, and nearly a quarter of all those served would be infants. From then on, it will be necessary to provide staff and equipment to cope with the multiple staffing levels in an "ascending system". In other words, with unchanged numbers, a continuous increase of at least 25% in the cost of the child protection system will be necessary for two decades, based on 2023.

The ~5000 extra children per year would probably only reduce the rate of population decline but would not reverse the trend. However, an increase in the number of children in the child protection system will, in addition to nominal improvements, also justify structural changes to ensure that the significantly larger number of children in the system can be educated to an appropriate cultural and social standard and that children can move from residential child protection institutions to appropriate educational institutions without problems and then enter the labour market after leaving the system.

From this point of view, it is regrettable that the public social and educational sectors are experiencing staff shortages in many areas and that there are fewer young people entering higher education. From a national economic point of view, the State needs the growing number of human resources leaving the child protection system to have marketable skills and the social skills needed to successfully integrate into the workplace.

Although Hungary has a centuries-old history of child protection system, allowing such many new care leavers into the system today, in 2024, is politically unimaginable and requires very thorough planning and preliminary system assessment. In the near past, in the first half of 2024 it became a huge domestic political scandal when it was revealed, that the President of the Republic had pardoned a person sentenced to a term of imprisonment because, as deputy director of a child protection institution, he had actively prevented the authorities for years from investigating the pedophile acts committed by his boss, the director of the institution, against the children in his care. The development of a new secure signalling system has not yet been completed. A comprehensive audit of the system is still underway to investigate whether this



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was an "accidental incident" or an internal fault coded into the system that needs to be detected and corrected.

Given the current labour market situation, notwithstanding the fact that under current public education rules compulsory education lasts until the end of the school year in which the child turns 16 (Article 46(3) of Hungarian Labor Law Act), it is probably appropriate for children in the child protection system to complete a school leaving certificate and then higher education in order to acquire more effective and marketable skills.

MAY IT BE WORTH RAISING A WORKER?

So far, it may seem commercially unprofitable to take on all the costs of having a child until the child reaches the age of 18 years (including pregnancy and compulsory schooling rather than abortion as the child is in the child protection system until this age). These costs cannot legally be demanded from the child in any way, nor can he or she be obliged to work in Hungary for the same period.

Perhaps the question should be asked in terms of the timeframe of the plan to maintain the country's population at a level that can sustain the economy at a normal level. Since we are dealing here with a trend change in the number of human resources, which can be assessed over a period of decades, neither planning nor evaluation can be applied using the traditional, commonly used methods, where the total project timeframe is five years or less. In the first 20 years, the project will undoubtedly represent a significant increase in expenditure, not insignificant from the point of view of the public budget. The next project, which will also require a significant budgetary outlay, is to encourage young people who have completed their compulsory education to obtain a higher level of qualification, which will lead to higher productivity in the national economy - for which a study contract is already possible as per the Hungarian Labor Law Act §209. This is a "win-win" solution, both for the person concerned, who will have a higher income, and for the State that will gain a more productive citizen, who will remain a domestic taxpayer and citizen for the duration of the contract. On the other hand, marketing and PR activities should be used to persuade citizens so that they want to live as tax-paying citizens in their home country.

Once the young adult reaches the age of 18, he or she is taken out of the child protection system, but it is possible under current legislation to conclude a study contract with the young person, with the provision of benefits in kind until the end of his or her studies, the cost of which is then paid for out of his or her wages. Children of compulsory school age are obliged to be educated by the State, so children aged 0-16 years are obliged to be looked after by the State in the child protection system and cannot claim any compensation for this either then or later. It is evidence



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nowadays not only in the field of HR that the higher the level of education, the more educated the person, the easier it is for them to get a job and the higher the income. Therefore, just as families wish to provide their children with the best possible education in the appropriate educational institutions, the State is also interested in helping the children it educates to obtain the qualifications best suited to their skills and abilities. In this respect it can conclude a study contract with the student after the age of compulsory schooling, in which it can quite legitimately stipulate that he or she is obliged to work in Hungary for the period corresponding to the duration of the support.

It has been known 'beyond human memory', to use a term from legal history, that the higher the level of education received, the higher the standard of living in many cases, and consequently the higher the amount of money paid into the budget in various forms of taxes and contributions.

According to the data of the Hungarian National Bank and the Hungarian Central Statistical Office (mnb.hu ksh.hu), in 2022, the average cost of raising a child, counting only the necessities and services, but not the cost of maintaining the building, will be 33.000€, up to the age of 16. Up to the age of 18 a further 7.000€ is needed and up to the higher BA level a further 10.000€ - the cost of BA varies greatly between courses, here I give a weighted average rounded to the nearest thousand. By very rough calculation, if a young person leaving the system with a BA degree has cost the State 2.000€ (to compensate for pregnancy costs and loss of income) + the above mentioned cost of 33.000€ + 7.000€ + 10.000€, it means a total of 42.000€ with the young worker with a BA degree who will most likely earn in the contracted time rounded up to 27.000€ GDP/capita. Taxed at the 30% Hungarian tax rate means that over five to six years the person will pay about 42.000€ to the budget only on the basis of the taxes and contributions on his/her work. In other words, it can still be assumed, to a high degree of approximation, that a person leaving the state child protection system with a BA qualification will "repay" the State the amount spent on his upbringing over six years through the public taxes he pays on his work. Since the worker cannot be tied down for a period longer than the duration of the training and the study contract can only cover three years of BA training, it is possible to use extra legal means to ensure that the person wishes to continue working in the country.

GUEST WORKERS

The childbearing model outlined above will undoubtedly be a very costly project for several decades without any noticeable impact. The other solution, used by several EU Member States, is to bring in guest workers, which does not require a budgetary outlay of the same magnitude as the one outlined above and the person starts working immediately, thus increasing both the state's GDP and budget revenue.



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As in this case the entire training costs of the worker are borne by the "exporting" country, international experience of the last decades shows that sooner or later, the demand for "brain drain" will arise, mainly among the population and/or leaders in the exporting country, which could easily turn into a political agitation against the importing country.

As we have seen above, the population is growing in numbers at least at the global level, despite the fact that many economically developed countries do not have a fertility rate of 2.1 to maintain population levels, but in economically less developed countries it is well above 2.1, with a peak of 6.0 in several African countries.; in these countries emigration is also high, but below the rate of population growth [1]. In the long term, it is therefore worthwhile to ensure that the labour supply comes from places where the education system also provides graduates with the skills needed for the modern labour market.

In this context, it is worth recalling Thomson's theory of the 'demographic transition' [6], which states that the size of human civilization has changed in four stages in history. In pre-industrial societies, with high birth rates and high pre-fertility mortality rates, the population stagnates or even increases very slightly. In the early industrial age, birth rates remain high, but the pre-fertility mortality rate falls significantly, so the population grows rapidly. In the late industrial age, the birth rate falls, and the population stagnates. Finally, in post-industrial societies, with low birth and death rates, population stagnation slowly turns into a slight decline. In the last century, we have seen Thompson's theory put into practice in a number of industrialized countries. In many developed countries the data show population decline for decades, even in the absence of war and natural disasters. There is yet no scientific consensus on a theory to reverse the last stage of the model, or to outline a new fifth stage of it, but, sensing the problem, several solutions to stop population decline are being experimented with around the world. All of them use socio-political methods to stop population decline, like improving the family support system, strengthening the position of women in the labour market, promoting equality between men and women, improving the education and health systems, reforming the pension system and encouraging immigration.

Before addressing the labour issue through guest workers, it is worth noting from a macroeconomic perspective that long-term historical time series show the trend that population growth was slow until the last century, when medical advances made many previously fatal diseases curable, and vaccinations protected the population from many diseases. Medical progress is clearly beneficial to the economy, as it reduces the number of hours lost from production due to illness, including the training of new workers to replace the ones lost. On the economic side, however, the question arises about the scope of compensation for medical research, treatment and health promotion activities, whether it is at individual, national or global level. After all, on the one hand, medical treatment and disease prevention have generated value for the person concerned, for the company employing him or her and, on the



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macroeconomic level, for the budget and GDP. On the other hand, at the global macroeconomic level, the economic value generated by the treatment may -because of the foreign guest work undertaken by the person - generate revenue for a company or state that has not invested any significant amount in this medical project. Such a problem can be dealt with in individual cases by lengthy civil and economic litigation under most modern legal systems, but if it becomes a mass problem, it can only be properly dealt with at international level, to the satisfaction of all parties concerned.

As the previous two paragraphs suggest, in the long run it is worthwhile for the world economy and most national economies to help poorer countries with higher fertility rates to improve their health and education systems, as there is a not insignificant long-term chance that they will import labour directly or spontaneously from such countries.

Based on the available data for each country, it is possible to forecast several versions of the multi-decade macroeconomic path for each country.

HUMAN RIGHTS

Today, it is international legal evidence that all human beings have equal fundamental human rights, despite the fact that according to surveys of many organizations there are many people who are unable to enjoy some of their fundamental rights (in varying proportions). Without going into the history of the development of human rights, it is worth noting that the right to life, property and the right to dispose of it, as a born human being, is enshrined in all legal systems. The human rights issues to be considered in the human resource acquisition solution outlined in Parts 2-5 are as follows.

The freedom of the pregnant woman concerned to choose whether or not to enter into a contract must be respected to the maximum extent possible. If the answer is 'no', she should be subject to medical intervention under the relevant health and health insurance rules; if the answer is 'yes', the pregnant woman should be reimbursed for all costs incurred in relation to the contract.

From birth, the child shall enjoy full and unconditional equality of rights like every human being as well as Hungarian nationality and the right to be cared by the state child protection system until the age of 18.

Upon completion of compulsory education, aged 16, and thus legally of limited capacity, the young person is entitled to conclude a study contract with the State, in which he or she undertakes to work in an employment relationship determined by the State for a period corresponding to the duration of his or her studies.



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From then on, the relationship becomes a fully general employment relationship, whether he or she works under a traditional or any other employment relationship. From then on, this worker is likely to have the advantage - primarily at the macroeconomic level, but not noticeable at corporate and micro level - of being fully socialized in the country's cultural system, which will make it easier for him to relate to his national colleagues and avoid the risk of conflicts arising from the different cultural backgrounds of the workers [1]. It is important to briefly mention here that guest workers are much more likely to develop conflicts with colleagues and residents [3].

THE MOUSE: PET, PEST RODENT OR LABORATORY ASSISTANT

Today, mice in the European Union are found in one of these three categories. Here, I highlight the results of the work of the American ethologist and behavioural scientist J.B. Calhoun on the "third job". Calhoun's experiment, UNIVERSE 25, investigated the social behaviour of mice in "paradise conditions", where they were provided with sufficient food and space, at ideal temperatures, free of predators and disease. In the first period of the experiment, the mouse population grew rapidly, but after a while the population started to contain increasing numbers of individuals that (1) became "hermits", (2) neglected or attacked their offspring or their mates, (3) behaved aggressively towards other mice, (4) lost sexual interest. The spread of such behaviour caused the mouse population to rapidly collapse after a few generations of stagnation [7].

Based on the experiment, Calhoun concluded that "for an animal as simple as the mouse, the most complex behaviours involve an interrelated set of courtship, maternal care, territorial defense, and social organization within and between hierarchical groups". According to the results of an experiment modelling post-industrial societies - that have been disputed -, e.g. the studies of the psychologist J. Friedman's show that crowding has no similar detrimental effect on people [8]. In our human resource management question, we see from the UNIVERSE25 experiment that it is worthwhile to introduce new individuals into the community when the population stagnates, because after stagnation there is a rapid collapse.

It is worth comparing the data and theories of Calhoun and Thompson. Phases 2 and 3 of Thompson's demographic theory are clearly reflected in Calhoun's data; phase 4 is (hopefully) different. There was no example in Calhoun's experiment of importing extra individuals into the system from outside, either in the stagnating or collapsing phase. The thought experiment described in the preceding points 2-5 quasi-imports future workers from outside to supply the national economy with sufficient human resources.

CONCLUSION



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Today, with fertility rates in the most economically advanced countries typically below the 'sustainable' 2.1, countries concerned are dealing with domestic human resource shortages by importing labour of some kind, which experience shows the unintended side-effect of various conflicts. To avoid these, I have sketched out a thought experiment for increasing human resources from domestic sources, considering the constitutional rights of the people concerned. In the thought experiment, I made calculations based on official Hungarian data for 2023 and the relevant legislation. Based on the results of the experiment, assuming the outcome of the fetal protection counselling, the woman, with a conservative estimate and assuming the consent of 25% of the persons concerned, agrees to bear the child and the State agrees to compensate the woman for the loss of income and justified costs of pregnancy and to raise the child in State care, then, assuming the child graduates with a BA, her income tax for six years will pay the State's costs incurred in this connection. Other public tax payments are from then on "pure profit" for the State. In addition, since he has lived his entire childhood here, there are no cultural or linguistic issues that arise with human resources imported from abroad (whether as employees or entrepreneurs).

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FOREST MANAGEMENT USING SPATIAL TECHNOLOGY TOWARDS SUSTAINABLE APPROACH: A CASE STUDY OF SIRSIYA BLOCK (SHRAVASTI DISTRICT, UP, INDIA)

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ABSTRACT

Spatial technology is a powerful technology in forest development, management and conservation. Environmental modelling using spatial technology (GIS, RS & GPS), as platform, can support many database queries tied to spatially referenced object and their associated attributes in waste land reclamation and management. Waste lands, which are marginally suitable area in open forest, found after analysis and modelling in GIS as 33.37 sq. km. This waste land area can be developed by considering basic needs like energy and biomass for local community members. Genesis of wasteland and their typologies into degraded forests, undulating land, gullied and ravinous land, degraded pastures, waterlogged, salt-affected and sand-affected areas etc. have been mapped and analysed with special reference to their relationship to natural environment, other land uses, human response and the problems and potentialities for reclamation. Action plan was developed for management and development of waste lands into forest cover to achieve sustainability.

Keywords: *Spatial Technology, GIS Modelling, Degraded Forest, Sustainable Development, Forest Management.*

INTRODUCTION

A degraded land and soil may be highly productive if forest is developed and spatial technology is one of the best available technologies used in forest management. Average fertile top soil composition by volume is: mineral-45 % plus organic matter-5 % makes solid portion; and air- 25 % plus water- 25 % constitute pore space [1]. Soil is supposed to have increased reflectance between 0.4 to 1.1 micro- meter wavelengths [2]. Land and soil degradation processes are site specific. So, it is essential to characterise and map the degraded areas because of site-specific development [3] and management plans could be made. Ecosystem functions are affected broadly due to all human activities.



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Remote Sensing (RS) Applications coupled with Geographic Information System (GIS) is extremely useful in the decision and solution [4] for environments management. The application areas for remotely sensed data are both wide and varied [5]. Radiometric data potentially represent a very useful source of information in pedological research and land use pattern [6]. Ready and timely availability of satellite observations of existing land use pattern from various remote sensing satellites now provide a most cost-effective means of identification of different forms of land, status of water resources, quantification of soil moisture content and soil degradation to enable all nations to take appropriate measures for maintaining productive use [7] of environments.

An environment may be related topologically with wastelands or forest ecosystems [8-10]; and may be affected by industrial pollution and consequently this may interfere indirectly with community people [11] living in nearby surrounding area and their economic status [12]. Remote Sensing coupled with Geographical Information System (GIS) can be extremely useful [13] for environment management. Soil is basic requirement for maintenance of biodiversity [14]. GIS is computer-based powerful system [15] that provides the following four sets of capabilities to handle georeferenced data: (a) input; (b) data management (data storage and retrieval); (c) manipulation and analysis; and (d) output. Because of the arid climate, complex geological conditions, and human activities, environmental problems like lake of water resources, desertification, salinization, and biogeochemical endemic diseases etc. occur in fragile regions of the environment [16]. Hence, there is an urgent necessity of systematic inventory, mapping and monitoring of land resources [17-18] leading to an ecological balance in an area. The digital data can be used to map various types of wastelands.

The spatial distribution and soil nature of these lands can serve as the base for the implementation of various reclamation measures and afforestation programmes [19-20]. Proper monitoring and planning, through spatial technology, leads to management of natural resources and ecosystem for sustainable development [21]. Spectral signatures of water, agricultural land, forest, wasteland etc. differ from each other distinctly [22]. Environmental protection and ecological balance are essential to ensure that development is sustainable in the long run [23]. The physiography, hydrology and chemical characteristics of soils are greatly responsible for the various kinds of land-degradation hazards [24]. Any major disaster affects a wide range of sectors of a society which can include political, social, cultural, environmental, physical, technological and economic aspects [25]. The spectral behaviour of each unit varies according to the nature and percent cover [26]. The characteristics of the pictures reflected on the remote sensing images are formed mainly by the difference in information of the tone and the form characteristics [27].

STATEMENT OF PROBLEM

Fast industrialization, local demand of forest items and development degraded ecosystem. Spatial technology, which include Geographical information system, Remote sensing and GPS, play important role in forest management. An effective strategy for enhancement of atmospheric carbon absorption productivity is through forests development in degraded forest areas and waste lands development.



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Forestry sector has significant emissions removal capability which can further be enhanced by operationalizing major afforestation and reforestation initiatives like National Mission for a Green India besides continued strengthening of the present protection regime of forests. Different types of waste lands require different strategies for their development into forest areas; but few waste lands like rocky regions, glacier regions etc cannot be developed into forest areas. Atmospheric carbon management is major problem before world community in present circumstances to control environmental pollution.

Related Work

Various types of remote sensing data, such as, SAR, MSS, TM, ETM, MOMS, AVHRR and SPOT etc. have been used for earth resources management and development of semi-arid regions by various governmental agencies, institutions, and universities of the world. Remote sensing and GIS are economic and adequate for the land survey and land use classification of semiarid regions of Paraíba state of Brazil [28]. Digital image analysis of Landsat-TM data in eastern Connecticut for regional land use and land cover classification [29] can provide better visualization of the environment. The results were found most satisfactory for regional planning in the state of Connecticut. ERDAS Imagine Software and SPOT data is a good combination for land use and land cover mapping in order to develop the region of the Paraíba state of Brazil [30-32]. GIS system can be extremely useful for land use planning and management of semi-arid regions of northeastern Brazil, using digital image processing on Landsat-TM and SPOT data [33].

Supervised classification for the soil and land use studies for a part of semiarid regions of Brazil [34] and comprehensive work for land use planning in semi-arid regions of NE Brazil, using SPOT HRV data were analyzed in detail [35-36]. Wasteland means degraded land which can be brought under vegetative cover with reasonable efforts, and which is currently under-utilized, or land which is deteriorating due to lack of appropriate water and soil management or on account of natural causes [37].

About 16 per cent of the country's geographical area is under wastelands [38]. Information on geographical location, aerial extent and spatial distribution of wastelands is essential for their effective management and sustainable development [39]. The plains of north Bihar in eastern India have recorded the highest number of floods in India in the last 30 years [40]. In India, an estimated 2.46 Mha of land is reported to have suffered from water logging [41]. India is estimated to have about 58.2 million hectares of wetlands [42] many of which are distributed around the Indo-Gangetic plains.

Study Area

Sirsiya Block (Shravasti District, UP, India) covering an area of 529.502 sq. km. between longitude 81°49' to 82°12' North and latitude 27°36' to 28°56' East. It falls adjacent to the foot hills of Nepal in Survey of India (SOI) Toposheet No. 63E/13 & 14 and 63I/1&2 on 1:50,000 scale.

DATA USED & METHODOLOGY



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Data Used

Data used in the study are primary and secondary. Secondary data was collected from various sources and reports. Primary and secondary data was analyzed.

Methodology

In Methodology in forest management using spatial technology (Remote Sensing, GIS & GPS) was used for identification and demarcation of waste lands in forested area. Degraded forest areas were also identified as these areas can be used to increase canopy cover. Methodology followed (in case of waste land development by management of degraded forest ecosystem in Sirsiya Block, (Shravasti District, India) include: (i) preparation of base-map from Survey of India topographical sheet; (ii) visual interpretation of Satellite data/ Imagery to study the various aspects of environment like biogeological aspects, vegetation, geology, urban-sprawl, hydromorphogeology, structural features and land use of the area; (iii) digital enhancement of Remote sensing data for delineating vegetation, geomorphic and structural elements; (iv) correlation of digital enhanced Remote sensing data with other data; (v) preparation of vegetation anomaly map, hydromorphogeological & land-use maps from satellite imagery for study of vegetation aspects, land degradation aspects, groundwater potentiality and change in recharge capacity by changed land-use patterns; (vi) imposition of interpreted Remote Sensing data on base-map; (vii) soil samples' analysis to estimate fertility aspects; (viii) field traverses for sample collection of soil, water & chlorophyll data using guide map and analysis; (ix) analysis and modelling in GIS; (x) application of GIS based approach for planning & management of waste land development to take decision as per action plan.

Modelling in GIS

GIS has all the functionality of a conventional DBMS plus much of the functionality of a computer mapping system. GIS as a DBMS that allows us to explicitly handle the spatial. In our study, Geomedia Intergraph GIS System was used. In analysis/ modelling, equation and syntax used in GIS (INTERGRAPH) for different overlays is: $\text{Output} = \text{select}\{i_1=1,1,0\} + \text{select}\{i_2=2,2,0\} + \text{select}\{i_3=3,3,0\} + \text{select}\{i_4=4,4,0\} + \dots$, where i is input and 1,2,3,4, --- N represents number of layers overlayed. Analysis and overlaying steps for open degraded forest area were done in following steps: Step-1: Open forest map Vs. Ground water potential map; Step-2: Step 1 Vs. Soil texture map; Step-3: Step 2 Vs. Soil fertility map; Step-4: Step 1,2 and 3 repetition for various combinations. Final output was obtained in the form of required manner and combinations as per objectives of research problem for action plan to implement.



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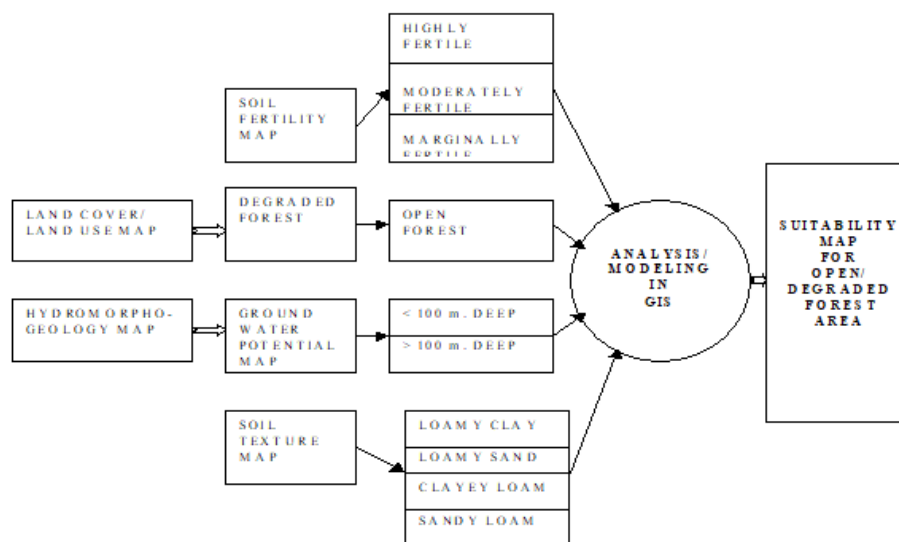


Figure 1. Flow chart for open degraded forest area sustainability analysis

RESULT & CONCLUSION

Output of Analysis

Figure 2 shows the results of analysis and modelling in GIS. Analysis and modelling in GIS provide output in desired manner as per objectives for execution and implementation of action plan during decision. Sirsiya block covers total open forest area 46.26 sq. km. Highly suitable, moderately suitable and marginally suitable area in open forest found after analysis in GIS are 1.60 sq. km., 11.29 sq. km. and 33.37 sq. km. (basically waste land) respectively; and hence, the attention for development and management of open degraded forest, basically waste land area, is given as per required suitability prioritization. GIS based dynamic maps indicating waste lands (open degraded forest) development/ management based on objective(s) to implement action plan and red, pink and blue colours are used to depict waste lands for development as highly suitable, moderately suitable and marginally suitable respectively for execution of action plan.



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Figure 2: GIS based dynamic map indicating waste lands (open degraded forest) development/management plan. Red, pink and blue colours are used to depict waste lands for development as highly suitable, moderately suitable and marginally suitable respectively.

DISCUSSION

Application potentiality of spatial technology for development of waste lands into forest is very high. According to the 2021 India State of Forest Report (ISFR), India's total forest cover is 7,13,789 square kilometers, which is 21.71% of the country's geographical area. India's area under forest tree cover sequesters 138 million tons of CO₂ every year. Estimations reveal that the average carbon absorption of the forests was around 1,240 grams (1.240 Kg) of carbon per square meter of canopy area. To stabilize atmospheric CO₂, role of forestry depends on harvesting and disturbance rates, expectations of future forest productivity, and the ability to deploy technology and forest practices to increase the retention of sequestered CO₂. There is a considerable self-damping effect that will moderate the future increase of the atmospheric carbon dioxide concentration.

Capacity of the ocean to absorb carbon dioxide is limited; but atmospheric carbon absorption potentiality of India forests can be increased tremendously through reforestation, afforestation and development of degraded forest areas and waste lands. The Government policies for forest management and development must be understood with respect to local people of the area, along with fauna and flora in the region. About 60 % of Indian waste lands can be developed to increase forest cover with



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reasonable efforts. When National Mission for a Green India as part of the 'National Action Plan on Climate Change' (NAPCC) becomes operational, the capability of the forestry sector to contribute in GHG removal will further enhance. Furthermore, afforestation and reforestation of 6 million hectares of degraded forest land covered under the National Thus, application of Spatial technology is extremely useful for development and management of forests in sustainable manner to meet the demands of people and industry.

CONCLUSION

Spatial technology (Remote Sensing or RS, Geographical Information System or GIS and global positioning system or GPS) opens ways for better monitoring, planning, development and management of waste land development in sustainable manner to grow forest. Spatial patterns and variations of different attributes relating to landform, land use, wasteland and demographic characteristics and their spatial association are brought out in the study.

For open degraded forests (crown density 10-40%), which includes waste lands, following species are recommended : (i) to increase the crown density, species like *Tectona grandis*, *Shorea robusta*, *Terminalia tomentosa*, *Bombax cieba*, *Bahunia perviflora*, *Adina cordifolia*, *Cassia fistula* etc. are suggested; (ii) to meet the requirement of fuel and fodder of the nearby local people, species like *Su babul*, *Prosopis juliflora*, *Dalbergia sissoo*, *Albizzia* species, *Acacia* species and *Ziziphus* species are suggested in the outside notified forest areas; (iii) *Eucalyptus*, *Poplar* etc. are in great demand for pulp and paper and match box industries. So, these species are suggested in suitable areas within the notified and non- notified areas for waste land development. GIS can handle huge data sets (spatial & non-spatial data).

All the data (spatial & non-spatial) are integrated and analysis & modelling in GIS using satellite and other data is done for monitoring, planning & management plans and finally for decision making & sustainable development and therefore in biodiversity, ecosystem and environment management. Because reflected electromagnetic radiations are different for different substance or object therefore digital number (DN) value is different for different objects, this DN value is useful for object identification & image interpretation which is done through involvement of shape, size, tone, shadow, pattern, texture, size (location), association, and resolution of satellite imagery/ data. Spatial information/ data & distribution pattern of each Parameter/ component of Natural Resources (NRs) & ecosystem is obtained through interpretation of satellite/ Remote sensing data with limited ground truth/ checks (field based).

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CASSAVA (*MANIHOT ESCULENTA* CRANTZ) GENOTYPE EFFECT ON SOIL LOSS DUE TO CROP HARVESTING

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ABSTRACT

Soil loss due to crop harvesting (SLCHcrop) has been recognized a soil degradation process in many countries of the world. A field experiment was therefore carried out at the Teaching and Research Farm, University of Ibadan, Nigeria, to investigate the effect of cassava genotype on soil loss due to crop harvesting. A total of twelve cassava genotypes (TMS01/1368, TMS30555, UIC-17-1200, UIC-17-1453, UIC-17-1713, UIC-17-2402, UIC-17-25, UIC-17-257, UIC-17-2610, UIC-17-444, UIC-17-707, and UIC-17-93), were laid out in Randomized Complete Block Design with three replications. Crop yield, SLCHcrop and nutrients losses were determined. Cassava genotype (UIC-17-1713, UIC-17-2610, UIC-17-257, and UIC-17-93) produced highest yield ($> 12.0 \text{ t ha}^{-1}$), followed by genotypes (UIC-17-1453, UIC-17-25, UIC-17-444, and TMS30555) with moderate yield ($5.0 - 12.0 \text{ t ha}^{-1}$), and the genotypes (TMS01/1368, UIC-17-1200, UIC-17-2402, and UIC-17-707) produced lowest yield ($< 5.0 \text{ t ha}^{-1}$). However, the UIC-17-93 had the highest SLCHcrop ($36.5 \text{ kg ha}^{-1} \text{ harvest}^{-1}$), followed by UIC-17-25, UIC-17-257, UIC-17-1453, UIC-17-2610, and UIC-17-444 ($18.9 - 11.5 \text{ kg ha}^{-1} \text{ harvest}^{-1}$) and least in UIC-17-1713, TMS30555, UIC-17-1200, TMS01/1368, UIC-17-707, and UIC-17-2402 ($9.3 - 0.4 \text{ kg ha}^{-1} \text{ harvest}^{-1}$). Similarly, soil nutrient losses (N, P, and K) exhibited the same trend as SLCHcrop. The differences in cassava genotypes resulted into variation in soil and nutrient losses during harvesting of cassava. Thus farmers, should consider cassava genotypes of high yield potentials with low soil loss due to harvesting for sustainable soil conservation

Keywords: Soil loss, nutrient loss, crop yield, cassava genotype.



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INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a perennial crop native to tropical America, with the probable centre of origin in the southern rim of the Amazon basin of Brazil (Olsen and Schaal, 2001). It is a starchy root that is among the most important tropical food crops. Thirty countries (18 in Africa, 4 in Latin America and 8 in Asia) are considered to be the major global cassava growers, each producing from 1 – 50 million tonnes annually (FAOSTAT, 2014). Cassava is one of the major food security crops in Africa, particularly in Nigeria. It stores food below ground in roots. This attribute makes cassava to be associated with soil loss due to harvest. Soil loss due to crop harvesting (SLCH) is the soil adhering to the crop, loose soil or soil clods and rock fragments that are normally exported from the field together with these harvested crops to different locations such as headlands, farmsteads and crop processing factories. Soil loss due to crop harvesting has been established as important soil erosion process that has significantly contributed to soil degradation in highly mechanized agriculture (Iabirye et al., 2007). Oshunsanya et al. (2021) also reported a significantly high SLCH in cassava and peanut in tropical soils in Nigeria and Uganda where traditional farming predominates.

Although studies on soil loss due to harvesting of cassava have been reported, there is little or no focus on the cassava genotype effect on soil loss due to harvesting. Therefore, this study was conducted to investigate the effect of cassava genotype on soil loss due to crop harvesting in a traditional farming system.

MATERIALS AND METHODS

The experiment was carried out at the Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria, to investigate the effect of cassava genotype on soil loss due to crop harvesting. The experimental site lies on latitude N 7°27'7.03368", longitude E 3°53'25.43496" and altitude of 209.4 m. A total of twelve cassava genotypes (TMS01/1368, TMS30555, UIC-17-1200, UIC-17-1453, UIC-17-1713, UIC-17-2402, UIC-17-25, UIC-17-257, UIC-17-2610, UIC-17-444, UIC-17-707, and UIC-17-93), were laid out in Randomized Complete Block Design with three replications on May, 2022. Crop yield, soil and nutrients losses were determined. The data collected were analyzed using Genstat Discovery Edition 8.0 and the mean were separated using Duncan Multiple Range Test (DMRT). Harvesting was done 365 days from cultivation, and the freshly harvested tubers were brushed using soft brushes on the field to remove the soil adhering to the harvested cassava tubers.

The soil loss value per unit mass of crop (SLCH spec), the total soil loss for a given crop per unit area (SLCH crop) and nutrient losses were determined as outlined by Ruyschaert et al. (2007) as presented in the equation (1, 2 and 3)



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$$\text{SLCH spec (gkg}^{-1}\text{)} = \text{Mds} / \text{Mroot} \quad (1)$$

Where, Mds = Mass of dried soil loss (g) obtained the harvested roots

Mroot = root mass (kg)

$$\text{SLCH crop (kg ha}^{-1}\text{ harvest}^{-1}\text{)} = \text{SLCH}_{\text{spec}} \times \text{M}_{\text{cy}} \quad (2)$$

Where, $\text{SLCH}_{\text{spec}}$ = Soil loss per unit root mass (gkg^{-1})

M_{cy} = crop root yield (kg ha^{-1})

$$\text{Nutrient loss} = (\text{Nutrient (g)} / 100 \text{ g of soil}) \times 10 \times \text{SLCH crop (kg ha}^{-1}\text{ harvest}^{-1}\text{)} \quad (3)$$



Plate A.1: Harvesting of Cassava roots

RESULTS AND DISCUSSION

The yield of cassava across the genotypes was presented in Table 1. Cassava genotype (UIC-17-1713, UIC-17-2610, UIC-17-257, and UIC-17-93) produced highest yield ($> 12.0 \text{ t ha}^{-1}$), followed by genotypes (UIC-17-1453, UIC-17-25, UIC-17-444, and TMS30555) with moderate yield ($5.0 - 12.0 \text{ t ha}^{-1}$), and the genotypes (TMS01/1368, UIC-17-1200, UIC-17-2402, and UIC-17-707) produced lowest yield ($< 5.0 \text{ t ha}^{-1}$). A high variation in yield among genotypes could be responsible for differences in SLCHcrop.. According to Oshunsanya et al (2018), higher crop yield has been found to bring about higher SLCHcrop. It was also reported by Ruysschaert et al. (2007), that specific contact area for cassava experienced 66% of SLCH spec. Root density is one of the major factors influencing SLCH, followed by soil texture and moisture (Mwango et al., 2013, Dada et al., 2016; Faraji et al.; 2017).

$\text{SLCH}_{\text{spec}}$ values were significantly ($p < 0.05$) affected by cassava genotype (Table 1). UIC-17-1200 had the highest $\text{SLCH}_{\text{spec}}$ ($> 6.00 \text{ g kg}^{-1}$) followed by TMS01/1368, UIC-17-1453, UIC-17-257, UIC-17-444, UIC-17-93, UIC-17-25, UIC-17-707, and TMS30555 ($1.00 - 2.60 \text{ g kg}^{-1}$) and UIC-17-1713, UIC-17-2610, and UIC-17-2402 had the least values ($< 1.00 \text{ g kg}^{-1}$). As expected, SLCHcrop exhibited similar trend as $\text{SLCH}_{\text{spec}}$



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(Figure 1). UIC-17-93 had the highest SLCHcrop ($36.5 \text{ kg ha}^{-1} \text{ harvest}^{-1}$), followed by UIC-17-25, UIC-17-257, UIC-17-1453, UIC-17-2610, and UIC-17-444 ($18.9 - 11.5 \text{ kg ha}^{-1} \text{ harvest}^{-1}$) and least in UIC-17-1713, TMS30555, UIC-17-1200, TMS01/1368, UIC-17-707, and UIC-17-2402 ($9.3 - 0.4 \text{ kg ha}^{-1} \text{ harvest}^{-1}$). Differences in the SLCHcrop among cassava genotypes can be attributed to differences in the shape, size, length and roughness of the roots which may affect adhering of soil to harvested roots. Similar report was made by Oshunsanya (2016 b) that ten cultivars of potato impacted SLCHcrop differently. Bereez and Thomas (2021) also reported that elongated potato transported 20.6 % soil loss more than the spherical potato.

Table 1: Effect of yield on SLCHcrop and SLCHspec among cassava genotypes

Cassava genotypes	Yield (kg ha^{-1})	SLCHspec (g kg^{-1})	SLCH crop (kg ha^{-1})
UIC-17-2402	1708fg	0.25	0.4d
TMS01/1368	4781defg	1.57	5.5bc
UIC-17-1453	9615bc	1.68	17.7bc
UIC-17-257	13417ab	1.32	18.1b
UIC-17-2610	14250ab	0.96	14.4bc
UIC-17-444	6096cde	1.21	11.5bcd
UIC-17-93	12292b	2.52	36.5a
UIC-17-25	9458cd	2.04	18.9b
UIC-17-707	950g	1.67	3.0d
UIC-17-1200	4729efg	6.08a	8.1bcd
TMS30555	5708cdef	1.10	9.1bcd
UIC-17-1713	17271a	0.61	9.3bcd

In addition, losses of nutrients (N, P, and K) significantly ($p < 0.005$) varied among 12 cassava genotypes (Table 2). The amount of N loss due to harvesting ranged from $12.4 \text{ g ha}^{-1} \text{ harvest}^{-1} \text{ year}^{-1}$ (UIC-17-93) to $0.02 \text{ g ha}^{-1} \text{ harvest}^{-1} \text{ year}^{-1}$ (UIC-17-2402) with %CV of 1.24. However, P – loss was highest in UIC-17-25 ($1.27 \text{ g ha}^{-1} \text{ harvest}^{-1} \text{ year}^{-1}$) and lowest in UIC-17-2402 ($0.001 \text{ g ha}^{-1} \text{ harvest}^{-1} \text{ year}^{-1}$). Similarly, K loss ranged from $1.11 \text{ g ha}^{-1} \text{ harvest}^{-1} \text{ year}^{-1}$ for UIC-17-25 to $0.02 \text{ g ha}^{-1} \text{ harvest}^{-1} \text{ year}^{-1}$ for UIC-17-2402 with %CV of 0.88. The trend exhibited by nutrient losses revealed that, the ability of cassava genotypes to export nutrients are different. Oshunsanya (2016 a) reported higher nutrients (N, P, and K) transportation by red cocoyam compared to white cocoyam under traditional farming system. The author attributed the difference in nutrient transportation between the types of cocoyam to differences in roughness of cocoyam corms.



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In another experiment, Oshunsanya et al. (2021) reported that yam cultivars exported nutrients (N, P, and K) at varied concentrations due to differences in their root structure particularly root hair density.

Table 2: Soil nutrient loss as affected by cassava genotype

Cassava	N	P	K
genotypes	⁻¹ g ha ⁻¹ harvest		
UIC-17-2402	0.02d	0.01d	0.02c
TMS01/1368	1.29cd	0.02cd	0.26bc
UIC-17-1453	8.92ab	0.21bcd	0.72ab
UIC-17-257	4.12bcd	0.28bcd	0.75ab
UIC-17-2610	4.19bcd	0.21bcd	0.48bc
UIC-17-444	2.71cd	0.17cd	0.33bc
UIC-17-02	12.40a	0.54b	1.07a
UIC-17-25	7.20abc	1.27a	1.11a
UIC-17-1200	0.75d	0.18bcd	0.09c
TMS30555	2.71bcd	0.55b	0.31bc
UIC-17-1713	8.17a	0.45bc	0.31bc
%CV	1.24	1.04	0.88

%CV = Coefficient of variation

CONCLUSION

This study demonstrated that cassava genotypes differently impacted soil loss due to crop harvesting. This was attributed to differences in the yielding potential and root morphologies of cassava genotypes. The N, P, and K losses varied among the genotypes suggesting that cassava genotypes export nutrients differently during crop harvesting. It is therefore suggested that farmers select cassava genotype of high yielding potential with low affinity for soil adherence during crop harvesting.

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PLASTIC POLLUTION IMPACTING ECOSYSTEM HEALTH: MAJOR THREAT IN DEVELOPING COUNTRIES LIKE INDIA

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ABSTRACT

Plastic pollution is a global problem affecting all ecosystems and life on earth. All people are not aware about plastic hazards and its impacts in developing countries like India and there is urgent need to spread awareness about plastic pollution impacts and its management. Microplastics (MPs), are found in all ecosystems, have been detected in human blood stream, stool, and placenta and in other body organs. Microplastics can interfere with genetic material and cell functions, and it is one major cause coupled with other environmental and health conditions for death of human and other species. More than 13,000 chemicals have been identified as associated with plastics pollution and plastic decomposition takes 20 to 500 years or more. The manufacture of plastics has become a major source of greenhouse gas emissions and driver of climate change. More than 300 million tons of plastic is produced every year and only about 9 % is recycled. Women, children, and senior citizens are more susceptible to these toxic chemicals released from plastic items, and exposures during fetal development and in children can cause, for example, neuro-developmental/ neuro-behavioural related disorders. Existing evidence calls for urgent action to address plastic pollution management strategies for effective policy to protect ecosystems, human health, and the environment for toxic-free and sustainable circular economy. Some strategies like stainless steel bottles for water and glass/ ceramic containers for food storage shall be good ideas to make life plastic-free. Strict implementation of rules for plastic pollution management coupled with effective laws like Environment (Protection) Act, 1986 in Indian situation can be good step for sustainability.

Keywords: Plastic, Pollution, Chemicals, Ecosystem, Health, Circular Economy, Environmental Governance.

INTRODUCTION

Plastic Utilization

Plastics are considered very necessary in terms of their properties and functionality in contrast to other belongings such as metals and wood. Plastic pollution is an escalating ecological and socio-economic crisis in many developing countries. Rapid urbanization, rising consumption, inadequate waste



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management infrastructure, and expanding informal recycling economies drive high leakage rates of plastics into terrestrial, freshwater, and coastal ecosystems. Approximately 360 million tons of plastic is used around the world every year. Currently, only 1% of these can be listed as biodegradable plastics. The extensive use of plastics in large-scale and diverse applications pose economic and environmental problems. These directly generate large amounts of waste and take years to decompose naturally. With growing concerns about the threat posed by plastic waste to the atmosphere, several countries are reducing plastic waste through the production of biodegradable plastic materials and pursuing a number of waste management projects. Scientists are conducting intensive research on the synthesis of biodegradable plastic materials. [1-4]. Biodegradable plastic, a sustainable and ecologically advantageous substitute, can be obtained from biomass and degradable materials [5-6].

Microbial populations are also helpful in obtaining biodegradable plastics from biological waste [7]. Biodegradable plastics are environmentally friendly materials because they emit less CO₂ during production, which contributes to global warming. The utilization of renewable raw ingredients for bioplastic production can reduce the volume of greenhouse gases such as methane and carbon dioxide, released into the environment compared to traditional plastic synthesis from fossil fuels [8]. Biodegradable plastics degrade naturally in the environment. This has been achieved by microorganisms present in the environment metabolizing and breaking down the structure of biodegradable plastics. Biodegradable plastics are of two types.

Firstly, can be decomposed in an aerobic process (composting) and the secondly in an anaerobic environment i.e., landfill [9]. In a definite time, and in an explicit environment, it is broken down by microorganisms into carbon dioxide (CO₂), methane (CH₄), water (H₂O), and biomass. For example, biodegradable plastics based on thermoplastic starch, polylactic acid (PLA) and poly-3-hydroxybutyric acid (PHB) [10].

Plastics have transformed modern economies due to durability, light weight, and low cost. The same properties, however, result in persistence in the environment, fragmentation into micro- and nanoplastics, and long-distance transport through air and water. In developing countries, material flows far outpace waste management capacity, producing high leakage rates into rivers and soils and ultimately to the ocean. India, with rapid urbanization and a large agricultural base, illustrates these dynamics vividly: plastic use is rising across packaging, textiles, construction, agriculture (e.g., mulch films, irrigation pipes), and consumer goods, while collection and processing systems remain heterogeneous across states and municipalities. This paper synthesizes the state of knowledge on plastic pollution pathways and ecosystem effects in developing contexts; analyses India-specific drivers, exposure hotspots, and ecological consequences; and proposes a policy and research agenda emphasizing prevention, equitable circularity, and standardized monitoring.

Biodegradable plastics have also been adopted in the circular economy [11]. Biodegradable plastics can be a green substitute to traditional plastics [12-14] and utilized in throwaway items such as crockery, packaging, cutlery, bowls, straws, and pots. Biodegradable plastics have been utilized in numerous sectors like, packaging, aerospace, industrial machinery, automotive, in offices for office equipment, electronics, medical, furniture etc. [15-22].

CONCEPTUAL FRAMEWORK: SOURCES–PATHWAYS–RECEPTORS–IMPACTS



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Sources–Pathways–Receptors–Impacts (SPRI) framework was adopted to structure evidence and policy options. As far as sources (S) are concerned, primary plastics (pellets, microbeads, fibers) and secondary fragments from mismanaged macroplastics exists.

Major sectors include packaging (single-use films, multi-layer laminates), retail, e-commerce, food service, textiles (synthetic fibers), construction, agriculture, health care. For pathways (P), it is important to note that terrestrial littering; open dumping and burning; storm-water runoff; river transport; wastewater is effluent and combined sewer overflows; atmospheric transport of microfibers; coastal tourism; industrial loss of pre-production pellets is involved.

Receptors (R) are soils (including cropland), freshwater (rivers, lakes, wetlands), estuaries and deltas, coastal seas, mangroves, coral reefs, and urban ecological niches. Impacts (I) includes physical harm (ingestion, entanglement), biochemical effects (leachates and additives), altered biogeochemical cycles (soil aggregation, water infiltration, carbon turnover), invasive species rafting, and socio-economic externalities (flooding due to drain blockage, crop impacts, fisheries losses, public health co-exposures).

INDIA IN FOCUS: DRIVERS AND LEAKAGE DYNAMICS

Consumption and material flows

Rapid growth in packaged food, personal care, and e-commerce has increased flexible plastic use, particularly difficult-to-recycle multi-layer laminates (MLPs). As far as urban–rural contrasts are there, metropolitan areas generate large volumes of post-consumer packaging; smaller towns and peri-urban settlements often rely on uncontrolled dumps and open burning. Agricultural uses (mulch films, greenhouse covers, drip lines) contribute to diffuse soil contamination when retrieval and end-of-life management are weak.

Waste system characteristics

For collection, service coverage varies widely; informal waste pickers provide a significant share of recovery for high-value fractions (PET bottles, rigid HDPE/PP) while low-value films are commonly leaked or burned.

For sorting and recycling, predominantly small-scale units; quality and safety standards vary; large volumes of low-value plastics are down-cycled to roads, boards, or refuse-derived fuel (RDF). For leakage hotspots, it is important to note the exact locations of open drains, riverbanks near transfer stations, peri-urban dumpsites, and coastal cities with seasonal tourism.

APPLICABLE PLASTIC GOVERNANCE IN INDIA



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Policy Framework

India's plastic governance has evolved over the last two decades, with increasing emphasis on waste reduction, recycling, and circular economy principles. The key pillars include Plastic Waste Management (PWM) Rules, 2016 (and Amendments in 2018, 2021, 2022); Solid Waste Management Rules, 2016; and BIS Standards. Introduced Extended Producer Responsibility (EPR), making producers, importers, and brand owners responsible for post-consumer plastics; banned certain categories of single-use plastics (e.g., straws, cutlery, stirrers, polystyrene cups); mandated plastic carry bag thickness increase (from 50 to 120 microns) to promote reusability; and introduced compostable and biodegradable alternatives, subject to certification by the CPCB (Central Pollution Control Board) acts. Framework for segregation at source, door-to-door collection, and integration of informal waste pickers and it provides indirect governance over plastics as part of municipal solid waste. Bureau of Indian Standards has begun developing norms for recycled plastic content and safe food-contact applications. India's plastic governance rests on a strong legal framework (PWM Rules, EPR, bans), but faces challenges in enforcement, informal sector integration, and handling of low-value plastics. Moving toward an equity-centered circular economy requires robust monitoring, inclusive systems, and upstream product redesign.

Institutions and Enforcement

Central Pollution Control Board (CPCB) oversees national compliance with PWM Rules, issues EPR guidelines, and monitors bans. State Pollution Control Boards (SPCBs) are responsible for granting consent, monitoring compliance, and enforcing bans at state level. Urban Local Bodies (ULBs) Implement collection, segregation, and enforcement on the ground. National Green Tribunal (NGT) acts as a judicial body addressing violations, often directing state governments to act on plastic pollution.

Extended Producer Responsibility (EPR)

It was Introduced formally in 2016, strengthened in 2022. Producers, Importers, and Brand Owners (PIBOs) must collect and recycle a specified share of the plastic they put into the market; meet annual EPR targets (by category: rigid plastics, flexible packaging, multilayered plastics); submit reports via a centralized EPR portal (launched by CPCB in 2022) for digital tracking; and eco-modulation of fees (in discussion) could incentivize recyclable packaging design.

Bans and Restrictions

National ban (2022) was imposed on certain single-use plastics prohibited (cutlery, straws, polystyrene). State-specific bans in some states (e.g., Maharashtra, Tamil Nadu, Himachal Pradesh) had earlier independent bans, but enforcement varied. Carry bags campaign was promoted and nationwide thickness mandates to reduce littering and improve recyclability.

Challenges in Governance



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It includes enforcement gaps (widespread non-compliance with bans due to weak monitoring, availability of cheap alternatives, and uneven state-level enforcement); informal sector exclusion (Informal waste pickers recover 70–80% of recyclable plastics, but remain largely outside formal EPR frameworks); low-value plastics (Multi-layered laminates, sachets, and thin films remain unrecyclable at scale and often leak into ecosystems); data gaps (limited standardized monitoring of plastic flows, leakage, and recycling rates across states); and technology and infrastructure deficits (few large-scale Material Recovery Facilities (MRFs), poor segregation at source, limited safe recycling standards).

Recent Innovations, Initiatives and Way Forward

EPR Portal (2022) for digital traceability for compliance; Swachh Bharat Mission 2.0 focus on 100% source segregation and reduction of single-use plastics; plastics in roads (Ministry of Road Transport allows shredded plastics in bitumen road construction); startup and circular initiatives like reuse systems, recycling technologies (mechanical & chemical), and biodegradable packaging innovations emerging; and UN Plastics Treaty Participation for member countries as India is actively part of global negotiations for a legally binding instrument on plastic pollution. Strengthen enforcement of bans and EPR obligations through penalties and audits; integrate informal sector into EPR systems with social protection and fair contracts; promote circular design (mono-materials, higher recycled content); invest in infrastructure (safe recycling facilities, biodegradable alternatives); and harmonize monitoring with standardized indicators (plastic footprint, leakage rates, recycling efficiency) are important.

MONITORING AND METHODS: TOWARD COMPARABLE EVIDENCE

Sampling domains

Standardized approaches are necessary to support risk assessment and policy evaluation. Sampling domains includes water column, sediments, soils (including cropland), biota (gastrointestinal content, tissues), atmospheric fallout, and storm-drain solids.

Size classes and taxonomy

Macro (>25 mm), meso (5–25 mm), micro (5 mm–1 µm), nano (<1 µm) are different sizes. Important parameters are particle size distributions, shapes (fibers, fragments, films, beads), and polymers (e.g., PE, PP, PET, PS, PVC).

Analytics

Visual microscopy with FTIR/Raman for polymer ID; pyrolysis-GC/MS for mass-based quantification; thermo-extraction desorption; QA/QC with procedural blanks and contamination control, especially for fibers are important and included procedures.

Indicators for policy



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Leakage rate (kg per capita per year), capture efficiency of storm-drain nets, plastic density in river cross-sections (items m⁻³), microplastic concentration in soils (items kg⁻¹) and sediments (items kg⁻¹ or m²), and mismanaged waste share (%) were important parameters which were considered.

ECOSYSTEM-LEVEL IMPACTS

Freshwater systems

It affects hydrological function. Plastics accumulate in storm drains and canal networks, reducing conveyance and elevating urban flood risk during heavy rainfall. Blocked drains also create anaerobic conditions and vector breeding. There is disturbance and reduction in biodiversity. Fish, turtles, and birds are affected by ingestion and entanglement; microplastics in sediments alter benthic community structure and can act as substrates for biofilms that modify nutrient dynamics. Biogeochemistry has impact due to nanoplastics. Microplastics change sediment porosity and oxygen exchange; additives and sorbed pollutants (e.g., hydrophobic pesticides, PAHs) may co-transport with particles.

Coastal and marine ecosystems

In Mangroves and estuaries, root structures trap plastics, leading to smothering of pneumatophores, reduced seedling survival, and altered sediment microenvironments. As far as coral reefs and seagrass beds are concerned, films and fibers can abrade tissues and reduce light penetration; macroplastic debris promotes disease vectors and macroalgal overgrowth. Fisheries are affected severely. Gear entanglement and ghost fishing reduce stock biomass; ingestion of microplastics has been recorded in commercially important species, with potential sub-lethal effects.

Terrestrial and agro-ecosystems

Soil structure is impacted due to nanoplastic and microplastic. Films and fragments disrupt aggregation, water retention, and infiltration; microplastics can alter microbial community composition and enzyme activities relevant to nutrient cycling. Plant performance is affected. Evidence indicates variable effects on germination and root growth depending on polymer type, size, and concentration; black mulch films benefit yields in the short term but become contamination sources when retrieval is incomplete. Livestock and wildlife is also affected on large scale. Grazing animals ingest plastics at dumps or littered fields; birds and ungulates show gastrointestinal obstruction and reduced condition.

Airborne microplastics

Synthetic fibers from textiles and tire wear particles become airborne, depositing onto land and water. Inhalable fractions raise concerns for urban ecosystem health and co-exposures.



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INDIVIDUAL SPECIES-LEVEL IMPACTS

Mechanisms of Nanoplastic Transfer Across the Placenta

Maternal Uptake and Circulation is important to understand for individual and single species. Entry routes are inhalation (lungs → bloodstream), ingestion (gut → bloodstream), or dermal contact. Blood circulation does rest job for nanoplastic. Once in maternal blood, NPs can circulate bound to proteins (protein corona) or as free particles. Interaction with placental trophoblasts takes place. These cells form the barrier between maternal and fetal blood.

Nanoplastic crosses the Placental Barrier. The placenta has multiple layers (syncytiotrophoblasts, cytotrophoblasts, connective tissue, fetal endothelium). NPs can cross via endocytosis (Placental trophoblast cells engulf NPs via clathrin-mediated or caveolin-mediated endocytosis) and transcytosis (Vesicles carry NPs across trophoblasts and release them into fetal circulation). Smaller and positively charged particles are more efficiently transported. If NPs disrupt tight junction proteins (e.g., claudins, occludins), they can leak between cells, and this is known as Paracellular Transport. Inflammation in the placenta increases permeability, making it easier for NPs to pass through. Very small hydrophobic NPs (<50 nm) can diffuse directly across lipid bilayers of placental cells, and this is known as Passive Diffusion. Carriers are adsorbed, NPs with a protein corona may be mistaken for nutrients (e.g., lipoproteins) and taken up via nutrient transport pathways.

For example, NPs coated with albumin or cholesterol can mimic natural molecules. Placenta is supposed to protect the fetus, but nanoplastics (NPs, <1 µm) are so small that they can bypass its defense.

CELLULAR-LEVEL IMPACTS

Crossing the Blood–Brain Barrier (BBB)

Nanoplastics can cross the BBB, which normally protects the brain from harmful substances. Studies in rodents and zebrafish have shown that polystyrene nanoplastics can accumulate in brain tissue. Mechanisms: Endocytosis by endothelial cells, disruption of tight junctions, or transport along the olfactory nerve after inhalation.

Neurotoxicity and Oxidative Stress is generated. Once in the brain, nanoplastics may generate reactive oxygen species (ROS), leading to oxidative stress. This can damage neurons and glial cells, impairing their function. Oxidative stress is linked with neurodegenerative diseases like Alzheimer's and Parkinson's. Nanoplastics can activate microglia (the brain's immune cells). Chronic microglial activation may cause neuroinflammation, which contributes to neuronal death and cognitive decline. Therefore, it is responsible for inflammation.

Nanoplastics interact with brain cells primarily by crossing the BBB, entering neurons and glial cells via endocytosis or membrane disruption, and then inducing oxidative stress, inflammation, lysosomal dysfunction, and synaptic disruption. Over time, these processes contribute to neurodegeneration and behavioural alterations.



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Pathways include transcellular transport (uptake by endothelial cells via endocytosis (clathrin-mediated, caveolin-mediated); paracellular transport (disruption of tight junction proteins (claudins, occludins) increases BBB permeability; trojan horse effect (NPs carried by immune cells like macrophages that cross the BBB). Through olfactory pathway, inhaled nanoplastics can travel along the olfactory nerve directly into the brain.

Intracellular Effects includes oxidative Stress (nanoplastics increase ROS generation in mitochondria, leads to mitochondrial dysfunction, reduced ATP, and neuronal apoptosis); inflammatory signalling [microglia recognize NPs as “foreign,” triggering NF- κ B activation and secretion of pro-inflammatory cytokines (IL- 1β , TNF- α)]; then there is chronic activation which leads to neuroinflammation; autophagy and lysosomal damage (NPs accumulate in lysosomes $\rightarrow$ rupture $\rightarrow$ release of enzymes and cell damage, impaired autophagy contributes to protein aggregation); and synaptic dysfunction [altered calcium signaling disrupts neurotransmitter release (dopamine, glutamate), leads to memory and learning deficits]. In developing brains, NPs can interfere with neural stem cell proliferation and differentiation, axon guidance and synapse formation, and epigenetic changes (DNA methylation, histone modification) that affect long-term brain function. There is synergistic toxicity as nanoplastic are carrier of pollutants. Nanoplastics adsorb heavy metals (e.g., Pb, Cd), endocrine disruptors (bisphenol A, phthalates), and hydrophobic organics (PCBs, PAHs). Once in the brain, these co-contaminants are released, amplifying neurotoxicity. Nanoplastics acquire a “protein coat” in biological fluids, which alters their interaction with neurons and glia to create Protein corona effect.

Neurotransmission and Behaviour

Animal studies have reported altered neurotransmitter levels (e.g., dopamine, acetylcholine) in response to nanoplastic exposure. Behavioural effects in zebrafish and rodents include reduced learning and memory performance; anxiety-like or hyperactive behaviour; and impaired motor coordination. In embryonic or juvenile models, nanoplastic exposure disrupted neurodevelopment, affecting brain morphology and synapse formation. Prenatal exposure (in pregnant mice) suggested that nanoplastics can cross the placenta and influence fetal brain development. Nanoplastics often adsorb heavy metals, pesticides, or persistent organic pollutants. This can increase the toxicity burden on the brain, worsening oxidative stress and inflammatory responses.

Mechanisms of Toxicity in the Womb

Nanoplastics can cross the placenta mainly through endocytosis/transcytosis, paracellular leakage, passive diffusion, and protein-mediated transport. Once inside, they may compromise placental function and directly expose the fetus to plastic particles and associated chemicals, with potential long-term developmental consequences. There is Oxidative Stress; Placental cells exposed to NPs produce ROS $\rightarrow$ DNA damage, apoptosis. There is Inflammation also. Placental inflammation can impair nutrient/oxygen transport to the fetus. Consequently, Hormonal disruption is there; some NPs carry endocrine-disrupting chemicals (like bisphenol A or BPA, phthalates), which affect fetal development. Finally Epigenetic modifications take place, NPs may alter DNA methylation in fetal cells, influencing long-term health outcomes.



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Evidence from Studies

In vitro (human placental cells, ex vivo perfusion of human placenta) studies were conducted and found that Polystyrene NPs cross within hours. Animal studies (rodents, zebrafish) were also done. Maternal exposure → accumulation of NPs in fetal brain, liver, and GI tract. Human evidence (limited) exists. Microplastics have been detected in human placenta samples, but nanoplastic detection in fetal tissues is still developing.

RESULTS AND CONCLUSION

Community burdens are unequal as low-income neighbourhoods often abut dumpsites and receive flood waters bearing mixed waste, compounding health risks from contaminated water and vector-borne disease. Human exposure pathways (dietary, inhalation, dermal) intersect with chemical additives (phthalates, bisphenols, flame retardants) and adsorbed pollutants; while ecological harm is documented, many exposure–outcome relationships for human health require further study to establish causality and dose–response. Solutions landscape and case-appropriate Interventions are important strategies to deal with nanoplastic pollution problem. Upstream and market-based measures are essential aspects in management of plastic pollution.

Design for circularity deals with shift from multi-layer laminates to mono-material or compatible structures; eliminate problematic additives and pigments; incorporate minimum post-consumer recycled (PCR) content with quality standards for food-contact safety. EPR clear targets for collection and recycling, eco-modulated fees favouring design changes, traceable Producer Responsibility Organizations (PROs), and alignment with state and municipal plans. Concept of reduction and reuse must be emphasized. Levy or ban selected single-use items with proven alternatives; incentivize refill/reuse systems for food service and e-commerce; support durable packaging pools for B2B logistics are better are other tools in management of plastic pollution. In midstream systems and infrastructure, concept of inclusive collection for door-to-door segregated collection with material recovery facilities (MRFs) that integrate informal workers as formalized cooperatives; provide PPE, health insurance, and fair contracts is highly effective. Leakage control in case of litter prevention and enforcement; storm-drain trap nets and smart litter interception at high-load are good step.

Biodegradable plastics are sustainable, environmentally friendly alternatives made from biomass and degradable materials that have emerged as a resolution to the undesirable effects of plastics. The production of bioplastics uses large amounts of natural resources, including plants and agricultural waste. These biodegradable films are an excellent and innovative alternate to conventional plastics due to their outstanding biodegradability, thermal stability, elasticity, and capability to utilize biomass while ensuring eco-safety and sustainability. By using sustainability strategies such as, enlightening technologies to increase the lifetime of biodegradable plastic, manufacturing new additives to obtain biodegradable plastics totally degradable etc., the biodegradable plastics can be more sustainable and used in a sustainable society effectively.



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Adoption of plastic free life is one of the best options to deal with plastic pollution. Replacement of stainless-steel bottles, like these from pure stainless ones that can work for the whole family, from babies to kids to adults. Look for food products stored in glass over plastic and store leftovers at home in glass or ceramic containers as well. Avoid plastic labeled with the recycle symbol #3 is made of PVC. Try not to heat food or liquids in plastic or pouches. High heat allows plastic to leech chemicals faster. Plastics pollute the environment, ecosystems, oceans, impacting biodiversity, and affecting human health. A systemic change is needed where resources are valued, redesigned, and reused. Well, evidence-based impacts at genetic, cellular, tissue and organism level effects have been established by medical toxicology experts throughout the globe. A plastic-free planet should not be only for the privileged but should also provide solutions and alternatives for many who depend upon this cheap, light, and accessible material. It is important that in the rush to become plastic-free, we do not suddenly turn to unsustainable or damaging alternatives.

Through programs in education, activism, and science, we advocate for global change to support a circular economy and sustainable communities worldwide to end plastic pollution in a sustainable manner. Many types of microbes can degrade plastic, including bacteria and fungi. Some bacteria that can degrade plastic include *Bacillus*, *Pseudomonas*, *Escherichia*, *Rhodococcus*, *Azotobacter*, *Ralstonia*, *Halomonas*. Some fungi that can degrade plastic include *Aspergillus* and *Filamentous* fungi. These microbes can be found in a variety of ecosystems, including soil, compost facilities, and even insect guts. Environmental and Biotechnology applications can play important role in plastic pollution management toward sustainability.

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DIGITALIZATION AS A DRIVER OF CIRCULAR ECONOMIC TRANSITION IN CHINA

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ABSTRACT

The transition to a circular economy is critical for sustainable development, particularly in resource-intensive economies like China. Emerging digital technologies have the potential to serve as key enabling factors for this transition. China's policy frameworks, including the 14th Five-Year Plan and net-zero commitments, strongly support this digitalized transition, offering a regulatory foundation for innovation. The paper explores the transformative role of digitalization in advancing China's transition to a circular economy, a model that emphasizes resource efficiency, waste reduction, and sustainable growth. By analysing the synergies between digitalization and circularity, the study explores how digital technologies can enable and support a circular economy in China. The research provides insights into the opportunities and challenges of leveraging digitalization to drive China's circular economy transition through a comprehensive literature review, SWOT and TOWS analysis. The findings indicate that digitalization promotes a circular economy and sustainable development, it also advances China's economic goals by fostering innovation and international competitiveness.

Keywords: China, circular economy, digitalization, economic transition, sustainable development.

INTRODUCTION

Digitalization represents a transformative force in the global economy, enabling industries to innovate and transition towards sustainable practices. In the context of China, where rapid economic growth has often strained natural resources and caused environmental challenges, digitalization offers a unique opportunity to facilitate the circular economic transition. China has achieved significant advancements in its circular economy, contributing to 25% of the



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nation's carbon emission reduction efforts. Over two decades, China has emerged as a global leader in the circular economy despite its late start compared to the United States and European nations.

Key initiatives include transforming industrial parks, which contribute to 30% of China's carbon emissions, by optimizing waste recycling and establishing robust industrial chains. In 2023, China utilized 4 billion metric tons of bulk solid waste, with a nearly 60% usage rate for newly added waste. The country also recycled 260 million tons of steel waste, streamlining production processes to cut energy use and carbon emissions. China's online electronics recycling platforms play a growing role in the circular economy. Although over 400 million mobile phones are discarded annually, only 5% enter professional recycling. Platforms now offer services like home collection of secondhand goods, with plans to expand coverage to 1,000 cities by 2025 [1]. By integrating digital technologies – such as Internet of Things (IoT), big data, artificial intelligence (AI), and blockchain – with circular economy principles, China has the potential to achieve a sustainable economic model that balances growth with environmental preservation. This research underscores the critical role of digitalization in enabling China to meet its ambitious sustainability goals, fostering a resilient, resource-efficient future.

The objectives of this study are to: (1) provide an overview of China's circular economy policy, (2) identify key digital technologies that contribute to the acceleration of the circular economy, and (3) conduct SWOT and TOWS analyses to determine the prospects for utilizing digitalization for the development of the circular economy.

Literature review. The intersection of digitalization and circular economy (CE) in China has become a critical area of research, with numerous studies highlighting the transformative potential of digital technologies in advancing sustainable economic models. This review synthesizes key literature on how digitalization drives the transition to a circular economy in China, focusing on policies, technological innovations, and institutional frameworks.

The United Nations Conference on Trade and Development (UNCTAD) highlights the transformative potential of digital trade for developing countries, including China. Digital platforms can significantly enhance market access, streamline transactions, and foster inclusive growth.

However, UNCTAD (2022) identifies barriers such as insufficient infrastructure, gaps in digital literacy, and regulatory complexities that hinder the realization of these benefits. Addressing these challenges is essential for integrating digital trade into the circular economy framework in China [2].

The KPMG report "Investment in Technology Innovation" explores technological advancements with substantial potential to reshape industries and create value. The study identifies technologies such as the IoT, AI, blockchain, and robotics as central to fostering



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innovation in business processes. KPMG (2019) further provides recommendations for organizations to maximize returns on technological investments, including focusing on value-driven funding, maintaining a lean yet impactful technology portfolio, and emphasizing agility in managing investments. These strategies are directly relevant to China's efforts to leverage digital technologies for CE practices, particularly in resource management, waste reduction, and sustainable production systems [3].

China has been actively pursuing a circular economy through national policies and strategic frameworks, aiming to decouple economic growth from resource consumption. Chen (2023) provides an in-depth review of China's circular economy policies, reflecting on the effectiveness of these frameworks in addressing environmental sustainability and industrial transitions [4]. These policies are increasingly intertwined with digitalization, as digital technologies are seen as essential tools to monitor, optimize, and scale circular practices across industries.

In the latest 14th Five-Year Plan, China has prioritized the development of a circular economy, recognizing the need for technological advancements such as big data, IoT, and AI to drive resource efficiency and sustainability [5]. The government has also introduced regulations that specifically encourage the use of digital tools for waste management, recycling, and product lifecycle management [6].

The role of digital technologies in the circular economy is a key theme in recent research. Chi et al. (2023) explore how digital technologies such as IoT, big data, AI, and blockchain can create a more efficient circular economy [7]. These technologies enable better resource tracking, waste reduction, and the optimization of recycling processes. For instance, blockchain can ensure transparency in material flows, while AI can optimize waste sorting and improve recycling efficiency.

Du, Xu, and Yuan (2024) further emphasize the symbiotic relationship between digital technologies and circular economy principles, highlighting how innovations like 3D printing, AI, and digital sharing platforms can lead to smarter resource management and less environmental impact [8]. They argue that advanced digital technologies help industries move from a linear to a circular production model by facilitating more efficient product design, recycling, and resource reuse.

Despite the technological opportunities, institutional barriers remain a significant challenge to the digitalization of the circular economy. Yin et al. (2024) explore the role of institutional theory in understanding how China's regulatory environment influences the adoption of digital solutions for circularity [9]. They argue that while digital technologies can offer substantial benefits, their implementation is often hindered by outdated regulations and the slow pace of institutional reform.



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Similarly, Ranta et al. (2017) highlight the differences in institutional frameworks across regions, noting that China's government has a more centralized approach, which can both facilitate and hinder the integration of circular economy principles through digital means [10]. The centralized structure allows for top-down policy enforcement but also limits flexibility and innovation at the grassroots level.

Urban sustainability, particularly in China's rapidly industrializing cities, is another key area where digitalization and circular economy principles intersect. Hongyue et al. (2022) identify key drivers of urban digital economy development, which include digital infrastructure, data-driven governance, and technological innovation [11]. These drivers are crucial for creating sustainable urban environments by integrating circular economy practices such as resource sharing, waste management, and energy optimization through digital platforms.

Ma and Lin (2023) examine how digitalization can support energy-saving and emission-reduction goals in Chinese cities. Their study underscores the importance of harmonizing industrialization and digitalization to achieve the synergies needed for a sustainable urban circular economy [12].

Looking forward, Liu et al. (2021) and Govindan (2023) identify the need for further research on integrating digital economy and circular economy strategies [13], [14]. They argue that while there is growing recognition of the role of digitalization, challenges remain in terms of policy alignment, technological readiness, and cross-sector collaboration. The future of digitalization in China's circular economy lies in creating an ecosystem that fosters innovation, integrates digital technologies at scale, and overcomes institutional barriers.

Moreover, Lu et al. (2024) suggest that China's pathway towards a net-zero and circular economy involves not only adopting advanced digital technologies but also modelling different scenarios to understand the long-term impacts of digitalization on resource efficiency and carbon emissions [15].

The transition to a circular economy in China is heavily influenced by digitalization, which serves as both a driver and enabler of more efficient and sustainable practices. While China has made significant strides in integrating digital technologies into its circular economy strategy, challenges related to institutional frameworks, technological innovation, and policy enforcement remain. Future research and policy development should focus on addressing these challenges while further harnessing digital tools to accelerate the circular economy transition.

MATERIAL AND METHODS



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A comprehensive literature review is conducted, drawing upon sources such as official government documents, academic publications, and industry reports, as well as reports from international organizations, white papers, and news articles. To identify key digital technologies contributing to the acceleration of the circular economy, a systematic literature review is conducted using relevant keywords. SWOT and TOWS analyses are conducted to determine the prospects for utilizing digitalization. Data will be collected through a combination of internal and external sources, including case studies, market research reports, and analysis of industry trends.

RESULTS

China's circulation economy policy overview. At the legislative level, the first steps to ensure environmental protection were taken in 1979 with the adoption of the Law on Environmental Protection of the People's Republic of China. In 2002, at the 16th National Congress of the Communist Party of China, Jiang Zemin proclaimed in his report that among the tasks of forming a middle-class society [16]:

"...The capability of sustainable development will be steadily enhanced. The ecological environment will be improved. The efficiency of using resources will be increased significantly. We will enhance harmony between man and nature to push the whole society onto a path to civilized development featuring the growth of production, an affluent life and a sound ecosystem..."

In 2008, the Circular Economy Promotion Law of the People's Republic of China was adopted, coming into force on January 1, 2009 (amended in 2018). This law aims to promote the efficient use of resources, environmental protection, and sustainable development. According to the law, new industrial policies must align with the criteria of a circular economy. Through this framework, the government encourages research and development as well as international scientific cooperation on circular economy issues.

The 12th Five-Year Plan for Economic and Social Development of the People's Republic of China (2011–2015) emphasized energy conservation and climate change mitigation, focusing on reducing energy consumption, promoting alternative energy production, and gradually establishing a carbon market. These measures were intended to stimulate the development of a low-carbon economy.

In 2013, the Circular Economy Development Strategies and Action Plan was adopted, outlining three levels of the circular economy: enterprise, industrial park, and city or province. For example, the Action Plan specified that the coal industry should advance in five key areas: "green mining, integrated coal operation and utilization, energy conservation and



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consumption reduction, environmental protection, and the construction of industrial networks.”

The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China (2016–2020) identified the circular economy as a critical area within ecosystem development and environmental protection. Over this five-year period, the government planned to implement a cyclic development management plan, promote closed-loop processes in industrial enterprises, and establish demonstration zones for waste recycling. Additionally, the plan allocated USD 360 billion in investments for renewable energy sources and aimed to reduce energy consumption per unit of GDP by 15% (noting that this metric decreased by 70% from 1980 to 2010) [17].

In 2024, the National Development and Reform Commission unveiled a new plan to promote the circular economy as part of the 14th Five Year Plan (2021–2025). The plan focuses on improving resource efficiency and fostering high-quality development, aiming to conserve resources, ensure national resource security, and help China meet its carbon emission goals—peaking emissions by 2030 and achieving carbon neutrality by 2060.

The CE model emphasizes recycling, reusing, and refurbishing materials. The plan aims to create a resource recycling industry worth 5 trillion yuan by 2025, significantly improving resource utilization efficiency. Key targets include a 20% increase in resource productivity, reductions in energy and water consumption per unit of GDP by 13.5% and 16%, respectively, and improving the utilization of agricultural and industrial waste [18].

In addition, the Development Plan for the Circular Economy contains additional sectoral projects that contribute to achieving this goal. These projects affect sectors like automobiles, electronics, e-commerce, and logistics. Table 1 presents a list of key CE projects according to their implementation level (micro, meso, and macro) and scope (product, industry, and country), along with the corresponding department responsible for each project.

Table 1: China's 14th FYP Circular Projects by Level and Department

CE project	Accountability department	Implementation scope
Macro level		
The construction project of urban waste materials recycling system	- National Development and Reform Commission - Ministry of Commerce - Ministry of Natural Resources - Ministry of Industry and Information Technology - Ministry of Housing and Urban-Rural Development	Country



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The circular development project of the industrial parks	- National Development and Reform Commission - The Ministry of Industry and Information Technology	Country
Demonstration project of comprehensive utilization of bulk solid waste	- National Development and Reform Commission - Ministry of Industry and Information Technology - Ministry of Ecology and Environment - Ministry of Agriculture and Rural Affairs - The National Forestry and Grassland Administration	Country
Meso level		
Demonstration project of resource utilization of construction waste	- The Ministry of Housing and Urban-Rural Development - National Development and Reform Commission	Industry
The key technology and equipment innovation project of the CE	- Ministry of Science and Technology - National Development and Reform Commission	Industry
The high-quality development of the remanufacturing industry	- National Development and Reform Commission - Ministry of Information Technology	Industry
Micro level		
The action to improve the quality of waste from electrical and electronic products	- National Development and Reform Commission - Ministry of Ecology and Environment - Ministry of Industry and Information Technology - Ministry of Commerce - Supply and Marketing Cooperatives	Product
The promotion of automobile use lifecycle management	- National Development and Reform Commission - Ministry of Commerce - Ministry of Industry and Information Technology - Ministry of Public Security - Ministry of Ecology and Environment - Ministry of Transport - General Administration of Customs	Product
The special action for the whole chain of plastic pollution control	- National Development and Reform Commission - Ministry of Ecology and Environment - Ministry of Industry and Information Technology - Ministry of Commerce - Ministry of Housing and Urban-Rural Development - Ministry of Agriculture and Rural Affairs	Product



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	- The General Administration of Supervision - The State Post Bureau - The Supply and Marketing Cooperatives	
The green transformation of express packaging	- National Development and Reform Commission - The State Post Bureau in conjunction with industry - Ministry of Information Technology - Ministry of Ecology and Environment - Ministry of Transport - Ministry of Commerce - State Administration for Market Regulation	Product
The recycling action of waste power batteries	- Ministry of Industry and Information Technology - National Development and Reform Commission - Ministry of Ecology and Environment	Product
The improvement of the CE statistical evaluation system	- National Development and Reform Commission - National Bureau of Statistics - Ministry of Industry and Information Technology - Ministry of Commerce - Ministry of Ecology and Environment	Product

Source: modified by the authors based on [19]

Digital technologies for a circular economy in China. Initial initiatives to adopt the circular economy in China focused on transforming industrial parks. This was achieved by fostering ‘symbiotic relationships,’ where the waste generated by one process became the input for another. This approach, inspired by the principles of industrial ecology, aimed to mimic natural systems where resources are continuously cycled. Early successes laid the foundation for larger-scale adoption of CE principles across industries and regions.

Currently, China’s circular economy strategy is built around four key pillars, each addressing specific challenges and opportunities within the framework of sustainable development [20]:

1. Circular production – The integration of reducing, reusing, and recycling principles into entire production processes has become a cornerstone of China's industrial policies. By minimizing resource use and waste at every stage of production, companies not only lower costs but also reduce environmental footprints. Advanced manufacturing technologies, such as smart factories and artificial intelligence, play a crucial role in monitoring and optimizing production efficiency, further supporting circular practices.
2. Circular systems in industry, agriculture, and services – This pillar emphasizes the importance of optimizing processes across various sectors. In agriculture, for instance, by-products such as crop residues are repurposed into biofuels or fertilizers, creating closed-loop systems that reduce dependency on external inputs. In the service sector,



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- circularity extends to hospitality, retail, and logistics, where companies adopt sustainable practices like energy-efficient operations and reusable packaging solutions.
3. Expansion of the recycling industry – As urbanization accelerates, the volume of urban waste streams grows rapidly, posing challenges and opportunities for resource recovery. By investing in modern recycling facilities and developing remanufacturing technologies, China has positioned itself as a leader in urban waste management. This not only helps reduce landfill dependency but also ensures valuable materials like metals, plastics, and glass are reintroduced into the economy. The development of renewable energy sources, such as solar panels and wind turbines, further complements this effort by reducing reliance on finite resources.
 4. Green consumption (‘circular values’) – Guiding citizens toward smart, health-conscious, and safe consumption patterns is critical to sustaining the circular economy. Public awareness campaigns, educational initiatives, and incentives for eco-friendly choices encourage individuals to embrace sustainability in daily life. For example, digital platforms now enable consumers to access second-hand goods, share products through rental models, and recycle waste more effectively, reinforcing the shift toward circular consumption.

China’s commitment to the circular economy is also reflected in its policy framework. Laws and regulations have been implemented to support these pillars, including financial incentives for businesses adopting circular practices, strict penalties for excessive waste production, and funding for research and innovation in circular technologies.

The following examples of Chinese companies and initiatives illustrate these priority areas while showcasing China’s transition from being a global manufacturing powerhouse to becoming the largest consumer market in the world (Table 2).

These case studies highlight how the circular economy is reshaping industries, driving economic growth, and contributing to the global fight against resource depletion and climate change. They serve as a testament to the potential of a well-coordinated strategy in achieving a balance between economic development and environmental sustainability.

Table 2: Examples of Circular Economy Implementation in China

Company/Initiative	Field of Activity	Key Achievements	Impact
GEM Co. Ltd	Material recycling (electronics, automobiles, batteries, wastewater)	Leader in material recycling in China.	Significant resource savings (3 million tons of waste processed in 2016).
		Highest battery reuse rate in China (over 10%).	Energy savings equivalent to 14



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Company/Initiative	Field of Activity	Key Achievements	Impact
Jingdong (JD) Reuse Platform	Reuse platform (mainly smartphones)		million barrels of fossil fuel.
		Recovery of nickel and cobalt for new battery production.	
		\$150 billion investment in platform development.	Reduced material waste by extending product life cycles.
		Quality assurance by Aihuishou.	Encouraged consumers to care for their gadgets.
Mobike	Bike-sharing system	7-day return policy.	
		Successfully expanded to 160 cities worldwide.	Reduced congestion and air pollution.
		28 patents, including GPS and IoT technologies.	Promoted integration with other modes of transportation.
Y Closet	Clothing rental subscription	Subscription model for \$75/month with access to 150,000+ clothing items.	Reduction in textile waste.
		Partnerships with renowned brands (Kenzo, Acne Studios).	Provided an economic and environmental alternative to fast fashion.
Guangzhou Huadu	Automotive remanufacturing		
		Remanufactures 35,000 gearboxes and automotive transmission units annually.	Estimated market potential of USD 30 billion annually.
		Collaborates with 21 auto companies and a large 4S franchise.	Up to 80% energy savings and 70% reduction in waste production.
		Offers remanufactured products insured by Pingan.	Supported by national schemes like “Trade Old for Remanufactured.”

Source: [20]

To achieve sustainable development within the framework of the circular economy, modern technologies play a pivotal role in optimizing resource use, reducing waste, and promoting recycling. Innovative approaches in the technological sphere enable efficient process



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management, enhance supply chain transparency, and unlock new opportunities for material reuse. The table 3 below outlines key technologies and their applications in the context of the circular economy, highlighting their importance in building sustainable business models and optimizing production processes.

Table 3: Technologies for Sustainable Resource Management and Circular Economy

Technology	Application
Internet of Things (IoT)	- Sensors for monitoring resource usage.
	- Tracking product life cycles.
	- Optimizing production processes to reduce waste.
Big Data	- Data analysis for efficient resource management.
	- Demand forecasting to avoid overproduction.
	- Identifying recyclable waste.
Artificial Intelligence (AI)	- Developing optimal logistics models for material reuse.
	- Data analysis to improve recycling processes.
	- Automating waste sorting.
Blockchain	- Transparent accounting of materials and raw resources.
	- Tracking supply chains in the circular economy.
	- Ensuring product compliance with sustainable production standards.
3D Printing	- Using recycled materials to create new products.
	- Minimizing waste in manufacturing.
	- Printing parts on demand to avoid surplus.
Digital Sharing Platforms	- Online services for renting, reselling, and exchanging products.
	- Marketplaces for secondary resources.
	- Coordination between enterprises for shared resource usage.
Renewable Energy Technologies	- Solar and wind installations for providing "green" energy.
	- Energy storage systems for continuous production operations.
Biotechnology	- Transforming organic waste into biofuel or biomaterials.
	- Producing biodegradable materials.
	- Using microorganisms for water and soil purification.
Robotics	- Automating waste sorting.
	- Robots for dismantling old devices and extracting valuable components.



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Technology	Application
Cloud Technologies	- Manufacturing with minimal human intervention.
	- Data storage for monitoring resources and waste.
	- Integrating data across companies in the supply chain.
	- Simplifying access to information about materials and processes.

Source: [2], [3]

SWOT and TOWS framework for assessing digitalization in China's circular economy transition. The comprehensive analysis, structured around the SWOT, identifies the nation's strengths, weaknesses, opportunities, and threats in applying digital technologies for sustainable economic development. The TOWS matrix based on SWOT analysis, reveals strategic pathways for China to apply digitalization in advancing its circular economy initiatives (Table 4).

Table 4: TOWS Analysis: Harnessing Digitalization for China's Circular Economy

	Strengths 1. Policy alignment 2. Technological leadership 3. Research and innovation hubs 4. Efficient logistics systems 5. Industrial base 6. Strong public-private partnerships	Weaknesses 1. Infrastructure gaps 2. Fragmented data systems 3. Skills shortage 4. High costs 5. Legacy systems 6. Complex supply chains
Opportunities 1. Technological innovation 2. Global collaboration 3. Increasing circular economy financing 4. Export growth 5. Consumer awareness 6. Urbanization trends	1. <i>Technology-Driven Innovation Leadership</i> - Combining technological leadership with innovation opportunities to develop cutting-edge circular economy solutions; - Using research hubs to pioneer new digital technologies for waste reduction and resource optimization. - Utilizing strong public-private partnerships to accelerate technological advancement. 2. <i>Global Market Expansion</i> - Capitalizing on efficient logistics systems to support export growth in circular economy solutions.	1. <i>Infrastructure Development</i> - Using increasing circular economy financing to address infrastructure gaps; - Leveraging global collaboration to improve data system integration; - Taking advantage of urbanization trends to upgrade legacy systems. 2. <i>Capability Enhancement</i> - Utilizing technological innovation to address skills shortages; - Leveraging international partnerships to build expertise; - Using increased financing to modernize systems and processes. 3. <i>Supply Chain Optimization</i> - Deploying new technologies to simplify complex supply chains;



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	- Using industrial base strength to meet growing global demand for sustainable products. - Deploying technological expertise to establish international collaborative platforms. 3. <i>Urban Digital Integration</i> - Aligning policy frameworks with urbanization trends to create smart, sustainable cities. - Utilizing public-private partnerships to implement digital circular economy solutions in urban development. - Exploataing research capabilities to develop urban-specific circular economy technologies.	- Leveraging growing consumer awareness to justify supply chain investments; - Using global collaboration to establish more efficient systems.
Threats 1.Regulatory uncertainty 2.Economic slowdown 3.Market resistance 4.Environmental concerns 5.International competition 6.Cybersecurity challenges	1. <i>Regulatory Leadership</i> - Leveraging policy alignment to establish clear regulatory frameworks, reducing uncertainty. - Utilizing public-private partnerships to develop industry standards and best practices. - Using technological leadership to address cybersecurity challenges proactively. 2. <i>Competitive Advancement</i> - Deploying industrial base and technological leadership to maintain competitive advantage. - Utilizing research hubs to stay ahead of international competition. - Using efficient logistics systems to mitigate economic slowdown impacts. 3. <i>Environmental Protection</i> - Aligning policies with environmental protection goals. - Using technological capabilities to address environmental concerns. - Deploying research expertise to develop eco-friendly solutions.	1. <i>Risk Management</i> - Solving cybersecurity challenges while upgrading fragmented data systems; - Developing skills and expertise to handle regulatory changes; - Implementing cost-effective solutions to counter economic slowdown. 2. <i>System Modernization</i> - Upgrading legacy systems to meet environmental standards; - Removing infrastructure gaps to remain competitive internationally; - Streamlining supply chains to reduce market resistance. 3. <i>Collaborative Solutions</i> - Partnership with international organizations to address skills shortages. - Sharing costs and risks through industry collaborations. - Developing joint solutions for complex regulatory challenges.

Source: developed by authors



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Harnessing digitalization is a pivotal strategy for overcoming the challenges and maximizing the opportunities within China's circular economy. Through innovative technological applications, enhanced public-private partnerships, and robust global collaborations, China can achieve systemic modernization and sustainable development. The strategic insights provided by the TOWS framework underline the importance of addressing regulatory uncertainty, market resistance, and cybersecurity risks while capitalizing on consumer awareness, urbanization trends, and circular economy financing. By integrating these elements, China is poised to lead a global shift toward sustainable practices.

CONCLUSION

Digitalization is a pivotal factor in China's transition to a circular economy, facilitating sustainable economic growth through the integration of innovative technologies and policy frameworks. By applying digital tools such as IoT, AI, blockchain, and big data, China has advanced its resource management, waste reduction, and recycling systems, demonstrating the transformative potential of digitalization in fostering circularity. The nation's regulatory support, exemplified by the 14th Five-Year Plan and net-zero commitments, has provided a robust foundation for aligning industrial practices with circular economy principles.

Despite significant progress, challenges like fragmented infrastructure, skill shortages, and regulatory barriers persist. Addressing these issues requires a synergistic approach that combines technological advancements with institutional reform, fostering public-private partnerships and global collaborations. The SWOT and TOWS analyses underscore strategic opportunities for China to further integrate digitalization into circular economy practices, enhancing competitiveness and sustainability.

China's efforts exemplify how a digitally driven circular economy can balance economic growth with environmental preservation, offering a scalable model for global adoption. Potential for future research focuses on overcoming existing barriers, fostering innovation, and ensuring the long-term sustainability of digital and circular synergies to achieve a resilient and resource-efficient economy.

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GENETIC BEHAVIOR FOR RICE YIELD AND ITS ATTRIBUTES USING TRIPLE ANALYSIS

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ABSTRACT

A triple test cross was conducted to assess genetic variance in rice yield traits, examining epistasis, additive, and dominance effects using testers Giza 177, Grain Super Rice IR2-9-L1-L3R2, their F₁ hybrid, and 15 promising lines across three seasons. Results showed significant total epistasis, especially type i for traits like flag leaf area and grain yield, while j + l types were beneficial for all traits under recurrent selection. Line MJ5460-4 contributed notably to epistasis. Additive and dominance variances were high, suggesting early selection for additive traits (filled grains, flag leaf area) and late selection for traits with partial or over-dominance effects.

Keywords: Triple test cross, Rice genotypes, additive, dominance, epistasis, yield component

INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food for more than half of the world's population. It is the staple food for more than half of the world's population. It is a nutritious cereal crop, provides 20 percent of the calories and 15 percent of the protein consumed by world population [1]. The world population anticipated to reach eight billion by 2030 and rice production must increase by 50 percent in order to meet the growing demand [2]. To meet the demand of an increasing population, developing new high yielding hybrids and improved lines/varieties along with a stable agricultural climate is a major challenge. One of the main constraints for low yield is insufficient understanding of gene action governing



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yield and most of the yield components (quantitative traits), which decide the choice of selection to be followed for their improvement aiming to obtain higher yield. While estimating genetic parameters of variance for a metrical trait from second degree statistics, three difficulties inevitably arise. While estimating genetic parameters of variance for a metrical trait from second degree statistics, three difficulties inevitably arise. First it is supposed d that non-allelic interactions are absent. This assumption may be correct for some traits but not for others. Therefore, these analyses rarely provide a valid test of this assumption. Second, estimates of dominance components always have much larger standard errors than the corresponding additive component [3]. Third, additive and dominance components are differentially affected by linkage and correlated gene distribution in the parents and are only comparable in the unlikely event of population sample being in linkage equilibrium. A good inheritable model is that which enables the breeder to have precise and unprejudiced estimates of all the components of genetic variance.

To overcome these penalties, a design which is a simple extension of design III of [4] was proposed by [5]. This design is common as ‘Triadic Test Cross’ (TTC), provides not only an efficient estimate of dominance but also an unequivocal (unequivocal) test for epistasis. The information about nature and magnitude of genetic components of variance for grain yield, its components and some vegetative traits is essential for planning an efficient breeding program in any crop.

The Triadic test cross (TTC) design developed by Kearsey and Jinks (1968) as an extension of the North Carolina Mating Design III (Comstock and Robinson 1952), which was latterly expanded and modified by [6, 7]. The primary purpose of the triadic test cross design is to unambiguously descry epistasis for quantitatively inherited traits, and assuming that the L₁ and L₂ are extremely high and low selection lines [5], it also provides independent tests for the presence of additive and dominance components of genetic variation that are equally precise in the absence of epistasis [7].

TTC analysis (Kearsey and Jinks 1968) gave estimates on epistatic variation, further estimating the additive and dominance components of variation when epistasis is absent. The (hypotheticals) assumptions for a TTC analysis aren't demanding, and the model is independent of gene correlation, (lovmaking) mating system and allelic frequency [5]. The present study aims to detect epistasis along with assessment of (genetic components viz, additive and dominance) for different physio-morphological traits; genetically least exploited traits in rice.



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MATERIALS AND METHODS

The present investigation was carried out at the Research at Farm of Sakha Agricultural Research Station, Sakha, and Kafr EL-Sheikh, Egypt during the three successive 2020, 2021 and 2022 seasons. This work aimed to study the genetic behaviour of grain yield, its components and some vegetative traits of rice (*Oryza sativa* L.) using the modified Triadic test-cross analysis of Ketata and coworkers [8].

Field procedures: Two rice genotypes, Giza 177 (P_1) and Grain Super Rice IR2-9-L1-L3R2 (P_2) designated as L_1 and L_2 , respectively were used as tester genotypes. Two rice genotypes with various growth and yield characteristics and hybridized in a combination of Giza 178 x GSRIR2-9-L1-L3R2 in summer 2020 season. The resulting F_1 was the third tester designated as L_3 . Fifteen true breeding genotypes, MJ5460-1, MJ5460-2, MJ5460-3, MJ5460-4, MJ5460-5, MJ5460-6, MJ5460-7, MJ5460-8, MJ5460-9, MJ5460-10, MJ5460-11, MJ5460-12, MJ5460-13, MJ5460-14 and MJ5460-15 were crossed with three testers (L_1 , L_2 and L_3) in next year summer 2021 season. The testers were used as females in the entire Triadic test cross combinations. The experiment thus consisted of 45 crosses i.e. 15 L_{1i} , 15 L_{2i} and 15 L_{3i} progeny families of a Triadic test cross (T.T.C.) design and at the same time, Giza 177 (L_1) and GSRIR2-9-L1-L3R2 (L_2) were crossed to produce their F_1 hybrid (L_3) during the same season. The materials consisting of 3 testers, 15 lines, and 45 crosses were planted in randomized complete block design with three replications in 2022 season. Each replicate consisted of one row of F_1 hybrid among two rows of each parental line; the row was five meters long, 20 cm apart and contained 25 plants. The plant-to-plant spacing between and within the rows were kept 20 cm respectively. All agricultural practices were made according to rice recommendations of RRTC [9]. Data were recorded on 10 plants randomly were taken from each replication for the following traits: flag leaf area(cm^2), panicle weight (g), panicle density, number of filled grains/ panicle, seed set%, 1000-grain weight (g), grain yield/hill (g) as recommended by Standard Evaluation System (SES) of IRRI [10].

Analysis of variance: The analysis of variance was performed following the system described by Singh and Chaudhary [11] to estimate the significance of treatments and to partition the treatment effect so as to determine the significance variations between the hybrids, parents, lines, testers, $P_1 + P_2$ vs. F_1 , P_1 vs P_2 , lines vs. testers and hybrids vs. parents for each character using the TTC system.

Test for epistasis: The detection of epistasis was performed according to Singh and Chaudhary [11]. The test of significance of the difference ($L_{1j} + L_{2j} - 2L_{3j}$) (j = genotypes), provides information about the presence or absence of epistasis. Therefore, the $L_{1j} + L_{2j} - 2L_{3j}$



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for each line (genotype) and each replication was first computed (a replication thus consisted of 4 values each for a genotype) and then tested. The total epistasis for 4 degree of freedom was calculated as uncorrected genotype (lines) sums of square $[S ((L_{1j} + L_{2j} - 2L_{3j}))^2]/n$ on the total number of replications. The total epistasis was partitioned into two factors.

The correction factor c.f. = $[S (L_{1j} + L_{2j} - 2L_{3j}))^2 / n]$ essentially the epistasis of additive-by-additive type (i type) for one degree of freedom and corrected genotypes sums of squares $[S ((L_{1j} + L_{2j} - 2L_{3j}))^2 / n - \text{c.f.}]$ measures essentially the j + l type (additive x dominance and dominance x dominance) for 3 degrees of freedom. The sum of square associated with the interaction of epistasis with blocks (replications) was calculated as the difference between total sum of squares and type of epistasis (total s.s – total epistasis / i type epistasis / j + l type epistasis).

Each of three types of epistasis was tested against their respective interaction with blocks. However, before testing individual epistasis, the homogeneity of the interaction was first tested.

As there were only 2 variances (i x block and j + l x block) homogeneity were tested as under: $F(2, 6) = \text{Mean square of i type interaction} / \text{Mean square of j and l type interaction}$. Where the homogeneity of the interaction variances was not significant, the i and j + l type epistasis were also tested against the pooled error, i.e., total epistasis x block interaction.

Individual genotypic epistasis: The individual contribution of each line to the total epistasis was estimated and tested for significance according to Ketata and his coworkers [8] for those characters in which the total epistasis was significant. The mean value $(S L_{1j} - L_{2j} - 2L_{3j}) / r$ (where r is replications number) of each genotype for a trait was tested using a t-test with 8 degrees of freedom as follows: $t = \text{Mean} / \text{S.E.}$ Where S.E. = $(\text{Error mean square} / \text{replication})^{1/2}$

Additive-dominance model: The traits where total epistasis effects were not detected by either test, an additive-dominance model was fitted to the data [5, 6]

Estimation of additive variance component (D): The sum of $L_{1j} + L_{2j}$ for each genotype was calculated replication accurately and showed the analysis of variance as follows:

Table (1): The form of analysis of variance to estimate the additive components of the genic variance.

Source of Variance	df	MS	M.S. Expected
Replications	r-1	MS_r	
Genotypes sum ($L_{1j} - L_{2j}$)	g-1	MS_s	$\sigma_e^2 + 2\sigma_s^2$
Error	(r-1) (g-1)	MS_e	σ_e^2



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Where r = Replications; g = Genotypes; MS_r , MS_s , MS_e = Mean squares of replications, genotypes (sums) and error, respectively; σ^2_e and σ^2_s = Expected mean square of error and genotypes (sums).

The observed mean squares were substituted into the equations as follows:

$$\sigma^2_s = (MS_s - MS_e)/2r$$

$$\sigma^2_s = (1/4) D$$

$$D = 4(MS_s - MS_e)/2r$$

Estimation of dominance component (H): The difference in $L_{1j} - L_{2j}$ for each genotype was calculated replication accurately and showed to analysis of variance as follows;

Table (2): The form of analysis of variance to estimate the dominance components of the genic variance.

Source of Variance	df	MS	MS Expected
Replication	$r-1$	MS_r	
Genotypes difference ($L_{1j}-L_{2j}$)	$g-1$	MS_d	$\sigma^2_e + 2r\sigma^2_d$
Error	$(r-1)(g-1)$	MS_e	σ^2_e

Where r = Replication; g = Genotypes; MS_r , MS_d , MS_e = Mean squares of replication, genotype (differences) and error, respectively; σ^2_e and σ^2_d = Expected MS of error and genotypes (differences).

The observed mean squares were substituted into the equations as follows:

$$\sigma^2_d = (MS_d - MS_e)/2r$$

$$\sigma^2_s = (1/4)H$$

$$H = 4(MS_d - MS_e)/2r$$

Average degree of dominance was calculated as $(H/D)^{1/2}$, where H and D were the dominance and additive variance components, respectively.

Direction of dominance (r s,d) was determined by calculating the linear correlation coefficient $r_{s,d}$ between the sum ($L_{1j} + L_{2j}$) and the genotypic differences ($L_{1j} - L_{2j}$) for all genotypes. Significant positive and negative correlations would indicate a predominant direction towards decreasing and increasing values of the trait, respectively [6]. All the triadic test cross calculations were performed using COSTAT-C package (Michigan State University and Agricultural University of Norway).

RESULTS AND DISCUSSION

Analysis of variance



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The analysis of variance effects for various growth and agronomic characters of rice genotypes is shown in Table 3. Highly significant differences in genotypes, hybrids, parents, lines and testers were noted for all the studied characters indicating presence of considerable variability among the genotypes. The significant mean squares of P_1 vs. P_2 and $P_1 + P_2$ vs. crosses. for flag leaf area, panicle weight, panicle density, number of filled grains/ panicle, seed set%, 1000-grain weight and grain yield/hill. The significant mean squares of P_1 vs. P_2 and $P_1 + P_2$ vs. F_1 for all the studied traits showed existence of worth of variations between testers (L_1 and L_2). High differences between L_1 and L_2 resulted into expression of high mean performance of their F_1 (L_3) as revealed by significant variance due to $P_1 + P_2$ vs. F_1 . Because two tester lines showed highly significant differences for each trait, therefore they would provide precise estimates of additive and dominance variance as reported by [5].

Moreover, highly significant differences were recorded for all the characters among genotypes including parents, lines, testers, crosses, $P_1 + P_2$ vs. crosses, lines vs. tester and hybrids vs. parent. These results coincide with the findings and [12]. They also found significant differences between parents vs. crosses.

Table 3: Mean squares for various growth and yield and its related component traits in

S.O.V	Df	Flag leaf area	Panicle weight	Panicle density	Filled grains/ panicle	Seed set %	1000 grain weight	Grain yield / hill
Replication	2	0.17	0.22	0.33	67.84	0.71	0.33	0.17
Treatments	62	523.97**	4.70**	16.30**	4418.80**	690.92**	14.34**	171.44**
Hybrids	44	418.58**	4.05**	14.00**	4577.12**	700.53**	6.47**	57.73**
Parents	17	266.60**	3.18**	14.20**	2730.04**	199.57**	30.55**	137.32**
Lines	14	167.77**	3.33**	13.37**	2518.17**	69.38**	36.35**	156.41**
Testers	2	456.03**	2.69**	3.21**	993.43**	938.01**	4.94**	44.12**
L_1+L_2 vs hybrids	1	381.34**	3.56**	5.77**	43.21*	1759.23**	6.76**	54.67**
L_1 vs L_2	1	530.72**	1.82**	0.65	1943.64**	116.78**	3.12**	33.56**
Lines vs Testers	1	1271.40**	2.07**	47.71**	9169.43**	545.34**	0.57	56.49**
Hybrids vs Parents	1	9536.11**	59.35**	153.32**	26161.64**	8620.83**	84.95**	5754.78**
Error	124	1.89	0.04	0.21	9.36	1.40	0.25	1.87

rice.

Mean performance of parents and their F_1 hybrid combination:

Data in Tables 4 and 5 showed that Mean of lines, testers and their hybrids indicated strong of genetic variability for the improvement of panicle weight (g), panicle density, filled grains per



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panicle, seed setting (%), 1000 grain weight (g) and weight grain yield hill⁻¹, which are important in breeding rice are showed in Tables 4 and 5, among the lines, the lines MJ5460-5, MJ5460-9, MJ5460-10, MJ5460-14 and MJ5460-15 was recorded the desirable values for 1000-grain weight (33.22g), panicle density (13.10), seed set% (93.49%), flag leaf area (47.06cm²), panicle weight (6.64g), no. of filled grains/panicle (215.89) and grain yield hill⁻¹(57.43g), respectively. With respect to testers, the rice variety Giza 177 recorded the desirable values for seed set% (92.33), while, the hybrid Giza 177 x GSRIR2-9-L1-L3R2 recorded the desirable values for flag leaf area (54.08cm²) , panicle weight (5.37g), panicle density (8.67), 1000 grain weight (29.05g) and grain yield hill⁻¹ (50.47), respectively) and the line GSRIR2-9-L1-L3R2 recorded the desirable value for filled grains panicle⁻¹ (149.31). Concerning hybrid combinations MJ5460-4 x GSR recorded the desirable values for flag leaf area (72.22cm²),while, the cross MJ5460-3 x GSRIR2-9-L1-L3R2 recorded the desirable value for panicle weight (8.54g), the cross MJ5460-14 x G177 recorded the highest value for panicle density and filled grains/ panicle (16.70 and 276.00) and the cross combination MJ5460-1 x Giza 177 recorded the highest values for seed set% (97.59%), On the other side, the cross; MJ5460-10 x GSRIR2-9-L1-L3R2 recorded the desirable values for 1000 grain weight (32.27g), while, the hybrid combination MJ5460-8 x F₁(Giza 177 x GSR) gave the desirable value for weight grain yield hill⁻¹ (68.54g), so, rice breeders should be use these genotypes as donors to development new varieties in rice breeding programs.

Table (4): Mean performance of genotypes for flag leaf area, panicle weight, panicle density, no. of filled grains/panicle, seed set%, 1000 grain weight and grain yield hill⁻¹ during 2021 and 2022 growing season.

Traits	Flag leaf area (cm ²)	Panicle weight (g)	Panicle density (%)	No. of filled grains/panicle	Seed set %	1000- grain weight (g)	Grain yield/hill (g)
Lines							
MJ5460-1	26.13	3.44	6.43	109.67	82.98	25.31	45.58
MJ5460-2	26.41	3.23	5.66	105.78	85.53	30.55	43.67
MJ5460-3	34.19	4.83	8.14	144.10	83.85	30.18	55.41
MJ5460-4	35.82	5.14	10.81	148.48	77.46	29.19	37.53
MJ5460-5	31.47	6.16	10.10	177.18	89.17	33.22	47.55
MJ5460-6	24.87	4.33	10.77	153.66	86.91	24.20	54.08
MJ5460-7	20.05	3.73	12.40	167.38	80.13	22.24	39.47
MJ5460-8	21.22	4.00	12.72	183.88	83.54	21.57	37.52
MJ5460-9	29.08	5.13	13.10	191.17	81.84	25.20	54.83
MJ5460-10	30.55	5.32	9.32	168.27	93.49	29.75	56.14
MJ5460-11	39.65	6.20	10.49	177.38	91.38	31.28	52.31
MJ5460-12	40.11	5.62	9.83	180.46	90.71	29.44	56.41



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MJ5460-13	35.35	5.57	9.92	174.78	90.67	29.60	55.17
MJ5460-14	47.06	6.64	11.59	215.89	88.66	29.51	52.83
MJ5460-15	35.87	5.73	9.63	172.88	92.06	30.24	57.43
Mean	31.85	5.00	10.06	164.73	86.56	28.10	49.73
Tester							
Giza 177	30.87	3.48	6.64	113.32	92.33	27.93	42.88
GSR	49.68	4.58	7.30	149.31	83.51	26.49	47.61
Giza 177 x GSR (F ₁)	54.08	5.37	8.67	126.67	58.26	29.05	50.47
Mean	44.87	4.48	7.54	129.77	78.03	27.82	46.98

Table (5): Mean performance of F₁ (triadic test cross) for flag leaf area, panicle weight, panicle density, number of filled grains/panicle, seed set%, 1000-grain weight and grain yield/hill during 2022 growing season.

Hybrid combinations	Studied Traits						
	Flag leaf area (cm ²)	Panicle weight (g)	Panicle density(%)	No. of filled grains/panicle	Seed set %	1000-grain weight (g)	Grain yield / hill (g)
MJ5460-1 x Giza 177	38.76	5.22	8.11	177.79	97.59	28.22	58.91
MJ5460-1 x GSR	67.81	5.94	9.63	157.89	61.54	29.73	62.89
MJ5460-1 x F ₁	56.14	6.36	10.94	217.30	76.88	28.18	66.14
MJ5460-2 x Giza 177	39.50	5.90	9.47	199.01	96.10	28.33	63.98
MJ5460-2x GSR	69.62	5.22	9.60	129.30	51.05	31.14	65.08
MJ5460-2 x F ₁	46.17	6.45	16.37	212.72	67.27	26.50	69.12
MJ5460-3 x Giza 177	40.28	7.06	12.61	230.57	87.97	28.64	63.97
MJ5460-3 x GSR	82.03	8.54	14.15	249.44	62.52	31.12	68.15
MJ5460-3 x F ₁	64.20	7.08	11.97	221.99	73.33	30.35	67.56
MJ5460-4 x Giza 177	54.89	7.23	9.81	211.29	89.98	32.41	67.09
MJ5460-4 x GSR	72.22	8.15	13.09	226.23	63.71	30.17	72.15
MJ5460-4 x F ₁	53.07	4.88	8.57	141.76	73.15	30.39	65.35
MJ5460-5 x Giza 177	37.01	6.44	11.02	210.92	92.21	30.54	54.17
MJ5460-5 x GSR	45.37	6.89	10.52	164.10	59.77	29.70	56.13
MJ5460-5 x F ₁	56.06	2.67	9.32	84.03	35.46	29.83	58.48
MJ5460-6 x Giza 177	34.08	5.71	12.60	188.17	76.83	29.61	58.38
MJ5460-6 x GSR	55.81	7.40	14.60	202.40	59.34	30.42	55.89
MJ5460-6 x F ₁	41.52	5.16	12.64	157.67	57.13	26.85	64.73
MJ5460-7 x Giza 177	34.36	5.65	11.41	202.10	85.61	26.33	58.35
MJ5460-7 x GSR	46.55	6.69	14.68	221.90	64.29	27.94	64.84



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MJ5460-7 x F _i	41.14	4.71	11.08	143.57	59.48	28.11	60.76
MJ5460-8 x Giza 177	36.08	6.49	12.90	209.57	84.24	29.12	57.79
MJ5460-8 x GSR	51.07	7.48	14.31	214.17	64.87	29.85	58.73
MJ5460-8 x F _i	44.19	6.15	12.19	194.30	70.00	27.26	68.54
MJ5460-9 x Giza 177	39.99	6.31	11.58	188.08	79.38	30.74	58.94
MJ5460-9 x GSR	75.02	7.53	12.45	203.76	64.69	31.57	57.69
MJ5460-9 x F _i	52.84	5.82	12.23	167.40	61.93	27.50	66.53
MJ5460-10 x Giza 177	36.92	6.06	10.61	171.87	80.19	31.38	57.34
MJ5460-10 x GSR	59.83	7.56	13.17	203.76	62.14	32.27	59.63
MJ5460-10x F _i	46.78	5.22	11.02	147.83	56.88	31.48	63.01
MJ5460-11x Giza 177	38.98	5.55	9.75	205.07	91.07	29.67	54.27
MJ5460-11x GSR	65.97	7.28	13.65	190.84	54.38	30.93	56.68
MJ5460-11x F _i	51.93	3.29	9.04	74.17	36.38	28.35	61.95
MJ5460-12x Giza 177	37.92	7.13	12.78	224.59	85.06	28.65	54.29
MJ5460-12x GSR	63.14	6.91	10.08	175.73	59.35	31.33	64.04
MJ5460-12x F _i	44.82	6.02	13.11	193.10	72.75	29.65	60.17
MJ5460-13x Giza 177	40.94	4.89	6.70	145.07	96.37	30.18	62.95
MJ5460-13x GSR	44.56	5.52	12.42	171.88	58.61	28.72	59.96
MJ5460-13x F _i	42.64	5.25	12.48	154.60	57.89	29.73	62.54
MJ5460-14x Giza 177	39.15	7.91	16.70	276.00	90.24	29.34	57.79
MJ5460-14x GSR	50.46	6.03	14.47	211.60	63.22	28.81	59.45
MJ5460-14x F _i	58.43	5.73	10.36	182.27	69.22	28.57	64.33
MJ5460-15x Giza 177	43.14	5.98	8.65	156.21	90.20	29.84	59.25
MJ5460-15x GSR	46.55	6.32	10.25	175.40	62.04	29.34	57.63
MJ5460-15x F _i	50.74	5.25	10.36	135.23	56.15	30.38	61.24
Mean	49.75	6.16	11.63	184.95	70.19	29.54	61.49

Detection of epistasis:

Presence of epistasis (Table 6) was evidenced by the significance of variance ($L_{ij} + L_{2j} - 2L_{3j}$). The total epistasis was found to be highly significant for all the studied traits. Further partitioning of total epistasis into, *i* type (additive x additive) and *J* and *I* type (additive x dominance and dominance x dominance) interactions showed that *i* type interaction was highly significant for panicle weight, filled grains/ panicle, seed set%, 1000- grain weight and grain yield/ plant, while, *J* and *i* type interaction was found to be significant for flag leaf area and panicle density traits

The greater magnitude of *i* type epistasis than *j* and *i* types has a special significance in rice, being a self-fertilized crop where a linear directional and fixable component (*i* type epistasis)



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of genetic variation can be most easily exploited for panicle weight (g), number of filled grains/panicle, seed set%, 1000- grain weight (g) and grain yield /hill, through standard hybridization and selection procedures. The *j* and *l* type epistasis are non-directional and unfixable by selection under self-fertilization and therefore would not be favorable for developing pure lines for flag leaf area (cm²) and panicle density (%), however it can be used in the development of hybrids according to [13]. Though *i*, *j* and *l* type epistasis were simultaneously significant for panicle weight(g), number of filled grains/ panicle seed set (%), 1000- grain/ weight and grain yield /hill but higher value of type *i* epistasis suggests that pure lines for these traits may be developed.

The *i*-type epistasis was found to be much larger in magnitude than *j* + *i* type of epistasis indicating the predominant role of *l* type non- allelic interaction in the inheritance of these traits. The results showed that *i* and *j* + *i* types of epistasis were in complete harmony with those obtained by [14, 15]. The existence of non-allelic interactions for economic character might have important role in inheritance in plant breeding. The *l* type of epistasis represents fixable while *j* + *i* types show non-fixable portion of genetic variations [16]. The results have indicated the presence of *i* and *j* + *i* types of epistasis for most of characters, therefore in this condition recurrent selection technique is suggested. Although some earlier workers [17, 18] indicated evidence of epistasis for most of the traits investigated but, in our investigation, we determined epistasis in all traits. The presence or absence of epistasis may depend upon the environment in which the genotypes have been evaluated and thus, it may not always be related to the inherent capacity of a genotype. Similarly reports [7, 19] indicated that the components of variance changed to different degrees over the environment.

Table (6): Analysis of variance to detect epistasis for yield and its related component traits in rice genotypes.

S.O.V	Df	Flag leaf area (cm ²)	Panicle weight (g)	Panicle density (%)	No. of filled grains/panicle	Seed set %	1000-grain weight (g)	Grain yield/hill(g)
<i>l</i> type epistasis	1	35.520	272.86**	14.05**	215832.16**	29916.29**	177.88**	2623.11**
<i>j</i> + <i>l</i> type epistasis	14	605.33**	21.162**	99.78**	28035.14**	1766.60**	27.16**	169.83**
Total epistasis	15	567.35**	37.942**	94.07**	40554.94**	3643.24*	37.21**	333.39**
<i>l</i> type epistasis x block	3	1.106	0.000	0.736	102.777	35.958	0.088	25.441
<i>j</i> + <i>l</i> type epistasisx block	42	13.305	0.107	0.906	30.151	7.211	0.066	6.882
Total epistasisx block	45	12.492	0.100	0.895	34.993	9.127	0.067	8.119



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The epistatic deviations of individual lines for flag leaf area, panicle weight (g), panicle density (%), number of filled grains/ panicle, seed set%, 1000-grain weight(g) and grain yield/ hill (g) are presented in Table 7, to show the direction of dominance and relative magnitudes and to identify the lines, which interacted with L₁ and L₂ to produce significant deviations. Line MJ5460-4 was active and contributed significant portion to the total epistasis for all the studied traits. Moreover, lines, GZ MJ5460-8, MJ5460-9, MJ5460-11 and MJ5460-14 were recorded maximum positive and highly significant portion of the total epistasis for panicle weight, panicle density, filled grains/ panicle, seed set% and 1000-grains weight traits. MJ5460-5 recorded maximum positive and highly significant portion of the total epistasis for flag leaf area, panicle weight, number of filled grains/ panicle and seed set%. Also, MJ5460-6 showed maximum positive and significant portion of the total epistasis for flag leaf area, panicle weight, filled grains/ panicle, seed set% and 1000-grains weight. The line MJ5460-10 recorded maximum positive and significant portion of the total epistasis for flag leaf area, panicle weight, panicle density, number of filled grains/ panicle and seed set%.

The influence of lines on non-allelic interaction of these traits indicated that the appearance of epistasis is determined to some extent by the lines employed for the study. Therefore, several lines and extreme high vs. low testers (L₁ and L₂) should be used in such studies aimed at the detection of epistasis and for estimation of additive and dominance component of variation with equal precision by the TTC technique. The optimal experimental size required to detect epistasis through TTC depends largely on the gene diversity in the tester parents [20]. Therefore, several lines and extreme high vs. low testers (L₁ and L₂) should be used in such studies aimed at the detection of epistasis and for estimation of additive and dominance component of variation with equal accuracy by the TTC technique.

Table (7): Epstasis deviations of individual rice genotypes exhibiting significant differences for grain yield and its related component traits in rice.

S.O.V	Flag leaf area (cm ²)	Panicle weight (g)	Panicle density	No. of filled grains/ panicle	Seed set %	1000-grain weight (g)	Grain yield/hill (g)
MJ5460-1	-5.70**	-1.56**	-4.15**	-98.93**	5.38**	1.59**	-10.49**
MJ5460-2	16.78**	-1.78**	-13.67**	-97.12**	12.60**	6.47**	-9.17**
MJ5460-3	-6.09**	1.45**	2.82**	36.03**	3.82**	-0.93*	-3.01**
MJ5460-4	20.98**	5.62**	5.76**	153.99**	7.39**	1.80**	8.54**
MJ5460-5	-29.75**	7.99**	2.91**	206.97**	81.06**	0.58	-6.66**
MJ5460-6	6.85**	2.78**	1.93**	75.24**	21.90**	6.33**	-15.18**
MJ5460-7	-1.37	2.92**	3.92**	136.87**	30.94**	-1.94**	1.67
MJ5460-8	-1.23	1.68**	2.83**	35.13**	9.11**	4.46**	-20.57**
MJ5460-9	9.33**	2.20**	-0.44	57.04**	20.21**	7.31**	-16.43**



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MJ5460-10	3.18**	3.18**	1.74**	79.96**	28.56**	0.70	-9.05**
MJ5460-11	1.09	6.25**	5.32**	247.57**	72.70**	3.90**	-12.94**
MJ5460-12	11.41**	2.01**	-3.36**	14.13**	-1.09	0.68	-2.02
MJ5460-13	0.22	-0.09	-5.85**	7.75**	39.20**	-0.57	-2.18*
MJ5460-14	-27.26**	2.49**	10.45**	123.07**	15.03**	1.02**	-11.43**
MJ5460-15	-11.78**	1.80**	-1.83**	61.14**	39.95**	-1.57**	-5.60**

Additive and dominance components:

The estimates of additive (D) and dominance (H) variance, degree of dominance $(H/D)^{1/2}$ and direction of dominance (rs.d) are showed in Table 8. The additive and dominance effects have significantly equal importance for all the traits. The higher magnitude of additive variance for flag leaf area, panicle weight, panicle density, number of filled grains / panicle, 1000-grain weight and grain yield/ plant, indicate the presence of common alleles in the testers and their cumulative effect in the expression of these traits which can be improved by pedigree method of selection. The predominance of additive and non-additive gene action for yield and yield related traits in rice have been described [21, 18]. The estimated degree of dominance $(H/D)^{1/2}$ showed over dominance gene effect for seed setting% indicating the high influence of dominance components. Whereas, flag leaf area, panicle weight, panicle density, number of filled grains/ panicle, 1000-grain weight and grain yield/plant showed less than unity value of degree of dominance indicating, partial or incomplete dominance. These results confirm with the finding [22, 18]. If (r) was negative and significant, then increasing type of gene are dominant and vice versa. The correlation coefficients between sums and differences were found to be negative for flag leaf area, panicle weight and grain yield / plant however, the remaining traits (for traits showing absence of epistasis) showed positive correlation coefficients of sums and differences and both directions were insignificant. Non-allelic interactions, depicted for yield and its component traits can be manipulated through recurrent selection technique for the improvement of these traits. Recurrent selection has also been suggested for non-allelic inherited traits in rice [23, 24]. Since dominance gene effects were insignificant for yield and its component exception seed setting%, simple selection procedure in the late generations may not contribute significantly to the improvement of these traits. The additive components in these traits can be successfully exploited through pedigree method of selection because of major contribution of additive gene effects in early generations of segregating populations. For exploitation of all type of gene effects, bi-parental approach inters se crossing and /or recurrent selection may be practical for improving grain yield and its component for rice lines in advanced generations [25].



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Table (8): Estimates of additive genetic parameters for agronomic traits showing non-significant epistasis in rice genotypes.

Genetic parameter	Flag leaf area (cm ²)	Panicle weight (g)	Panicle density	filled grains/ panicle	Seed set %	1000 grain weight (g)	Grain yield / hill (g)
<i>D</i>	848.54	8.7603	57.134	10865	130.64	19.509	245.84
<i>H</i>	516.53	3.7294	19.211	4870	300.95	9.0922	42.691
$(H/D)^{1/2}$	0.780	0.652	0.580	0.669	1.518	0.683	0.417
<i>rs.d</i>	-0.741	-0.150	0.255	0.030	0.487	0.204	-0.299

CONCLUSION

The additive components in these traits can be successfully exploited through pedigree method of selection because of major contribution of additive gene effects in early generations of segregating populations. However, for flag leaf area, panicle weight, panicle density, number of filled grains/ panicle, 1000-grain weight and grain yield/hill additive gene effects can be exploited in early generations. For exploitation of all type of gene effects, bi-parental approach inters se crossing and /or recurrent selection may be practical for developing high yielding rice lines in advanced generations.

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HOW IS KOSOVO DEALING WITH THE CLIMATE CRISIS -WHAT HAS BEEN DONE; WHAT IS BEING TAUGHT; WHAT ARE THE SOLUTIONS?

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ABSTRACT

Climate change is accepted worldwide as something detrimental to the health of the Earth and all species that live on it. Since the industrial revolution, fossil fuel emissions, waste, population, and pollution have experienced exponential growth. With that growth has come the greenhouse effect; insulating the atmosphere and destroying the world's habitats and the organisms that rely on them. Although much has been done to reverse the damages done by humans in more affluent countries, certain countries like Kosovo have not taken action to reduce environmentally destructive behaviors and consequently face the deterioration of the natural and public health. Adolescents, especially in Kosovo, know little about what is happening with the climate. Kosovo being a young country, there is inadequate research on Kosovo's climate status, action plans on mitigation and adaptation on climate change, what teenagers in Kosovo already know about climate change, and what existing strategies implemented in other countries may be compatible with Kosovo. The purpose of this research paper is to explore these topics and has thus been divided into four corresponding sections. Section One investigates the repercussions of Kosovo's lack of bureaucratic action on its environment. Analysing the harmful practices of the country, specifically regarding energy usage, the section explains the results of said practices and how it is destructive to the environment. However, some action has been done in Kosovo on climate change. The second section explores the various strategies proposed or implemented in Kosovo by departments within the government as well as multitude of international organizations and treaties. Within Kosovo, a significant issue is the lack of awareness among citizens, but specifically adolescents. To gauge this lack of awareness, a survey was developed to quantify the level of knowledge about climate change in high school students in Kosovo. This survey is thoroughly analyzed in the third section. Section Four looks to the future for Kosovo by studying



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the steps other countries have already taken to combat climate change and determining each strategy's compatibility with Kosovo's individual traits.

CLIMATE CHANGE: CONSEQUENCES PRESENT IN KOSOVO

Climate change is a widespread problem that more than 80% of the world land area is facing, with estimates shown that at least 85 percent of world's population is impacted by climate change (Callaghan). Scientists conclude that Climate change established a great expansion since the early 19th century (Pidcock) when human activities such as the industrialization period following its consequences, started taking its toll on the Earth's biosphere. The process of burning fossil fuels to generate electricity has been widely used since 1700s and is still in use today, on the top charts of energy resources used universally. Based on research, use of burning fossil fuels has dropped at a rate of 62% by 2021 (Jones) from an approximate of 63.3% during 2019 (Ritchie) of the most usable energy resources. Greenhouse gas emissions will always continue to rise because of human activities; however, some countries are already taking action to reduce polluting-coal and gas and oil-fired stations with clean energy and nature friendly such as solar and wind generation; ways that are quickly spreading through developed countries but remain elusive in developing countries.

Fossil fuel energy consumption produced in Kosovo with an annual of 90.2% in 2013 would be surpassing Britain and Wales during the early industrialization period with an annual estimate of 77%. This is a great showcase of how much pollution Kosovo is facing since it is comparable with two of the most polluting places during the 19th century. As Kosovo's electrical energy is produced with more than 91.43% of burning fossil fuels, England and Wales per capita energy consumption was 88.3 at different per capita GDP levels in 1851. (Warde)

It is concerning to see those results of harmful gas emissions in Kosovo would be as harmful as countries during early developing periods. The state of Kosovo is comparable with many states during the early and late 1900s, and even dates back to when burning fossil fuels started being put into use. When compared with large, industrialized countries; it is noticeably concerning when observing Kosovo's situation as the third-poorest country in Europe with a reported capita GNI of \$4,440 in 2020. (SIDA)

ENERGY GENERATION IN KOSOVO

Until today, Kosovo continues to use outdated energy generation methods, by using power plants A and B to generate electricity in all of Kosovo. These power plants are coal-fired, with lignite, which based on an article emits around twice as much carbon dioxide in relation to its energy content as burning natural gas (Quaschnig). Kosovo is the third with the largest coal reserves among European countries with an estimate of 12.5 billion tons of lignite. This system in which Kosovo has adapted not only creates health problems but also affects economic growth and development. In 2018, "the general



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unemployment rate is at 33%, with youth aged 15-24 years experiencing a 60% jobless rate. Therefore, job generation is a top priority for the government "(World Bank). Even though power plants do provide jobs for the people that live in Kosovo, it causes them to have major health problems, interfering with the respiratory system and causing chronic respiratory and cardiovascular diseases. Health problems can be too intense that mortality rates were exceedingly high during 2005 reported by the World Health Organization (WHO).

Gas produced from these power plants contributes to depleting the ozone layer which means that every year, as there is less protection from the UV radiation, there are higher chances of more people developing certain types of "skin cancer, eye cataracts and immunodeficiency" (European commission). Heavy metals, mercury, lead, sulfur dioxide, nitrogen oxides, particulates, and many other airborne toxins are released from these methods of producing electrical energy. With the combustion of fossil fuels, production of nitrogen oxides and sulfur dioxide emitted in the atmosphere transported in different areas by wind currents, mixed with more of the extracted smog from vehicles, and finally reacting with water, will form acidic rain.

Lead contamination is another problem to deal with in Kosovo, and its biggest consequences are health concerns. Lead emissions come from the lead processing facilities, lead smelters and mines. It can also be generated from homes, automobiles, other vehicles, and as from all these sources, it is understandable that lead contamination is caused by human activities. Lead mines contaminate the water, air, and soil. Expose of lead contamination is likely to be more present in urban areas than in rural areas. From a study carried out by the World Health Organization (WHO) in 2004, blood samples containing lead were analyzed from kids under the age of 4 that showed their IQ reduction. Cases like such continue to happen and awareness should continue to grow towards victims of lead-poisoning in Kosovo, and closure of lead mines, or relocation.

Coal is quite a common source in Kosovo, and it serves more purpose than just as a storage used for power plants. Most of the cars in Kosovo run on fossil fuels, which worsens the environment. The widespread use of coal as a source of heat in many homes and buildings in Kosovo is also a significant obstacle to air pollution prevention.

BIODIVERSITY LOSS

When exposed to UV radiation, vegetation communities will have lesser chances of surviving and restrained growth. This way, agriculture will also be at cost, considering that "Fifty-three percent of Kosovo is agricultural land" (USAID). The GDP of Kosovo is based on the agricultural sector, and if greenhouse gas emissions tend to rise, there will be a decrease in the GDP of Kosovo and food quality will be less favourable.

Livestock are also facing difficulties because there is a reduction in resources provided for them. An article from USAID shows that rising temperatures, reduced or more variable rainfall will have higher chances of increasing livestock mortality rates, harvest losses, water shortages, and greater chance of contracting new pests and diseases.



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It is reported that there are higher chances of forest fires because of drought years and hot temperatures. With 41 percent of Kosovo made from forests, there should be an increase in management and care to reduce the high temperatures.

Residual oil is a very harmful fuel oil that is discarded into the soil from industrial waste, or even by car servicing workshops and consumers. According to the ministry, in 2019, about 200 fines were imposed for dumping oils in inappropriate places. Oil residues can seriously contaminate the soil and have negative results. It will lower or eliminate vegetation opportunities in those areas that have been infected. Therefore, there will be a great amount of biodiversity loss from oil waste if there is no control over human activities.

The World Bank reported that in 2009 waste disposal including domestic and non-domestic products results in emissions of 345,000 tons of CO₂. This included backyard burning, solid waste in landfill, and other solid waste that has been tossed in aquatic systems. Municipalities and licensed companies are put into use now which until the year 2021, collection services for solid waste since 2019, have been collected over 80% of the population, but not yet 100%, reported the European environmental agency. "Currently, almost all MSW collected in Kosovo is landfilled, either at one of the growing numbers of illegal dumpsites (about 10 %) or at officially designated non-sanitary sites (50 %)" (European Environmental Agency)

WATER QUALITY

Water scarcity is quite common in Kosovo, although, it is predicted by multiple scholarly articles that water scarcity may occur in the five basins of Kosovo, and it might be highly notable by the year 2050 in Kosovo. These conclusions are based on the amount of precipitation, elevated temperatures, and growth of population. Droughts are quite common in Kosovo rivers and lakes, especially in the past decades. The security outlook of Kosovo by the World Bank states that droughts and temperatures will significantly rise even more in the future and climate change may lead to increase in annual days of "consecutive dry spell in the long run." (World Bank)

Climate change has also increased the intensity of floods, and flooding in Kosovo happens very often. It caused a lot of material and property damage. "It is estimated that a 100-year flood may lead to damage equivalent to 3 percent of the country's GDP (US\$200 million) and affect 50,000 people." (World Bank) Even though Kosovo is at full economic recovery recently, flooding causes indirect economic losses and restrain microeconomic positive impacts.

Kosovo's water storage capacity is inadequate. Kosovo is extremely vulnerable to climate change due to its limited renewable water supplies and storage capacity." Kosovo has a total storage capacity of 539 million m³, or 300 m³ per inhabitant, in five big dams. This is also significantly less than the area average of 799 m³ per person." (World Bank)

Hydropower plants have reported degrading the rivers quality in Kosovo. Prishtina Insight states that the energy regulatory office (ERO) reported 122 million euros being invested in hydropower plants. Despite investments in hydropower plants, only 2.7 percent of generated electricity comes from



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hydropower plants since about 95 percent of its electricity comes from coal. Other forms of energy are generated by wind turbines and solar panels. Kosovo's hydroelectric plants are in protected natural regions (Ramadani). Residents in these areas were previously unaware that hydropower plants were being built, and as a result, the plants dried up their crops and reduced the amount of drinking water available.

Wastewater is one of the key issues preventing the water quality from improving. Because of a lack of wastewater treatment systems, most rivers in Kosovo are polluted with low oxygen levels. Although groundwater reserves are low in Kosovo and surface water is extensively used, groundwater systems are preferred over surface water because they contain less pollutants and have a higher mineral content. The poor sanitation and cleanliness of the water that runs through the pipes, water that is tainted with *E. coli* causes health issues such as diarrhea and high death rates in children under the age of five, mostly children that live in the poorest households. The Kosovo Democratic Institute (KDI) stated that 90 percent of wastewater in Kosovo is directly or indirectly discharged into rivers without proper filtration. An example of a huge wastewater discharged is from the operation in Kosova B, to the Sitnica river which is not treated. There are only three wastewater treatment plants: Skenderaj, Junik, and Prizren.

Over the past few years, many aquatic systems have remained polluted and have lowered the population of fish in many lakes and rivers by reducing their resources and even poisoning them. Based on World Bank, there is an unacceptable amount of biological oxygen demand as well as a lack of dissolved oxygen due to the lack of functioning wastewater treatment facilities. According to Ramadani, one litter of waste oil can contaminate a million liters of water, and the presence of waste oils in rivers, lakes, and streams poses harm to aquatic life.

All the mentioned factors of the above are challenges that all earth is facing for sustainability. Climate change is derived from actions being taken regionally and then outruns in climate risks globally. With this statement being concluded, one way that balance can be restored worldwide and increase chances of lowering global warming, is with regions such as Kosovo upgrading into more favourable systems for the environment. This includes change and installation of new energy generation systems, groundwater systems, transportation vehicles, solid waste eradication that can provide clean resources and not interfere with the Biogeochemical cycles.

Considering the costs and affordability for all repairs, contributions were made in the past as well, by the UN, EU, etc. Although some contributions were not able to have a full recovery effect because of other consequences. Dating back to 1999, the EU invested over €400 million to rebuild Kosovo's energy system, however, in 2002, only a few months after the EU finished rebuilding Kosovo B, lightning struck the plant, causing a fire that completely wrecked the control and electrical equipment. Now, The European Commissions has been working with Kosovo Energy Corporation to help upgrade the energy sectors with investment. With Kosovo Environmental Protection Agency and many more associations that tend to uplift the environmental pollution, there is hope and strategies put into use that can take effect within a decade, with chances of greenhouse gas emissions and Solid waste contamination percentages decreasing.



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WHAT HAS KOSOVO IMPLEMENTED TO PREVENT CLIMATE CHANGE?

Kosovo, a country yet to be fully developed, has a long way to go before it can win the battle against climate change. There are a host of programs available for Kosovo to partake and strategies on hand laying out the specific details and measures to take. The hurdle lies in Kosovo’s acceptance of those strategies and programs, which can be classified into two groups: mitigation and adaptation. Mitigation references the actions to take to reduce greenhouse gas emissions and cease further global warming. Adaptation refers to the adaptation of the environment that has already been impacted by the rising temperatures and other damage done to the environment. The main leaders prompting Kosovo to take action include the UNFCCC, which provides the Cancun Adaptation Plan and Nairobi Work Program; the Energy Community Treaty, which laid the groundwork for Kosovo’s Energy Strategy; the NPISAA; and the National Climate Change Strategy.

UNFCCC

The UNFCCC, or the United Nations Framework Convention on Climate Change, was a treaty established by the UN to battle “dangerous human interference with the climate system” (UNFCCC 9). Signed at the United Nations Conference on Environment and Development in Rio de Janeiro, it called for several policies and actions to obligate countries to change their methods of industry without negatively impacting the population. It calls upon Annex I countries, or most developed countries, to act the most. Kosovo is not an Annex I country. However, if Kosovo does agree to sign the UNFCCC, it will be part of the group known as non-Annex I. This still obliges Kosovo to report through National Communication several times per year on greenhouse gas emissions (Ministry of Environment and Spatial Planning 48).

The Cancun Adaptation Plan is one of the plans developed in the UNFCCC. Being a framework that focuses on adaptation in developing countries, the program carries out activities related to adaptation through work programs and committees. For example, the national adaptation programs of action, or NAPAs, personalize actions and activities to prioritize for LDCs, or least developed countries (Cancun Adaptation Plan).

The Nairobi Work Program is another key project in the UNFCCC that could prove advantageous to Kosovo if implemented. It assists developing countries to improve the way they understand and assess their country’s vulnerability to climate change, the impacts of climate change, and how they should adapt to climate change. By educating using case studies, databases, workshops, meetings, and publications, the program teaches the country involved how to take informed actions on climate change based off science, technology, and their economic situation (Overview of the Nairobi work programme). These programs can support Kosovo in its efforts toward environmental improvement should Kosovo become a signatory to the UNFCCC. However, until this happens, these programs will not be able to assist.



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ENERGY COMMUNITY TREATY

Although Kosovo is not a signatory to the UNFCCC, as the Ministry of Environmental and Spatial Planning puts it best, “It has the responsibility to respond to the requirements as one of the signatories of the Energy Community Treaty” (46). The Energy Community Treaty sets targets for participating countries including Kosovo to reduce greenhouse gas emissions and increase the proportion of cleaner energy sources being used. The main objectives of the Energy Community Treaty are to create a stable market framework so that all parties of the treaty receive a stable energy supply and to improve the environment by changing the energy network to improve energy efficiency and increase renewable energy sources (Energy Community Treaty).

In Kosovo’s Energy Strategy for 2017-2026, the Ministry of Economic Development lays out the general plan for energy usage and the economy. The fifth objective refers to reducing non-renewable fossil fuel-derived energy sources to reduce the acceleration of climate change as guided by the Energy Community. The fifth objective states that “Kosovo has pledged to meet the 9% saving target from total energy consumption, targeting according to EU Directive 2005/32/EC. It has also assumed the obligations to implement the new EU policies deriving from European Directive 2012/27/EC on Energy Efficiency.” (Ministry of Economic Development 15). By these policies set by the Energy Community Treaty, Kosovo has also agreed to meet the standard of 25% of gross energy consumption being shared by renewable energy sources – and even set a higher target of 29.47% in 2013. In 2015, two years after this declaration, Kosovo has a renewable energy share of gross consumption of 19.7% (22). Kosovo has also developed feed-in tariffs: mechanisms to support investment in hydropower, wind energy, biomass, and photovoltaic energy. Kosovo aims to reduce lignite and wood consumption for heating. Kosovo has the second largest lignite reserves in Europe and fifth largest in the world at 12.5 billion tons. These reserves supply 97% of electricity in Kosovo. (18).

NPISAA

The NPISAA, or National Program for the Implementation of the Stabilization and Association Agreement, contains objectives and activities for Kosovo to implement for accession to the European Union to occur. As of February 2022, Kosovo has implemented six out of nine energy measures – referring to mitigation – and seven out of fourteen environment-related measures – alluding to adaptation (Report on the NPISAA during 2021 50-57).

Regarding alleviation of further climate change – Kosovo has implemented numerous directives, decisions, and regulations on monitoring and reducing pollutants, industrial emissions, and greenhouse gases in the air. Also accomplished was a directive on waste control and a regulation on chemical standards and use. Yet to be implemented a directive on Integrated Pollution Prevention and Control, which is a system that considers all facets of environmental damage to control the impacts of industrial activity. Five directives have been proposed but have not been implemented on water: assessing and managing flood risks, assessing urban wastewater treatment systems, protecting water



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from nitrate pollution as a consequence of agricultural practices, and protecting groundwater against deterioration and pollution. Two directives have been proposed but not implemented on the obligations of those selling timber and its products on the market (50).

Regarding adaptation to existing damage – the NPISAA has laid out a wide range of objectives. These include legislation on petrol, diesel, and gas oil specification and a mechanism to monitor and reduce greenhouse gas emissions as well as administrative instruction on energy efficiency in the private sector, the energy grid, and transmission system operators and distribution system operators (Report on the Implementation of the National Programme for Implementation of the Stabilisation and Association Agreement during 2021). To appease the objective of a draft-law on Petroleum, Kosovo has implemented Directive 98/70/EC, which specifies petrol, diesel, oil, and gas, and introduces a system to monitor and actively reduce GHG emissions. Kosovo implemented Directive 2012/27/EU on energy efficiency. This includes administrative instruction and tariffs for energy usage and efficiency in the private sector, energy grid, and for transmission system operators the transportation industry (55-57).
National Climate Change Strategy

The Climate Change Action Plan 2019-2021 presents a list of 11 specific objectives and 28 activities expected to be undertaken to reduce greenhouse gases and adapt to climate change by 2021. The program, which had been scheduled for 2017-2021, priorities improving the state of the physical environment. This includes sustainably managing water resources and riverbeds, protecting national parks and other protected natural areas, and improving infrastructure and spatial planning: construction, housing, land administration, and cadaster development, the development of registry detailing real estate information. The Climate Change Strategy was developed by the Ministry of Environment and Spatial Planning, supported by the United Nations Development Program. To draft the strategy, the MESP also established the IMWGCC, the Inter-Ministerial Working Group on Climate Change, for which the UNDP provided support (Ministry of Environment and Spatial Planning 7-12). The activities planned by the National Climate Change Strategy to cease further atmospheric warming include:

1. Drafting the Climate Change Document Concept, which outlines climate change in Kosovo and Kosovo's timeline and goals.
2. Drafting the Law on Climate Change, which sets specific climate targets and emission goals,
3. drafting Administrative Instruction for carbon capture, which a strategy to capture carbon dioxide from the air before it enters the atmosphere
4. the development of a GHG monitoring system in obedience to EU regulations that requires regularly updated and published monitoring to address and make an effort to reduce carbon emissions.
5. A review of Administrative Instruction on a mechanism for monitoring greenhouse gas emissions.
6. A workshop to improve accuracy and establish the importance of information and data exchange.



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7. Reducing and/or preventing the self-ignition of lignite, a type of coal, in mines in Kosovo. This is done through spraying special substances that prevent the lignite from self-igniting on the surface of the mine and will improve air quality and reduce loss of lignite.
8. Conducting a feasibility study on non-hazardous solid waste as a possible fuel alternative.
9. Organizing workshops to improve the capacity of citizens of the major cities in Kosovo for urban sustainable mobility.
10. Developing a pilot Sustainable Urban Mobility project in Pristina, which will not only reduce greenhouse gases, but also increase traffic safety, attractiveness of urban areas and quality of life in those areas.

(64-66)

The activities planned by the National Climate Change Strategy to adapt to climate change include:

1. Implementing Law no. 4/L-040 on Land Regulation. This law will restrict construction and settling on hazardous and endangered areas.
2. Regulating the Sitnica riverbed, which will reduce the threat of floods.
3. Conducting two campaigns to promote ecological construction. Ecological construction refers to the method of constructing buildings sustainably. Some examples include green roofs, solar panels, and geothermal heating systems.
4. Improving water balance through preventing and regulating deforestation. This will protect the natural landscapes, reduce illegal cutting, and save forest area.
5. Developing a study on climate incentives such as taxes and tariffs. These will acknowledge both local financial circumstances and international financial practices.
6. Drafting the Law on Eco-fond.
7. Establishing the Law on Eco-fond.
8. Improving water balance by reforesting 140 km around riverbanks.
9. Preparing and conducting a study on the areas through which species migrate.
10. Analysing the insufficiencies of habitat and species diversity in the Albanian Alps, Shala of Bangoura, Anamorava, Sharr Mountains, and the Drenica Region.
11. Creating corridors through tree planting to improve the climatic conditions for the animal population within the habitat, specifically regarding heat waves and maintaining humidity.
12. Organizing three trainings to map out endangered areas.
13. Organizing three trainings on risk assessment and management which will prepare climate change-related disaster plans.
14. Modernizing and improving the operation of the hydrometeorology sector by advancing forecasting and disaster warning instruments.
15. Organizing two round tables about how climate change has impacted the ecosystem and public health.
16. Conducting a campaign and leaflets to improve public awareness on water conservation.
17. Organizing public awareness-raising programs in the health sector on adapting to epidemics and health risks as a result of climate change.



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18. Designing a system to alert the population in the event of heat waves on protective measures.
(66-72)

Throughout the myriad strategies and plans for Kosovo to combat climate change, two main themes have arisen: mitigation and adaptation. If the world is to truly move past the adversity of global warming, the world as a whole – countries both rich and poor – must collaborate to not only heal the wounds caused by rising temperatures, deforestation, and pollution; but also, to prevent those wounds from ever reopening. These require preventative measures such as shifting to renewable energy sources in place of greenhouse gases and, specific to developed countries, becoming more frugal on the individual level. This will only work in a joint effort, however, and Kosovo's participation is crucial. Kosovo must become a signatory to the obligations of the UNFCCC, Cancun Adaptation Plan, and Nairobi Work Program. Kosovo must keep its promise to the Energy Community to decrease its fossil fuel usage. Kosovo must continue to complete the measures provided by the NPISAA. Kosovo must heed the advice of the National Climate Change Strategy. Kosovo must endeavour to make a change, as change cannot and will not occur alone.

TEENAGERS IN KOSOVO; HOW MUCH DO THEY KNOW ABOUT CLIMATE CHANGE?

Since the beginning of the industrial revolution in the 19th century, fossil fuels have become the main power source. However, the consequences of its usage have only been discovered and taught in recent decades. Combating negative consequences that human economic activity has in accelerating global warming comes at the cost of reduced economic activity, therefore politically not a very straightforward decision. In this sense different nations, depending on their development stage and political agenda, invest different amounts of time and resources in addressing this important issue. Kosovo, aspiring to join the European Union, is expected to have a strong commitment to harmonize its policies with the Union. Probably at this stage of the development, it is important to understand how much this topic has penetrated into the school system and how much youth are aware of the topic. We consider this so, as it is probably the young generation that will be responsible for implementing whatever environmental policy Kosovo will adopt. The subject of this research is to measure the level of understanding of climate issues among Kosovo youth, in terms of: a) their reported level of concern, b) acceptance of the issue as such, and c) understanding of the key concepts. To do so we have prepared a survey distributed throughout several schools in Kosovo. We are aware that the sample composition is not a true match of pupil population in Kosovo, due to time limitation in conducting the survey. Nonetheless, since the Kosovo population as a whole is relatively homogeneous due to small size of the country, uniform schooling program (with few exceptions), and limited cultural and economic diversity, we consider the sample makes a relatively fair representation of the category assessed. In a survey period (a week) 91 responses were collected, what I consider a very good result, especially having



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in mind the time of the year when the survey was conducted, coinciding with end of year exams and proms for most of the schools.

When preparing the survey in Albanian language, I struggled to find the words, that is awkward having in mind I am an Albanian native. I think this relates to the fact that the topic of the environment is not tackled at all in our daily discourse. We were positively surprised to see such interest in answering a survey – some of the participants took time to go beyond mandatory questions, answering and commenting on the optional section as well.

Since the schooling system in Kosovo does not offer specific subject covering environmental issues, the topic is almost not at all present in the political agenda, and media does not cover the topic at all, the level of interest and understanding of some of the surveyed students exceeds my expectations. Despite this, in interpreting the information one needs to bear in mind that the survey was answered on a volunteer basis, thus probably the representation of environment enthusiasts among the respondents may lead to sample bias. In the section below I will present the results from the primary data collected.

Composition of the Sample

According to the Kosovo Agency for Statistics, as of 2021 in Kosovo 80.183 students were attending secondary school education (ask). With our survey we have reached 91 respondents, which is only 0.1% of a total student population, thus the results of the study should have this small representation in mind.

	Number of secondary school students		Number of respondents by type of school	
Public	70,472	88%	23	25%
Private	9441	12%	68	75%
Prishtina	27,219	34%	80	88%
Other regions	52,964	66%	11	12%

Table 1

Table 2

Regarding age groups the sample is distributed as shown in table 2:

Age Group	Number	%
13-15	53	58%
16-19	38	42%
Total	91	



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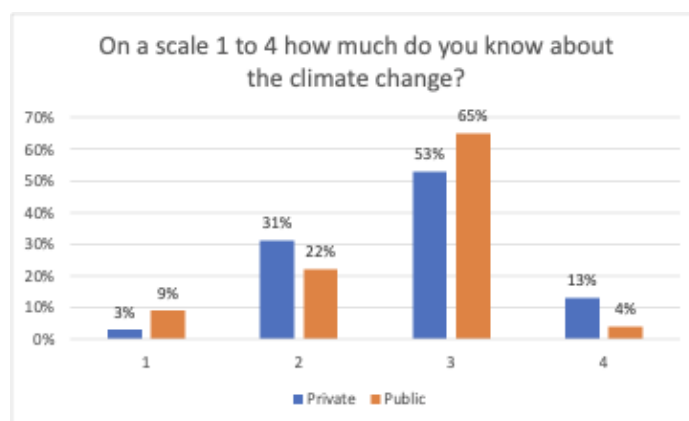
As it can be depicted from the table 1 above, the respondents do not represent the pupil population in Kosovo, as 75% of respondents come from private schools, this due to the limited amount of time we had in collecting the information and our limited possibility to get access to other schools in limited time of our study. The sample of respondents is also not representative in regard to the regions of Kosovo, as most of the respondents come from Prishtina with only a small fraction, 12% of them representing the regions. Despite sample biases mentioned, the results of the survey shed some light on the level of awareness, understanding and general attitude of young people in Kosovo with regards to environmental issues.

Survey Results (quantitative data)

The survey is broken down into questions that aim to measure the following:

- Student self-assessment of understanding the topic.
- Student opinion on different aspects of the topic.
- Test of the factual understanding of the student.

Students were asked first to make a self-assessment of their understanding of climate issues, as well as to report on their interest on the topic. The results presented in the graph below broken down by type of school:

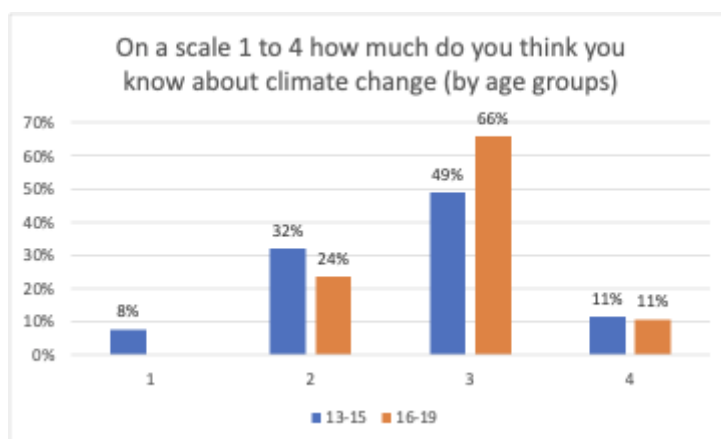


Graph 1



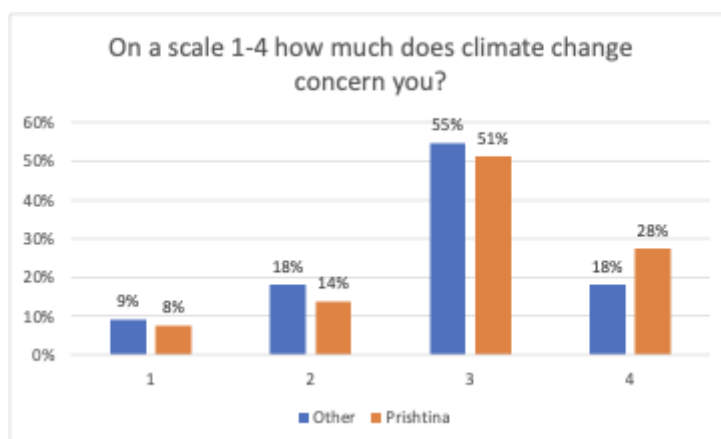
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Graph 2

Following this question, students were asked about their opinions on the topic. The graph below compares responses of students from schools in Prishtina and Other regions. Other regions are put as one group as I neither have a sample large enough for more analytical breakdown but also having in mind that Prishtina is expected to behave differently from other smaller towns and villages.



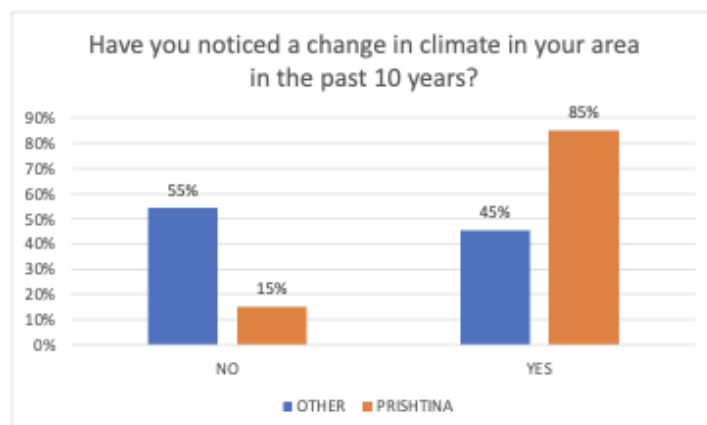
Graph 3

The following question's aim was to get the opinion of the respondent on climate issues in order to receive a better grasp of the participant's evaluations, reasonings and observations.

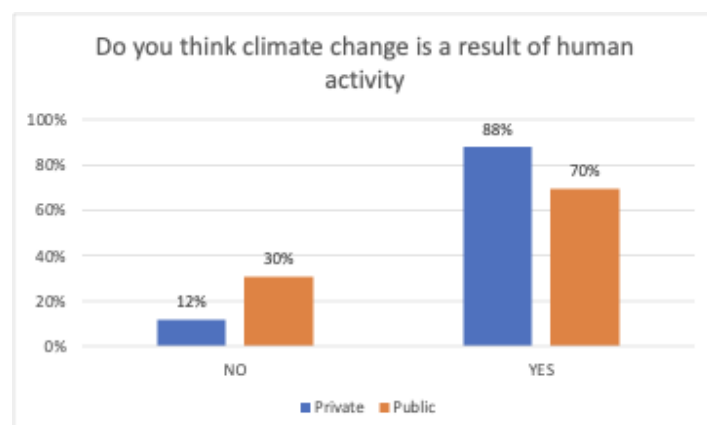


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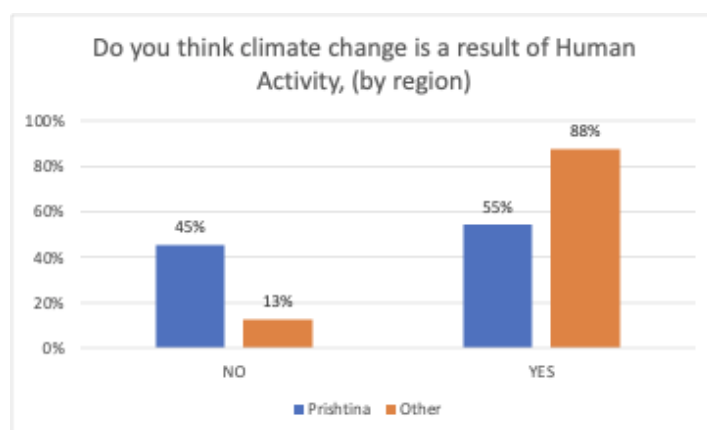
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Graph 4



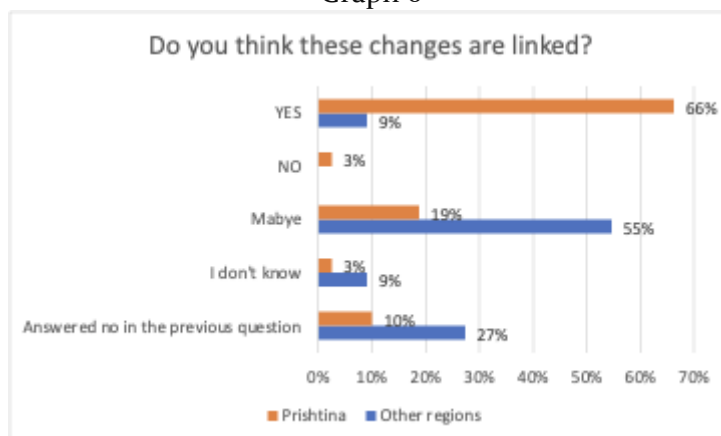
Graph 5



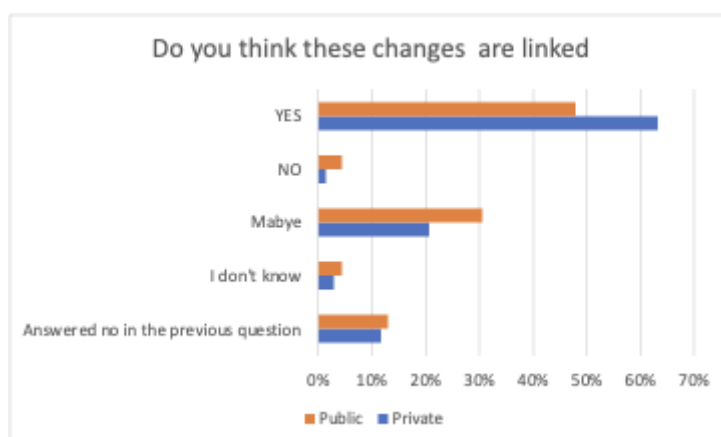


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Graph 6



Graph 7



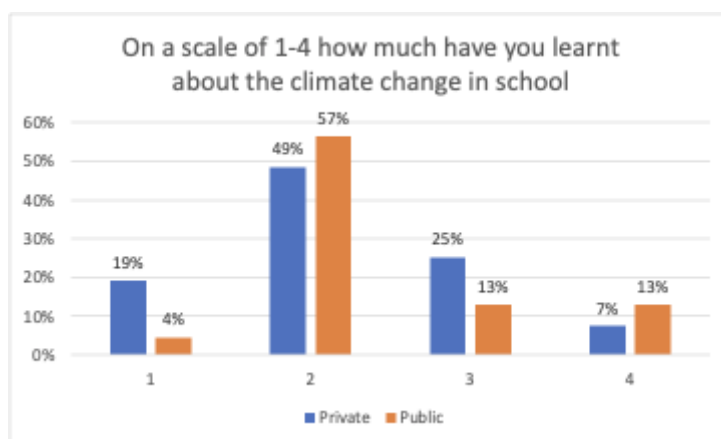
Graph 8

Next, we seek to understand if the participants were exposed to the topic via channels of formal education. Questions in this section aim to get both students interested in the topic, but also how much the topic is perceived to have penetrated the school curriculum, as a proxy for measuring government policy in environmental issues.

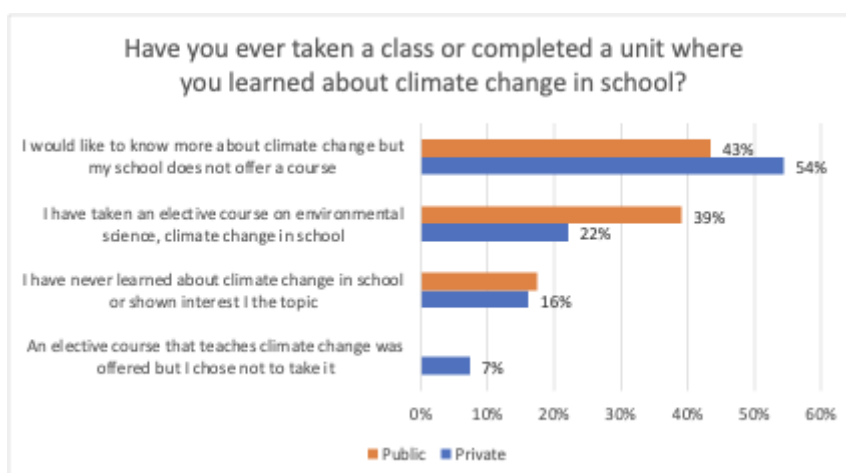


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Graph 9



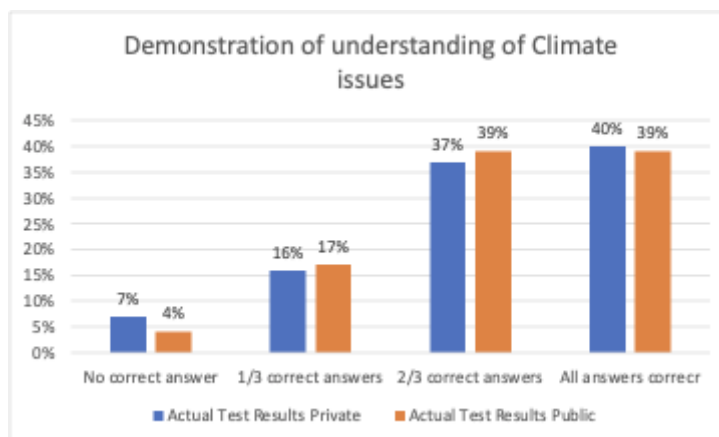
Graph 10

In the last section of the survey the student was asked three questions about climate change itself. These included descriptions of common terms such as “greenhouse gasses” and “fossil fuels”. When comparing results between public and private schools’ responses remain relatively the same.

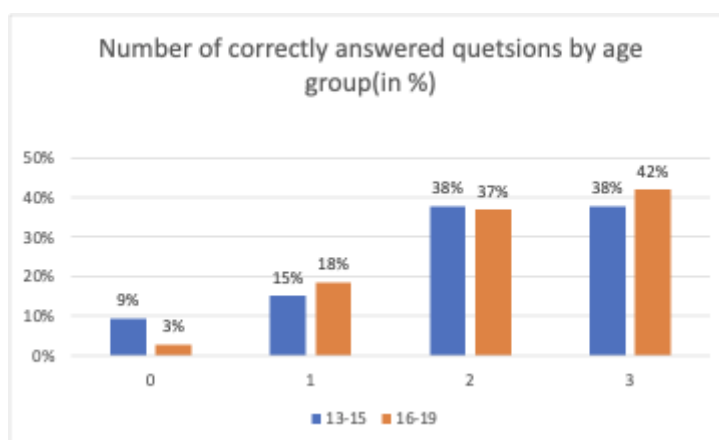


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Graph 11 Elder pupils perform slightly better than their younger peers.



Graph 12 **Qualitative data results:**

The qualitative section of this survey contained two very ordinary questions simply asking the participants if they want to add an extra comment or describe their struggles while taking the survey. The first question stated: “Any extra comments about your knowledge of climate change.”

This question was placed in the survey to get extra thoughts and opinions teens in Kosovo might have about climate change. 17% of participants took extra time to write about their thoughts and opinions on the topic. Some participants simply typed “no” or commented on the survey while others took time to write long sentences and paragraphs.

Respondent A stated: “releasing of Co₂ in the atmosphere damages the ozone layer which is used to protect against deadly sun rays and thus increases the global temperature”.

Respondent B stated: “Climate change has caused a change in wildlife behaviour.”



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Participant C stated: “causes the destruction of ecosystems in a domino-like effect”.,

Respondent D stated: “In order to slow down climate change, renewable energy is the way to go. Also enforcing a carbon tax would inhibit the burning of fossil fuels, etc.”

Respondent E stated: “Climate change is a problem slowly killing our planet. Although we think it is happening at a really slow speed it's actually the opposite. Comparing the climate change during the last decade it has changed by a small amount of 2 degrees but remember this is the average temperature if the earth meaning that changes in certain areas are much bigger. Climate change is a real threat not only to humans but also to hundreds or thousands of animal species. If we do not start to act immediately about stopping this problem, what once was a beautiful planet to live in and the history behind it will be gone in no time. The green, happy planet we once knew will be vanished in front of our eyes.”

Respondent F stated: “I know that the impacts of climate change on different sectors of society are interrelated. Drought can harm food production and human health.”

The second question was only meant for feedback on the quality of the survey itself. However, one comment left by one participant in these questions is very helpful to our data collection. Therefore, even though this question was not thought to be part of the initial analysis it is a great way to justify our conclusions.

Respondent G stated: “It was hard for me to answer the last questions since I have never learned about these topics”.

SURVEY CONCLUSIONS

Having in mind that the Kosovo school curriculum does not address sufficiently environmental issues, and the topic is not very present in mass-media or political agenda, my expectations regarding the level of youth awareness were not high. In addition to this, looking at schools by type, my expectations were that public school students would generally have less understanding of the topic, as the schools would strictly stick to Kosovo Curriculum of Schooling. About different regions in Kosovo, my expectations were that Prishtina students would have higher level of both interest and awareness, having in mind they are more exposed to pollution and as such more likely to have the topic present in their homes and social circles. I did not have any expectations in terms of age groups, but I thought if there were an impact of schooling in student level of information elder students ought to perform better in test questions.

Disregarding the type of education students receive, I expect that students reporting to be more concerned about the topic would also have better understanding of it.



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The results of the survey as depicted above reject my expectations in terms of differences of awareness or understanding depending on school type. Namely regarding self-assessment of the level of understanding of the topic there is no big difference between students of private schools and public ones (Graph 1), with private schools' students showing only slightly higher level of confidence. Such small difference cannot be attributed to their better awareness, it can simply be prescribed to the nurtured confidence in the private school as such. Private schools' students report not to have the topic present in their curriculum like public school students (graph 9, more than 60% of students in both sectors of school's report to lack courses related to climate change topics in their schools). In contrast with my expectations, though not conclusive is the finding in graph 10, where relatively more students from public school's report to have had a unit related to climate change in their education.

As expected, students from Prishtina report to be more observant (graph 4) and concerned (graph 3) than those from the other regions. Despite this observation they attribute these changes less to the human factor (graph 6). This absurdity deserves more research, but it can relate to the fact that students (or perhaps their families) living in a more industrialized region (Prishtina) hesitate to question their lifestyle.

To measure the difference between what students, perceive to their understanding of climate change with their actual test results, I took the difference between the number of correctly answered questions+1 and the scale of perception of the understanding of the topic captured in the respective question "On a scale of 1 to 4 how much do you think you know about climate change? ". I added 1 to the test result to have better measure, given the scale of understanding ranged from 1-4 while test points 0-3. Overall students underestimate their level of understanding of the topic, explained probably by the fact that they lacked formal education, notwithstanding they probably get the information from other sources, nowadays abundant.

Table 1

The difference between perceived and demonstrated understanding of the climate change	Private	Public
Overestimating their understanding of the topic	3 (4%)	
Slightly overestimating their understanding of the topic	11 (16%)	3 (13%)
Rightsizing their understanding of the topic	21 (31%)	8 (35%)
Slightly underestimating their understanding of the topic	27 (40%)	10 (43%)
Underestimating their understanding of the topic	6 (9%)	2 (9%)

Table 1: The conclusion above is explicitly reinforced by respondent G's statement, "It was difficult for me to answer the last questions because I had never learnt about these things." This participant, aged 13-15, from a Gjakovë public school, answered 1 in the self-evaluation and 3 when questioned about their level of concern, yet their scores show otherwise. Because the participant did not learn about the issue in school, these answers are almost certainly based on knowledge acquired outside of school. Although



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the participant answered 2/3 of the assessment questions correctly, they lacked confidence in their responses. We can deduct from the above statement that most of the knowledge that Kosovo's teenagers have concerning climate change has not been received from school, rather from outside sources.

In conclusion, one can observe elements of awareness among youth disregarding their age group, type of school or region. Also, there are elements of interest shown by the mere fact that such a big number of respondents took time to fill in the survey and even comment on it. It is promising to read that many respondents would take a course covering the topic if such a course was offered. This per se, does not imply the same individuals would act in reducing consumption of fossil fuels, but if awareness is the first step of every positive leaning, I remain confident that my generation will act on it.

COMPARISON TO OTHER COUNTRIES – ARE THEIR SOLUTIONS A GOOD FIT FOR KOSOVO?

Kosovo, one of Europe's newest countries, is quickly catching up to its European neighbours in terms of developing climate-change policies. Kosovo now needs personnel with the necessary skills and experience to design, implement, and enforce these new legal and regulatory frameworks. As climate change becomes more of an issue over time, Kosovo is basing its ideas on successful projects conducted by different countries that have effectively reduced the impact of climate change in the country. The initial stage for Kosovo is to compare and contrast different countries' ideas in order to get the best and easiest capable options. It will be simpler to make a judgment if we look at countries who have done a lot to combat climate change against those that have not. By examining both solutions and finding the best, Kosovo may begin to develop an effective climate change plan.

Through research, almost all countries have tried to do something toward climate change by implementing strategies and using other countries help to do so, but they have not always been successful. One of the countries that has done the least about the climate change crisis is Sudan, where 100 percent of the population are exposed to dangerous polluted air and the government only protects 2.8 percent of the total land. Sudan is among the most vulnerable countries in the world to climate variability and change. Droughts have been more frequent and variable in recent decades, putting a strain on the region's rainy agricultural and pastoralist systems, which are the principal sources of income in rural areas. Sudan has tried a range of approaches to tackling climate change. The most effective way to address climate change is to reduce greenhouse gases. Sudan has a high level of greenhouse gas emissions throughout the board. In the LUCF (land use change, and forestry) sector, biomass combustion accounted for 82 percent of emissions. Agriculture was the second-largest emitter (26.1%), accounting for 72 percent of total emissions, with enteric fermentation from cattle and manure left on pasture accounting for 72 percent. Energy was the third most prevalent source, accounting for 9.9%, with industrial operations accounting for 0.5 percent and garbage accounting for 0.4 percent. Sudan has not only aimed to reduce greenhouse gas emissions but also any type of harmful substance that could be released. To do so, Sudan has benefited from the assistance of various nations and



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organisations, who have adapted what they believe to be the best strategy for this crisis. The Adapt for Environmental and Climate Resilience Project (or ADAPT!) was initiated by UNEP in 2016 and ended in 2020. By incorporating climate resilience and environmental management into program execution, planning, and policy, this project aimed to increase knowledge of climate resilience and environmental management in international humanitarian response, recovery, and development initiatives in Sudan. It was established to help government agencies, civil society groups, and local communities come up with innovative ideas and construct long-term climate action coordination structures. The United Kingdom's Foreign, Commonwealth and Development Office (FCDO) has backed ADAPT, which was carried out by UNEP in partnership with the Sudanese government. Another program that has aided Sudan towards a better environment is the Sudan Integrated Environment Programme, which was sponsored by the United Nations Environment Programme (UNEP) from 2011 to 2015. This program allowed the country to develop its National Adaptation Plan (NAP) in 2016, following a thorough and inclusive consultation process. Sudan is one of just thirteen countries that have submitted a National Action Plan (NAP). This report addresses climate-vulnerable sectors such as water resources, agriculture and pastoralism, health, coastal zones, and energy, as well as issues and action suggestions. Sudan has demonstrated that it wants to improve the environment and is prepared to accept assistance in doing so. The established initiatives had a lot of potential and fantastic concepts, but they weren't exactly right for the country. The most important aspect of picking an appropriate program is to understand how the country operates. As can be seen, these were not quite right for Sudan, but with time, they may be. Kosovo may now evaluate these programs and determine if they are a good match or not.

Denmark has done the utmost to mitigate the country's impact from climate change. In Denmark, polluted air affects 56.9% of the population, and the government protects 17.9% of the country's territory. Despite the fact that the stats are not fantastic, this county has done the most to combat climate change. As stated, one of the biggest reasons for climate change is the emotion of greenhouse gasses which include Carbon dioxide etc. In only a few decades, Denmark was able to reduce greenhouse gas emissions by half while expanding the size of its economy. The country is today considered one of the happiest, healthiest, and wealthiest in the world. Denmark as a country does a lot to ensure the best for its people and one thing that it has done is enforcing the Denmark Climate Act which sets a goal of reducing emissions by 70% by 2030 compared to 1990 and achieving climate neutrality by 2050. The Act establishes a 10-year rolling five-year objective. To quantify greenhouse gas emissions and reductions versus the target, UN accounting procedures are utilised. The climate council has been reinforced and enlarged, with finances quadrupled and self-election of a new chairman and members bolstering its independence. The Act imposes a number of reporting requirements on the government, including an annual parliamentary review of the administration's progress toward achieving the goals. The government must publish data on the effects of its climate strategy on Danish imports and consumption. In addition, the government must submit an annual worldwide plan outlining how the government's foreign, development, and trade policies will secure Denmark's status as a global climate leader. Last year, Denmark pledged to phase out oil and gas development by 2050 and spend the earnings on retraining people for greener jobs. Recently, the country announced the



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construction of an artificial island in the North Sea that would house a gigantic wind farm that will offer power and energy storage to Denmark and its neighbours. Denmark has begun an unprecedented climate policy agenda with aggressive emissions targets, carbon pricing, innovation, public investment, and regulatory rules. Renewable energy's share of total power generation has risen from less than 10% in the mid-1990s to more than 80% by 2020. Denmark's 36 percent reduction in greenhouse gas emissions between 1990 and 2019, is making the country one of the least carbon-intensive countries in the OECD (Organisation for Economic Co-operation and Development).

Kosovo, as a post-war and developing country, must base its policies and programs on tried-and-true methodologies. By examining the approaches of other countries, Kosovo may be able to determine what is ideal for its state in this area. Kosovo has a set of legislation as well as some effective efforts when it comes to climate change. This isn't true for all of them. The most difficult element of making these laws and programs work is persuading people that they are necessary for their personal benefit, which is not the case with the people of this country, since some do not see climate change as a threat and others are completely oblivious of the problem. Obiliq thermal power station is a great example of this. Obiliq power station is one of the most important sources of energy, and it operates by burning wood and other chemicals, which produce fumes that are hazardous to humans and the environment. Putting a filter over the gas release chamber or discover a new technique to create energy is a simple but effective solution to limit gas being discharged into our environment. This is a simple approach that would significantly enhance the country's overall climate.

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METHODOLOGY AND ETHICS

Due to the lack of data regarding the knowledge and opinion of students in Kosovo when it comes to climate change, we decided to conduct our own research via survey. This questionnaire will gather majorly quantitative with an addition of qualitative data. We have created this survey using Google Forms, with multiple choice questions, linear-scale, and write-down answers.

The questionnaire consists of fourteen questions, and it is divided into 4 sections. The first section asks the participant their age, region, and school type, but also keeps the participants personal information at a minimal level by not sharing their names and school names. The second section Is opinion-based



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and consists of seven questions in which three of them are in a linear scale. Each linear scale question is intentionally made from a range of options 1 to 4 executing the 4-point Likert scale developed by psychologist Renzi's Likert. We originally planned to create linear scale questions with 5 options, but it is scientifically proven that by using the 4-point Likert scale method, we will gain more specific results from the readers since "the concept of four options will psychologically make the readers form their own opinion and not chose a 'safe' neutral option (Formplus, 2022)." This method is used by many market researchers, who tend to extend their capabilities in many ways by gathering helpful and distinct responses.

The 3rd section of the survey serves by means of testing the knowledge of the students by being asked 3 questions about what affects climate change and some terms of it with multiple choice answers. The last question that is within the survey is optional remaining as the only qualitative information that we will be able to get from the students.

After gathering the results of our survey from various schools around the country, we will do a data analysis, which will compare students' results based on their ages, school type, and district, to contrast differences towards their understanding of climate change and how well-educated they are about this topic. However, we will also try to find correlations between the results of the students comparing their age groups. Knowing the school type will also help us determine the quality of education that students are placed at, which impacts their level of knowledge. With the help of Google Forms, we will be able to find the medium answers for each category and implement the results on color-coded graphs. Lastly the students will give us feedback by answering if they found the survey to be clear, understanding, and effective, to help us make revisions, etc.

For our questionnaire to be more diverse and easily understandable, we made the survey in both English and Albanian language for both international and native students in Kosovo, as we contemplated that making this survey as diverse as possible will help us get more answers with different opinions and make out more specific conclusions after our analysis.

To make sure that students stay truthful and honest while completing this questionnaire, we have placed descriptions and steps in some sections for them to follow while doing the survey. Our aim was to make the readers form their own opinions and thoughts and not choose an option that they would think would be correct and the same as other students, since there are no correct answers until the 2nd section of the survey.

We have considered the risks of the survey being distributed to the wrong participants, therefore, to prevent this situation, we contacted educators to hand out the survey to students from ages 13 to 19 and gather the information from the required participants. To make sure that we evaluate teenagers only, we have placed two options on the first question for students who are less than 13 or by any chance over 19 years old. They will not be part of the evaluation system.

Since we were given time constraints, we were not able to carry out a full in-depth investigation that examined all schools around Kosovo regarding the teens' knowledge of climate change in Kosovo but instead carry it out to the possible schools that we could contact from each region. We managed to contact a few schools in Pristine, Gjakova/Peja, and Prizren. Our preferred goal was to extend the number of students that completed this questionnaire and dispense it widely in all schools to obtain a



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wide variety of the data needed to execute a full investigation as to the quality of knowledge and awareness for climate change that teens have.

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SURVEY TEMPLATE

TEENS IN KOSOVO; HOW MUCH DO THEY KNOW ABOUT CLIMATE CHANGE?

This survey is part of a research paper being developed by the Writing I and II students at QSI Kosovo. Our research paper is about the issue of climate change in Kosovo. We are collecting data on the level of knowledge about climate change in teens.

This survey will be completely anonymous. The only information needed for the survey is your age, and district. There is no risk, and the survey does not take long to complete and will be very useful in providing accurate data and information.

Please do not look up any answers or answer what you think we are expecting. You will not receive a grade, and this survey will not negatively impact your grades. Looking up answers or not answering truthfully will only lead to inaccurate results for our research.

We would like to thank you for your time in completing this survey. Your answers will be extremely helpful for our analysis.

*Required

1. Choose your age*

Mark only one oval.

13-15

16-19

under 13

over 19

2. What city is your school closest to? *

Mark only one oval.

Prishtinë

Mitrovicë

Pejë

Gjakovë

Gjilan

Ferizaj

Prizren

3. What type of school are you currently attending?*



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Mark only one oval.

Private

Public

Section 2

4. On a scale of 1 to 4 how much do you think you know about climate change? *

Mark only one oval.

nothing

1

2

3

4

I know a lot

5. On a scale of 1 to 4 how much does climate change concern you?*

Mark only one oval.

it does not concern me

1

2

3

4

I am very concerned about climate change

6. Have you noticed a change in climate in your area in the past 10 years?*

Mark only one oval.

Yes

No

7. If you answered yes, do you think these changes are linked to climate change and global warming? *

Mark only one oval.

Yes

No

Maybe

I don't know

Answered no in the previous question

8. Do you think climate change is a result of human activities?*

Mark only one oval.

Yes

No

9. On a scale of 1 to 4, how much have you learned about climate change in school?*

Mark only one oval.

nothing

1

2



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3

4

I learned everything that I know in school

10. Have you ever taken a class or completed a unit where you learned about climate change in school? *

Mark only one oval.

I have taken an elective course on environmental science, climate change in school

An elective course that teaches climate change was offered but I chose not to take it

I would like to know more about climate change but my school does not offer a course

I have never learned about climate change in school or shown interest in the topic

This part of the survey will be very similar to a test

Please answer truthfully and do not ask anyone or google any of these questions. We would like to remind you that this is completely anonymous and will only be used for our research paper. If you are not sure about an answer choose your best guess.

What is the greenhouse gas effect?*

Mark only one oval.

The greenhouse effect describes how "greenhouse gases" trap heat at the Earth's surface.

The term "greenhouse gas effect" describes the damage pollution does to plants.

"Greenhouse gas effect" describes the green smoke that comes out of dangerous chemicals.

Pick the option that is not considered a fossil fuel*

Mark only one oval.

Natural gases

Nuclear power plants

Gasoline

Coal

13. What is the largest contributor to climate change?*

Mark only one oval.

The sun

Climate change happens naturally

Plastic

The use of fossil fuels to produce energy

14. Any extra comments about your knowledge of climate change. (Optional)

Feedback

15. Comments on the survey. Did you find it effective? Were the questions clear?

This content is neither created nor endorsed by Google.



Forms

Raw Data Analysis



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Actual Test Results	Type of the school		Total
	Private	Public	
No correct answer	5 (7%)	1 (4%)	6 (7%)
1/3 correct answers	11 (16%)	4 (17%)	15 (16%)
2/3 correct answers	25 (37%)	9 (39%)	34 (37%)
All answers correct	27 (40%)	9 (39%)	36 (40%)

On a scale 1 to 4 how much do you know about the climate change?			
Self-perception	Type of school		Total
	Private	Public	
1	2 (3%)	2 (9%)	4 (4%)
2	21 (31%)	5 (22%)	26 (29%)
3	36 (53%)	15 (65%)	51 (56%)
4	9 (13%)	1 (4%)	10 (11%)

On a scale 1 to 4 how concerned are you about climate change?			
Concern	Private	Public	Total
1	5 (7%)	2 (9%)	7 (8%)
2	10 (15%)	3 (13%)	13 (14%)
3	36 (53%)	11 (48%)	47 (52%)
4	17 (25%)	7 (30%)	24 (26%)

Did you Have Formal Education at school	Type of School		
Concern	Private	Public	Total
An elective course that teaches climate	5 (7%)		5 (5%)



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change was offered but I chose not to take it			
I have never learned about climate change in school or shown interest in the topic	11 (16%)	4 (17%)	15 (17%)
I have taken an elective course on environmental science, climate change in school	15 (22%)	9 (39%)	24 (26%)
I would like to know more about climate change, but my school does not offer a course	37 (54%)	10 (43%)	47 (52%)

On a scale of 1 to 4, how much have you learned about climate change in school?	Type of School		
	Private	Public	Total
1	13 (19%)	1 (4%)	14 (15%)
2	33 (49%)	16 (70%)	49 (54%)
3	17 (25%)	3 (13%)	20 (22%)
4	5 (7%)	3 (13%)	8 (9%)



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POTENTIAL OF ELECTRIC VEHICLES FOR CLIMATE CHANGE MITIGATION AND ENVIRONMENTAL SUSTAINABILITY

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ABSTRACT

Electric cars have become famous and commonly used worldwide. This study is focused on introducing and using electric cars to help to improve their healthy lifestyle by providing air pollution free and use of electricity friendly cars. This paper therefore presents the potential of offering electric vehicles (EVs) as an arrangement to reduce environmental contamination and associated benefits. The transportation means could be a critical support to discuss contamination compared with conventional fossil fuel vehicles being a source of pollution. By conducting a comprehensive examination of the current state of quality, the impacts of conventional vehicles on the environment, and the benefits of transitioning to EVs. This involved the intensive focus on micro and macro competitor factors from the electric vehicle companies and reviewing related literature. These focusses on points to supply bits of knowledge into the potential of EVs in lessening environmental contamination. Moreover, the study further looked at the challenges and openings related to advancing and offering EVs foundation advancement, buyer mind set, and government arrangements in decision making. This investigation revealed that expanding EV appropriation is viable thus leading to a critical diminishment in contamination and a cleaner, more advantageous environment for all citizens and environmental integrity promotion. EVs deliver zero greenhouse gases emissions, meaning they don't emit toxic wastes such as nitrogen oxides, particulate matter, and carbon monoxide like conventional gasoline-powered vehicles. Embracing EVs adoption by nations can as well essentially diminish their general unnecessary gas outflows and move forward discussing quality for community electric car consumers. Furthermore, EVs have lower working costs and can help thus diminish reliance on fossil powers, advancing vitality, freedom and supportability. Generally, the appropriation of EVs presents a promising arrangement to address the natural challenges



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postured by transportation outflows. Lastly, it highlights recommendations for start-up businesses that promote improving public health and environmental sustainability.

Keywords: *Electric Vehicles, Transportation, Air pollution, environmental sustainability, Startup business, Climate change mitigation*

INTRODUCTION

The clean energy powering EVs, together with innovations in renewable energy sources, have been thought to offer a dynamic hope to mitigate climate change. This is because the energy grids provide more sustainable alternatives, therefore overall emissions related with EVs reduce, providing green light to a cooler, more environmental sustainability [1, 2].

With global trend of transition to renewable energy projects, higher ambition targets for EV implementation, and several countries being home to the world's largest mineral resources, foreign establishments in energy transformation will benefit the countries in developing their industrial sectors, increasing their human resources capacity and receiving technology transfer [3, 4]. Policies therefore require support for expanding local industries to take advantage of the significant value chain that will need to be tailored [5, 6]. The market needs signals that allow investments in competitive fabrication capacity from technologies like solar PV modules and larger balance of system components, batteries and EVs [7]. When combined with developments in renewable energy sources, the clean energy that powers EVs offers a potent way to fight climate change [1]. The overall emissions linked to EVs decline as the energy system integrates more sustainable options, providing a route to a more sustainable and climate change resilient future.

Various findings have pin pointed the role that renewables play in transition to clean and renewable energy and paths [8]. Renewable energy potentials are vastly underutilized, and most can be expanded for less cost to end-consumers than conventional energy sources. They also present significant economic opportunities as well as opportunities to create local value chains and industries [9, 10].

Meanwhile China has been among a leading manufacture and exporter to various countries with success in different continents and countries according to study reports [11, 12] always encourages me to keep going although faced with challenges. This is a true description of favourite quote from Genghis “Don't be afraid to move if you are afraid to move”. Once you move, you are not afraid to move. Every time you start a new business, big or small, you need to have faith and at least give it a try. If you don't give it a try, you will regret it later., most recently surprised cars and especially electric cars have been introduced and have over taken “horses” common for using as a transportation in previous times [13, 14]. That's why this study focused to on business of car market in Mongolia. Mongolians have such an interest in their health and global wellbeing so when it comes to cars, every Mongolians will interested [15]. There is a consecutive unsolved problem is air pollution in Mongolia of which think that even Mongolian government haven't solved yet this project study will solve with



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brand new technology in Mongolia by not only decreasing little bit air pollution but also saving money for buying gasoline every time by only using the power of electricity [16]. Electric cars are rapidly becoming a popular choice of environmentally conscious consumers [17, 18]. Electric vehicles offer a sustainable and clean alternative to transport, given the country's problems with air pollution and its dependence on fossil fuels. This study therefore presents advantages of electric vehicles, as well as the current market trends and policies that support their adoption examined. The study revealed that electric cars is a viable venture and health mode of transport more of an essential requirement than lodging so it can get to be a hot point of intrigued to everybody[19]. Everybody works difficult to induce a car since an individual without a car is considered nearly non-human and use gasoline causes a parcel of contamination debate. Therefore the introduction and sell of electric cars in is an environmental integrity option and have existing viable ground [20]. For example, the utilize of cars and vehicles in Mongolia begun to gotten to be more far reaching within the late 1990s and early 2000s [21]. Sometime recently that, due to the migrant way of life and the restricted framework, the larger part of Mongolians depended on conventional shapes of transportation such as steeds, camels, and bull carts. With the move to a showcase economy and the advancement of street systems, there was an increment within the accessibility and reasonableness of cars and vehicles. This driven to a surge in car proprietorship and utilization among users, particularly in urban ranges [22]. Nowadays, cars and vehicles have gotten to be a necessarily portion of everyday life-giving transportation for both individual and commercial purposes. In any case, it is imperative to note that whereas car possession has expanded, there are still tremendous ranges of nations where conventional shapes of transportation are utilized due to the challenging landscape and roaming way of life.

Problem statement and purpose

There's unsolved issue is still hurting individuals which is "Air pollution". This is my main reason of choosing this business[23]. Climate change and its impacts are increasingly causing health issues world over, Subsequently, the discussion on decontamination exponentially growing to forego conventional unclean technologies like burning crude coal. Vehicle outflows, fuel oils and characteristic gas to warm homes, byproducts of fabricating and control era. These especially coal-fueled control plants, and vapor from chemical generation are the essential sources of human-made discuss contamination and environmental sustainability. This study focused on use of electric vehicles as the potential to mitigate the climate change and promote environmental sustainability.

Globalization

It should be noted that for successful business, the seller should keep close intact with the buyer. Therefore, doing business in cars, I am obliged to share a brief introduction to cars and global market share. When it comes to cars, it'll be specifically associated with vehicle, so Karl Benz built a motorcar whose inside combustion motor was fuelled by gasoline. The advanced car is most related to Karl Benz. The development of the car is frequently ascribed to several people and advancements over time. In 1886, Karl Benz, a German design, protected his Motorwagen, which is considered the primary commonsense car fuelled by an inner combustion motor. Benz's development marked a noteworthy



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turning point within the advancement of the cutting-edge car. It is critical to note that there were other creators and engineers who made commitments to the improvement of the vehicle around the same time, such as Nikolaus Otto, Gottlieb Daimler, and Wilhelm Maybach [24]. Their collective commitments and progressions in engine innovation and vehicle plan laid the foundation for the cutting-edge car in recent times. Over time, cars have advanced to include various highlights and advancements, such as moved forward security measures, fuel effectiveness, consolation, and innovative developments. They have gotten to be a necessarily portion of advanced society, forming the way individuals live, work, and travel[25]. Usually as part of the microenvironment factors that affect all the companies in certain industries. It is vital to understand the in the same way how Japanese Toyota and Chinese electrical car, BYD in form of the size, capacity, capability and strategies are different. For example, the raw material suppliers are giving more concessions to large sized companies. However, they may not give the similar comparative advantage to small companies [26].

There are several reasons why one may choose to offer Chinese electric cars over Japanese cars. Chinese electric cars have been quickly moving forward in terms of technology, quality, and plan over the years and are presently getting to be increasingly competitiveness worldwide [27]. Furthermore, Chinese electric cars may offer better value for cash compared to Japanese cars making them a more alluring alternative for clients looking for reasonable electric vehicles. Besides, Chinese electric car producers may to offer more customization options and highlights that cater to the needs and references of your target clients in Mongolia. Eventually, the choice to sell Chinese electric cars over Japanese cars may be based on a combination of variables such as item quality, estimating, customization alternatives, and showcase request [28].

Globally, gasoline cars are Far reaching accessibility: Gasoline is readily available at gas stations all over the world, making it helpful for drivers to fuel up their cars. But it is very catastrophic for environment. Expenditure and refuelling time. Gasoline cars typically have a longer run compared to electric cars and refuelling them is much quicker than it takes as it were a few minutes. but Every time refuel, I need to pay. Execution. Gasoline motors frequently give way better increasing speed and general execution, particularly in high-performance vehicles. But individuals don't use high performance vehicles for everyday life. Established infrastructure. Gasoline cars have been around for a long time, so there is a well-established foundation in put for manufacturing, overhauling, and repairing them. But fabricating and repairing them is additionally a commerce so each time we repair them, we need to pay. Lower upfront cost. Gasoline cars are by and large cheaper to buy compared to electric cars, making them more reasonable for numerous buyers. But once you buy electric car, you do not get to pay to refuel the gasoline. Cons of gasoline cars: Environmental impact.

Gasoline cars contribute to air pollution and greenhouse gas outflows, which are major supporters to climate alter. Reliance on fossil powers. Gasoline cars consume a lot of fossil fuels which contribute to air pollution and environmental resources exhaustion. This leads to catastrophes like climate change and global warming characterized by flooding, drought and famine as well as economic decline.

Gasoline is inferred from fossil fuels, which are limited assets, and their extraction can have detrimental natural impacts. Fuel costs. The costs of gases such fuels are roof top because of factors of production involved in its processing and distribution. Gasoline prices can be volatile, and the taken a toll of



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fuelling a car can be a noteworthy cost for car proprietors, particularly amid periods of tall oil costs. Support and repairs. Support and repairs are key factors involved in the gasoline use is unbearable which make its use very expensive in the long run. Gasoline motors require regular maintenance, including oil changes, filter replacements, and tune-ups. They too have more complex mechanical frameworks, which can lead to higher repair costs.

Commotion and vibration: Gasoline motors tend to be louder and produce more vibrations compared to electric engines, coming about in a less refined driving experience. However, Pros of electric cars include the following:

Natural benefits. Electric cars create zero end of pipe outflows, decreasing discuss pollution and greenhouse gas emissions, and making a difference combat climate alter.

Energy productivity Electric cars are more energy-efficient compared to gasoline cars, as they change over the next rate of energy from their batteries into real driving power.

Lower working costs. Electric cars have lower fuel costs since power is for the most part cheaper than gasoline. They moreover require less maintenance, as they have fewer moving parts and don't need oil changes or tune-ups.

Calm and smooth driving encounter. Electric engines are calmer and deliver less vibration than gasoline motors, coming about in a more tranquil and comfortable driving experience.

Government incentives. Numerous governments offer motivations, such as assess credits and subsidies, to advance the adoption of electric cars, making them more reasonable for customers.

LIMITATIONS OF ELECTRIC CARS

Constrained expansion. Electric cars ordinarily have a shorter driving extend compared to gasoline cars, which can be a concern for long-distance travel. However, the run is moving forward with advancements in battery innovation.

Longer refuelling time. Charging an electric car takes longer than refueling a gasoline car, because it can take a few hours to completely charge the battery. Be that as it may, fast-charging stations are becoming more predominant thus decreasing charging times.

Charging infrastructures' accessibility. The charging stations is still limited compared to gas stations, especially in some regions or remote areas, which can cause run uneasiness for a few electric car proprietors.

Higher forthright taken a toll. Electric cars are generally more expensive to buy compared to gasoline cars, basically due to the fetched of the battery. In any case, costs are continuously diminishing as innovation propels, and economies of scale are accomplished.

Limited model options. While the variety of electric car models is expanding, the alternatives are still more constrained compared to gasoline cars, particularly in certain vehicles like trucks and SUVs. However, this is often anticipated to alter as the market grows.



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1.2.3 Delimitations

There are other nearest competitors from other countries like Japan and France among others, Toyota and other brands. I want to set my electric vehicle business better than theirs by using more online platforms to advertise and buying from the manufacturers so as to benefit from reduced selling prices. The business centers for electric car accessories so that customers can buy all electrical vehicle parts and accessories from my business as well as having a mobile team that move from one place to another within the country and more still adds some movements to customers for those who won't manage payment in full, or a small amount attached to the extended service.

Scope of study

With the prime focus of this thesis introducing and selling of electric vehicles Mongolia in 2024. The researcher largely studied the selling of electric vehicles around the global and possible issues involved. In the literature, effort was made to find some of the electric vehicle selling works progress on the topic of study. Then the appropriate methods were explored and discussed in detail including their pros and cons. This empirically deciphered the principles of micro and macro environment competition in the trade of electrical vehicles. The results of the studies are analyzed and then resulted presented based on the principles.

Theoretical foundation

The business environment in Mongolia has recently stabilized with new wave in modern economies and commerce [29]. This lays good ground for different kinds of business. In another form of unique characteristics, Mongolians have strong beliefs and commitment in business and life ambitions. Since most people have kind of ruined mentality and the individuals are a bit aggressive, they express themselves openly. Therefore, In Mongolia, Facebook is the greatest commerce stage that can reach a part individual exceptionally successfully. So, I will use social media platforms like Facebook power to advertise my business. Everybody who incorporates a mouth can talk. The reason is Mongolian government authorities and journalists, law enforcement, and on-screen characters are all associated, because of offering characteristic assets, putting open cash in their pockets, among others. Therefore, they are not regarded by individuals. Since Mass dissents and riots started within the Mongolian capital Ulaanbaatar on 4 December 2022. The reason for the challenge was a corruption embarrassment including the burglary of \$12.9 billion worth of coal. However, the new wave of favourable business environment for instance, 88th poorest nation within the world and GDP per capita is 14,939\$. It is of this situation, the regulation of importing and taxes are not quite strict thus it is advantageous to do my brand-new business.

Supply chain risks

Value Added Tax in Mongolia (VAT) at the rate of 10% is forced on the supply of products, administrations, and works imported, traded, and sold in Mongolia. This provides grounds for



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profitability of various ventures including electric vehicles trade. Tax obligations in Mongolia. To begin with and first, Mongolia isn't a tax haven despite reliably having a few of the lowest assess rates within the world - at 10 percent level for the major sorts, counting organization assess, individual salary tax and VAT. Taxation in Mongolia is among the risks however it's not so high comparatively. Mongolian taxi admission is not costly. Within the Ulaanbaatar city, a taxi passage is 1500 MNT (0.5 USD) per km. when you call the official taxi, the base expense is 1500 MNT. This is an important parameter for boasting trade within the country and abroad.

Consumer behaviour

Generally, there are two modes of cars, Electric and Watch (petrol car). However, Chinese electric cars may be particularly appealing to Mongolians several reasons. Firstly, this could be because China is a near to Mongolia geographically thus making it simpler to and benefit Chinese electric vehicles compared to vehicles from other nations. Also, Chinese electric cars are known for their affordability proficiency, making them a viable choice for clients in Mongolia. Besides, the expanding center on natural maintainability and reducing discuss contamination in Mongolia may make Chinese electric cars a more alluring alternative for naturally- conscious consumers. Chinese electric cars may be particularly engaging to Mongolians to their cost-effectiveness and natural maintainability. Electric cars are regularly as an eco-friendlier choice compared to conventional gasoline fuelled vehicles, which can be useful in Mongolia that's natural challenges such as discuss contamination. Moreover, Chinese electric cars may be more reasonable for Mongolians compared to other brands making them a prevalent choice for those looking to switch to electric vehicles. Chinese electric cars are particularly adapted to suit the requirements and references of Mongolian clients by offering highlights such as rough design for off-road driving in cruel climate conditions, longer battery life for extended utilize in inaccessible areas, and reasonable estimating to create them available to a more extensive run of customers. Finally, Chinese electric car manufacturers may also offer customization alternatives to cater to specific preferences of Mongolian clients, such as discretionary additional items for cold weather protection or expanded capacity for roaming ways of life.

Maslow's hierarchy of needs

Maslow's hierarchy of needs was used from the bottom of the hierarchy upwards, the needs in form of physiological, safety, love and belonging, esteem and self- actualization. This five-stage model can be translated into deficiency needs and growth needs[30]. This helped the researcher to understand if the electric vehicles are relevant

Four types of consumers buying behaviour

The types of Consumer Behaviour types were identified by experts in trade were also considered in this study[31]. Experts agree that there are four main types of consumer behaviour. complex-buying behaviour, dissonance-reducing buying behaviour, habitual buying behaviour, and variety-seeking buying behaviour 2, 33]. This enabled the researcher to understand the customers' needs market thus determining the viability of electric vehicles across the world.



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MARKETING MIX

Product

Chinese electric vehicles like BYD moreover offers a range of vehicles but is more centered on electric vehicles and hybrids. This gives them a unique quality which will attract more customers in Mongolia. More still it is the innovation of the Chinese electric vehicles. More interestingly, BYD is additionally known for its electric vehicle technology and has been a pioneer in the Chinese electric vehicle market. Reputation Toyota is populous for a notoriety in reliability, quality, and durability, while BYD is still building its notoriety, but its electric vehicles have picked up acknowledgment for their execution and expansion. Meanwhile, another factor of the products of Chinese electric vehicles is Generation Capacity. BYD has fabricating offices in China and has also expanded to other nations. After Sales Services Volume is another important factor to notice about Chinese electric vehicles. BYD has experienced noteworthy growth in later a long time but has a smaller deals volume compared to Toyota. Generally, Toyota has a longer history, a more built-up worldwide nearness, a more extensive run of vehicle offerings, and a more grounded notoriety. In any case, BYD is known for its electric vehicle innovation and is making strides within the Chinese showcases. However, the impediments and advantages of BYD cars and Toyota gasoline cars, and the stars and cons of gasoline cars is still a matter of debate.

Price

World over, there are numerous cars investments especially in electric cars targeting climate change mitigation and adaptation measures. For example, Mongolia Number of Vehicles data was detailed at 734,450.000 Units in 2022. This records an increase from the past number of 723,214.000 Unit for 2021. This is according to studies on trade patterns in Mongolia. The foremost sold car in Mongolia includes, the Toyota land Cruiser is by far the foremost prevalent modern car especially as fore mentioned.

Place

The products from delight whole seller suppliers and the one from China main electric cars would be through distributors and sellers then supply the middlemen or retailers. This could create employment opportunities to at least female workers and ever-growing youth to help in the electric car business in supplying the products and giving out different services. They would need ecofriendly means of transport; they would remain in the sales stores to serve the present customers conveniently. However, in the place of serving a customer from home one worker would have to go and serve the customer from home. And for that other special charges would be added to the organized amount to cater for the transport costs dependent.

Promotion

For the course of promotion, in the first place no adverts would be needed but satisfied customers could also help with telling others. This ensures the best service to customers in that if they go outside in



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their homes, they just sell electric cars to the public and the trend and social circles. But in the future, like in about four years it will need to start because of introducing mixing new services and for the branch that would be created. So, in that case we need to bring in advertising ways for new products and services and they will be created.

People

Employment opportunities generation and customer freedom in terms of choices

METHODOLOGY

Research purpose

The goal of this research is to thoroughly understand the potential of electric vehicles towards promoting climate change migration and environmental sustainability to illustrate the future of Chinese electric cars market through analysing profound insights and valuable elucidation. It firmly seeks to dive into the varied and complicated aspects that have greatly contributed to Chanel's awe-inspiring success while also attempting to passionately analyze and methodically evaluate the influence of the crises on the revered brand. Furthermore, this comprehensive study meticulously focuses on electric cars progress and profound changes, seamlessly adapting to the unique challenges posed by the pandemic and cleverly capitalizing on the plethora of unprecedented opportunities that have emerged in the beautiful and burgeoning Chinese electric vehicle market.

Furthermore, it astutely strives to successfully deliver unmatched and vital insights and sage advice, assuring electric cars industry as a holistic and continuous growth, unshakable presence, and incomparable arena in the vast and competitive market by this research, hopefully it could answer these questions.

How is introducing and selling electric cars?

What is the background of the electric vehicles?

How have electric vehicles impacted transport system and climate change?

What are the necessary electric cars changes recommended?

What are the suggestions for electric vehicles that are operating their business?

RESEARCH APPROACH

The researcher used different approaches to plan the procedures for research. Spanned from the steps and from broad assumptions leading to detailed methods of data collection, analysis, presentation and interpretation. These included statistical methods, case study methods, and comparative methods.

Data collection



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Primary Data

Primary data was obtained from the consumers of electric vehicles to back up the literature obtained from users and manufacturers and government officials.

Secondary data

Secondary data was obtained from manufactures websites and publication as well as market channels to understand the viability of introducing and selling electric cars sourced from China to Mongolia. Different online databases including Google Scholar, Science Direct, Elsevier, Jstor etc., were used as founding sources for identifying important documents related to current research.

RESEARCH QUESTIONS BASED ON LITERATURE REFERENCES

To understand the trade Mongolia, relevant research questions were prepared to ascertain the viability of introducing the electric vehicle. They included the following, Car utilization. Not at all like in Unused York City, where there are numerous tram lines, buses, and indeed ships over the water, in Mongolia nearly everybody drives a car. Of course, there are buses within the city as well, and people get from one city to another employing a bus or prepare. This makes it convenient to transact within the country across all the regions and abroad especially among the electric vehicles’ giants like China.

Driving safety in Mongolia? Driving in Mongolia can be unsafe, particularly at night, due to destitute, perceivability street conditions and vehicle support. The security system of Mongolia has been stable enabled by government security department thus makes it favourable niche to do business by foreign brands and local brands by nationals and citizens. It’s moreover conceivable to go it alone and lease your own vehicle from the likes of Sixth or Drive Mongolia. You’ll require your domestic driving permit on substantial for at slightest one year as well as a universal driving allow.

DISCUSSION AND ANALYSIS

Data analysis tools were used to work on the data received from the literature and other various sources. This was intended to increase the accuracy of the results presented.



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Electric Automotive Market

The living without electric cars would affect their daily lives and lifestyle therefore it is worth it, it would have a noteworthy effect on different viewpoints of their lives. Here are a few conceivable scenarios:

Elective modes of transportation. Individuals would rely more on public transportation frameworks like buses, trains, cable cars, and subways. These modes of transport would have to be expanded and made strides to suit the expanded request. But it'll take so much time, uncomfortable, you can't be yourself, always carry your assets etc.

Cycling and strolling. Without cars, individuals would likely resort to cycling and walking for shorter separations. This would lead to healthier lifestyles, decreased contamination, and less activity clogs. But in Mongolian situationship, there is no cycling road, so its incomprehensible.

Progressed framework. In this scenario, cities would have to contribute to superiority foundation for people on foot and cyclists, such as devoted bicycle paths, more extensive sidewalks, and safer crosswalks. This would improve the by and large liveability of urban zones, however building this criterion is not that tedious.

Car and ridesharing. Rather than owning individual cars, individuals might depend on car-sharing administrations or ride-sharing stages like Uber and Lyft for intermittent trips or longer ventures. This would diminish the number of vehicles on the street and advance asset sharing. But even it diminishes number of vehicles, we got to pay transportation fee so once we bought us possess car, no requirement to pay to purchase petrol.

Neighbourhood economies. With less cars, nearby businesses would likely thrive. Individuals would be more slanted to shop at adjacent stores, driving to expanded foot traffic and back for nearby economies. But in local shops, there are limited choices, so you wish to go big advertise or enormous stores by car or open transportation to get what you like.

Decreased natural effect. The non-attendance of cars would altogether diminish discuss contamination, commotion pollution, and nursery gas emissions. This would have a positive effect on the environment and help combat climate alter. That's why i need to offer electric cars to use without contaminating discuss.

Wellbeing benefits. Expanded physical action from strolling and cycling would lead to improved fitness levels and way better overall health. Moreover, the diminished contamination levels would result in superior discuss quality, diminishing respiratory and cardiovascular issues. But in case we live without car, the wellness centers and exercise centers cannot make cash. Too, if we walk to work every day, we will be depleted and cannot put vitality on work.



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Changes in urban arrangements. Without cars, cities may well be overhauled to prioritize pedestrians and cyclists. More green spaces, more extensive sidewalks, and community-oriented spaces would supplant stopping lots and congested streets. But city looks like farmland if its looks all green, nowadays urbanized cities have big buildings and complex car streets.

Reduced stress and clog. Without cars, activity blockage would be altogether diminished, driving to less stress and shorter commute times. This would improve the quality of life for individuals and make cities more wonderful to live in. But this environment makes people feel more moderately motioned, apathy and post phoned sentiments.

Move in way of life. Living without cars would require individuals to arrange their ventures in progress, depend on public transportation plans, and adjust to elective modes of transport. This might lead to a more careful and purposeful approach to travel and a move in lifestyle choices. But adjusting to a new way of life can make individuals more unpleasant, conjointly takes time to embrace. Meanwhile, whereas living without electric cars may present a few challenges, it also offers various benefits for people, communities, and the environment. But living with electric cars has its own benefits and preferences. Here are a few of the pros of having cars.

Comfort and adaptability. Cars give a high level of comfort and adaptability in terms of travel. They permit people to travel whenever and wherever they want, without being subordinate on open transportation schedules.

Timesaving. Cars can spare a noteworthy sum of time compared to other modes of transportation. They offer coordinated courses and speedier travel times, particularly for longer distances or zones with restricted open transportation options.

Openness. Cars give availability to regions which will be troublesome to reach by open transportation, particularly in rustic or inaccessible ranges. They permit individuals to get to work openings, administrations, and recreational exercises that might something else be blocked off.

Consolation and Security. Cars offer a comfortable and private mode of transportation. People have control over the temperature, music, and in general environment in their vehicle, giving a personalized and comfortable travel encounter.

Safety. Cars give a sense of security and security, particularly amid crises or when traveling at night. People have control over their environment and can bolt their doors, guaranteeing individual security.

Carpooling and Commuting. Cars encourage carpooling and shared commuting, permitting people to share rides with others. This decreases activity clog, spares money on fuel costs, and promotes social interaction.



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Transportation of Goods. Cars are fundamental for transporting goods and supplies, whether it's for individual use or for businesses. They enable the development of products productively, supporting financial exercises and exchange.

Freedom. Cars give a sense of independence and independence. Individuals can make unconstrained trips, investigate new places, and have the flexibility to travel freely without relying on others or open transportation.

Work Openings. The automotive industry makes various work openings, extending from fabricating and deals to support and repair. Cars contribute to financial development and provide employment for millions of people worldwide.

Personalization. Cars permit people to personalize their vehicles according to their inclinations and needs. They can choose the make, model, color, and highlights that suit their lifestyle and personality. While cars offer these points of interest, it's important to consider their natural effect, activity clog, and the requirement for feasible transportation arrangements to moderate the negative impacts related to their use. I recommend individuals buy electric cars.

Therefore, distance between and other related factors of micro and macro environment of competitors are so favourable, therefore expounding understanding of how much the electric car critical in Mongolia.

BYD Auto

As for now, we cannot live in this century without cars, but in other countries such as China, they don't have a problem of polluted air, so they do not care about gasoline or electric cars but still I see in the streets in Shanghai, there are lot of more than 50% of Chinese using electric car “BYD”. So, the purpose of my thesis is to analyze the potential impact of electric cars on reducing carbon emissions and improving air quality. By understanding the benefits and challenges of electric vehicle adoption in the country, policymakers and industry stakeholders can make informed decisions to promote sustainable transportation options. This research finding will contribute to the ongoing efforts to mitigate climate change, electric vehicles commerce and improve public health welfare.

BYD in international Automotive markets

In this case, YD (Construct Your Dreams) and Toyota are both car companies, but there are a few contrasts between them for example, BYD may be a Chinese company, whereas Toyota may be a Japanese company and Toyota encompasses a much longer history, having been established in 1937, whereas BYD was established in 1995. In terms of Nearness, Toyota could be an all-inclusive recognized



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brand and has a solid nearness in different markets around the world. BYD, on the other hand, is still establishing itself as a global brand and encompasses a stronger presence within the Chinese advertise while Vehicle Extension, Toyota offers a wide run of vehicles, counting sedans, SUVs, trucks, crossovers, and electric vehicles.

Mongolia also does have BYD cars. BYD Auto, a Chinese vehicle producer, includes a nearness in Mongolia and offers its cars in the nation. BYD offers a run of car models in Mongolia. Some of the well-known BYD car models are available like incorporated BYD e6, BYD Tang, BYD Qin, BYD Song, and BYD Yuan. These models vary in terms of size, features, and powertrain options, catering to different customer inclinations.

The estimating of BYD cars can shift by locale and show year. Be that as it may, by and large talking, the BYD Yuan is considered one of the more reasonable models within the BYD lineup. It is a compact crossover SUV that offers a combination of affordability and electric powertrain alternatives. If you don't mind note that costs may shift based on components such as trim level, discretionary highlights, and neighbourhood taxes and directions.

It is recommended to check with local BYD dealerships or authorized merchants for the most precise and up-to-date estimating information. Therefore, Chinese electric cars can be an awesome alternative. This is because, they are frequently more reasonable than Japanese electric cars, making them open to a more extensive extend of consumers. Additionally, Chinese electric car producers may offer customization choices and highlights that cater to the needs and inclinations of Mongolian drivers, such as rough plans suited for harsh landscape or bigger battery capacities for longer driving separations.

Generally, Chinese electric cars can be down to earth and cost-effective choice for the advertisement among Mongolians market. They are fascinating advantages of electric cars which tempt consumers. Firstly, the Over its lifetime, the average new electric vehicle produces around half the greenhouse gas emissions of an equivalent petrol or that burns petrol or diesel[34]. Such reports from various groups of Concerned Scientists compare the total emissions from gas and electric vehicles.

POTENTIAL FINANCIAL ANALYSIS AND SALES

Firstly, Oil cars are the most competitive enemy of electric cars because of those mentioned advantages of gasoline cars. Moreover, the automotive engine oil market is currently being experiencing steady growth due to various factors such as increasing vehicle production, growing demand for high performance engines and increasing of the importance of regular vehicle maintenance of vehicles[35]. The market is expected to continue an upward trend in the coming years, driven by the expansion of the automotive industry, particularly in emerging markets. One of the key trends in the automotive engine oil market is the shift towards synthetic and semi-synthetic oils, as they offer better performance and protection for modern engines compared to conventional oils. Consumers are increasingly opting for these premium products to ensure the longevity and efficiency of their vehicles. Furthermore, the growing popularity of electric vehicles is also influencing the market share, as these vehicles require



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higher levels of fuel efficiency, market, as these vehicles require lubricants to optimise their performance. There are also significant growth opportunities in the market, particularly in the aftermarket segment. With several vehicles on the road. Vehicles on the road, the demand for engines for both maintenance and replacement purposes. This provides an opportunity for manufacturers to expand their product range and reach a wider customer base. In addition, the increasing focus on environmental sustainability is driving the development of environmentally friendly engine oils, which are expected to gain traction in the market. Overall, the automotive engine oil market is poised for growth in the foreseeable future, driven by technological advancements, changing consumer preferences and the expanding automotive industry. Manufacturers and suppliers in the market will need to innovate and adapt to capitalize on the emerging trends and opportunities to remain competitive.

To sum up, global oil demand growth continues to lose momentum, with 1.6 mb/d growth in 1Q24, 120 kb/d below our previous forecast due to exceptionally weak OECD supplies. For instance, with the post-Covid recovery now there are largely now largely complete, and vehicle efficiency and a growing EV fleet acting as a further drag on oil demand, growth slows to 1.2 mb/d and 1.1 mb/d in 2024 and 2025 respectively. Similarly, non-OPEC+, led by the US, will drive global supply growth through to 2025, with global production forecast to increase by 770 kb/d to 102.9 mb/d in 2024. Non-OPEC+ production will increase by 1.6 mb/d, while OPEC+ supply could fall by 820 kb/d if the voluntary cuts remain in place. By 2025, global growth could rise to 1.6 mb/d. non-OPEC+ is forecast to lead gains, rising by 1.4 mb/d, while OPEC+ production could increase by 220 kb/d if cuts remain in place. Of course, oil cars are the main necessity in the world, but the most crucial thing is which country should use which type of car. Meanwhile, in Mongolia, oil cars are un environmentally friendly [20, 36].

Supply chain description

Supply chain of electric cars will be designed through the network of companies and people that are involved in the production and delivery of a product or service especially in Mongolia and China wholesalers, suppliers and manufactures. These components of a supply chain include producers, vendors, warehouses, transportation companies, distribution centers, and retailers will facilitate prompt service delivery and easy communication between

Consumer buying behaviour changes

Globally there is massive shift from onsite shopping to online shopping behaviour. Similarly, it has the most significant penetration in customer behaviour by shifting towards online shopping. There is convenience of browsing products from home thus leading to a rise in e-commerce. In fact, global e-commerce sales are expected to rise in all countries following these changes in consumer behaviour. Further still, the exponential global climate change concerns from greenhouse gases have also prompted a change in them has accelerated the demand for electric vehicles, leading consumers to actively and joyfully explore and embrace the immense options accessible in the green world. Simultaneously, there has been an unprecedented and translated emphasis on health and sustainability,



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with people increasingly selecting items and behaviours that promote personal well-being while also boosting to a more sustainable, eco-friendly conscious, and socially responsibility for the next generation.

Marketing innovations

The company has its corporate central command within the Ping SHan Locale, Shenzhen, Guangdong area of China. Not as it were China but too department workplaces found in USA and other nations as well. Since I am neighbouring nation of China, it is less demanding to buy directly from China. There's a good option which is buying online. So, it'll be less demanding for me to reduce transportation charge but on the other hand, I must check everything in my eyes and purchase myself since it is me to begin with start-up trade. Be that as it may, I still can purchase BYD electric cars through their official site or through authorized dealerships. Some dealers may offer the alternative to buy online, but it's best to check with them specifically for the foremost up-to-date data on acquiring alternatives. Contact providers and arrange estimating and terms for acquiring the electric cars. There may be motivating forces or discounts available for purchasing a BYD electric car, depending on your area and neighbourhoods' government directions. It's suggested to check with BYD straightforwardly or together with your neighbourhood dealerships for data on any accessible motivating forces or discounts.

Therefore, organization for transportation of the cars from China to Mongolia. It's conceivable that it may need to pay moment charges as traditions and obligations on the electric car in the event of importing from China. It's best to check with the significant specialists ascertain the directions and prerequisites for importing electric vehicle from China.

Appropriations for electric vehicles shift by nation, so it's a great thought to investigate what motivating forces may be available for utilizing an electric car. For example, the setting up conveys an arrangement for offering the electric cars. This creates a promotional procedure to promote electric cars to potential clients and climate change mitigation goals and objectives.

RESULTS AND DISCUSSIONS

This is an important consideration in establishing a business venture because it determines the future of trade. For instance, most cars are used by the Toyota Prius, Toyota Arrive Cruiser, Mitsubishi Delica. The Toyota Arrive Cruiser is by distant the foremost prevalent modern car in Mongolia. This shows that there are favourable grounds for business ventures. This is also attached to factors like, They Prius is solid and very solid, There's the cost point that's exceptionally cheap. Toyota isn't making premium on advertising here as the larger part of the Prius on the street are utilized, which makes them reasonable, \$2-6k or so. Mongolia also charges no excise or discusses contamination charge on crossovers, so they don't care around how much they contaminating discuss. In the nutshell, all the items from consumable items like clothes to electric merchandise are imported from China but as it were most Cars imported from Japan. Therefore, these kinds of ventures and inquiries therein venture



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from Mongolian government. That is the need to offer electric cars from China and found out that Mongolia drive on the correct side of the road and drivers sits on the left-hand side of the car. In any case, you'll see as numerous right-hand drive cars as left-hand drive cars since the inception of the cheap second-hand car imported from Japan, among others .

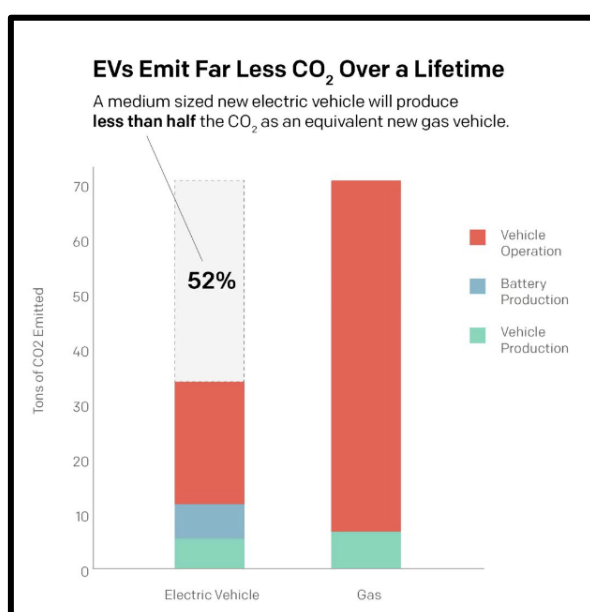


Figure 1. Comparison of electric and gas-powered vehicles emissions

As the modern control entered into force as early as January 1, 2020, proprietors of vehicles in Ulaanbaatar city required to pay street assess from MNT 100 thousand to MNT 250 thousand depending on the sort of vehicle each year, which approximately equivalent to MNT 8300 month[37] For instance, it is believed that numerous streets cover Mongolia that out of an add up to 50,000Km of streets in Mongolia, as it's where almost 10,000Km (20%) are landing area (black-top) cleared streets. The rest are rock and soil streets, basically driving out of the capital city Ulaanbaatar. This will encourage tapping on ventures for further areas of interest.

From the extract in figure 1, it is evident that electric vehicles are best in terms of emission release although their production is still lacking. The operation costs of gas are quite high compared to the electricity as shown in the figure. The battery life of electric cars is also promising, therefore, a good ground to flourish electric vehicles for economic and environmental friendliness. Similarly, if electric vehicles are spread over the world market, it will be able to have same benefits to the user communities as well as environmental integrity. Therefore, the research would encourage electric cars to super ride the markets and the world at large.



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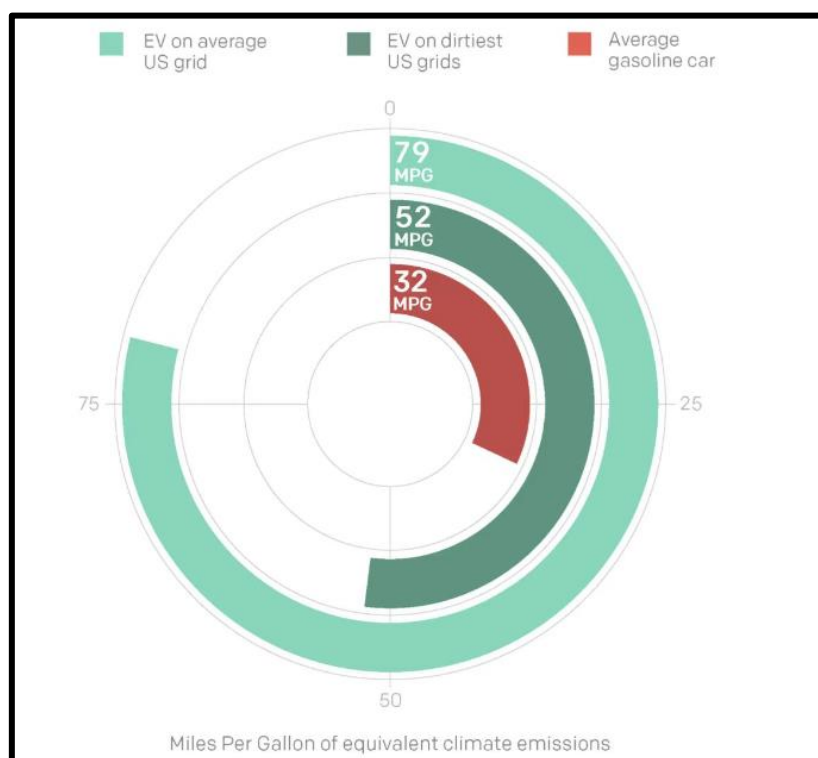


Figure 2. Comparison of electric and gas-powered vehicles on climate change

There are a number of reasons EVs are atop notch[35]. For instance, electric motors use much more efficiently than their internal combustion which wastes a huge amount of energy through friction. Electric motors can convert up to 85% of the energy they have into motion, compared to less than 40% for an internal combustion engine. But there's a much more obvious. Electric vehicles don't need to be needed to fill up with petrol and burn it this contributes to less emissions into the environment as portrayed in Figure 3. Electric vehicles need no charging, and some of that electricity may be generated via burning fossil fuels. Electricity grids in the United States are with clean energy [38]. For example, at Earth justice, there has been limited efforts towards the country's transition to clean energy. As the world's largest nonprofit environmental law firm, employment of the power of the law to force the retirement of more than 150 coal-fired power plants. So additionally, both mining minerals for battery fabrication and drilling for oil to fill a gas tank have serious environmental impacts - but the scale of the impact is very different. There are many ways to compare the material resource requirements of electric and internal combustion cars. Another ideology about it is in terms of lifetime raw material consumption from the earth. This has been evident in the calculation by the European Federation for Transport and the Environment found that the lifetime fuel consumption of a conventional car requires a tower of oil barrels as tall as a 25-storey building. The metals needed to make an EV battery, meanwhile, are about the size of a microwave oven. While the switch to electric



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vehicles will lead to new mining operations and some of the environmental metals in electric vehicle batteries can be recycled.

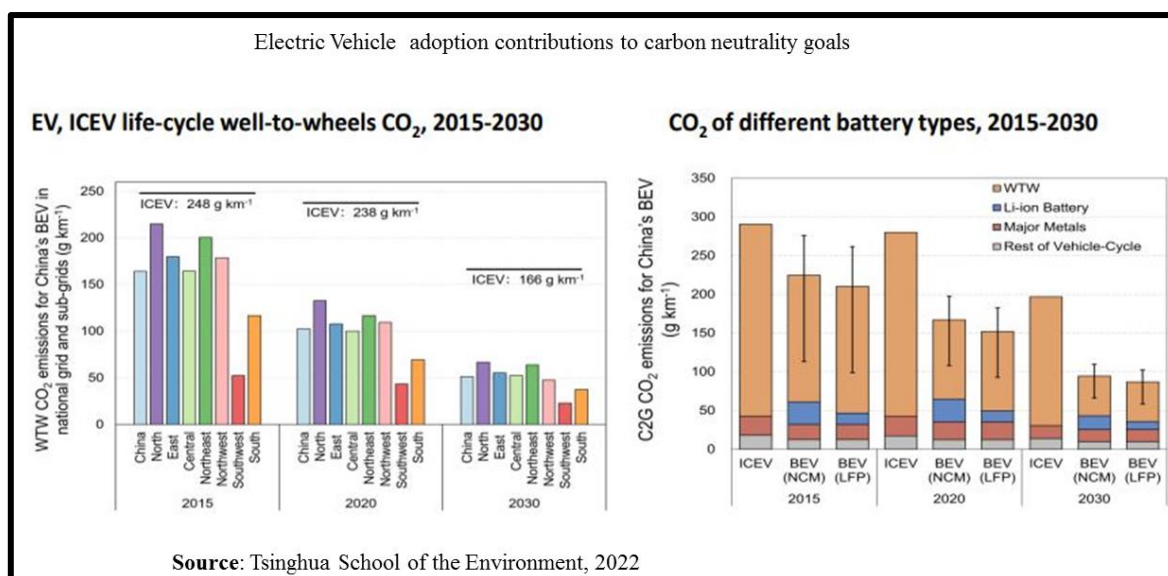


Figure 3. The contributions of electric vehicles towards air pollution emissions

Once you've burned the petrol in your tank, there's no way to recycle it - we'll be breathing the resulting pollution, and you'll have to buy the next tank of petrol again. That's why because of those reasons we should substitute electric cars over gas cars. Electric cars are a huge improvement on the millions of combustion engine cars on the road today [39]. But one big climate solution in the mix isn't about cars at all: it's about giving people better access to public transit, biking, and other low-impact transportation options - and electrifying all the buses, trains, and ferries in our transit systems. To that end, for example, the Biden Administration recently announced the largest investment in passenger rail since Amtrak was created, using funds from the Inflation Reduction Act to expand passenger rail across the country. Therefore, there is need for bolder federal action like this to make public transportation affordable and accessible for all.

In perspective of commercial electric cars, it has registered exponential growth globally. The electric car is becoming more common in use, for example in the Paris-based forecaster said to grow battery electric and plug-in hybrid electric vehicles will be sold, an increase of more than previously [40]. The LEA also said that most electric cars will cost the same as petrol equivalents by 2030 as prices fall. By 2025, electric vehicle sales could account for up to 20% of new car sales. By 2030, electric vehicle sales could reach 40% of new car sales. It is believed by 2040; electric vehicle sales could account for almost all new car sales. Therefore, this business needs not only cars but also all the supplements and fixing and alternative equipment which also opens a door for other businesses for other individuals who can import that electric car-related equipment. The utilization of e-commerce like Taobao but they are not



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used for BYD car for offering in Taobao but there was Volkswagen electric cars so not as it were BWD therefore can purchase directly from the producer. Luckily, there are all the equipment and requiring things in Taobao so I can moreover purchase and offer at the same time.

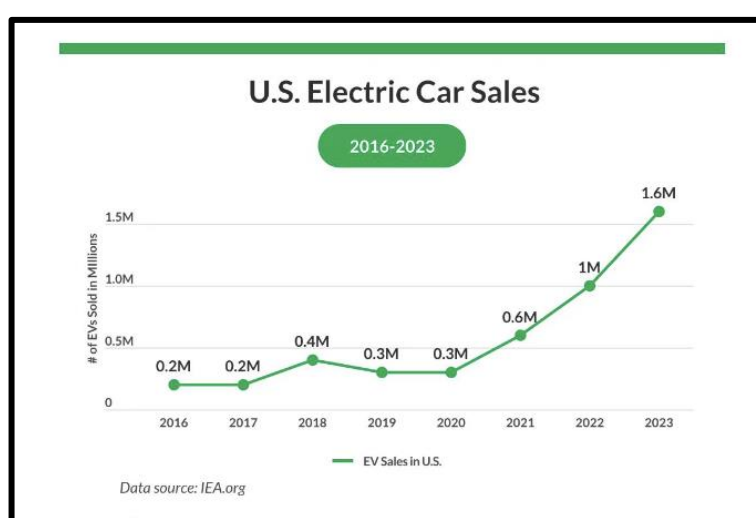


Figure 3. Trends in Electric Car Sales in USA (Source: Market Watch Guides)

Therefore, there are a few reasons why consumers may select Chinese electric cars over Japanese cars[41]. Firstly, Chinese electric cars may offer a more cost-effective alternative for buyers due to lower fabricating costs. Additionally, choosing Chinese electric cars can contribute to the improvement of the Chinese electric vehicle industry and support mechanical headways to green transportation economies of scale. Finally, by selecting for Chinese electric cars, Mongolians can adjust with worldwide endeavors to combat climate alter and advance feasible hones [11]. Electric car sales have gained a profound market share in the U.S since 2020. In this case, about 1.6 million EVs were sold in the U.S.in 2023-a60%increase from the 1 million sold nationwide in 2022.The U. S. accounted for 9.7% of all new Ey registrations worldwide in 2022. Globally sales peaked 10 million after a while since 2022. In the first quarter of 2023, over2.3 million electric vehicles were sold globally, a roughly 25% year-over-year increase. Similarly, as of October 2023, Tesla accounted for more than half of the US EV market share while Chevrolet was the second largest EV brand in America, with 5.9% market share, and Ford was close behind with 5.8%.

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To offer Chinese electric cars in Mongolia I can begin by investigating the market demand for electric vehicles in Mongolians recognizing potential customers. The next step would be setting up associations with Chinese electric car producers or distributors to consequently promote electric vehicles. Moreover get to comply with any controls or necessities for offering remote vehicles in Mongolia [15]. Additionally, consider setting up a showroom or online platform to grandstand and offer the electric cars. Marketing and advancing the benefits of Chinese electric cars, such as cost-effectiveness and natural supportability, will too be important for drawing in clients. I investigated and recognized solid electric car producers in China [42]. A few of the cheapest electric car producers in China incorporate BYD, Geely, and Chery. These companies offer reasonable electric vehicles that are prevalent within the advertisement. It's continuously a great thought to compare costs and highlights some time recently making a choice on which electric car to buy for the most part focus on BYD cars [43]. As for the archives it would depend on the necessities of bringing in and offering electric cars in Mongolia. At great extent, qualifications require consequence licenses, traditions documentation, certificates of beginning, vehicle enrollment reports, and commerce licenses. It's prudent allude to ">to refer to lawful and exchange specialists to guarantee compliance with all regulations and requirements. This might incorporate the bill of filling, commercial receipt, moment licenses, compliance certificates, and any other relevant paperwork. Bringing in necessities from China: Section show (CBP Shape 7533) or Application and Extraordinary Allow for Prompt Conveyance (CBP Shape 3461), Prove of right to create section, a commercial receipt or a program receipt, pressing records and Proof of consequence permit or allow (if my merchandise require it)

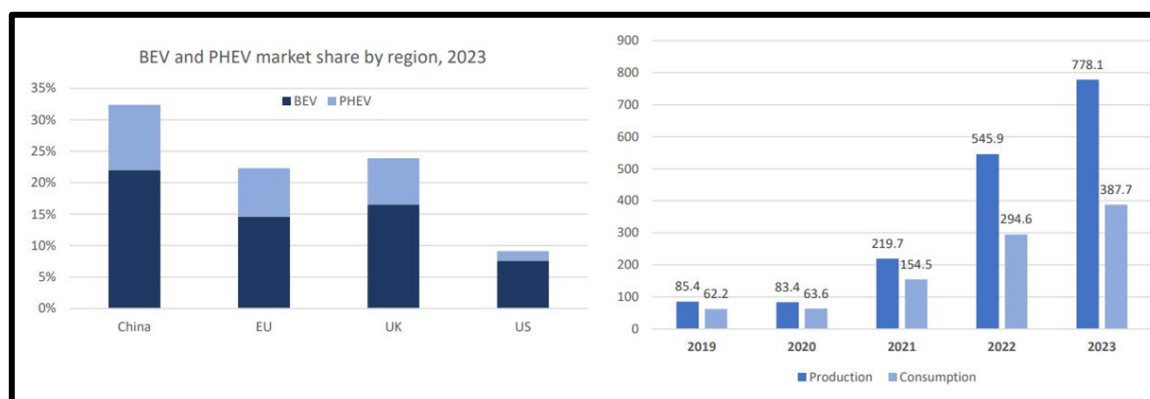


Figure 4. China Electric Vehicles market ahead of other major regions (**source:** Oxford Institute for Energy Studies – 2024)



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In figure 4, above the production and sale of electric cars from China showing higher in recent years from 2022 and 2023 meanwhile the market share is also promising for both BEV and PHEV compared to other countries. This implies there is hope for flourishing of export market supply with respect to Mongolia.

	2022	2023	change
Lithium carbonate	RMB 600k/tonne	RMB 100k/tonne	-83%
Nickel	USD 30k/tonne	USD 16k/tonne	-45%
Synthetic graphite	RMB 51k/tonne	RMB 42k/tonne	-18%
Natural graphite	RMB 48k/tonne	RMB 33k/tonne	-31%
LFP electrolyte	RMB 5.3	RMB 1.9	-63%
NMC cell	RMB 0.92/Wh	RMB 0.515/Wh	-44%
LFP cell	RMB 0.825/Wh	RMB 0.42/Wh	-48%

Figure 5. Comparison of key Electric Vehicle inputs: year-end 2022 versus 2023 (source: OIES 2024, CBEA 2024)

From the figure 5, above it is obvious that the cost of battery inputs for electric vehicles in China have drastically fallen. This implies production and export to other countries is possible. This further gives for new existing markets like Mongolia soon and thus a great opportunity ahead.



Figure 6. Several factors other than subsidies at work (source: Oxford Institute for Energy Studies – 2024)



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From figure 6, it is evident that the growth factors electric vehicles are subsidized and are boosting manufacture of vehicles especially in the first-tier cities like shanghai and customer satisfaction is growing for electric vehicles than fossil vehicles. The brand image, equality, reliability as well as sales and service satisfaction are promising. This gives hope electric vehicle production and sales in other countries including Mongolia because they will be user friendly and great satisfaction of the consumers.

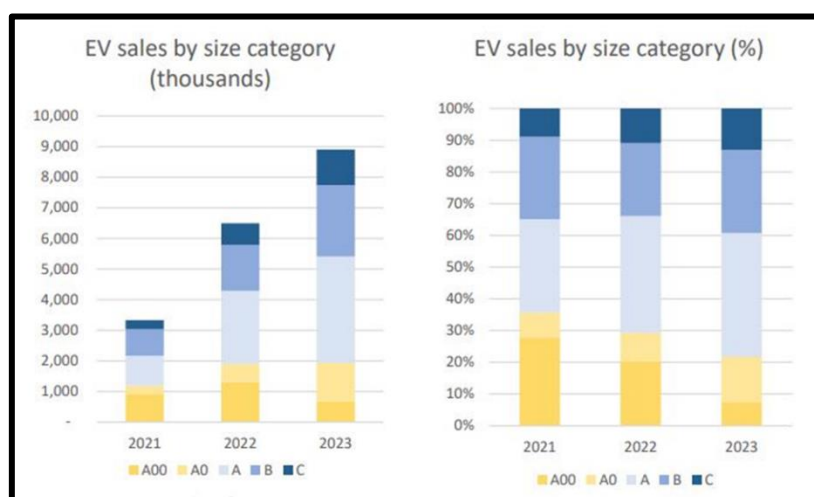


Figure 7. Electric vehicle category (source: Oxford Institute for Energy Studies – 2024)

From the figure 7 above, electric vehicles sales in thousands and percentage had attained 100%. This implies that Micro-EVs (class A00) are exponentially losing market share, whereas alternative categories are growing. Another observation is that there is stiff growth of A-class vehicles. Sedans, crossovers as well as small SUVs. This provides a platform for variety and possibility of exportation. This will translate to bigger market prospect home and abroad.

Meanwhile, China has dandy costs over \$5,000 per piece, there will be a 27 percent traditions obligation exacted in case they are for commercial use[44]. If i purport them for individual utilization only, I will be charged 2.9 percent. From my understanding, the essential and best way (imho) is through China, at the harbor of Tianjin as your vehicle will be containerized and transported through prepare to the Mongolian border [45]. Once the vehicle arrives, it'll at that point once more be placed in Mongolian carriers since of variation of track measure between China and Mongolia. The car will at that point arrive to Ulaanbaatar be beyond any doubt, typically costly, a traditions specialist will have to be held moreover, the exporter will buy their shipping holder not beneficial to send them back to China. The charges depend on the age and motor measure of your vehicle. Vehicles less than 3 a long time ancient are saddled lower than vehicles 3 to 10 a long time ancient. Vehicles more seasoned than 10 years are incredibly burdened. There's moreover a scale for motor capacity.

The reason i chose car out of many is in case somebody needs to do trade in Mongolia, in case you arrange to offer dress, which is cheap, you'll sell successfully, in the event that it's not cheap, you may



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be come up short. Since 70% of the population is considered as a destitute, but destitute implies individuals has car at slightest, Mongolians prefer cars to flats, lot of individuals lease flats than buying since buying apartments are so costly, Mongolia is exceptionally youthful nation. There's a saying from the communist time that "mold ends in Mongolia". Presently, as times have changed, so have people's utilization. Be that as it may, in truth, all sorts of businesses that have as of now been pushed out of the world advertise on the opposite, prosper in Mongolia. It would not be enough to mention each of them. I would like to say here that Mongolia is the goal for cars that have as of now concluded their service life and are constrained out of use and thrown into landfills. You can't fault the individuals who don't make them possess cars, but need to claim a cheap, fuel-efficient ride. But this crave of our own isn't turning our nation into the foremost perilous press dump.

At one time, one of the concerns of the Japanese government was the transfer of ancient cars in landfills. Of course, for the country, which incorporates a little area equal to one-fourth of the full range of Mongolian territory, the issue has been very serious. Now, the problem has been illuminated, and the Japanese have solved the over issue to a little degree, with the development of countries willing to purchase ancient cars that are nearly no place to be dumped. Not to specify, Mongolia is the most agent of "waste" buyers. Our people are more interested in Toyota Prius because it is cheap, expends less fuel, and begins rapidly in winter. Therefore, one out of each three cars on the capital's streets may be a Prius, and 20,000 Prius were imported final year alone. This is equal to 52.5 percent of the whole car imports of our country. Not as it were that it doesn't matter how numerous a long time it has been utilized in Japan and Korea. But it is no mystery that the length of time it has been in Mongolia is a degree of how ancient or modern the car is. The same old cars proceed to utilize the roads and emanate poisonous vapor in a nation that's the pioneer in discuss pollution in Asia. After a couple of years, when the cover stops working, there is moreover a system of dismantling and offering it.

The dismissal of Japanese and Koreans is to buy a used car, and if the current car breaks down, they will buy a save portion for another utilized car that works superior. In this way, the point where car save parts and apparatuses are used until there's nothing to buy is turning into Mongolia and how long will this situation last. But there's a way out. Like citizens of other nations, we have the opportunity to buy and use an unused and cheap car with a direct wheel on the correct side according to the rules of the street. In doing so, let's import a new car from our southern neighbor. Rather than bringing in used and scrap cars from Japan, let's get an unused car from a neighbor over the border. The specialists ought to moreover sign an understanding with the government of the nation with which they have close financial relations and decrease their traditions obligations. Wouldn't it be conceivable to utilize an unused and cheaper car when traditional obligations and shipping costs are saved? In general, all the companies that produce spare parts for the world's major car manufacturers are found in China. In expansion, they are also creating high-quality and appealing metal bars in-house. But we ought to see this as an opportunity. Nowadays, it is very difficult to oversee your work life without a car. Well, on the off chance that open transport was as well created as in other cities of the world, the circumstance would be a small difference. However, it has not, however, created much in our country. In a nation like Mongolia, which has a huge range and a contract area, there is a got to have your claim transportation, but since there is no money related opportunity to buy a modern car, the number of people buying utilized cars



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would not diminish in the future. So, it's questionable whether importing cars from our southern neighbors to push the utilized cars out of the market, or the authorities.

Electric cars particularly address the natural challenges confronted globally in a few ways including, diminished of environmental contamination. Similarly, Chinese electric cars zero tailpipe emissions which makes a difference move forward discuss quality, where discuss contamination is a significant issue [46, 47]. Diminishing reliance on fills through transitioning to electric cars can decrease its reliance on unimproved petroleum items and decrease its carbon impression [35, 48].

Advancement of renewable vitality Electric cars make an opportunity for Mongolia to coordinated more renewable energy sources, like sun and wind power oriented, into its transportation framework.

Maintainable transportation arrangement. Chinese electric cars offer a long-term sustainable transportation arrangement adjusting with worldwide endeavors to combat climate alter and promote green innovation. By and large, the selection of Chinese electric cars in Mongolia can contribute essentially to tending to the country's environmental challenges and promoting a more feasible future. For instance, buying would be from Shenzhen, Guangdong Territory to purchase electric cars and make the contract since buying online for the primary time isn't trustful. The study analyses the current car industry scene, assesses the potential request for electric vehicles, and identifies the challenges and methodologies for effective advertisement infiltration to promote climate change mitigation and related benefits. By examining various variables such as natural concerns, government arrangements, infrastructure readiness, and buyer inclinations, these inquiries about points to supply profitable experiences for businesses looking to lock in within the offering of Chinese electric cars. Presents a promising showcase for electric vehicles because it endeavors to decrease carbon outflows and reliance on fossil powers. With the headway of innovation and the push towards maintainability, there's a growing interest in electric cars around the world. Chinese electric car producers have risen as key players within the worldwide market offering competitive estimating and imaginative arrangements. This study further examined the openings and challenges of selling Chinese electric cars according to previous studies [27, 35, 49].

Therefore, to sum up these investigations first, I will start with the cheapest electric vehicles, the average price of a new EV is just under \$60,000. federal and state tax incentives also affect the final EV. Some of the most popular and affordable electric vehicles include Audi Q4 e-tron: Built on the LD.4 platform, the Q4 e-tron starts at just under \$50,000 with a range of about 265 miles. Chevrolet Bolt and Bolt EUV: Priced under \$30,000, the Bolt EV and Electric Utility Vehicle (EUV) achieve a range of over 240 miles. Hyundai Kona Electric: Sales of this 258-mile EV are limited to 12 states, with prices starting at \$33,000. Whereas Kia Niro EV: Priced at nearly \$40,000, Niro EV claims a range of 250 miles. Presently let's jump into trade thoughts in Mongolia, there have been changes in terms general control. It previously required a long time to begin a trade or open a bank account, but the Mongolian government realized that to create a country they require a part of foreign trade benefits like cash and employment opportunities among others.



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This had previously rendered the economy referred as one of the slightest controlled nations among the Asian countries. There are as it were three businesses that are controlled in Mongolia including mining, media, and banking. Mining, of course, requires direction since there is need to prepare, but other than that there's nearly no direction. On a bright note, they've made it amazingly simple for foreigners to go there and do commerce, open a bank account, or form a company. In a nutshell, there's bounty of opportunities and little control, but assessment could be a little of a concern.

There is another further discussion on outside financial specialists into Mongolia. It is clearly made open that Mongolia unquestionably needs to pull in outside speculators on how Mongolia treats foreign investments. From the specialists who've been on the ground in Mongolia, it shows up that foreign financial specialists are pretty welcome within the nation. The Mongolian government isn't likely to take advantage of a foreigner's bank account with a nation this is little and with a small population on the off chance that they take advantage of through the universal media which the economy continues to manage well. There's a recognition potential within the government and among the individuals like what happened to the economy previously in 2012 which tempted upset of remote financial specialists. And presently it's exceptionally vital for them to pull them back in. The truth of the matter is, I'm not beyond any doubt in case they scare them off. The financial specialists who were mining speculators in worldwide product prices caused those mining companies to lose capital for themselves thus remote speculation dropped off. But in case you examined any article coming out, they made a botch and scared off remote speculators which are doing everything they can to undertake and win their certainty once more. Each mining company in the world is troubled, each economy that has mining as a bigger portion of their financial adjacent to endure nowadays and has been so since 2012. Indeed, the unused government's message to the world is that they're the business-friendly, mining-friendly government. Further still, apriority should be directed to attracting back foreign venture. Therefore, affect the sort of businesses that would do well in Mongolia. However, the reality doesn't have anything to do with Mongolia. Instep wise, inquiry to address, "What can be done?" What are you great at, what have been done in the past effectively? This is targeted to measure the abilities and potential of what you've got to offer are a good fit.

CONCLUSION AND RECOMMENDATIONS

Although it is small consumer coverage, request is bound to extend throughout the global economies. With the growing three million population in various nations that scarcely scratch the surface of the three trillion dollars' worth of its demonstrated savings, there's a great opportunity that every single one of these three million people might be tycoons or extremely rich people. For example, the numbers of the extravagance brands are doing well in market stores like Brands like Zegna, Armani and Gucci are flying off the racks. There's going to be a little, very wealthy buyer showcase there. That's progressing to be an extraordinary put to take an interest but not within the extravagant trade. This can also be same for electric vehicle markets globally thus mitigating climate change and promoting environmental sustainability.



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Anything else that anyone else within the world needs, proceedings to build up riches, they're reaching to needy few. The advantage isn't the difference of a few openings; everything is an opportunity with as it were three million people in fresh popular government. Coffee shops, burger joints, KFC, pizza shops and more are as of now popping up all over the worldwide. If you do something modern or different, it's fair like Los Angeles where everybody flocks to the most recent, most prominent thing. It's all about attempting to hang on to those customers.

In short, a venture is a resource purchased by an individual or organization based on the desire of future profit. Stocks and real bequest are both shapes of investment. Contribution is an endeavor to trade one's assets that is cash and credit for resources in stocks as well as genuine domain for future benefits. For illustration, a speculator may purchase a stock with the desire that the cost will rise or get profits within the future. An understudy can invest in a university education to begin working in a career of their choice. In the end Individuals regularly think of contributing in terms of cash, but you'll also invest your time and vitality. You'll encounter misfortune on your investment when the esteem of the resource you purchased falls or other benefits in form of rental wage from the speculation property do not meet expectations.

Marketing Mix and segmentation, targeting, and positioning. The aim of this study report is to identify drivers and barriers as well as to look at opportunities and challenges of introducing and selling and electric vehicles toward climate change mitigation and environmental sustainability. These three basic steps determine how marketers can identify the right customers, serve them the right messaging, and feed them with appropriate information they need for successful targeting. The effect of greenhouse gas emissions from fuel vehicles phases out have a long-term goal of achieving completely emission-free automobiles. Previous studies have shown that emissions initiatives like cap and trade, carbon pricing under carbon markets programs in the order of magnitude like the environmental impact from the automobiles.

Therefore, getting investment from not only for example Mongolian but to other foreign countries and companies is very challenging however, attempting to begin an e-commerce will be the best alternative. Recently, most importantly, utilizing all-social media accounts to pull in customers. The highest level of utilization of the Facebook platform within the world. Since eight-year-olds to 80-year-olds have Facebook accounts, there are numerous trade approaches to using the network in addition to media. Therefore, posting on social platforms like Facebook bunches to pull in more individuals and arrange with influencers will promote trade commerce. In many places including Mongolia, there is less outcry of the individuals in utilizing Facebook, Instagram and YouTube.

These platforms will aid circulating and cross-promote your social media profiles, Utilize a substance calendar and schedule of posts, leverage patterns that relate to your audience, develop a stylish social media, embrace user-generated substance, Utilize social media as a form of customer benefit as well as work with micro-influencers. Finally, the best way to urge speculation is to Participate Apprentice tv show across the globe in 2025. The Disciple show is the biggest entryway of opportunity to urge venture not only that company but moreover be well known and other companies or people can work with me



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or can be a partner for each other. This show has part of gathering of people so at slightest if I take part, I can be well known.

Theoretical implications. There are various ventures from the other nations particularly from USA and other countries but creating showcase and gigantic mineral resources are seen as a beneficial opportunity for financial specialists, but powerlessness to outside financial and monetary stuns and the ineffectiveness of the debate determination handle requires stakeholders to yield their opinions to the authoritative prepare. Constrained opportunities lead to caution this limiting the progress of electric vehicle business. There are few deterrents forced by the government on offering goods in the showcase and investors enjoy unhindered get to the advertisement, except for a couple of confinements related to speculation world over.

Research limitations. Although the study was successful, Lack of system limits and data, as well as uncertain emission factors and method choices. This means that there is great uncertainty associated with direct and especially indirect emissions during the non-electric vehicles. To sum up, In Mongolia, Investment isn't that common extraordinarily great companies don't venture in at individual level however gratefully the government investment in the infrastructure towards to the community involvement and participation and moreover consumption behaviors appear to contribute to individuals as well.

ACKNOWLEDGEMENTS

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AUTHORS' CONTRIBUTIONS

Concept and design of the manuscript, acquisition of data, and manuscript write up were done by Innocent Tayari Mwizerwa and critically revised the manuscript for important technical content and findings of this work



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EFFECT OF MIXING ENERGY ON VARIOUS FRESHLY DEVELOPED MICROCARRIERS

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ABSTRACT

In the development of biological wastewater cleaning moving bed biofilm reactors (MBBR) are one of the most efficient ways to remove pollutants from water. To have MBBR cleaning technology a biofilm carrying media required. Their key parameter is specific surface area (SSA), which is the available space for biofilm to develop colonies. The colonization rate and speed depend on many factors, such as microorganism type, nutrient forms and availability, temperature and flow velocity around the media. Traditional carriers have a massive, rigid construct, which is durable in almost any mixing condition applied in wastewater cleaning, however significantly smaller microcarriers are a different topic.

With laboratory scale experiments we measured different types of carriers under various mixing conditions to analyze if any harm to the structure of the media. We also studied hydrogels freshly after production and hydrogels that have been in use to determine if any activities change their size range. Calculations to determine the flow speeds around the carrier can predict their ability to be colonized by various types of microorganisms. In conclusion all types of media can endure heavy mixing in laboratory scale, however freshly produced media shows a small degradation in diameter, which can be caused by sticking together during production.

Keywords: MBBR, microcarrier, PVA based media, wastewater treatment, shear stress

INTRODUCTION

In the wastewater treatment industry one of the most common cleaning methods is to have anaerob/anox/aerob (A₂O) biological reactors after physical pretreatment. Mostly flocs used in them, which consist of cleaning bacteria, substrates, organic and other inorganic parts (Rieger et al 2012). In modern treatments moving bed biofilm reactor (MBBR) are more efficient, as they include



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microorganisms carrying medias, which can be made from HDPE, PE PP (Barwal & Chaudhary, 2014) but also PVA is one of the best materials for media (Al-Amshawee et al, 2020).

The size and the shape of the carriers also affect the properties of the biofilm over their surface. In Bjornberg et al's (2009) study they experienced with media that has inner and outer parts, and their results shows that in the inner circles the biofilm thickness reached up to 300 μm , while on the outer areas the biofilm were absent, but reached close to zero average thickness. However, Torresi et al (2016) suggests that biofilm thickness should not be above 200 μm to maximize the nitrifying activity. They used a special AnoxKaldness[®] media that controls the biofilm thickness by its shape and structure.

Either technology is used, the biofilm or microorganisms' colonies greatly affected by the shear forces, the flow velocities in the biological reactor. To determine their affect Xinyan et al (2013) used velocity gradient to calculate the shear stress of microorganisms. Their calculations include the tank volume, solution viscosity, impellers constant at turbulent flow, rotational speed and impeller diameter. Di Iaconi et al (2005) modified the original formula of shear stress calculation to modell the carrier shape resistance (surface friction). They showed high positive correlation between shear forces and biofilm mass, which is due to the shelter behaviour (Tijhuis et al, 1995), that means greater shear stress makes the biofilm thickness, denser. Rittman (1982) showed that weak shear forces lead to weaker organic structure, Liu&Tai (2002) had similar results, however they also showed that shear forces have great effect not only on biomass density, but any metabolic activities.

MATERIAL/METHODS

At the first experiment we tested the carriers with different mixing conditions, to see if anything happens with the carriers during the biological tests, that's not because of the mixing conditions. The experiment was taken in a 5-litre reactor with 180-220-330 RPM.

Secondly, we examined the shear stress' effect on different microorganisms with 6 reactors with the following setup:

Table1: experimental setup

Number	Culture	RPM
1	heterotroph	180
2	heterotroph	220
3	heterotroph	330
4	autotroph	180
5	autotroph	220
6	autotroph	330

Each reactor setup consists of 500ml PVA based microcarrier, 4l of artificial wastewater (according to the need of microorganism's type) and 500ml of sludge which were stirred to cell fractions and filtered.



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Each cycle lasted 6hrs with 5h 45min. of aeration and mixing, 10 min of settling and 5 min of water change. One water change was 2 each.

To determine forces affecting the particles in any system the following formula required:

$$F_{shear} = \tau * A$$

where:

τ is shear stress,

A is the surface of the particle.

This equation shows the amount of force on each particle in a stirred aqueous system. The surface can be calculated from the diameter of the media. But we also need to determine the shear stress in the system, which is given by this equation:

$$\tau = \eta * \gamma$$

where:

η is the fluids viscosity,

γ is the shear rate. (autmix.com)

The experiments carried out in water, around room temperature, so the viscosity is mPas, and for calculating shear rate we used the formula:

$$\gamma = \frac{N}{D}$$

where:

N is the number of rounds per second of the impeller,

D is the diameter of impeller. (Huda, 2021)

$$V = \sqrt{\frac{2 * \tau}{C_d * \rho_f}}$$

MSZ ISO 6060 (COD), MSZ 1484-13:2009 (nitrate-nitrogen, nitrite-nitrogen), MSZ ISO 7150-1:1992 (Ammonium-nitrogen), MSZ 448-18:1977 (phosphate-phosphorous) standards were used during the laboratory measurements. pH, dissolved oxygen, and temperature were measured on-site using a Hach HQ40 portable multimeter.

The diameter of carriers and the growth of biofilm were monitored via light microscopic analysis. The samples were TTC (triphenyl tetrazolium chloride) coloured and taken 30 pictures for statistical analysis.



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RESULTS

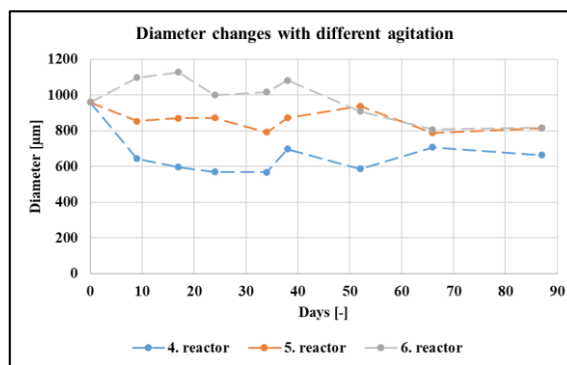
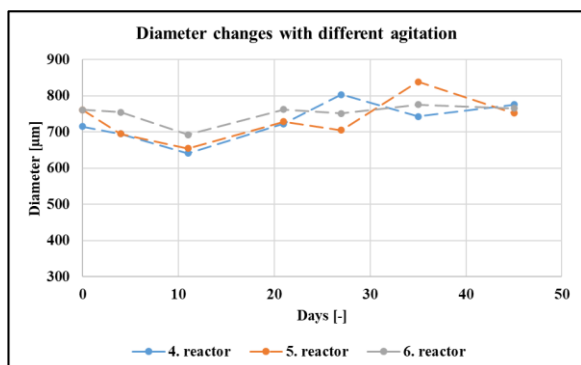
First, we calculated the velocities and shear forces in each reactor using the formulas above. The results can be seen in **Table 2**.

Table 2: The shear forces and flow velocities in different experiments

Reactors number	Organism type	Shear force [μN]	Flow velocity [cm/s]	Carrier producing method
1	Heterotroph	0,16	1,98	Warm polymerisation
2		0,11	1,62	
3		0,09	1,46	
4	Autotroph	0,16	1,98	
5		0,11	1,62	
6		0,09	1,46	
1	-	0,16	1,98	Cold polymerisation
2		0,11	1,62	
3		0,09	1,46	
4		0,16	1,98	Warm polymerisation
5		0,11	1,62	
6		0,09	1,46	

Table 2. we can see that in each different reactor the shear force can be measured in micronewton, which force represents the shear stress to each individual carrier. Flow velocity shows us how fast are the particles in the system which correlates with the shear stress.

To determine if the mentioned shear forces have effects on our freshly developed carriers we made control reactors, that has no major biological activities. It shows us the effect of different mixing conditions on the medias physical properties (size). The results can be seen in **figure 1-2**.





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Figure 1 – Diameter changes of warm polymerized media

Figure2. – Diameter changes of cold polymerized media

In Figure xx. the experiments with warm polymerized media can be seen. It shows no major differences between the reactors and shows no changes during our 45 days of experiment. The minor differences may be the measurements known margin of errors. However cold polymerized media show differences in the first 40 days between the reactors. The 4. reactor with highest shear force shows the smallest media size, and 6. reactor has the largest. After day 40 we increased the mixers RPM values up to 400 RPM (initially it was 330; 220 and 180). With increased shear forces 5. and 6. reactors average diameter size decreased to the level of 4. reactor, which did not show any size decrease. With the experiences during the microscopic we can conclude to the fact that the medias were stucked together after the polymerisation process by relatively strong but only physical bonding, that fall apart with the increasing shear forces. But with even 20% increased shear stress the media did not have any decrease in their actual structure.

After testing the medias physical properties, we tested their ability to be colonised by different types of microorganisms. In **figure 3-4.** we can observe the in and effluent of the heterotroph reactors COD values with cold polymerized media.

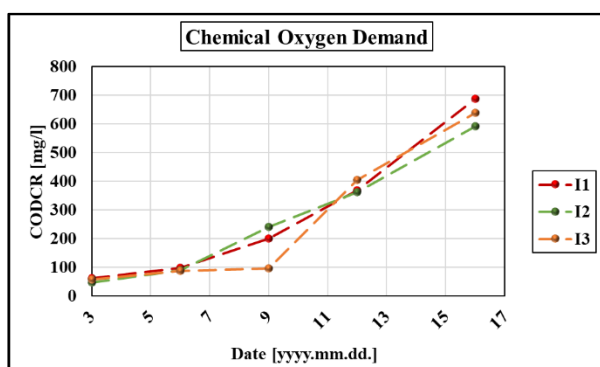


Figure3. – Influent COD values of heterotroph reactors

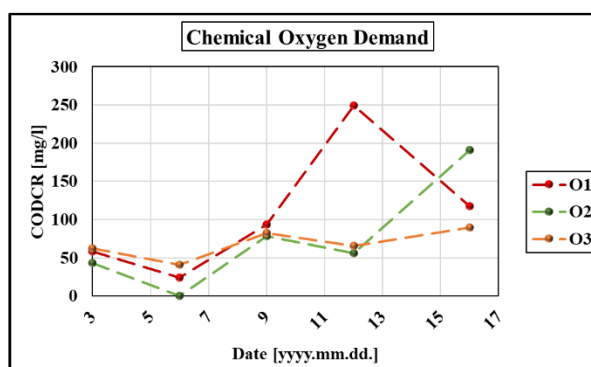


Figure4- – Effluent COD values of heterotroph reactors

We can see that during the experiments we increased the influent values from 50 mg/l up to 650 mg/l values, which is close to the COD concentration in municipal wastewater. We can conclude from Figure xx. that 1. reactor adapted a little slower to the increasing OLR (organic loading rate), but overall, the reactors show small differences in their cleaning efficiency. We also measured one full cycle to determine the metabolism speed of different cultures in the reactors (**Figure 5**). The we doubled the OLR to see how fast they can adapt to the sudden increase of COD values (**Figure 6**).



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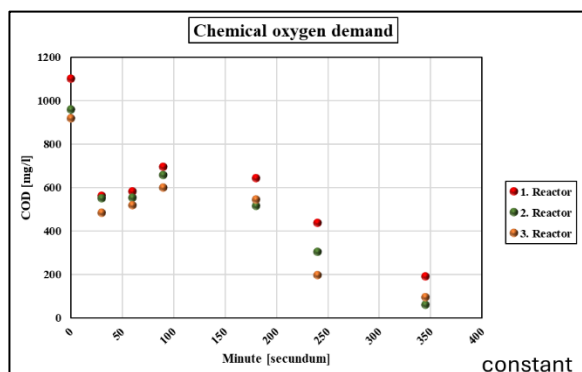


Figure 5. – Full cycle of heterotrophs

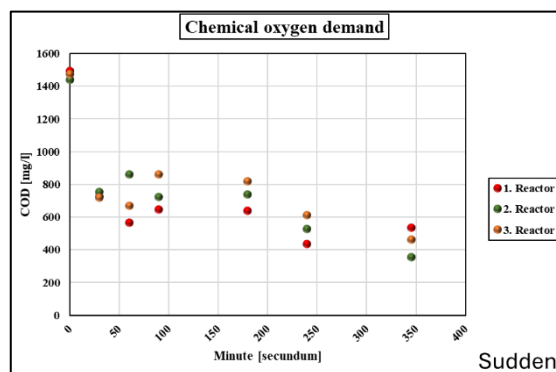


Figure 6. – Full cycle of sudden OLR increase of heterotrophs

We can see that in the first 100 minutes the COD values decreased to the half of the initial amount, after that a smaller decrease occurred. With increased OLR the heterotrophs significantly increased their metabolism, as in the first 100 minutes they degraded 800 mg/l of OLR. However, after that their metabolism slowed, and at the end of the cycle they could not get lower concentrations than 400 mg/l. The experiments show no significant differences between the reactors, all have great COD removal rate, and shows rapid adaptation to increased OLR.

In the 4-6. reactors we experimented with autotroph cultures, both with *Nitrosomonas* and *Nitrobacter*. In Figure 7-9. we show the nitrogen forms in the effluent.

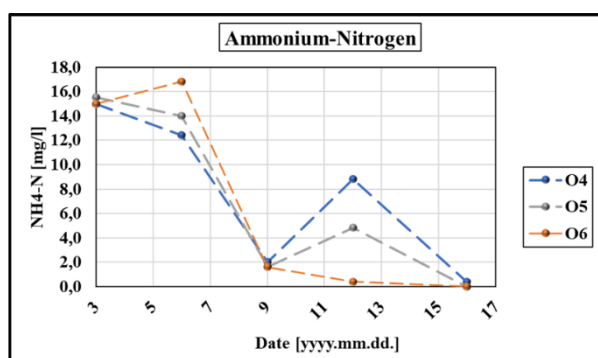


Figure 7. – Ammonium-nitrogen values of autotrophs

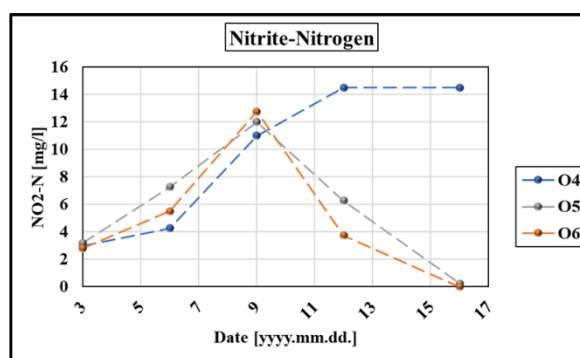


Figure 8. – Nitrite-nitrogen values of autotrophs



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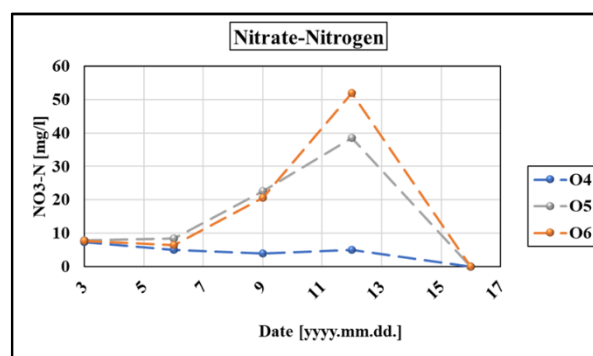


Figure 9. – Nitrate values of autotrophs

We can see that ammonium-nitrogen values decreased over time as biofilm began to develop. First few days 6. reactor shows slower progress, but after that it has highest *Nitrosomonas* activity. As ammonium began to decrease nitrite-nitrogen began to increase, however from day 9 *Nitrobacter* cultures developed in 5. and 6. reactor, so nitrate-nitrogen appeared, and nitrite-nitrogen decreased. However, in 4. reactor *Nitrobacter* cultures were handicapped due to the too high shear stress. We measured the same two cycles as at heterotrophs, one with constant loading rate and after increasing the influents ammonium concentration (Figure 10-15.)

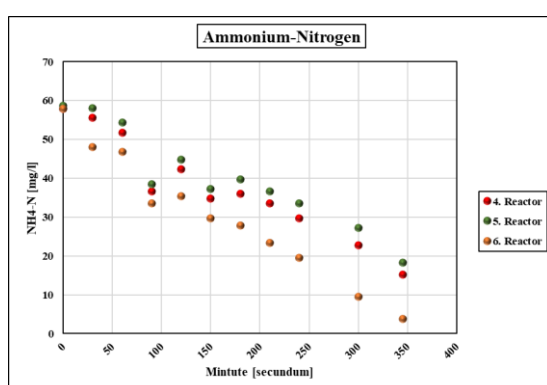


Figure 10 – Ammonium-nitrogen at constant cycle

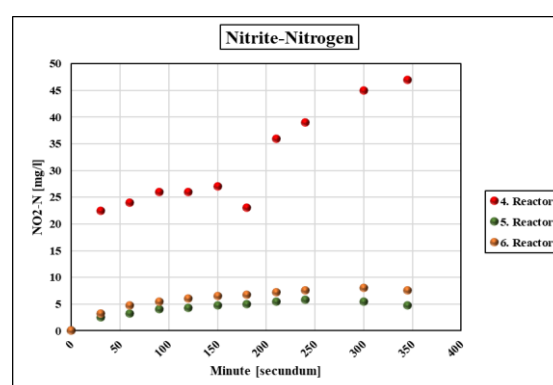


Figure 11. – Nitrite-nitrogen at constant cycle



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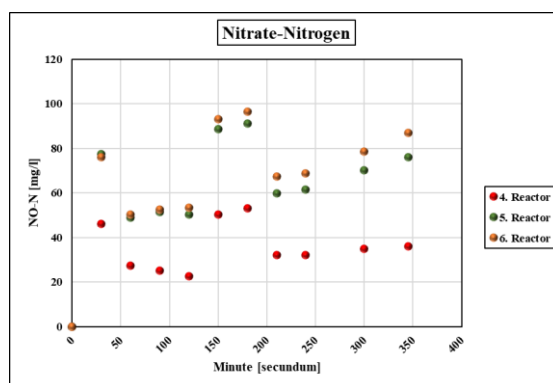


Figure 12. – Nitrate-nitrogen at constant cycle

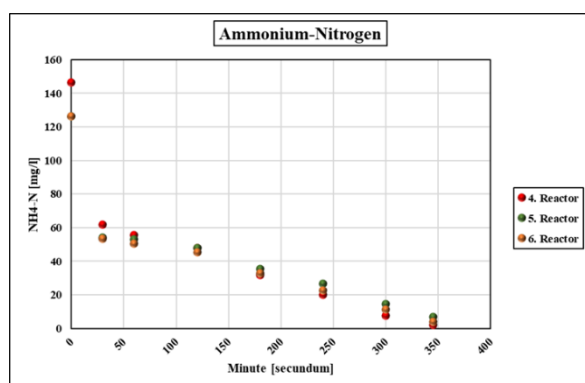


Figure 13. – Ammonium-nitrogen at sudden cycle

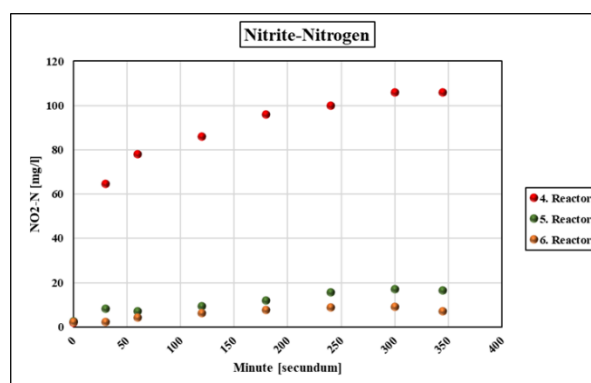


Figure 14. – Nitrite-nitrogen at sudden cycle

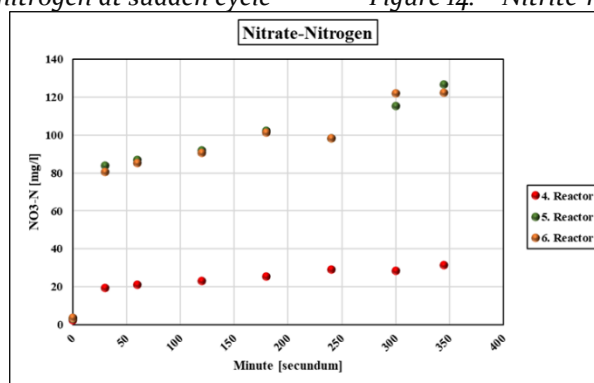


Figure 15. – Nitrate-nitrogen at constant cycle

reactor is handy capped both cycles in terms of turning nitrite into nitrate, however this reactor has slightly better *Nitrosomonas* activity, than 5. reactor. It produces nitrate; however, it stays almost constant with small increase. When sudden ammonium load occurs, 4. reactor show even smaller *Nitrosomonas* activity, their values remain under 40 mg/l, however its *Nitrobacter* cultures are able to



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degrade the whole ammonium influent concentration. The other two reactor (5. and 6.) shows slight decreased *Nitrobacter* activity as in constant load. However, they also removed all of the initial ammonium concentration, which is impressive considering we doubled the loading rate from a relatively high (60 mg/l to 120 mg/l) starting point.

CONCLUSION

We made many different experiments to determine the capacity of our freshly developed carriers both in terms of microorganisms carrying capacity and durability and resistance against shear forces. We found that both warm and cold polymerised medias are able to stand various shear forces without any decrease in size. After the producing method cold medias are likely to stick together, for detachment relatively strong shear forces are required.

Both autotroph and heterotroph cultures are able to colonize the warm polymerised medias. Heterotrophs show almost no decrease due to any shear stress, and their COD removal rate are outstanding even with sudden OLR increases. While autotroph organisms can colonise well the medias, they shows decrease in their activity due to shear stress. With increased shear stress *Nitrobacter* activities tend to show a significant amount of decrease even with constant loading rates. *Nitrosomonas* activity however shows almost no decrease and also have an impressive ability to remove ammonium from inlet water even with doubled loading rates.

ACKNOWLEDGEMENT

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GRAPHICAL, STATISTICAL AND INDEX-BASED TECHNIQUES INTEGRATED FOR IDENTIFYING THE HYDROCHEMICAL FINGERPRINTS AND GROUNDWATER QUALITY OF IN SALAH ALGERIAN SAHARA

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ABSTRACT

Groundwater, a predominant reservoir freshwater, plays a critical role in providing a sustainable potable water and water for agricultural and industry uses in the In Salah desert region of Algeria. This research collected 82 underground water samples from Albian aquifers to assess water quality and identify hydrogeochemical processes influencing mineralization. To achieve this objective, various methods were employed to evaluate water quality based on its intended uses. The drinking water quality index utilized revealed the water potability status, while the indicators of irrigation potability were employed to evaluate its quality for agricultural purposes. The findings of this study revealed that the groundwater quality for consumption fell into four categories: good (2.44%), fair (29.27%), poor (65.85%), and non-potable (2.44%). Concerning agricultural irrigation, the indexical results indicated that 15.85% of the waters exhibited adequate quality, while 84.15% were questionable for irrigation. Calculations based on various corrosion and scaling evaluation indices showed that most wells were prone to corrosion, with a tendency for calcium bicarbonate deposit formation. Furthermore, the hydrochemical study identified three water types: Na-Cl (53.66%), Ca-Mg-Cl (37.80%), and Ca-Cl (8.54%) waters. Analyses of correlation matrices, R-type clustering, factor loadings, Gibbs diagrams, scatterplots, and chloro-alkaline indices highlighted that the chemistry of the Albian groundwater is fundamentally impacted by several processes such as silicate weathering, evaporite dissolution,



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ionic exchange, and anthropogenic inputs, that played impactful role in the aquifer's water chemistry.

Keywords: Geospatial map, Groundwater composition, Graphical plotting, In Salah Multivariate statistics Water quality evaluation.

INTRODUCTION

For many years, residents of the Sahara have relied on groundwater for drinking water and irrigation of palm groves. The Continental Intercalary aquifer in In Salah has been over exploited through wells. However, substantial population growth has led to an increased demand for water in the region, resulting in a proliferation of boreholes. This expansion has led to a decrease in piezometric levels and a deterioration in water quality, caused by human activities and climate change.

MATERIALS AND METHODS

Study area

The study area is located in the In Salah region, situated in the southern part of Algeria, in the central Sahara and delimited by the border. l'Algérie, située dans le Sahara central et délimitée parpar les coordonnées UTM: latitude nord de 27°0'00"à 27°0'00" N et longitude est de 2°0'00" à3°0'00" E.

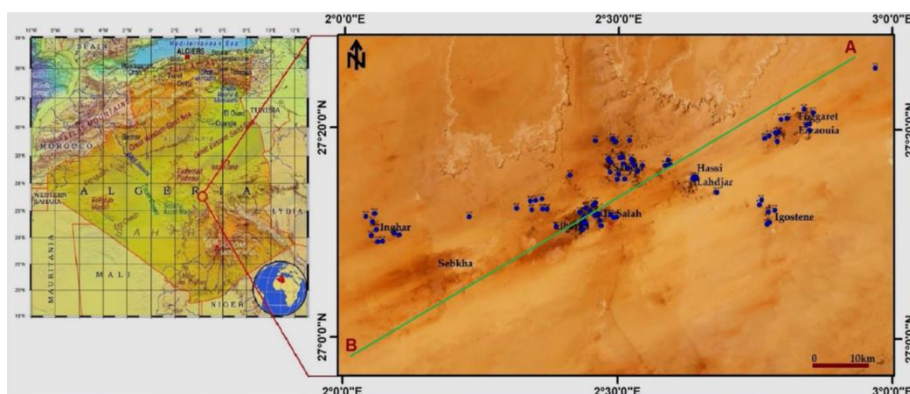


Fig1. Situation map and inventory of water samples analyzed.

Water quality index Method (WQI)

$$WQI = Sli = Wiqi = wini = 1wi * CiSi * 100 \text{ (Eq. 1)}$$

$$Wi = qi / ni = 1qi \text{ (Eq. 2)}$$

Ci: parameter concentration measured in the laboratory



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Si: guide value set by WHO (2017). (Tab. 2)

wi: parameter weight

qi: parameter notation (Tab. 2)

Wi: relative weight, (equation 2)

Sli: the sub-index of parameter i.

The results obtained for the water quality index (WQI) were classified into five water quality categories (Touahri et al. 2022; Bouselsal and Saibi 2022): excellent (<50), good (50 to 100), poor (100 to 200), very poor (200 to 300) and unfit for consumption (>300).

Tab.1 Parameter weights used to calculate WQI

Paramètres	(qi)	(Si)	Wi
Ph	4	8.5	0.114
CE	4	1000	0.114
TDS	5	500	0.114
Ca	2	75	0.057
Mg	1	50	0.028
Na	2	200	0.057
K	2	12	0.057
Cl	3	250	0.085
HCO ₃	3	300	0.085
SO ₄	4	250	0.114
NO ₃	5	45	0.114
Total	35	-	1

RESULTS AND DISCUSSION



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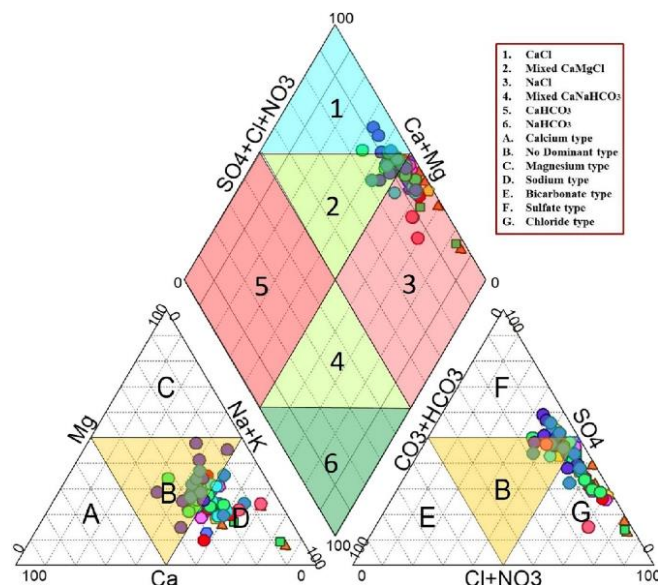


Fig.2 Piper diagram showing water types in the Albien

Suitability of water for human consumption

In the In Salah region, groundwater quality index values for the Albien 15.85% of samples fell into the "good" category quality, while 84.15% were classified as of "doubtful".

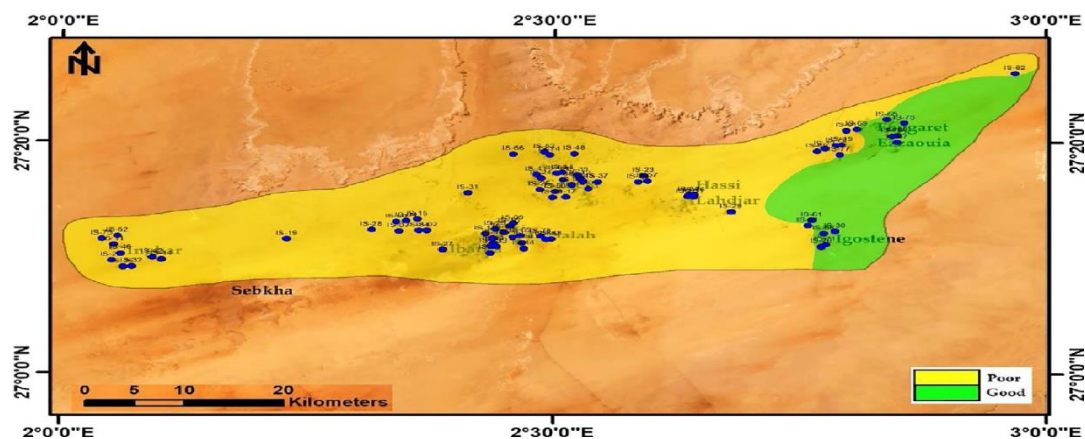


Fig. 3 Map of the variation of the water quality index (DWQI)

Interpretation

Many of these waters show high concentrations of minerals, exceeding World Health Organization standards, the groundwater mineralization in the Albien geological formation in the In Salah region is



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mainly due to evaporation processes mainly due to evaporation processes and interactions between interactions between water and rock, underlining the need for treatment before consumption.

CONCLUSION

These results highlight the implications of anthropogenic activities and climatic variations in groundwater quality. This study highlights the need for rigorous management and continuous monitoring of the aquifer to secure drinking water supplies in this strategic but vulnerable region.

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CHARACTERIZATION OF COPPER OXIDE–JATROPHA OIL NANOFLUID AS A SECONDARY REFRIGERANT

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ABSTRACT

Nanofluid is a new fluid with special characteristics that can be used in various industrial heat transfer applications. The nanofluid was created using the two-step approach of dispersing nanoparticles into Jatropa oil. The experiments were conducted for four samples of mixture nanofluid at four different volume concentrations of 0.5%, 1.0%, 1.5%, and 2%. The nanoparticles were characterized by X-ray diffractometric analysis, X-ray fluorescence spectroscopy, and scanning electron microscopy. The greatest increase in thermal conductivity for CuO–Jatropa oil nanofluids was made possible by 0.5%, 1.0%, 1.5%, and 2% mixture was 4.5%, 6.01%, 7.6, and 9.1%. The study observed that a mixture achieved the highest thermal conductivity for nanofluid at 2%. At a mixture of 0.5%, the lowest value of thermal conductivity within the range under consideration, a “deeding” effect was seen. To determine the thermal conductivity of CuO–Jatropa oil nanofluids based on temperature, volume concentration, and nanoparticle mixture volume concentrations, the study suggested and compared four sample models. The effect of nanoparticles on the rise of thermal conductivity and viscosity was investigated at temperatures ranging from 298 to 323 K. The X-ray diffractometer is used to characterize nanoparticles. Viscosity and thermal conductivity have been tested in the lab. The findings show that the copper oxide nanoparticles improved the base fluid’s thermophysical abilities more than Jatropa oil alone. For the evaluation of the thermal conductivity and viscosity of nanofluid, new empirical correlations were presented based on experimental data. The thermal conductivity of the nanofluids increases as the temperature rises, while the viscosity of the nanofluids decreases.



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INTRODUCTION

Secondary refrigerant is a sustainable solution for reducing main refrigerant leakage in low temperature multievapora for cooling applications such as hypermarkets. The use of a secondary loop refrigeration system, as shown in Figure 1, has two advantages: it saves primary refrigerant and prevents leakage [1–3]. Jatropa oil and copper oxide nanofluids have been utilized as secondary refrigerants for a long time [4]. The solutions' antifreeze temperature has been set at -20°C , which allows for fixed primary refrigerant reduction. Using traditional solution-based nanofluids can improve heat transmission even more [5, 6]. Recent numerical and experimental investigations have demonstrated that the use of nanofluids secondary working fluids — coolant on the condenser side and secondary refrigerant on the evaporator side — could improve the heat transfer properties and performance of the refrigeration [7]. Jatropa oil with copper oxide has also recently attracted interest due to its improved ability to transport heat. Both nanoparticle types in this nanofluid share similar properties, which improve heat exchanger efficiency and working fluid performance; in order to improve the performance of air conditioning systems, refrigeration, and heat pumps, nano- fluids can take on three different forms: (a) nanorefrigerants, (b) nanolubricants, and (c) secondary refrigerants for coolant and evaporator sections for heat-release unit in the system of refrigeration. The excellent type of refrigerant known as nano-refrigerant contains suspended and long-term dispersed nano- particles of nanofluids for heat transfer applications. Having particles in a base fluid was first Proposed. To improve the fluid's thermo physical properties, micrometer—and millimeter-sized particles were included in the base fluid. But despite everything, this cate- gory of liquids has faced some notable challenges because of problems like erosion, stability, and clogging [8]. This paper presented a different concept of adding nanoparticles to the base fluids, which were later known as nanofluids, as a result of the development of nanotechnology [9]. It is necessary to improve nanofluids to improve the heat transfer capabilities of various heat-transfer fluids. Due to the greater thermal conductivity of nanoparticles; nano-refrigerant has the potential to improve the thermal characteristics of refrigeration systems [10]. The use of nano-refrigerants in residential refrigeration has been linked to some fundamental benefits [11]. The first benefit of using nanoparticles is that it could improve the miscibility of the refrigerant and lubricant. Second, nanoparticles are successful in enhancing a refrigerant's thermal conductivity and heat-transfer behaviors. Finally, compared with traditional refrigerants, nanorefrigerants showed a decrease in wear rate and friction coefficient. The heat-transfer efficiency of refrigeration processes could be improved by adding nano- particles to old refrigerants. To assess the effectiveness of nanorefrigerants, consideration must be given to their thermophysical appearances [12]. Density, surface tension, Specific heat, thermal conductivity, latent heat, and viscosity are all important thermal and physical properties of fluids [13]. In the past, there have been many studies on the thermal conductivity of nanofluid, and more recently, there have nanorefrigerants [14]. Because convective heat transfer and boiling coefficients are related to fluid thermal conductivity, thermal conductivity is one of thermo physical properties [15]. As a result, thermal conductivity has received a lot of attention recently, and investigations have verified that it increases nonlinearly with temperature. For researchers in this field, the viscosity of nanorefrigerants is crucial. Typically, adding nanoparticles to a refrigerant would increase



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its viscosity, which would increase the pressure drop across the flow [16]. Although viscosity increased and pressure decreased, the improved heat transfers capability and thermal conductivity pre-dominate [17]. Even though gains in heat transfer and thermal conductivity of nanorefrigerants looked to be substantially greater than improvements in viscosity, it is critical to quantify the viscosity deviations related to the integration of nano- particles into base fluid [18]. Since all the solutions have an antifreeze temperature, the principal refrigerant ammonia (R717) can be reduced at a temperature of -20°C . Other solution-based nanofluids can be used to further improve heat transmission. Recent numerical and experimental investigations have shown that the performance and heat- transfer characteristics of a vapor compression refrigeration system can be enhanced by the use of nanofluids as secondary working fluids — coolant on the condenser side and secondary refrigerant on the evaporator side. Jatropa oil and copper oxide nanofluids have recently attracted attention as well to improved heat transfer properties brought on by high potential. Both particle kinds in this kind of nanofluid share their qualities and improve heat exchanger and working fluid performance. For practical application, however, energy and cost studies of system components like the evaporator with new secondary refrigerant are crucial. Figure 1 shows the flow of the primary loop refrigerant, ammonium refrigeration sys- tem, and secondary refrigerant, as shown in the secondary loop, is copper oxide – Jatropa oil nanofluid which flows in opposite diction to the primary refrigerant.

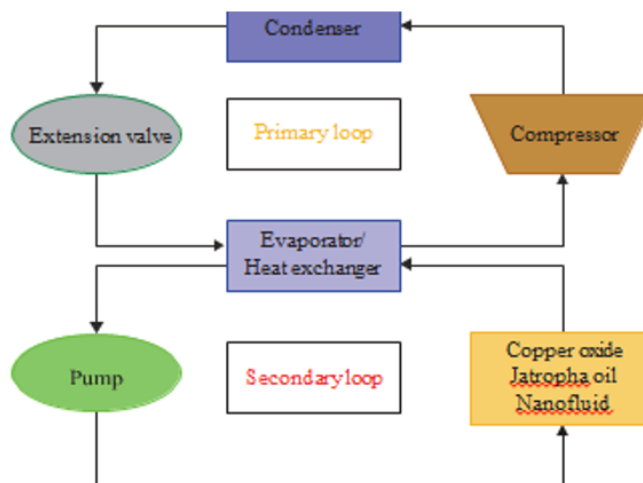


Figure 1: Layout of primary and secondary loop refrigeration system.



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MATERIALS AND METHODS

Nanofluid Preparation.

The four samples of the CuO–Jatropha nanofluids were prepared using the two-step process, which is frequently utilized by different researchers, at varying volume percent concentrations of 0.5%, 1%, 1.5%, and 2% without the use of any surfactant. Table 1 provides comprehensive details on the CuO nanoparticles. It is commonly known that copper oxide nanoparticles, a metal oxide, may disperse well in working fluids. The above Table 2 shows the thermos-physical properties of the Jatropha oil at a temperature of 40°C.

Table 1. Physical properties of copper oxide nanoparticles at 30°C.

Class	P-type	Unit
Shape	Spherical	
Size	30–55	nm
Density	6,310	kg/m ³
Specific heat capacity	32	kJ/kK
Surface area	>10	m ² /g

Table 2: Physical properties of Jatropha oil at 40°C

Properties	Unit	Values
Thermal conductivity	w/mK	0.169
Density	kg/m ³	
Viscosity	mPa/S	32
Specific heat capacity	J/kg K	33.1
pH		



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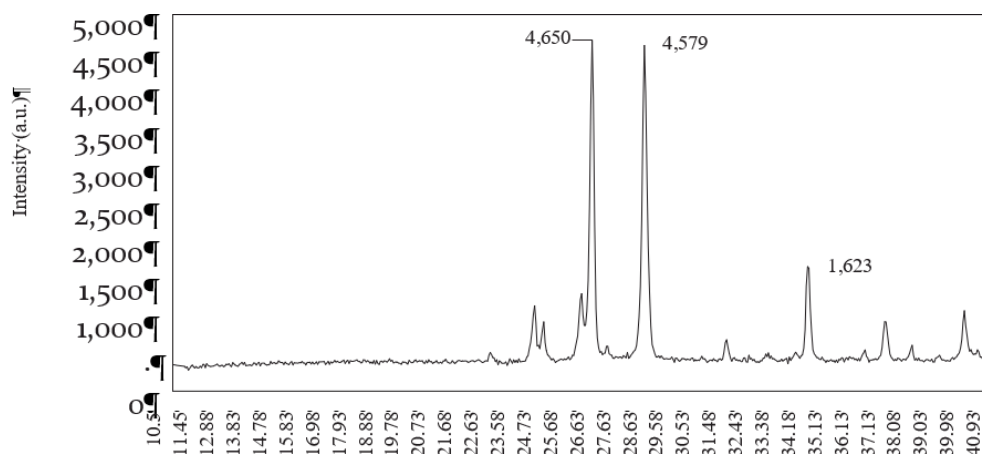


Figure 2: XRD 2θ pattern of copper oxide nanoparticles.

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Characterization of CuO Nanoparticles.

An X-ray diffractometer and a scanning electron microscope have been used to evaluate the particles for structural characterization and crystalline size estimate, and a KD2 Pro thermal analyzer was used to determine the thermal conductivity. The peaks in Figure 2 indicate good copper oxide nanoparticle crystallites. The Debye–Scherer equation determines that the average crystal particle size is 30 nm.

Dynamic Viscosity Measurement

A vibrio-viscometer has been used to calculate the nanofluid’s viscosity. Researchers mostly use this tool to determine the dynamic viscosity of various nanofluids. The instrument has 2% accuracy and 5% repeatability. Its operating temperature range is from 298 to 323 K, and its measurement range is between 0.3 mPa/s and 1,028 mPa/s. Utilizing the specified viscometer, the viscosity of the nanofluid generated for the study at five different concentrations was assessed. Table 3 shows the measurement results value of viscosity with CuO (30 nm) dispersed in the base fluid. They asserted that nanofluid viscosity depends on the base fluid properties. Shown in certain experimental cases that the average size of the nanoparticle’s diameter is 22 nm. The viscosity of nanofluid was affected by increasing



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temperature concentration of the nanoparticles and increased with particle concentration ranging from 0.005 to 0.02 at 298–323 K intervals and the viscosity results of CuO/Jatropha oil nanofluid has been depicted in Table 3 and Figure 3.

Concentration was affirmed at 298 K; the viscosity of base fluid increased from 50.3 mPa/S when the particle loading increased from 0.005 to 0.02 concentrations. The increase in the concentration, the Scherer constant, the X-ray wavelength (1.5404 nm), the peak width, the Bragg's angle, and the average diameter of nanoparticles in nm, respectively. As Figure 2 shows, the X-ray diffract meter plot of copper oxide nanoparticles of the maximum broad peak is observed at $2\theta = 35.8$ which can be attributed to the presence of amorphous copper oxide nanoparticles. Addition of CuO/Jatropha oil nanofluid increased the interactions between the particles and base fluid molecules resulting in nanofluids. The viscosity decreased with an increase in temperature. This may be due to the weakening of intermolecular interaction and a further increase in their molecular spacing. The reductions of nanofluid viscosity for volume concentrations of 0.5%, 1.0%, 1.5%, and 2.0% volume concentration. Critical for learning more about the heat-transfer characteristics of nanorefrigerants [14]. Because convective heat transfer and boiling coefficients are related to fluid thermal conductivity, thermal conductivity is one of a Nano key refrigerant's thermophysical properties [15]. As a result, thermal conductivity has received a lot of attention recently, and investigations have verified that it increases nonlinearly with temperature. For researchers in this field, the viscosity of nanorefrigerants is crucial. Typically, adding nanoparticles to a refrigerant would increase its viscosity, which would increase the pressure drop across the flow [16]. Although viscosity increased and pressure decreased, the improved heat transfer capability and thermal conductivity predominate [17]. Even though gains in heat transfer and thermal conductivity of nanorefrigerants looked to be substantially greater than improvements in viscosity, it is critical to quantify the viscosity deviations related to the integration of nanoparticles into base fluid [18]. Since all of the solutions have an antifreeze temperature, the principal refrigerant ammonia (R717) can be reduced at a temperature of -20°C . Other solution-based nanofluids can be used to further improve heat transmission. Recent numerical and experimental investigations have shown that the performance and heat-transfer characteristics of a vapor compression refrigeration system can be enhanced by the use of nanofluids as secondary working fluids—coolant on the condenser side and secondary refrigerant on the evaporator side. Jatropha oil and copper oxide nanofluids have recently attracted attention as well to improved heat transfer properties brought on by high potential. Both particle kinds in this kind of nanofluid share their qualities and improve heat exchanger and working fluid performance. For practical application, however, energy and cost studies of system components like the evaporator with new secondary refrigerant are crucial. Figure 1 shows the flow of the primary loop refrigerant, ammonium refrigeration system, and secondary refrigerant, as shown in the secondary loop, is copper oxide–Jatropha oil nanofluid which flows in opposite direction to the primary refrigerant.

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RESULTS AND DISCUSSION

Table 2 contains comprehensive data about the KD2 Pro device. It is important to remember that each measurement set was carried out five times, and the mean values were recorded. Additionally, a hot water bath temperature has been used to stabilize the temperature and maintain it at the required temperature for the thermal conductivity measurement.

The experimental results show that the thermal conductivity of CuO/Jatropa oil nanofluids increases as the concentration of the samples increases with increase in temperatures of the value of five prepared samples: the thermal conductivity. Base fluid increase from 0.175 to 0.187 W/m K as particle loading increases to a maximum value of 2.0% volume at 323 K. This phenomenon could be attributed to the high surface area of the solid nanoparticles. Moreover, further augmentation of thermal conductivity was observed as temperature increased from 298 to 323 K. The corresponding increments ranged between 0.175 and 0.187 W/m K for the nanofluid concentration of 2.0% volume. The reason for thermal conductivity enhancement with temperature could be attributed to possible Brownian motion and interactions between the nanoparticles



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Table 4: Experimental thermal Conductivity Measurement calibrated CuO/Jatropha oil

Temperate K	Thermal conductivity				
	Base 0.0%	0.5%	1%	1.5%	2%
298	0.160	0.163	0.165	0.169	0.172
303	0.163	0.164	0.166	0.172	0.176
308	0.166	0.169	0.170	0.174	0.178
313	0.169	0.172	0.181	0.175	0.181
318	0.172	0.175	0.178	0.181	0.184
323	0.175	0.178	0.180	0.184	0.187

–Jatropha oil nanofluid’s thermal conductivity was measured for a variety of samples, including 0.5%, 1%, 1.5%, and 2%. Additionally, measurements of viscosity and thermal conductivity were made at six different temperatures (298, 303, 308, 313, 318, and 323 K) and four different volume concentrations (0.5%, 1%, 1.5%, and 2%). Theoretically, as the temperature rises within the study’s temperature range, thermal conductivity should rise as well. The CuO nano- fluids’ 9% thermal improvement at 2% volume concentrations and 323 K temperature were the highest recorded. The five samples were plotted from the data present in Table 5, which is also depicted in Figure 5. The studied result shows as the concentration of CuO increases, the thermal conductivity of the nanofluid maximum also increases from 298 to 323 K at a concentration range from 0.005 to 0.02. Table 5 shows the measurement results value of thermal conductivity with CuO (30 nm) dispersed in the base fluid. The thermal conductivity of the nanofluid was increased by increasing the temperature concentration of the nanoparticles and increased with particle concentration ranging from 0.005 to 0.02 at 323 K. The thermal conductivity of nanofluid was measured using a thermal property analyzer (KD2 Pro, Decagon Devices Inc., USA). The device measures the thermal conductivity of liquids in compliance with ASTM and IEEE standards using a transient hot-wire (THW) technique. Thermal conductivity of the base fluid increase from 0.175 to 0.187 W/m K as particle loading increases to a maximum value of 2.0% volume at 323 K. This phenomenon could be attributed to the high surface area of the solid nanoparticles. Moreover, further augmentation of thermal conductivity was observed as temperature increased from 298 to 323 K. The corresponding increments ranged between 0.175 and 0.187 W/m K for the nanofluid concentration of 2.0% volume.

Table 3: Experimental viscosity calibrated CuO/Jatropha oil

Temperature	Base fluid	0.005	0.01	0.015	0.02
298	50.3	56.3	59.3	62.4	65.4
303	47.2	53.1	56.1	59.3	62.3
308	44.4	49.4	53.3	55.9	59.3
313	41.5	46.5	50.3	53.3	56.3
318	39.3	43.3	47.1	50.3	53.3
323	37.1	40.2	44.2	47.2	50.2



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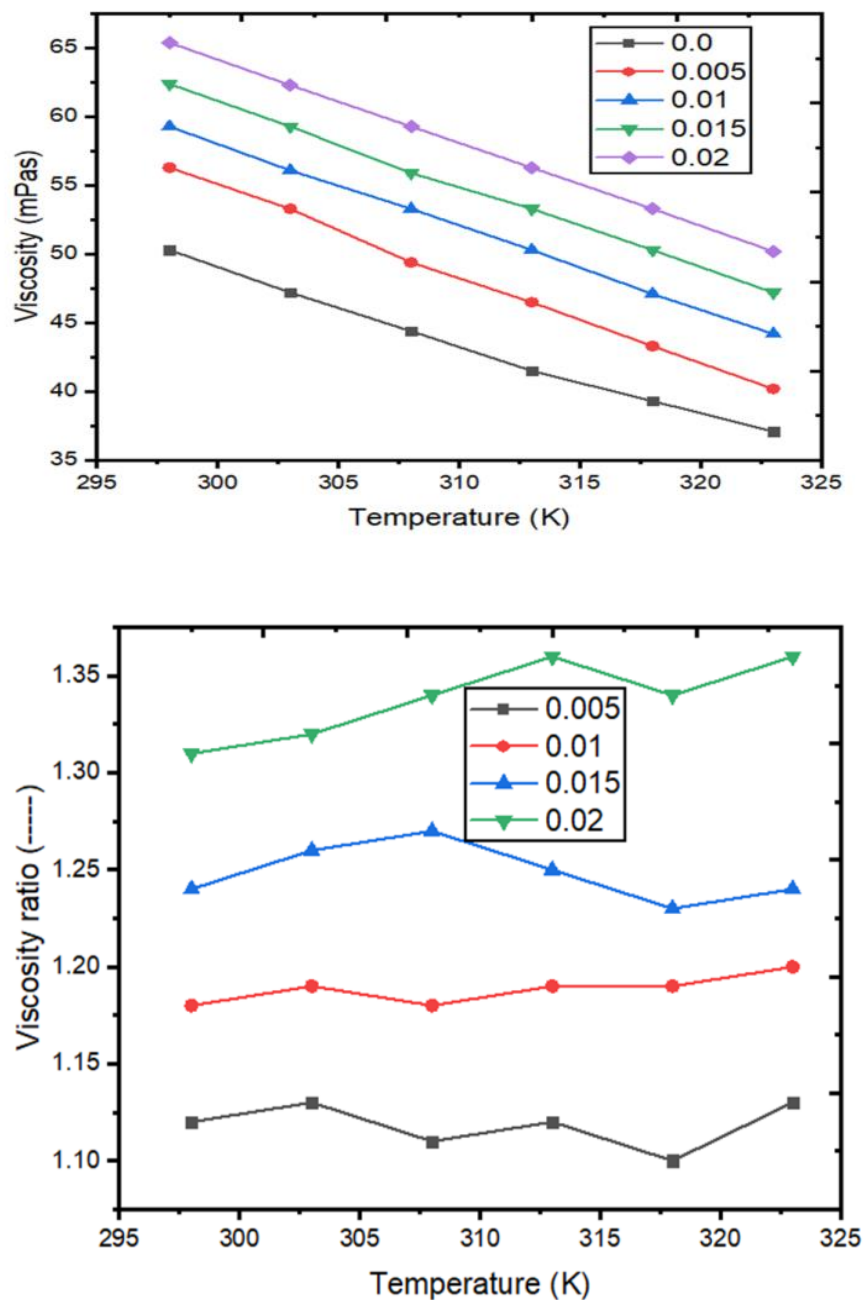


Figure3: Variation of Viscosity versus temperature

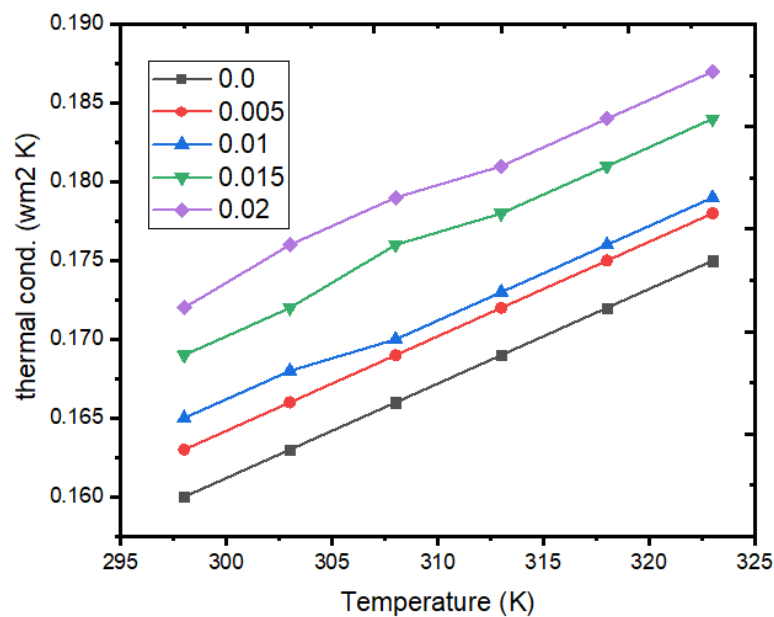


Figure4.Experimentalviscosity ratio enhancements.

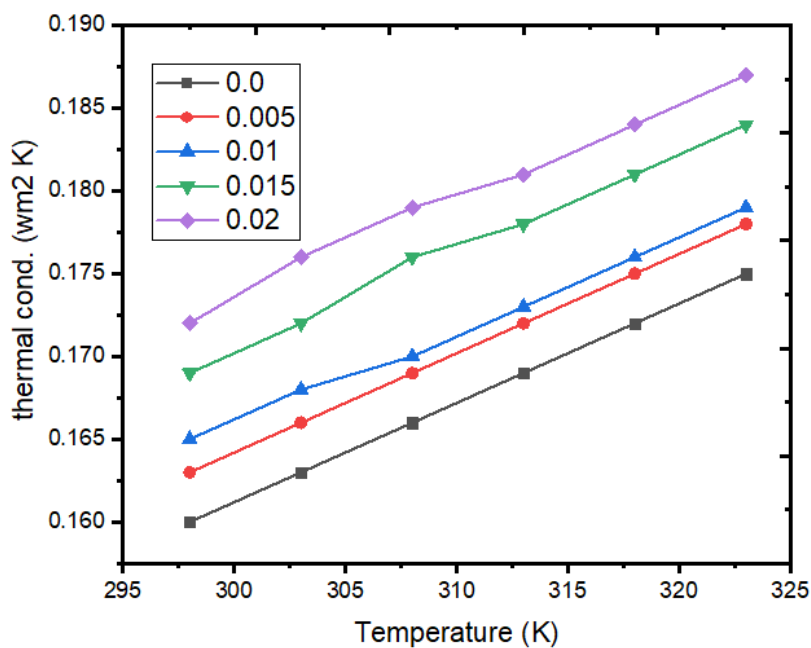


Figure 5: Variation of thermal conductivity versus temperature



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Table 1: Comparison of experimental and empirical correlations for viscosity nanofluid

Temperature (K)	ϕ (%)	Experimental results	Einstein model	Bachelor model	ΔE (%)	ΔB (%)
303	0.0	47.2	47.2	47.2	0	0
	0.5	50.1	50.72	50.73	1.2	1.2
	1	53.1	54.42	54.46	2.01	2.5
	1.5	56.3	58.41	57.0	3.6	1.2
	2	58.8	59.1	62.94	1.3	1.2
313	0.0	31.5	31.5	31.5	0	0
	0.5	33.5	33.91	33.92	1.2	1.2
	1	36.10	37.0	37.12	2.4	2.7
	1.5	38.50	39.94	40.0	1.4	3.8
	2	45.30	47.56	47.68	4.7	4.9
323	0.0	21.1	21.10	21.10	0	0
	0.5	22.6	22.88	23.61	1.2	4.2
	1	24.2	24.81	25.23	2.4	4.1
	1.5	27.2	28.22	28.26	3.3	3.7
	2	28.2	29.61	29.23	4.7	3.5

Thermal Conductivity Measurement.

KD2 Pro thermal property analyser has been used to measure the thermal conductivity of pure oil and the CaO–Jatropha oil nanofluid, another instrument that is frequently utilized by researchers. The transient hot wire approach underlies how the device operates. The manufacturer-supplied glycerine has been used to examine the calibration of the apparatus.

CONCLUSIONS:

Four different samples at volume concentrations of 0.5%, 1.00%, 1.5%, and 2%. The results of the nanofluid measurements conducted experimentally are presented, together with the following key conclusions:

- As temperature rises within the specified range, the thermal conductivity of the nanofluids rises with an increase in volume concentration.
- For nanofluids, the maximum thermal conductivity improvement was 9%, respectively, at volume concentrations of 2% and 323 K.
- When the samples are at 0.5%, thermal conductivity shows a “deepening” effect. The total number of particles in the nanofluid and the variation in average particle size, in our opinion, are the



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causes of this impact.

- As the volume concentration rises, the viscosity of the nanofluids also rises and falls.
- The experimental results agreed with the two known viscosity models, same with errors of 2.9%.

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A STUDY ON RAIL FREIGHT TRANSPORT EMISSIONS AND POSSIBLE WAYS TO REDUCE THEM

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ABSTRACT

The rail sector, although often seen as environmentally friendly, faces significant challenges in terms of emissions, especially for diesel locomotives. This article examines the current emissions situation in rail freight, with a particular focus on the impact of diesel engines and possible solutions. The impact of nitrogen oxides (NO_x) is analysed by reviewing key studies and case studies. The primary aim of the article is to show how emissions from rail transport have changed since 1990 and the causes of the changes. In addition, from a rail transport perspective, technical proposals are given to help railways to really reduce emissions of air pollutants from rail, since if we want to increase the share of rail transport, these solutions are essential to avoid a drastic increase in the emission of chemicals that are harmful to the environment

Keywords: rail freight, NO_x reduction, EGR system, AdBlue AU 32 system, diesel locomotives

INTRODUCTION

Rail transport is a key mode of transportation for the European Union, contributing to sustainable mobility while playing a significant role in the fight against climate change. Rail freight remains the most environmentally friendly form of transportation, especially compared to road transport, which contributes more significantly to greenhouse gas (GHG) and pollutant emissions. However, the EU has



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set ambitious goals, aiming for full climate neutrality across all sectors of transport by 2050, including rail. Despite these challenges, a significant portion of rail vehicles, particularly diesel locomotives used on non-electrified lines, still emit large amounts of harmful pollutants. Currently, more than 50% of the European locomotive fleet (48.7% in Hungary in 2022, according to Eurostat) is still diesel-powered, with over 10,000 diesel locomotives in use, many of which are more than 20 years old. This is especially true for shunting locomotives, where most are outdated and operate with older technology, further increasing local emissions.

The European Union has introduced strict emission regulations to reduce diesel locomotive emissions. These regulations are based on Directive 97/68/EC, amended by Directive 2004/26/EC to cover locomotives. The directives set emission limits in different stages (Stage IIIA, IIIB, and IV), primarily focusing on reducing emissions of carbon monoxide (CO), nitrogen oxides (NO_x), hydrocarbons (HC), and particulate matter.

Modernizing diesel locomotives and introducing new technologies is essential from both economic and environmental perspectives. For railway companies, acquiring new diesel locomotives is an extremely costly process, with the price of a modern shunting locomotive ranging between 1.5 and 3 million euros, and mainline locomotives costing up to 4–6 million euros. These high investment costs pose a significant financial burden, especially when considering the budgetary constraints present in the rail sector and the fact that a large portion of the existing locomotive fleet, while still operational, is technologically outdated.

At the same time, the EU's climate policy objectives emphasize the critical role of rail transport in reducing emissions. To increase the volume of goods transported by rail and make transportation greener, locomotive emissions must be drastically reduced. If emission levels do not improve, the increase in transport volumes will proportionally increase emissions, contradicting sustainability goals. This poses a particular challenge for companies using diesel locomotives, as the long procurement processes and high costs of modern technologies mean that acquiring new locomotives is not always feasible quickly or economically. The modernization of locomotives and the use of alternative emission reduction technologies, such as EGR (Exhaust Gas Recirculation) and SCR (Selective Catalytic Reduction) systems, could be important interim solutions. These technologies allow the reduction of emissions from existing locomotive fleets while avoiding the costs and delays associated with purchasing new vehicles.

Implementing technological advancements in the railway sector is a time-consuming process, as it requires not only procurement but also the installation of new equipment and the development of the necessary infrastructure, all of which require significant investment. Therefore, modernization solutions are not only economically advantageous but also help companies contribute to the EU's long-term environmental goals while improving the efficiency of rail freight transport.

LITERATURE REVIEW



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Rail transport, as one of the most environmentally friendly modes of transport, can play a crucial role in reducing the emissions of air pollutants and greenhouse gases. By exploring the potential of diesel locomotives and developing railway infrastructure, alongside the implementation of digitalization and innovations, the railway sector can offer significant environmental benefits.

Therefore, it is essential to focus on railway transport as a possible solution to global climate challenges. Enhancing the sustainability of rail transport can contribute to emissions reduction not only at the local level but also globally, promoting sustainable development.

The European Union's goal is to achieve full climate neutrality by 2050, which is why it places great emphasis on developing railway infrastructure and reducing harmful emissions. Achieving this requires expanding electrification and utilizing more modern, lower-emission vehicles, especially diesel locomotives, which still make up a significant part of the rail fleet.

Currently, around 56% of Europe's railway network is electrified, but diesel-powered vehicles still operate on the remaining 44%, which results in significant nitrogen oxide (NO_x) emissions. Modernization efforts include introducing technologies like EGR (Exhaust Gas Recirculation) and SCR (Selective Catalytic Reduction) systems, which can significantly reduce emissions even for existing diesel locomotives (3).

However, the introduction of new technologies and the modernization of existing infrastructure come with significant financial burdens, making it important for railway companies and decision-makers to find economically sustainable solutions to meet environmental goals.

The European Union has established the legal framework for the railway sector to begin working on reducing air pollutants and greenhouse gas emissions from rail transport. We will focus primarily on freight transport, as it requires more technological changes within the sector. In a liberalized rail market, it is essential to maintain and improve the efficiency of all processes related to transportation, as noted by Šperka, A., et al. (3). In our research, we will compare the availability of locomotives with emission-related issues. For diesel locomotives, one of the most urgent questions in fleet operations is reducing the number of starts. Improving the starting system of long-distance diesel locomotives using supercapacitors allows for multiple restarts, meaning the engine can be turned off more frequently without wasting fuel while idling, as noted by Malozyomov, B.V., et al. (4). This research is closely related to the risk of failure based on consumption in diesel locomotives, as explained by Baranovskyi, D., et al. (5). The structure of the exhaust system also plays a role in emissions, as turbulence in the exhaust can negatively affect combustion, increasing emissions, according to G. Benek and O.A. Özsoysal (6). Operational dynamics, such as maximum acceleration and deceleration rates and idle times, are also significant factors that contribute to increased emissions, as described by Patryk Urbański et al. (7).

Several studies have examined the effect of mixing diesel fuel with biodiesel on emissions. However, in this study, it was concluded that in the case of the 16V265H diesel vehicle, the use of biodiesel could only be increased to a limited extent. According to the optimization of the Optimizer model, NO_x emissions from diesel engines burning biodiesel at varying ratios showed an increasing trend at 75% load (8).



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In terms of traction vehicles, research primarily focuses on the operation of internal combustion engines. However, compared to road vehicles, there are still gaps in measuring actual emissions. To address this issue, PEMS (Portable Emission Measurement System) has been introduced to measure emissions from rail diesel-powered vehicles. The PEMS system was tested in South Korea, where it was found that actual locomotive emissions differ significantly from the EPA TIER standard, as noted by Kim, M.-K., and Park, et al. (9).

For diesel-powered vehicles, it is not only necessary to measure emissions but also to explore new solutions to reduce fuel consumption. Some studies suggest that using energy storage systems in diesel-powered vehicles can store up to 32.64% of kinetic energy. Using this energy during traction mode could reduce fuel consumption by about 50%, as noted by Riabov, I., et al. (10).

In addition to fuel savings, several studies focus on the possible replacement of diesel locomotives. Some studies explore the use of electric energy, including battery applications, according to Cipek, M., et al. (11). Kapetanović, M., et al. also researched supplying locomotives with battery storage, which determines the exact size of the battery needed for the locomotive (12).

Our literature review identified numerous solutions for reducing emissions from rail transport. In our study, we now delve into the extent of rail emissions. We compare the emissions of rail passenger and freight transport and present solutions for significantly reducing emissions, particularly in freight. In our analysis, we also highlight the most feasible solutions for reducing emissions from diesel-powered rail vehicles operating in Hungary.

It is important to note that while many studies prioritize solutions based on consumption, our research proposes a solution that can reduce NO_x emissions in the most cost-effective manner.

Our literature review found that direct scientific analyses addressing NO_x emissions are extremely rare, especially in the field of rail transport. Therefore, we believe further investigations are needed on how to directly reduce NO_x emissions from rail transport, particularly in case of traffic growth.

To resolve the detailed problem, we propose the possibility of implementing EGR (Exhaust Gas Recirculation) and SCR (Selective Catalytic Reduction) systems.

In the case of EGR, it is important to consider that at higher temperatures, NO_x reduction is more favorable, but this also increases solid deposits in the EGR system, thus requiring more maintenance, according to Solaimuthu, C., et al. (12). While both SCR and EGR systems are individually beneficial for NO_x reduction, their combined use is the most effective, as noted by Darsh P. (13). According to Johnson, T., et al., the combined use of EGR and SCR systems is the most effective in reducing NO_x gases (14). Before the introduction of EGR and SCR systems, Vojtisek-Lom, M., et al., analyzed very good technical implementations in a study that examined two diesel-powered locomotives under real operating conditions in the Czech Republic (15). In the case of introducing EGR, it is useful to consider supplying LNG to the fuel for diesel-powered vehicles, as significant fuel consumption reduction is expected. However, the presence of gas necessitates further calculations, according to Lipsits I. (16). According to Jiaojun D., et al., the EGR technology can reduce NO_x by 90%, but it increases fuel consumption and soot. In contrast, SCR technology can reduce NO_x by more than 90% without increasing fuel consumption. However, the SCR system takes up a lot of space and the cost of the reducing agent is high (17).



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INTRODUCTION TO THE EGR SYSTEM

The **EGR (Exhaust Gas Recirculation) system** is an exhaust gas recirculation technology used in diesel engines to reduce harmful emissions. The EGR system directs a portion of the engine's exhaust gases back into the combustion chamber, thereby reducing nitrogen oxide (NO_x) emissions, which is one of the biggest environmental challenges associated with diesel engines. A valve (EGR valve) located near the combustion chamber controls the exhaust gases, directing them into the engine's intake system. During a specific point in the combustion cycle, part of the exhaust gas is recirculated into the engine, reducing the oxygen concentration in the combustion chamber. Recirculating the exhaust gases cools the combustion product, lowers the combustion temperature, and thereby decreases NO_x formation. The use of EGR is particularly beneficial for diesel engines, where NO_x emissions can be higher compared to gasoline engines. In addition to reducing harmful emissions, the system also plays a role in optimizing engine performance. With proper settings, the EGR effectively reduces emissions without significantly affecting engine performance.

Chemical reaction equation during EGR valve operation: $N_2 + O_2 \rightarrow 2NO$

Benefits of the EGR system

- **Reduction of pollutant emissions** One of the main benefits of the EGR system is that it effectively reduces emissions of nitrogen oxides, which are a major cause of air pollution, especially in diesel engines
- **Cost-effective Upgrading** the existing engine fleet is less expensive than buying new vehicles, as EGR reduces emissions from existing engines.
- **Low operating costs** EGR systems have relatively low maintenance costs and can be easily integrated into existing engines

Disadvantages of the EGR system

- **Pollution and maintenance** During EGR system use, recirculated exhaust gases can reduce combustion chamber cleanliness and increase the build-up of soot and other deposits in the engine, which may require frequent maintenance
- **Power loss** Although the effect is minimal, the use of the system can reduce engine power as the recirculated gases can reduce combustion efficiency

The **EGR system** is therefore an important tool for reducing emissions from diesel engines, but the potential drawbacks associated with the maintenance of the systems and the long-term effects must also be considered. The emission reductions that can be achieved through its application can bring significant benefits to rail transport, particularly for diesel locomotives.

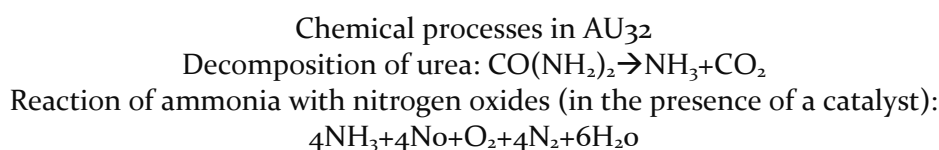


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INTRODUCTION TO THE AU₃₂ (ADBLUE) SYSTEM

AdBlue is an environmentally friendly additive that is injected into the exhaust system of diesel engines to reduce nitrogen oxide (NO_x) emissions. The system is the basis of SCR (Selective Catalytic Reduction) technology, which is used in modern diesel engines to meet stringent emission standards such as Euro 6. AdBlue is a mixture of water and urea, containing 32.5% carbamide and 67.5% distilled water. AdBlue is injected into the exhaust system directly into the engine exhaust using a special injector. The carbamide molecule reacts with NO_x in a chemical reaction facilitated by the SCR catalyst. The liquid reacts with the temperature catalyst in the exhaust system. During the reaction between AdBlue and NO_x, the catalyst controls the reaction rate and the conversion, converting the nitrogen oxides (NO_x) molecules in the exhaust gas into nitrogen (N₂) and water vapour (H₂O). The catalyst ensures that the conversion only takes place to the desired compounds, so NO_x is not released back into the atmosphere, thus reducing emissions.



The benefits of AdBlue

- **Emission reduction** AdBlue effectively reduces emissions of nitrogen oxides, which contribute to air pollution and global warming. The SCR system allows vehicles to meet stringent environmental standards (Euro 6 standards) and dramatically reduce NO_x emissions by up to 90%.
- **Sustainability** The AdBlue system contributes to sustainable transport solutions by helping to reduce the environmental impact of vehicles without significantly affecting engine performance or fuel consumption
- **Low running costs.** The use of AdBlue offers a relatively low cost solution to reduce NO_x emissions and the running costs of the system are not too high.

Disadvantages and opportunities

- **Refilling AdBlue** must be constantly refilled as it is necessary for the system to function. The consumption of AdBlue depends on the engine operating conditions, but some vehicles require several litres of AdBlue per month, so it is important to top up
- **Tank and infrastructure** A separate tank is required in vehicles to store AdBlue, which can take up extra space in the vehicle. Developing infrastructure (e.g. filling stations) can also be time-consuming and costly.
- **Urea quality** The quality of AdBlue is essential. If the wrong quality of additive is used, the SCR system may not function properly, which can damage the catalyst or reduce the efficiency of the system.



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ECONOMIC ASPECTS

For diesel engines, the use of AdBlue and SCR can be an economically advantageous solution as it significantly reduces the environmental impact and allows vehicles to meet EU emission standards. Instead of purchasing new vehicles, the introduction of AdBlue is a more cost-effective way to reduce emissions from the existing fleet. Long-term maintenance costs, such as the purchase of AdBlue and system maintenance, are typically low. AdBlue and SCR systems are an effective means of reducing emissions from diesel engines and play a key role in the sustainability of transport. The use of AdBlue is economically beneficial as well as environmentally compliant, and the technology is helping to create a greener, more environmentally friendly future for rail and road transport. In addition to demonstrating the solutions described above, the use of AdBlue not only helps to reduce NO_x emissions but can also generate economic benefits.

THE EUROPEAN UNION'S APPROACH TO EXTERNALITY AND THE RELATIONSHIP BETWEEN THE SYSTEMS WE PROPOSE

Sustainable transport, reducing emissions and improving energy efficiency are priorities in the European Union's transport policy. The transport sector, in particular road and rail transport, generates significant negative externalities. In the case of road transport, for example, emissions from cars and trucks, such as carbon dioxide (CO₂), nitrogen oxides (NO_x) and particulate matter, contribute directly to air pollution, climate change and human health problems. To mitigate these effects, the EU has introduced strict environmental regulations to reduce the negative impacts of these externalities. The environmental burden of rail transport needs to be quantified, which is why the European Union has introduced the marginal external cost coefficient as an indicator for rail transport. The marginal external cost coefficient is significantly reduced when EGR/SCR is applied.

1. table. Marginal cost of rail passenger transport Externalia (€-cent/person km)

<i>Train type</i>	<i>Fuel</i>	<i>Emission class Equipped with EGR/SCR</i>	<i>Metropolitan area</i>	<i>Urban area</i>	<i>Rural area</i>
<i>Intercity trai</i>	Diesel	Yes	0,47	0,38	0,23
<i>Intercity trai</i>	Diesel	No	0,7	0,67	0,40
<i>Regional train</i>	Diesel	Yes	1,52	1,17	0,71
<i>Regional train</i>	Diesel	No	2,1	1,99	1,20

source: Guide to the externalisation of rail passenger transport; Handbook on the external costs of transport Version 2019 - 1.1



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2. table. Marginal cost of rail freight transport Externalia(€-cent/tkm)

<i>Train type</i>	<i>Fuel</i>	<i>Emission class Equipped with EGR/SCR</i>	<i>Metropolitan area</i>	<i>Urban area</i>	<i>Rural area</i>
Short Container freight train (420 m)	Diesel	Yes	0,356	0,309	0,184
		No	0,781	0,638	0,377
Short bulk freight train (300 m)	Diesel	Yes	0,238	0,207	0,123
		No	0,521	0,426	0,252
Long Container freight train (620 m)	Diesel	Yes	0,128	0,111	0,067
		No	0,280	0,229	0,136

source: Handbook on the external costs of transport Version 2019 – 1.1 Guide to the externalisation of rail passenger transport; Handbook on the external costs of transport Version 2019 – 1.1

Tables 1-2 show that rail transport can benefit significantly from the technical solutions we have described. These discounts could even represent significant tax reductions in the excise duty refund on fuel consumption, since the harmful effects of rail transport need to be taken into account when determining the rate.

Benefits for rail users of the introduction of EGR/SCR

Large companies that require rail transport are now choosing partners not only on the basis of transport costs but also on environmental considerations. Sustainable transport solutions such as green logistics are essential to remain competitive. Transporting goods in environmentally friendly vehicles not only provides a competitive advantage for suppliers, but also improves the image of companies, as they increasingly favour suppliers who comply with environmental standards.

The future development and competitiveness of rail transport depends on how operators can integrate innovation and sustainability into their daily operations. The introduction of EGR and AdBlue systems not only ensures environmental compliance but also has economic benefits by reducing long-term running costs and improving the fuel efficiency of vehicles. Taking all this into account, the use of sustainable transport modes on a large scale is a mandatory requirement for mandates from international operators. So, if the railways cannot meet this, they will not be able to submit a suitable tender to the contracting entity and the contracting entity will choose another mode of transport.



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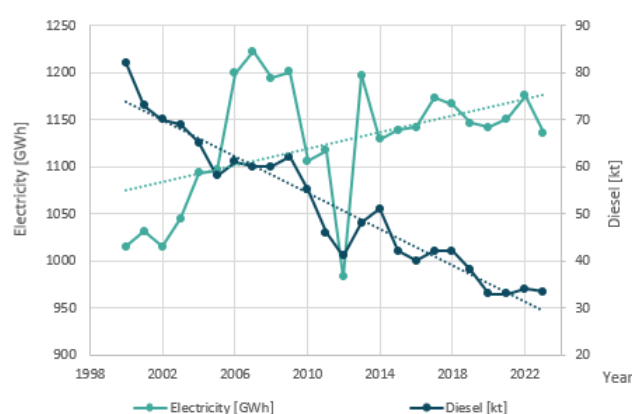
LITERATURE SUMMARY

From the literature review presented above, further research on the topic we are investigating is worthwhile. In many cases, it is observed that vehicle consumption is considered the most important parameter, as well as the efficiencies found during operation. However, in our opinion, it is also possible to reduce air pollutant emissions by holding constant the given vehicle consumption parameters. From a cost-effectiveness point of view, this is the most optimal solution, which is moreover one of the simplest ways to solve the problem of reducing NO_x emissions from railways, if the technologies we propose are applied alongside it.

DATA ANALYSIS

In our analysis, we calculated the NO_x and CO₂ values for the period 2000 - 2023 based on the consumption parameters of diesel locomotives operating on the Hungarian railway network and the guidelines set by the European Union. The results were compared with the quantities transported by rail in Hungary and with the parameters for the rail infrastructure.

In the analysis we also considered it important to determine the comparison of energy consumption in rail transport, as it is important to show how electricity and diesel consumption are related in the long term. After defining the indicators related to railway consumption and performance, we will show how our technical proposal works under real conditions.



1. figure. Energy use in rail transport

Source: KTI collection (<https://mekh.hu/eves-adatok>)

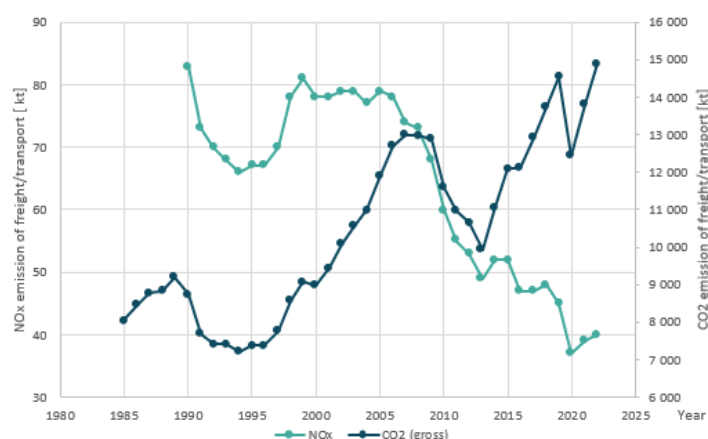
Figure 1 shows the change in energy use in rail transport after 1990. This is due to several factors. One of the most important factors is the increase in the use of electricity on electrified railway lines, while the use of diesel oil has decreased. However, the weight of goods transported has decreased by 49%



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between 2001 and 2023. This decline has contributed significantly to the reduction in greenhouse gas (GHG) and air pollutant emissions, as less energy has been used as traffic has fallen. This relationship shows that the reduction in emissions is not only due to technological improvements, but also to the reduction in traffic. If freight volumes increase, emissions could increase again if the fleet is not modernised, especially for diesel locomotives.

Figure 2 shows that total transport NO_x as well as CO₂ (gross) emissions are on an upward trend, which suggests that we are transporting increasingly, but the modal split is shifting less towards sustainable transport modes. To achieve further results in our study, it is necessary to carry out more detailed studies that will bring us closer to understanding rail transport.

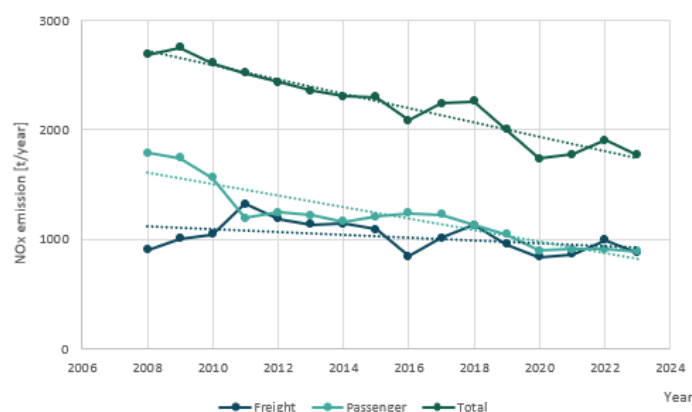


2. figure. Air pollutant and GHG emissions from rail transport
Forrás: https://www.ksh.hu/stadat_files/kor/hu/kor0017.html

Figure 3 analyses the NO_x emissions from rail transport. From the analysis passenger and freight transport show similar reductions at almost the same level. One explanation for this is that in our country freight transport is on the same track as passenger transport, so if the line is not electrified, it is necessary to use diesel traction. Another important argument is that no new technical solutions are currently being applied to vehicles to reduce NO_x emissions. In addition, there have been several cases of passenger services being withdrawn in our country, usually with diesel traction.

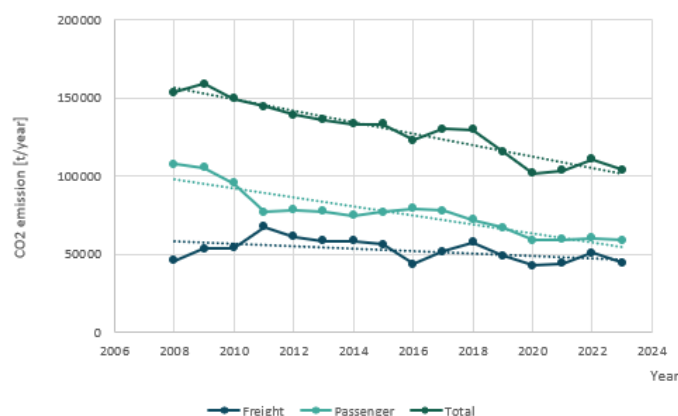


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3. figure. NO_x emissions from rail transport
Source: KTI calculation

Unfortunately, however, rail freight traffic is declining. Thus, the decrease shown in the graph can only be considered as a positive trend.



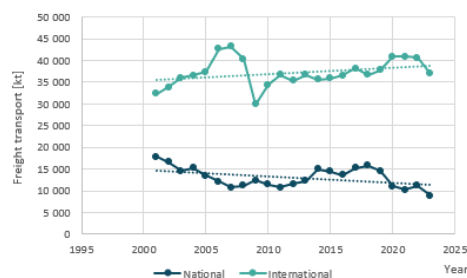
4. figure. CO₂ emissions from rail transport
Source: KTI calculation

Freight transport performance in terms of inland transport decreased between 2000 and 2023. At the same time, less modern diesel locomotives continue to operate at transshipment stations and on marshalling yards.



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5. figure. Railway transport performance

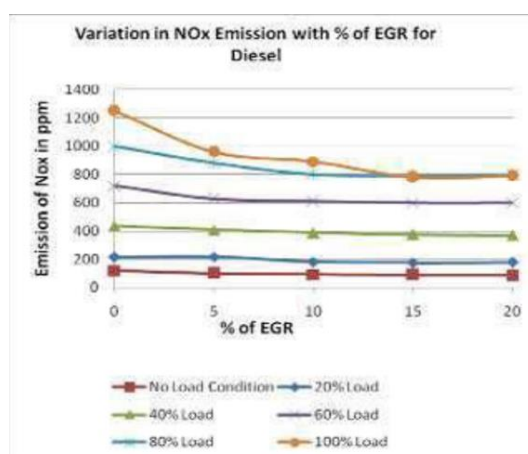
Source: KTI collection (<https://www.ksh.hu/stadat?theme=sza;24.1.1.2-4>)

PROPOSED SOLUTIONS TO REDUCE EMISSIONS

Use of the EGR system

As detailed above, the role of the EGR valve in internal combustion engines is to reduce the emission of nitrogen oxides (NO_x), a major pollutant. The EGR valve recirculates part of the exhaust gas back into the combustion chamber where it mixes with fresh air. This allows the combustion chamber to burn at a lower temperature, resulting in less NO_x formation. As shown in Figure 5, with EGR, 15-20 % exhaust gas recirculation improves NO_x emissions.

As a result, scientific results show that the introduction of the system significantly helps to reduce NO_x levels. In addition to the study cited, it is also worth noting that it does not depend on the ambient temperature, only on the temperature of the chemical process in the engine.



5. figure. EGR valve application testing

Source: Aresh, Poppathi & V.Madhava, & Babu, AV.Hari. (2015). Exhaust Gas Recirculation System. J. of Bioprocessing and Chemical Engineering. 3. 1-6.



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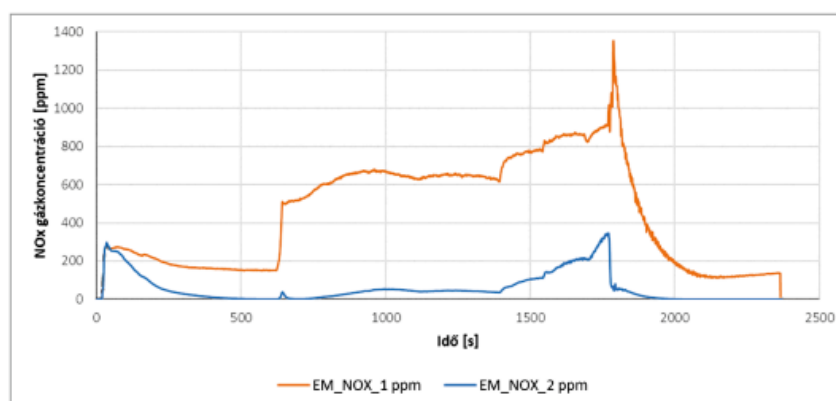
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Using the AU 32 (AdBlue) system

In the case of the AU 32 (Adblue) (Bíró Norbert et al. 2024), the measurements show that there are significant benefits of the Adblue system, as the Nox emissions are significantly reduced, thus significantly reducing the environmental impact. The emission maximum drops from nearly 1400 ppm to 350 ppm when using AdBlue. As a result of this study, it is worth considering the use of rail.



6. figure. Testing the use of AdBlue

source: Adblue dispenser development for exhaust gas treatment system optimisation Bíró Norbert, Dr. Pillinger György IBIDEN Hungary Kft., test engineer at Szent István University, GÉK, Institute of Process Engineering, Department of Vehicle Technology

Coupling of EGR and AU 32 (AdBlue)

Environmental considerations are becoming increasingly important in rail transport, to reduce emissions from diesel locomotives and multiple units. In this area, the combination of two major technologies, EGR (exhaust gas recirculation) and AdBlue (SCR, selective catalytic reduction) systems, has become popular because of their ability to effectively meet increasingly stringent international regulations such as EU Stage V or US EPA Tier 4 emission standards.

The EGR system essentially recirculates part of the exhaust gas back into the engine's combustion chamber. This reduces the combustion temperature, which directly reduces the formation of nitrogen oxides (NOx). This technology is not perfect, however, as it is prone to build-up of deposits inside the engine, which can impair performance in the long term. In contrast, the AdBlue system works in the exhaust system. AdBlue, a urea solution, is injected into the exhaust gas. At high temperatures, AdBlue breaks down into ammonia, which converts NOx into harmless nitrogen and water with the help of a catalyst.

There are several advantages to using the two systems together. EGR reduces NOx emissions once inside the engine, while AdBlue breaks down any remaining nitrogen oxides. This allows less intensive use of the EGR system, which reduces wear and other side effects such as particulate emissions. The SCR system, on the other hand, can provide better fuel economy by optimising engine operation for higher efficiency, as the burden of reducing NOx emissions is shared between the two technologies.



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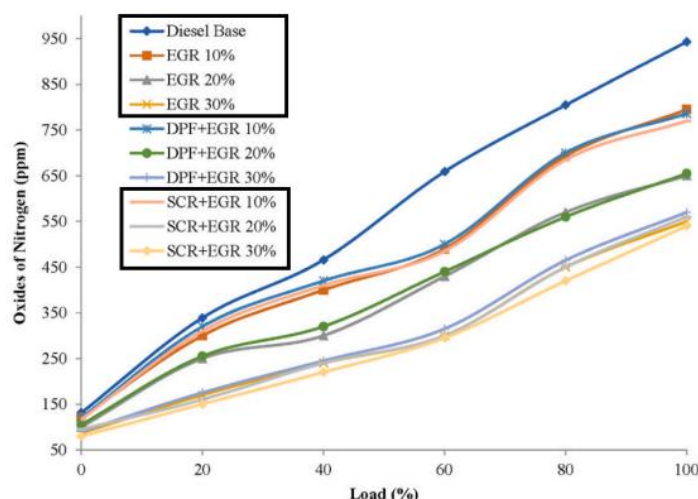


Figure 9: NOx Vs Load

7. figure. Testing the combined use of AdBlue and EGR

source: Patela, Darsh. "Optimization of NOx Reduction Using Combination of SCR & EGR in Diesel Engine's Exhaust System." (2024).

According to the study by Patela et al., maintaining EGR at 20-30% in combination with SCR proves to be the most effective in reducing NOx, minimizing the negative effects. Therefore, further studies are also needed in this case.

However, integration is not without problems. The combined use of EGR and SCR systems requires complex control mechanisms. Precise calibration is required to ensure proper operation, considering the different operating conditions of the engine. In addition, maintenance of both technologies is time-consuming and costly, for example EGR can cause deposits and SCR can cause urea crystallisation. A further challenge is the space requirements (space constraints) of diesel engines, as the installation and integration of both systems requires significant physical space.

In practical applications, we already see modern diesel locomotives and multiple units that combine both technologies. In the European and American rail markets, for example, several manufacturers are using this innovative solution to meet stringent environmental standards. Pilot projects are also underway to fine-tune EGR and SCR systems for the specific conditions of rail use. The EU Stage V standards and the US EPA Tier 4 standards have encouraged the introduction of such systems, as they impose strict emission limits. Several manufacturers (e.g. Siemens, Bombardier) have already introduced a combination of EGR and AdBlue systems in the latest generation of diesel locomotives. Some rail operators, for example in various EU countries, have launched pilot programmes to test the effectiveness of the technology.

In the future, these integrated systems could be further developed, for example by using advanced sensor technology or artificial intelligence-assisted control to improve system optimisation. There is



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also the possibility of combining diesel engines with hybrid powertrains or alternative powertrains (e.g. batteries or hydrogen) to further reduce emissions. Research could also be conducted into more sustainable alternatives to AdBlue, such as the development of bio-based urea solutions or alternative catalysts.

Overall, the combined use of EGR and SCR can play a key role in greening rail transport, but further improvements are needed to maximise efficiency and minimise costs.

SUMMARY

Based on our analysis, emissions of air pollutants and greenhouse gases from rail transport in Hungary showed a significant decrease compared to the base year, but the volume of goods transported also decreased over the period. This suggests that the decrease in emissions is linked to a decline in domestic rail freight transport.

The modernisation of diesel locomotives during the period under review did not lead to any progress in reducing emissions. This leads to the conclusion that when domestic rail traffic increases again, emissions will increase again. In this light, it is important to bear in mind that the purchase of modern locomotives is very expensive and pays off in the long term, so it is not always an economical choice.

Therefore, we sought solutions that could reduce emissions in the short and medium term and mitigate environmental external costs. Based on our research, we concluded that it would be advisable to upgrade railway diesel vehicles by implementing EGR (Exhaust Gas Recirculation) or SCR (Selective Catalytic Reduction) systems. These systems can result in significant emission reductions, meaning that even if rail freight transport increases, emissions would not necessarily rise. Furthermore, from an economic perspective, it is a favourable solution because it avoids the need for a complete fleet replacement, which would impose a significant financial burden on operators, while maintaining their competitiveness.

The future scope of our research includes determining the exact costs associated with installing EGR and SCR systems for the railway sector. It is especially important to focus on freight locomotives, as they currently operate in a competitive market in Hungary. In this case, a different type of calculation will be needed compared to passenger transport vehicles. For passenger transport vehicles, it is crucial to consider the payback period, noting that the passenger transport market in Hungary is currently not liberalized, and thus we are not dealing with a competitive market. Given these considerations, the current limitations of our research involve determining the financial returns. However, in summary, the continuation of this research could include further economic calculations.

In addition to calculating returns, it is essential to consider whether to apply only the EGR system, only the AdBlue (SCR) system, or a combination of both technologies to reduce NOx emissions.

The application of the findings from the above study is closely linked to increasing the rail modal split and thus cannot be overlooked. In fact, the conclusions outlined in the study provide important guidance for increasing the share of rail transport.



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GREEN FINANCING AND POLICY SUPPORT FOR SUSTAINABLE TOURISM INITIATIVES

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ABSTRACT

Sustainable tourism plays a vital role in addressing pressing global challenges such as climate change, biodiversity loss, and economic instability. This paper delves into the significance of green financing and supportive policies in nurturing sustainable tourism initiatives. It highlights mechanisms like green bonds, biodiversity-focused investments, and policy incentives that are instrumental in minimizing the ecological footprint of tourism while simultaneously generating economic advantages. The research identifies key challenges faced by the sector, including limited access to financing, inconsistencies in regulatory frameworks, and gaps in technical expertise. To address these issues, the paper proposes strategic solutions aimed at fostering collaboration among various stakeholders, including governments, financial institutions, and local communities study focuses on how financial strategies can turn tourism obstacles into opportunities for environmental and social advancement. It emphasizes the need for eco-friendly tourism practices that not only yield profits but also deliver social benefits. By assessing funding mechanisms and policy frameworks that engage diverse stakeholders, the research aims to promote authentic sustainability. The investigation reveals that innovative financing and supportive policies can enhance sustainable development initiatives by addressing both environmental and social dimensions. However, it also underscores challenges such as policy fragmentation and the risk of "greenwashing." The paper advocates for synchronized global policies and active local engagement to overcome these hurdles. Ultimately, it suggests actionable recommendations for enhancing green financing and adaptive policies that facilitate collaboration among all parties involved. This cohesive approach aims to transition the tourism sector from merely sustainable to regenerative, fostering ecosystem vitality and community development. The proposed model is adaptable across various industries striving for economic growth alongside environmental sustainability.

Keywords: Tourism, Sustainability, Green Financing, Policy Making, Environmental degradation



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INTRODUCTION

Green financing is increasingly recognized as a vital mechanism for promoting sustainable tourism initiatives. By providing the necessary funding and support, green financing helps tourism destinations achieve Green Destination status, which emphasizes environmental sustainability and responsible tourism practices.¹ Green financing and policy support are therefore crucial for advancing sustainable tourism initiatives, particularly in the context of growing environmental concerns and the need for economic resilience.² This article explores how these financial mechanisms can facilitate sustainable practices within the tourism sector, promoting both environmental conservation and socio-economic benefits.

Tourism accounts for a significant share of the world's GDP and ranks as one of the economically important sectors, especially in poor countries. However, the dependence of this sector on natural resources, energy, and infrastructure has raised certain ethical and social concerns about this industry. Hence the concept of Sustainable tourism. This notion tries to emphasize the need for sound environmental practices meant to protect natural resources and improve the living conditions of people in the region.³ This opinion was supported by recent research conducted in Ghana which found that good management boosts the economy while preserving the environment and culture. According to the study, tourism needs to be environmentally, socially, and economically sustainable to be deemed sustainable.⁴

The travel and tourism sector alone is responsible for about 8% of the total greenhouse gas emissions contributing to climate change; therefore, the solution to the pressing challenge of climate change lies at the heart of sustainable tourism development. Coastal risk management may include activities like the mangroves Protection projects, also seen as the best investments in supporting local coastal communities. It is in this context that sustainable tourism is seen as an opportunity to turn problems into solutions, that is, harnessing the power of the environment and society to make positive change.⁵ Of great importance in this transformation are the blending of green policies and finance as these can

¹ Rahman, M. H., Tanchangya, T., Rahman, J., Aktar, M. A., & Majumder, S. C. (2024). Corporate social responsibility and green financing behavior in Bangladesh: Towards sustainable tourism. *Innovation and Green Development*, 3(3), 100133. <https://doi.org/10.1016/j.igd.2024.100133>

² Fu, M., Huang, S., & Ahmed, S. (2024). Assessing the impact of green finance on sustainable tourism development in China. *Heliyon*, 10(10), e31099. <https://doi.org/10.1016/j.heliyon.2024.e31099>

³ Khatib, A. N. (2023). Climate Change and Travel: Harmonizing to Abate Impact. *Current Infectious Disease Reports*, 25(4), 77. <https://doi.org/10.1007/s11908-023-00799-4>

⁴ Albrecht, J., & Haid, M. (2022). Sustainable eco-tourism in Ghana: An assessment of environmental and economic impacts. *Journal of Global Research in Education and Social Science*. Retrieved from <https://academicjournals.org/journal/JGRP/article-full-text/BCo8B1169646>

⁵ Torres-Delgado, A., & López Palomeque, F. (2012). The growth and spread of the concept of sustainable tourism: The contribution of institutional initiatives to tourism policy. *Tourism Management Perspectives*, 4, 1-10. <https://doi.org/10.1016/j.tmp.2012.05.001>



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leverage funding and provide mechanisms for sustainable practices. Thus, Financial strategies can effectively transform obstacles in the tourism sector into opportunities for environmental and social advancement by focusing on sustainable practices, community engagement, and strategic financial planning.⁶ This study examines the connection between governmental support for sustainable tourism and green funding for tourism growth. It aims to identify the gaps that exist, the procedures that would be adequate, and how stakeholders may position themselves to help the tourism industry accomplish the goals of the global development agenda. This uniqueness of the studies lies in its integrative technique, which focuses on real-world applications while incorporating many facets of economics, policy, and case studies. For greater equality and sustainability of territory through tourism, governments, businesses, and inhabitants must work together.

IMPORTANCE OF GREEN FINANCING IN MITIGATING ENVIRONMENTAL IMPACTS

To lessen the tourism industry's environmental impact, green funding is essential. Destinations can embrace sustainable practices that safeguard biodiversity and natural resources by allocating the required funds for environmentally beneficial projects and developing and implementing eco-friendly tourism guidelines that help minimize environmental impacts while promoting responsible travel. This ensures the conservation of natural and cultural heritage sites, which is crucial for long-term sustainability. Improving infrastructure, such as accessibility and visitor facilities, supports sustainable tourism growth. This not only enhances the tourist experience but also preserves the environment by managing visitor flow and reducing strain on local resources.

The term 'green financing' describes financial services and products that assist initiatives that have a beneficial environmental impact, especially those that help sustainable development and climate change mitigation. A substantial rise in green finance is expected as future generations, including tourists, hold environmental values and expect financial institutions to provide those services. As a result, green financing plays a critical role in reducing carbon emissions to foster the development of tourism. Additionally, green funding promotes the adoption of sustainable practices and technologies by tourism operators, strengthening their ability to withstand the effects of climate change.⁷ Green financing is becoming a crucial instrument for promoting long-term success in the tourism industry as more locations realize how important sustainability is in drawing eco-aware tourists.⁸

⁶ Bozena Radzewicz-Bak et-al (2024) Preparing Financial Sectors for a Green Future: Managing Risks and Securing Sustainable Finance, International Monetary

Fund <https://www.elibrary.imf.org/view/journals/o87/2024/002/o87.2024.issue-002-en.xml>

⁷ Xu, S., & Wang, H. (2023). The role of green financing to enhance tourism growth by mitigating carbon emission in China. *Environmental Science and Pollution Research International*, 30(21), 59470. <https://doi.org/10.1007/s11356-023-26089-z>

⁸ Ibid



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- i. Green financing covers a range of tools, such as grants, green bonds, and public-private partnerships, which are briefly discussed below:
- ii. Green bonds are fixed-income financial products designed especially to generate capital for environmentally beneficial initiatives including sustainable land use, energy efficiency, and renewable energy. They give investors the chance to profit from their investments while simultaneously supporting eco-friendly projects.
- iii. Grants are sums of money given to certain projects by governments, nonprofits, or international organizations with no obligation of repayment. Small and medium-sized businesses (SMEs) in the tourism industry can benefit greatly from grants, which enable them to adopt sustainable practices without taking on debt.
- iv. Public-Private Partnerships (PPPs): These cooperative arrangements between private businesses and governmental organizations have the potential to raise funds for environmentally friendly travel projects. PPPs finance and carry out projects that benefit local communities and the environment by utilizing the assets of both sectors.
- v. Biodiversity Bonds: Financial instruments aimed at conserving natural habitats and promoting eco-tourism.
- vi. Debt-for-Nature Swaps: Agreements that redirect debt repayments toward conservation projects, exemplified by Seychelles’ initiative. This is an example of a government-restructured debt in exchange for pledges to protect marine habitats. This creative financing strategy showed how green financing can result in real environmental benefits by easing financial strain and enabling large investments in conservation initiatives.
- vii. Carbon Offset Program: Mechanisms that allow tourists and businesses to compensate for their carbon emissions by investing in renewable energy or reforestation projects

CHALLENGES FACED BY TOURISM'S SMALL AND MEDIUM ENTERPRISES (SMES) IN ACCESSING GREEN FINANCE

Accessing green finance is a major obstacle for tourism SMEs, which can limit their capacity to implement sustainable practices and support environmental preservation. High interest rates, difficult application procedures, and strict collateral requirements are some of these difficulties, which make it difficult to obtain the money required for environmentally friendly projects.⁹The high interest rates linked to green loans are one of the main challenges. High borrowing rates are a financial burden for many small and medium-sized tourism businesses, which may discourage them from making investments in environmentally friendly practices and technologies. This problem is exacerbated by the

⁹ IGI Global. (2024). Challenges and Sustainability of Green Finance in the Tourism Industry. Retrieved from <https://www.igi-global.com/chapter/challenges-and-sustainability-of-green-finance-in-the-tourism-industry/333975>



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fact that small and medium-sized tourism businesses sometimes lack sufficient collateral or financial records, which makes them less appealing to lenders than larger companies.¹⁰.

Another major obstacle is the intricate application procedures for green funding. For smaller enterprises that might not have the administrative resources or expertise, the documentation requirements and the complexities of qualifying for green financing can be too much to handle¹¹. Additionally, SMEs in the tourism industry may find collateral requirements especially difficult to meet. To obtain loans, financial institutions frequently demand significant collateral, which many small businesses are unable to supply. This keeps them from getting the money they need and feeds the loop of underfunding sustainable practices. Several tactics can be used to overcome these issues:¹²

- i. Financial institutions could develop specialized loan products with lower interest rates and more flexible terms specifically designed for tourism SMEs. This would make green financing more accessible and attractive to smaller businesses.
- ii. Streamlining the application process for green loans can help reduce the administrative burden on SMEs. Providing clear guidelines and support through workshops or online resources can empower these businesses to apply successfully.
- iii. Offering training programs focused on financial literacy and business management can equip tourism SMEs with the skills needed to prepare robust business proposals and effectively manage their financing needs.
- iv. Collaboration between governments, financial institutions, and tourism organizations can create supportive ecosystems that facilitate access to green finance. Initiatives like the Sustainable Island Mauritius project demonstrate how strategic partnerships can enhance knowledge sharing and improve financing conditions for SMEs. By addressing these barriers through targeted interventions, stakeholders can empower tourism SMEs to access green finance more effectively, enabling them to adopt sustainable practices that benefit both their businesses and the environment.

IMPORTANCE OF REGULATORY CONSISTENCY AND CAPACITY BUILDING

Regulatory consistency is crucial for creating a stable environment that encourages investment in sustainable tourism. Clear and coherent policies help build investor confidence and ensure that all stakeholders understand their roles and responsibilities. However, many regions face challenges related to technical capacity gaps among stakeholders, including government agencies, local communities, and private sector actors. Addressing these gaps is essential for effective policy implementation.

¹⁰ Fairoz, F.M., & J.A.T., C. (2020). Barriers of Implementing Green Business Practices of Small and Medium Scale Enterprises in the Tourism Industry. International Journal of Research in Social Sciences. Retrieved from <https://rsisinternational.org/journals/ijriss/Digital-Library/volume-2-issue-10/186-192.pdf>

¹¹ SSRN. (2022). The Challenges For SMEs In Green Finance Initiatives Adoption. Retrieved from https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID4232126_code3949121&mirid=1

¹² Ibid



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Capacity-building initiatives can enhance the skills and knowledge of stakeholders involved in sustainable tourism. This includes training programs focused on best practices in environmental management, financial literacy regarding green financing options, and community engagement strategies. By equipping stakeholders with the necessary tools and understanding, regulatory frameworks can be more effectively executed, leading to better outcomes for both the environment and local economies.¹³

POLICY SUPPORT FOR SUSTAINABLE TOURISM INITIATIVES

Effective policy frameworks are crucial for promoting green financing in the tourism sector. Governments can implement various policies that incentivize investments in sustainable practices, including tax breaks, grants, and low-interest loans. The United Nations World Tourism Organization (UNWTO) highlighted the significance of a supportive investment policy framework to accelerate green investments in tourism, which not only attracts funding but also aligns tourism development with broader environmental objectives.¹⁴

Policy support is essential for fostering sustainable tourism initiatives. Various frameworks have been developed to guide investments in this sector. The UNWTO has established guidelines that promote sustainable tourism investments, emphasizing the need for integrated approaches that align tourism development with environmental sustainability and social equity. These guidelines encourage stakeholders to adopt practices that contribute to the Sustainable Development Goals (SDGs), particularly in areas such as climate action, responsible consumption, and biodiversity conservation. The Components of Effective Policy Frameworks are:

- i. Financial incentives such as tax credits, rebates, grants, and low-interest loans are critical for attracting investments in renewable energy and sustainable tourism practices.
- ii. Governments must create comprehensive regulatory frameworks that support green financing initiatives. This includes establishing clear guidelines and standards for sustainable practices within the tourism industry.
- iii. Policies should be designed to ensure that tourism development aligns with national and international sustainability goals, including commitments to reduce carbon emissions and enhance biodiversity.

¹³ UNWTO Investment Guidelines (2021). UNWTO Investment Guidelines – Enabling Frameworks for Tourism Investment. Retrieved from <https://www.e-unwto.org/doi/book/10.18111/9789284422685>

¹⁴ Yaseen Eiweida (2024) How green demand can affect increasing demand for Sustainable Tourism available at ://www.solimarinternational.com/how-green-finance-can-address-the-increasing-demand-for-sustainable-tourism/#:~:text=The%20world%20of%20travel%20and,development%20of%20these%20necessary%20strategies.



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- iv. Continuous assessment of policy effectiveness is necessary to adapt to changing market conditions and stakeholder needs. This includes evaluating the impact of incentives on sustainable practices within the tourism sector.

Effective policy frameworks are therefore vital for facilitating green financing in tourism. By implementing supportive policies and creating an enabling environment for sustainable investments, governments can drive significant progress towards sustainable tourism development that benefits both the economy and the environment.¹⁵ The following are some examples of green financing initiatives in the tourism sector.

Seychelles’ Debt-for-Nature Swap In collaboration with The Nature Conservancy, Seychelles reallocated \$27 million of its national debt to fund marine conservation projects, establishing marine parks and supporting eco-tourism. This initiative has set a precedent for using innovative financial instruments to achieve sustainability goals.

Copenhagen’s CopenPay Initiative Copenhagen introduced a program rewarding tourists for sustainable behaviors, such as cycling and visiting cultural sites. Supported by Wonderful Copenhagen, this initiative reduced the city’s environmental impact while enhancing its appeal as a green destination.

Colombia’s Biodiversity Bond BBVA’s issuance of biodiversity bonds in Colombia funded projects focused on habitat restoration and eco-tourism, demonstrating the role of financial instruments in achieving dual economic and environmental objectives.

INNOVATIVE FINANCIAL INSTRUMENTS

Innovative technologies play a pivotal role in supporting green financing in the tourism sector, facilitating sustainable practices, and enhancing the overall efficiency of operations.¹⁶ The introduction of innovative financial instruments is vital for promoting sustainable tourism. Green bonds, for example, are increasingly being used to fund environmentally friendly projects within the tourism sector. These bonds attract investors who are interested in supporting sustainability while generating returns. Additionally, blended finance models that combine public and private funding can help mitigate risks associated with sustainable investments.¹⁷ By leveraging these instruments, tourism companies can secure the necessary capital to implement green initiatives. There are also important technologies that contribute to green financing initiatives in tourism some of these are:

1. **Blockchain Technology** - Blockchain technology offers transparency and security in financial transactions, making it an effective tool for green financing. By enabling traceability of funds,

¹⁵

¹⁶ ResearchGate (2024). Green Innovations in the Tourism Sector - ResearchGate. Retrieved from https://www.researchgate.net/publication/324112362_Green_Innovations_in_the_Tourism_Sector

¹⁷ Ibid



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blockchain can ensure that investments are directed towards genuine sustainable projects. This technology can also facilitate the issuance of green bonds by providing a clear record of how funds are utilized, thereby increasing investor confidence in the sustainability claims of tourism projects. The use of blockchain can help establish a more robust market for green investments by ensuring accountability and reducing the risk of "greenwashing"—where projects falsely claim environmental benefits.

2. Information and Communication Technology (ICT)- ICT-based solutions are essential for promoting sustainable tourism practices. These technologies can streamline operations, improve resource management, and enhance customer engagement. For instance, digital platforms can be used to promote eco-friendly accommodations and activities, allowing travellers to make informed choices that support sustainability. Additionally, ICT tools can facilitate data collection on environmental impacts, helping businesses measure their sustainability performance and attract green financing by demonstrating their commitment to environmental stewardship.

3. Smart Technologies -The integration of smart technologies, such as the Internet of Things (IoT) and artificial intelligence (AI), can significantly enhance the sustainability of tourism operations. Smart meters and sensors can monitor energy and water usage in real-time, allowing businesses to optimize resource consumption and reduce waste. AI-driven analytics can help operators identify areas for improvement in their sustainability practices, making it easier to secure funding for green initiatives by showcasing potential cost savings and environmental benefits.

4. Renewable Energy Technologies -Investments in renewable energy sources—such as solar panels, wind turbines, and geothermal systems—are crucial for reducing the carbon footprint of tourism operations. By adopting these technologies, tourism businesses can not only lower their operational costs but also enhance their appeal to environmentally conscious travellers. Green financing mechanisms can support these investments by providing access to low interest loans or grants specifically designated for renewable energy projects.¹⁸.

5. Green Building Technologies - Innovative construction materials and techniques that emphasize energy efficiency and sustainability are vital for developing eco-friendly tourism facilities. Technologies such as modular construction, sustainable materials sourcing, and energy-efficient design principles contribute to lower environmental impacts during both the construction and operation phases. Green financing options can incentivize developers to adopt these practices by offering favourable terms for projects that meet specific sustainability criteria.

CONCLUSION

¹⁸ ASERS Publishing (2024). Green Finance Supports Sustainable Environment: Empirical Approach - ASERS Publishing. Retrieved from <https://journals.aserspublishing.eu/tpref/article/view/8368>



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The future of sustainable tourism lies in transitioning from sustainability to regeneration, where the industry not only minimizes its ecological footprint but actively contributes to restoring natural environments and enhancing community well-being. This vision entails creating a tourism model that prioritizes ecological health, social equity, and economic resilience. By embracing regenerative principles, the tourism sector can become a catalyst for positive change, ensuring that destinations thrive while preserving their cultural and environmental heritage.

The adoption of innovative technologies is essential for advancing green financing in the tourism sector. By leveraging blockchain, ICT solutions, smart technologies, renewable energy systems, and green building practices, stakeholders can enhance their sustainability efforts while attracting private investment. These technologies not only improve operational efficiency but also provide a compelling case for securing funding aimed at promoting environmentally responsible tourism practices.

The research highlights the critical role of green financing and policy support in fostering sustainable tourism initiatives. Findings indicate that while there is a growing recognition of the need for sustainable practices within the tourism sector, significant challenges remain in accessing green finance, ensuring regulatory consistency, and implementing effective policies. The transition from traditional sustainable tourism to a more holistic regenerative approach is essential for creating long-term benefits for both communities and ecosystems. This paper bridges these gaps by offering a holistic view of how financing and policies can work together to overcome barriers and foster sustainable tourism.6. Challenges and Strategies.



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FINDINGS

- i. Innovative financial instruments, such as green bonds and public-private partnerships, are crucial for funding sustainable tourism projects. However, many tourism SMEs face barriers such as high interest rates and complex application processes that hinder their access to these funds.
- ii. Effective policy frameworks are necessary to guide sustainable practices in tourism. Regulatory consistency and capacity building among stakeholders are vital for the successful implementation of these policies.
- iii. The concept of regenerative tourism goes beyond merely minimizing negative impacts; it aims to restore and enhance ecosystems and communities. This shift requires a collaborative approach that includes all stakeholders in the tourism ecosystem.

RECOMMENDATIONS

- i. Develop clear, consistent regulations that promote sustainable practices while simplifying access to green financing for SMEs.
- ii. Implement capacity-building programs to equip local communities and businesses with the knowledge and skills needed for sustainable tourism development.
- iii. Foster public-private partnerships to leverage resources and expertise in promoting green initiatives.

The future of sustainable tourism lies in transitioning from sustainability to regeneration, where the industry not only minimizes its ecological footprint but actively contributes to restoring natural environments and enhancing community well-being. This vision entails creating a tourism model that prioritizes ecological health, social equity, and economic resilience. By embracing regenerative principles, the tourism sector can become a catalyst for positive change, ensuring that destinations thrive while preserving their cultural and environmental heritage. Through innovative financing mechanisms, supportive policies, and a commitment to regenerative practices, we can build a more sustainable future for the tourism industry that benefits both people and the planet.



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APPLICATION OF CLIMATE SMART AGRICULTURE APPROACH FOR AGRICULTURAL SUSTAINABILITY – REVIEW ARTICLE

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ABSTRACT

Climate-smart agriculture is an ideal approach to dealing with climate change, which has become a tangible reality, as climate-smart agriculture plays an important role in reducing the effects of climate change on the agricultural sector by being a new agricultural method to direct the required changes to agricultural systems to achieve the greatest possible food security, while paying attention to agricultural natural resources and reducing carbon emissions to the lowest possible level. The world has moved towards developing practical agricultural methods by making them more dependent on modern technological techniques and increasing their ability to adapt to climate change and meet the growing demand for food to meet the needs of population growth, which is known as climate-smart agriculture. The term smart agriculture has emerged as one of the results of the fourth technological revolution, as computational techniques, remote sensing devices, remote-operated machines and other modern tools and modern technological techniques have been adapted to increase the productivity and quality of agricultural crops and resist climate change through flexible smart agricultural practices that adapt to climate change. Mechanisms and criteria for transformation to implement the climate-smart agriculture approach

Ker Words: *Climate Smart Agriculture, Climate Change, Agricultural Sustainability*

INTRODUCTION



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Climate-smart agriculture is an ideal approach to dealing with climate change, which has become a tangible reality, as climate-smart agriculture plays an important role in reducing the effects of climate change on the agricultural sector by being a new agricultural method to direct the required changes to agricultural systems to achieve the greatest possible food security, while paying attention to agricultural natural resources and reducing carbon emissions to the lowest possible level. The world has moved towards developing practical agricultural methods by making them more dependent on modern technological techniques and increasing their ability to adapt to climate change and meet the growing demand for food to meet the needs of population growth, which is known as climate-smart agriculture. The term smart agriculture has emerged as one of the results of the fourth technological revolution, as computational techniques, remote sensing devices, remote-operated machines and other modern tools and modern technological techniques have been adapted to increase the productivity and quality of agricultural crops and resist climate change through flexible smart agricultural practices that adapt to climate change. Mechanisms and criteria for transformation to implement the climate-smart agriculture approach

Climate-smart agriculture is an approach developed by the Global Alliance for Climate-Smart Agriculture at the Food and Agriculture Organization (FAO).

The purpose of this approach is:

1. Increase the productivity and quality of agricultural production and thus increase farmers' income "economic dimension"
2. Reduce emissions resulting from various agricultural activities to the lowest possible level of "environmental dimension"
3. Implement good agricultural practices that are smart and climate-resilient, which are considered adaptation transactions or mitigation of the negative effects of climate change on the agricultural sector "social dimension"

The climate-smart agriculture approach acts to reduce the use of agricultural chemicals " synthetic fertilizers and pesticides" and other pollutants and work to preserve the agricultural environment to make it a sustainable agricultural environment. The approach also works to manage agricultural operations in a comprehensive manner and act to continuously improve them. Thus, gaining the confidence of farmers, suppliers, importers and consumers of fresh food.

Prospects for climate-smart agriculture for farmers:

Climate-smart agriculture is one of the main pillars for facing future challenges in the agricultural sector, whether for large investors or small farmers. It is expected that it will become necessary to apply this approach to ensure the sustainability of productivity and the limited resources facing countries, especially considering rapid climate change.

Climate-smart agriculture seeks to improve efficiency and reduce waste in the use of resources, which helps adapt to these challenges with the increasing interest in food security and reducing the effects of climate change. The application of climate-smart agriculture will be necessary to ensure the provision



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of food in a sustainable and safe manner for future generations. Moreover, global markets are increasingly moving towards sustainable agricultural practices, where it will be necessary to reduce the use of chemical fertilizers and pesticides, and reduce carbon emissions. In this context, it will be important to apply the climate-smart agriculture approach, which relies on modern technology in managing resources and achieving the highest levels of production and quality.

Also, with the move towards “organic agriculture” and global trade, tracking systems such as “barcodes” will be activated in international markets, which enhances the importance of implementing climate-smart agriculture and reducing the carbon footprint. Through this, farmers will be able to meet export requirements, while maintaining crop quality, thus improving competitiveness in global markets. Future expectations indicate that climate-smart agriculture will play a pivotal role in enhancing food security and increasing productivity under changing conditions, making it a promising option for the future in various parts of the world

Agriculture is the bedrock of sustainability of any economy (**Kekane, 2013**). It plays a key role in long term economic growth and structural transformation (**Syrquin, 1988**) though, may vary by country. In the past, agricultural activities were limited to food and crop production. But in the last two decades, it has evolved to processing, production, marketing, and distribution of crops and livestock products. Currently, agricultural activities serve as the basic source of livelihood, improving GDP (**Oyakhilomen, and Zibah, 2014**).

Climate smart agriculture, including the use of traditional and modern technologies, is critical to achieving a sustainable agricultural system through three main pillars: increasing agricultural productivity through the optimal utilization of natural resources and reducing greenhouse gas emissions. The phenomenon of global warming and adaptation to future climate change and mitigation. The application of climate smart agriculture will bring many benefits to the agricultural system by promoting improved horticultural and field productivity and access to safe and high-nutritious agricultural products and will reduce agricultural inputs such as pesticides and chemical fertilizers, which are a burden on the environment through pollution and emissions reduction, harmful pollutants and gases. The application of climate-smart agriculture depends on certain transactions that will eliminate or minimize greenhouse gas emissions. The carbon footprint means recognizing the number of emissions of any product during the production process of this product at different stages. Agricultural products, especially horticultural crops of vegetables and fruits.

The agriculture industry nowadays is experiencing rapid growth and adopting advanced technologies to bolster the overall yield of all crops. Accessibility of a huge amount of equipment and state of the art technologies like intelligent monitoring systems, drones, and robots, among others has totally revolutionized this important sector.

Advanced technologies such as remote sensing technology accompanied by 3D laser scanning are helpful and can provide crop metrics across thousands of acres of farming land. It can bring revolutionary changes from the perspective of time and efforts are monitored by the farmers. With the help of emerging solutions, farmers and farm enterprises can make better decisions during the farming as well as can assess a variety of things like weather conditions, temperature, water usage, or soil conditions in real-time.



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The Internet of Things (IoT) and Artificial Intelligence (AI) have been employed in agriculture over a long period of time, alongside other advanced computing technologies. However, increased attention is currently being paid to the use of such smart technologies.

Smart Agricultural is a global initiative to preserve resources and maintain sustainable agriculture (Bennett, 2014). Recently, researchers have adopted the Internet of Things (IoT) (Elijah et al., 2018), with a number of studies emphasizing the adoption and implementation of IoT in agriculture, farming, and irrigation (Jayashankar et al., 2018).

The Expert System is one of the applications of artificial intelligence in many fields such as medicine and agriculture. It is a computer program that simulates the specialized expert "expert group" which is consulted to solve a specific problem. Experiences needed by the user "farmer or agricultural producer" in a specialty to solve a specific problem, the expert system asks the user the same questions asked by the expert and from the user's answers the system reaches the appropriate solution. The practical application of the expert system in the agricultural sector has proved that it can contribute to solving many agricultural problems in record time, which positively reflects the increase in production.

Smart fertilizer technology in agriculture sector

Indeed, the best management practices for fertilization are those that support the achievement of the main goals of sustainability of agriculture: productivity, profitability and environmental health. One of the main pillars of this vision is smart fertilization to improvement in crop production (Manjunatha et al., 2016; Morales-Díaz et al., 2017). Nanotechnology can play an important part and role in promoting agricultural sustainability, after providing the viability of so-called "smart fertilizers". In other words, nanostructures act as a carrier of the nutrients and allow for controlled release.

Smart pesticides technology in agriculture sector

Chemical pesticides are mightily used to improve agriculture production and quality. However, chemical pesticides are unsuitable due to increase hazards for human health and environment. Nanotechnology has great potential to protect plants from diseases, viruses, pests, weeds, diagnoses of plant diseases, improve food yield and quality (Frewer et al., 2011; Sonkaria et al., 2012). Nonencapsulated pesticides can supply controlled release kinetics and improve solubility, permeability, stability, and efficiency (Kumar et al., 2019; Kumara et al., 2019). The utilization of nanotechnology to originate novel pesticide formulations has shown great possibility for providing environmentally safer alternatives. Smart nano-pesticides are intended to efficiently deliver enough effective ingredients in restraint to biotic and or abiotic stressors and potential to be used in agriculture (Haggag et al., 2018).

Bio Farming and Climate Change

Sustainable agriculture mitigates climate change and has the potential to adapt to climate. Sustainable agriculture, by definition, reduces damage to the environment, for example by limiting or removing pollutants such as pesticides and nitrogen fertilizers, water conservation practices, soil conservation practices, soil fertility restoration, and the conservation of agricultural biological diversity and



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biological diversity etc. An FAO review summarizes many of these environmental benefits in relation to organic farming. More importantly, sustainable agricultural practices can mitigate climate change. Bio agriculture, for example, uses fewer fossil fuel based inputs and has a better carbon footprint than traditional agricultural practices.

This is because traditional agricultural production uses more public energy than organic systems because of the heavy reliance on energy-intensive fertilizers, chemicals and concentrated feed, which is abandoned by organic farmers (Zeisemer, 2007).

Bio farming performs better than conventional one-hectare agriculture, in terms of both direct energy consumption (fuel and oil) and indirect consumption (synthetic fertilizers and pesticides), with high energy efficiency (Scialabba NEH, C Hattam 2002).

General indicators for measuring and verifying the application of climate-smart agriculture curriculum standards:

- 1- Estimating the extent of reducing carbon emissions from the agricultural sector compared to the baseline.
- 2- Estimating the extent of the per capita "farm" or farm – compared to the baseline "comparing carbon emissions before and after applying climate-smart and flexible agricultural practices and transactions".
- 3- Measuring the extent of growth and progress in the agricultural sector "farms that apply the criteria of climate-smart agriculture" compared to the baseline.
- 4- The percentage of increase in productivity and quality of farms applying the criteria of the climate-smart agriculture approach compared to the baseline.
- 5- Evaluation of the performance and development of the monitoring and early warning system for the effects of climate change on the agricultural sector.
- 6- Evaluation of the crisis management plan related to climate change and its effects on the agricultural sector system.
- 7- Evaluation of progress in performance indicators related to climate change.
- 8- Evaluating the volume of investments directed to the agricultural sector to combat climate change.
- 9- Evaluation of the volume of policies and projects supporting measures to mitigate and adapt to climate change and its impact on the agricultural sector.
- 10- Evaluation of the existence of a database of research efforts in the field of climate change.

Proposed standards for the climate-smart agriculture curriculum



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The criteria for the climate-smart agriculture approach must consider the pillars of the approach, which are as follows:

- 1- Increasing the productivity and quality of the agricultural sector and increasing the incomes of farmers and agricultural producers.
- 2- Act to reduce carbon emissions to the lowest possible level.
- 3- Act on conducting smart, flexible agricultural transactions and practices that contribute to acclimatization and mitigate the effects of climate change on the agricultural sector.

Adaptation practices

- 1- Intercropping agricultural crops.
- 2- Irrigation systems management.
- 3- Modern farming systems "soilless farming - hydroponic."
- 4- Conducting the grafting process in some vegetable crops to adapt to unfavorable conditions.
- 5- Using solar energy to operate irrigation machines.
- 6- Establishing agricultural meteorological stations and taking advantage of weather information to provide smart agricultural guidance on programs on farmers' mobile phones.
- 7- Production of industrial organic fertilizers "compost" by recycling the residues "agricultural waste."
- 8- Biogas production.
- 9- Fodder production "from the remains of agricultural crops"
- 10- Cultivation and cultivation of barley as "non-traditional fodder."
- 11- Cultivation on bales of "the remains of some agricultural crops."
- 12- Cultivation and production of mushrooms.
- 13- Establishing environmental services that achieve the concept of innovation and technology, such as irrigation using solar energy, growing algae, growing Paulina trees....etc.
- 14- Establishing an eco-tourism program.
- 15- Recycling palm waste to produce high-value environmental products.
- 16- Programs to encourage industries that depend on agricultural crops
- 17- Building the capacities of the agricultural community to face the effects of climate change.
- 18- Establishing an information center for agricultural climate change.
- 19- Establishing greenhouses to produce agricultural seedlings adapted to climate changes.



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- 20- Programs to support fishing as an economic activity complementary to agricultural activity.
- 21- Courses of maintenance, follow-up and environmental monitoring of the negative effects resulting from reducing pollution affecting crops and livestock.
- 22- Establishing a green belt around agricultural and residential areas as well.
- 23- Establishing a partnership system to monitor emissions and electronic control of factories in order to preserve the surrounding agricultural environment
- 24- Establishing a special unit for agricultural climate research, in partnership with development partners, to control marketing crops

Methods for improving agriculture:

In order for the agricultural sector to play its full role in economic and social development, some methods and approaches must be applied that will help increase and improve agricultural production, including the following:

- Good planning for the growth of the agricultural sector and investing it properly
 - Developing a clear and accurate agricultural policy
 - Monitoring the annual production of fields and evaluating their performance
 - Planting seeds for good and improved varieties of horticultural and field crops
 - Using appropriate means for water drainage
 - Getting rid of harmful weeds early
 - Rationalizing the use of agricultural fertilizers, and choosing the appropriate ones
 - Maintaining and preserving natural resources
 - Providing experts and trained workers to develop agricultural development projects
 - Raising the level of agricultural production in line with the interests of the national economy
 - Achieving harmony and integration between the various branches of agricultural activity
 - Benefiting from the results of agricultural scientific research in the applied field

Smart Agricultural Automation:

Harvesting by agricultural automation and robotics is one of the key technologies in modernizing agriculture.

For the world's agricultural production countries, including the United States, Japan, the Netherlands, the United Kingdom, Belgium, etc., agricultural automation has become the hottest trend today.

Usually, design companies will provide their various solutions for harvesting vegetables and fruits.

- The role of Internet Things in smart agriculture.

Practical applications of Internet of Things in agriculture:

Soil and crop monitoring

Precision agriculture and input management

Livestock monitoring and management

Greenhouses and indoor agriculture automation



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Weather and environment monitoring
Smart irrigation and water management
Supply chain tracking and marketing
Sensors and IoT devices

A vast ecosystem of connected sensors spread across fields measures and monitors key data points such as humidity, temperature, rainfall, soil nutrients, leaf health, agricultural equipment operations, and many other agricultural factors.

- Artificial Intelligence Technologies and Their Uses in Smart Agriculture

- 1- Monitoring Crop and Soil Health
- 2- Detecting Insects and Plant Diseases "Agricultural Pests"
- 3- Monitoring Livestock Health
- 4- Smart Pesticide Spraying
- 5- Automatic Weed Removal
- 6- Aerial Survey and Photography
- 7- Classifying and Sorting Agricultural Products

The need to apply the climate-smart agriculture approach:

Working to spread and localize climate-smart agriculture applications and technologies will inevitably result in maximizing agricultural production, through:

Improving the efficiency of using all agricultural inputs (fertilizers and pesticides)

Improving the efficiency of using agricultural machinery

Improving crop productivity

Ensuring an appropriate profit for agricultural projects and farmers

Preserving natural agricultural resources from water sources and agricultural soil

Help in making decisions quickly by relying on software and programs on mobile phones

Using short messages "SMS" in advisory and awareness activities to communicate with farmers.

When these technologies and practices are applied together, by different stakeholders "small farms":

Reduces water loss

Reduces land degradation

Increases soil water availability

Gives equitable distribution of water resources

Enhances agricultural production and productivity

Enhance food security

Creates resilience to climate change

Economic feasibility of implementing the climate-smart agriculture approach:

The application of climate-smart agriculture will achieve many benefits for the agricultural system from improving agricultural horticultural productivity and obtaining safe, healthy and high-nutritional agricultural products and will reduce the use of various agricultural inputs "synthetic fertilizers and chemical pesticides" which are considered a factor of pollution of agricultural resources of land and



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water and reduce harmful emissions. Accordingly, the use of the climate-smart agriculture approach and practices will achieve an agricultural renaissance and a significant agricultural economic addition. It is worth noting that the use of the climate-smart agriculture approach will not entail any additional economic burdens, but on the contrary will achieve a high economic return in the short and long term. The first steps necessary to start implementing the climate-smart agriculture approach:

The first step to spread the climate-smart agriculture approach is to communicate the concept of climate-smart agriculture to producers and farmers through agricultural awareness, traditional and smart agricultural guidance, agricultural media, and other means of communication with producers and farmers.

The second step is to benefit from the experiences of countries that preceded us in joining the Global Alliance for Climate-Smart Agriculture and work to benefit from them and from the success stories of climate-smart agriculture in different countries.

The third step is to continue attending and participating in global conferences and forums related to climate-smart agriculture, especially the annual forum of the Global Alliance for Climate-Smart Agriculture.

The fourth step is to evaluate the performance and manage the application of climate-smart agriculture in the field.

CONCLUSION:

Climate smart agriculture aims to provide modern sustainable agricultural practices and transactions and provide best practices for all agricultural transactions from smart irrigation, controlled fertilization, flexible pest control, and following modern agricultural systems such as hydroponics, soilless agriculture, vertical agriculture, marketing services, and veterinary services in animal, poultry and fish production. It also provides marketing services to small farmers and the best sources for obtaining production requirements from seeds, equipment, and raw materials. It also works on the possibility of direct electronic communication with experts through voice and video calls, in addition to the possibility of exchanging messages and pictures between experts and the farmers' audience.

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INVESTIGATION OF HEAVY METAL CONTAMINATION AT A FORMER CANNERY IN HALÁSZTELEK

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ABSTRACT

Today, pollution of our environment with heavy metals and other toxic elements is rising. These can enter the soil and, through plants, the food chain and, ultimately, the human body. The study area of the present work is in the northern part of the municipality of Halásztelek. It was formerly the site of a canning factory, which stored barrels and other materials after ceasing its original activities. An investigation assessed the site's possible contamination with heavy metals. Sampling points in the area were selected according to the standard MSZ 21470-1:1998. Concentrations of the following heavy metals were determined: iron, manganese, copper, zinc, cadmium, chromium, lead, and nickel using a Jobin-Yvon 24 ICP-OES. Digestion was carried out by a Milestone 1200 mega microwave digester, and the pH of soil samples was measured by an OP-211 pH meter (Radelkis, Budapest). For statistical evaluation, a two-factor variance analysis was performed using SPSS 16.0 for Windows. According to the results, the concentration of heavy metals in all samples (except sampling site 3) did not exceed the limits set by the Joint Decree 6/2009. Therefore, the area is not considered contaminated, except for the cadmium in-depth sample from sampling site 3, which exceeded the contamination limit set in the Regulation by a factor of two and a half and is therefore considered contaminated, and the nickel content, which also exceeded the limit set in the Regulation and is therefore considered contaminated for nickel content.

Keywords: ICP-OES, heavy metal, pollution, soil



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INTRODUCTION

The population of the Earth is inevitably growing [1]. It is necessary to manufacture increasingly more foods for the population's supply, but this is not easy. Unfortunately, universally, it can be related that the soils are worn out because of human irresponsibility primarily, eroded or they will be more contaminated [2]. The technique developed nowadays is that certain plants can be produced without soils, but some primary plants cannot be economically produced. Therefore, it is necessary to estimate and preserve the condition of the soils and improve their quality, but prevention is the most important. Nowadays, we hear more and more about environmental pollution [3], hopefully encouraging us to protect from it. Pollutants of all kinds, including heavy metals, can damage wildlife. Of course, pollutants can enter the food chain and cause disease [4] without sparing humanity. These pollutants have become increasingly important in the modern age, as their harmful effects are already known [5]. Humanity started polluting the environment when it turned to coal instead of wood for fuel. Since the Industrial Revolution, this impact has been multiplied, with the emergence of smog [6] in England, for example.

Since the Second World War, the pace has accelerated even more with the introduction of new materials and new manufacturing technologies. Today, the primary sources of pollution are transport, increasing waste and wastewater production, industry, and, not least, agriculture [7]. Most pollutants are released into the air and then settle as dust, contaminating soil and groundwater [8]. This shows that pollutants can travel a very long way, so it is essential to be aware of not only our environment but also the environment of others.

Chemical pollution, incredibly toxic heavy metals, is crucial as it damages the whole ecosystem, including human health. Therefore, it is essential and appropriate to monitor our environment and, if contamination occurs, take the necessary action [9].

Protecting soils is paramount, as plants feed on the soil and accumulate pollutants, which can enter the human body through plants and animals. Soil is thus the most essential part of the whole food chain [10].

Of course, not all heavy metals can be considered toxic. However, the long chemical evolution of the biosphere has allowed some microelements to become essential, i.e. chemical evolution has been followed by biological evolution, and life has evolved [11].

Non-toxic metals are called essential metals, or microelements, which are essential for the functioning of the living organism (e.g. Fe, Cu, Zn, Mn and Mo), but can become toxic if taken in excess, and deficiencies can lead to deficiency diseases [12].

People living in urban environments [13, 14] are potentially exposed to the effects of heavy metal pollution. Most sources of pollution (transport, factories) are concentrated in larger cities, so the effects of pollution are more pronounced. Therefore, searching for toxic elements within residential areas was considered appropriate.

The present study area is in the northern part of Halásztelek. The former factory has been dismantled and demolished. The area has been parcelled, and houses and gardens have been built. It was, therefore,



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appropriate to investigate whether there was heavy metal contamination in the area and whether there was any risk to the health of the people living there.

The area has been parcelled up, and houses and gardens have been built, which is why we started our investigations to determine whether there is any heavy metal contamination or whether there is any risk to the health of the people living there.

The aim of the investigation was:

- to determine the possible presence of heavy metal contamination and pollution (cadmium, lead, iron, copper, manganese, zinc, nickel) in the area
- to assess the risks of contamination

MATERIALS AND METHODS

Sampling area

The study area is in the northern part of the municipality of Halásztelek. Halásztelek (see Figure 1) is located on the island of Csepel, the largest island (257 km²) in the lowland section of the Danube, with a length of more than 50 km. The island is characterised by a flat lowland landscape, with gravel deposited by the Danube at 98 metres above the sea level. The terraced islands are characterised by river sand. The municipality is also a lowland landscape in terms of topography and climate. The annual daylight hours are around 2000 hours, the mean temperature in June is above +20°C, the mean temperature in January is between -1°C and -2°C, and the mean annual temperature is between 10°C and 10.5°C. The annual rainfall is between 500 and 600 mm. Nowadays, the prevailing wind direction is north-west to west [15].

The soil structure is characterised by meadow moulding, with a layer of clay and sand above 5 m and a layer of gravel below. The water level of the Danube also influences the position of the soil and layer waters, their movement being in an NW-SE direction. The water table is generally 2-6 m, which depends on the Danube water level. Several drinking water catchments are located along the village, from which the coastal filtered water is extracted and supplied to the surrounding settlements, and the water demand of the capital is also served from there [16].

The study area was previously a food processing factory, where a cold storage and processing industry was established. The acidification factory established in Halásztelek was called “Csepeli Duna Nektár” Ltd.



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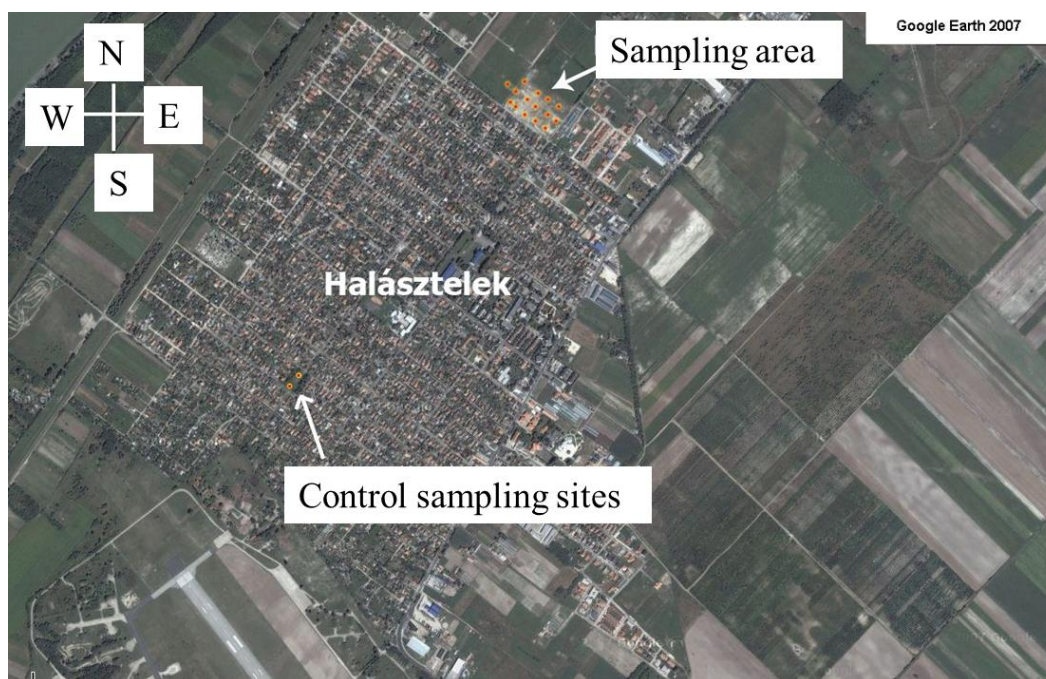


Figure 1: Sampling areas in Halásztelek

The factory was permanently dismantled in 2006, a process that took several years, and its function was replaced by storage after its original operation closed.

Since the heavy metals that may be released into the soil act as a potential source of pollution, this area was chosen to determine the concentration of these substances in the soil.

An insight was gained into the General Geotechnical Report of sampling area 14, which was used with the owner's permission and for which data from previous soil excavations in the surrounding area were used. On this basis, it was established, that the surrounding ground surface is completely flat - a consequence of previous landscaping. "The results of the surface excavation in the area show, that the ground surface is covered with an average of 20-40 cm of fill consisting of humic sand mixed with construction debris. Underneath, a fine Danube sediment, yellowish-grey silty sandy silt, typical of the surrounding area, is present." [17].

The soil sampling supported the general geotechnical opinion interpreted for this sampling point, and similar soil structure was encountered for the other sampling points, although it was not always possible to reach the desired layer (point 8 depth) and not always a surface sample was taken (point 9 surface-gravel). In addition, some sampling points had to be moved because they were entirely unsuitable for drilling (built-up area, large amounts of debris in the soil, etc.) - this is illustrated by the changed grid in Figure 2.



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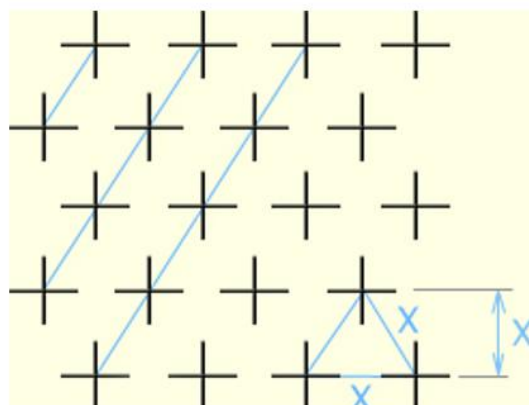


Figure 2: Sampling grid (drawn according to [18])

Soil sampling, soil tests

Soil sampling procedure

Sampling and the selection of sampling points were performed initially according to [18], i.e. according to the sampling method and sampling grid defined in the standard. However, for technical reasons, a minor modification had to be applied, i.e. deviations from the points specified in the grid were necessary in two cases for technical reasons.

The technical reasons include the impracticality of drilling and the inaccessibility of the sampling site. The distance between two adjacent points is 41.6 metres.

The sampling raster is overlaid on the Google Earth 2004 satellite image (see Figure 3), with the original raster in blue and the raster overlaid on the actual sampling points (yellow) in red. The former location of the eradicated objects has been considered when including the sampling points. The distance of the sampling points and the raster position were optimised according to the location of the former facilities. The height of the sampling area above sea level is 100 m (Institute for Surveying and Remote Sensing). The control samples were taken from an area with a similar soil structure (sandy-humic sandy soil) and less pollution exposure. A bird's eye view of the sampling area and the control sampling sites is shown in Figure 3.

The samples were taken with a 6 cm diameter hand drill made of stainless steel. The applicable length of the auger was 100 cm, which allowed samples to be taken from a depth of 90 cm, but this was not always possible, so the average depth drilled was about 70 cm. During the sampling, a surface-protected shovel was used to remove vegetation and surface root systems, leaving the drilling clear. Two samples per sampling point were taken: a surface sample, which is a mixed average sample taken from a depth of 10-30 cm from the soil surface, and a depth sample, which is also a mixed average sample. GPS equipment was used to determine the coordinates of the sampling points.



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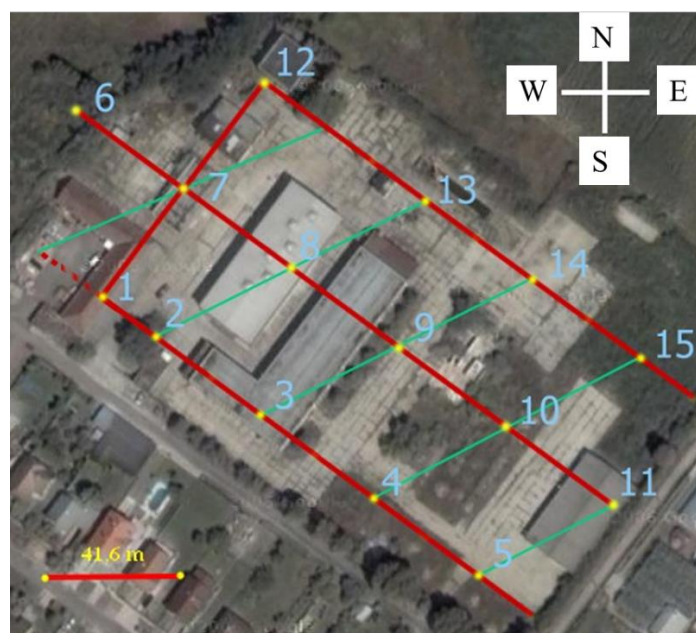


Figure 3: Sampling area

Determination and preparation of soil dry matter content, pH, measurement of heavy metal concentrations

The dry matter content was determined according to [19].

The pH of the soil samples was determined according to [20].

Digestion of soil samples

The samples were digested according to the standard [21], and the digestion of the samples was performed by microwave-assisted excavation, which is now considered one of the most modern methods. The samples were digested in a Milestone 1200 mega microwave digester.

The temperature, the time and the microwave current are determined by software (see Table 1).

The process of digestion:

The soil for digestion was weighed on an analytical balance at approximately 0.5 g and placed in the digestion vessel. I then added 5 cm³ of 65 % HNO₃ and 2 cm³ of 30 % H₂O₂ to the soil placed in the Teflon flasks. The caps were then hermetically sealed and digested according to Table 1 and cooled for half an hour after digestion. After cooling, the digest was opened under a hood, weighted into 25 cm³ flasks, filled to the mark with double distilled water, transferred to a plastic container after homogenisation, and stored in the refrigerator until the start of the measurement.



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Table 1: Digestion program

Step	Time (minutes)	Power (W)
	Soil	Soil
1.	5	250
2.	2	0
3.	5	400
4.	5	250
5.	7	700
Ventilation: 00:05:00 Rotorctrl: on Twist: on		

Determination of the concentration of heavy metals

The composition of the samples was analysed for eight elements (Cd, Cu, Cr, Fe, Mn, Pb, Zn, Ni) using a Jobin-Yvon 24 ICP-OES instrument according to [21].

As a first step, the instrument was calibrated. For the calibration, the standard solution was 70008-100 ML Multielement Atomic Spectrophotometer from Sigma-Aldrich Ltd.

Table 2: The instrument measured the elements at the following wavelengths

Element [□]	Wavelength·(nm) [□]
Cr [□]	283.563 [□]
Cd [□]	214.438 [□]
Cu [□]	324.754 [□]
Pb [□]	220.353 [□]
Ni [□]	221.647 [□]
Fe [□]	238.204 [□]
Mn [□]	257.610 [□]

Statistical evaluation

Data obtained were subjected to random block arrangement ANOVA. The SPSS 16.0 software package performed the statistical calculations.

In the statistical analysis of the data, answers were searched for to the following questions:

- ✓ Does soil heavy metal concentration depend on the sampling site (factor A) (P=5%)?



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- ✓ Is there a significant difference between the amount of heavy metals in surface and deep soil samples (factor B) (P=5%)?

RESULTS AND DISCUSSIONS

Heavy metal concentrations in soil samples

With the ICP-OES instrument, the concentration of the samples is given in mg/1000 cm³ solution, so the concentrations of the soil samples tested were converted to mg/kg soil dry matter.

The legislation on heavy metal contamination is Joint Decree No 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management on the limit values necessary for the protection of the geological environment and groundwater against pollution and on the measurement of pollution [22].

pH values of soil samples

Table 3: pH values of soil samples

Site	pH _(H₂O)	SD	pH _(KCl)	SD	Site	pH _(H₂O)	SD	pH _(KCl)	SD
9m	7.87	0.11	7.6	0.06	9m	7.87	0.11	7.6	0.06
10f	8.23	0.01	7.8	0.02	10f	8.23	0.01	7.8	0.02
10m	8.16	0.04	7.67	0	10m	8.16	0.04	7.67	0
11f	8.25	0.02	7.91	0.11	11f	8.25	0.02	7.91	0.11
11m	8.56	0.01	8.17	0.01	11m	8.56	0.01	8.17	0.01
12f	8.7	0.17	8.14	0.03	12f	8.7	0.17	8.14	0.03
12m	8.41	0.01	8.35	0.16	12m	8.41	0.01	8.35	0.16
13f	8.67	0.31	8.1	0.04	13f	8.67	0.31	8.1	0.04
13m	8.59	0.13	8.24	0.06	13m	8.59	0.13	8.24	0.06
14f	7.99	0.25	7.66	0.02	14f	7.99	0.25	7.66	0.02
14m	8.49	0.07	8.13	0	14m	8.49	0.07	8.13	0
15f	8.29	0.01	8.33	0.06	15f	8.29	0.01	8.33	0.06
15m	8.25	0	8.23	0.09	15m	8.25	0	8.23	0.09
k1f	8.42	0.04	7.62	0.03	k1f	8.42	0.04	7.62	0.03
k1m	8.62	0.02	8.03	0.03	k1m	8.62	0.02	8.03	0.03
k2f	7.63	0.05	7.51	0	k2f	7.63	0.05	7.51	0
k2m	8.43	0.01	7.65	0.01	k2m	8.43	0.01	7.65	0.01



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The average pH value of soil samples is $\text{pH}(\text{H}_2\text{O}) = 8.34$; $\text{pH}(\text{KCl}) = 7.95$. It can be concluded that the pH value of the soil samples can be considered slightly alkaline.

Heavy metal content of samples

Iron concentration in the study area

The average iron content of all soil samples (Figure 4) is 13551,4904 mg/kg soil dry matter.

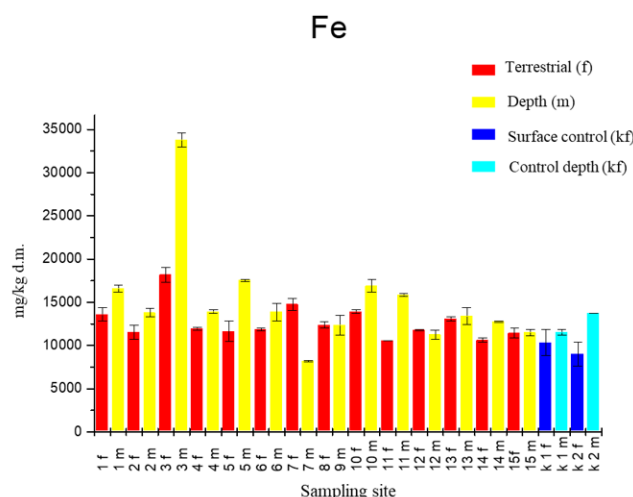


Figure 4: Iron concentration in soil

According to Szabó [23], the total iron content in domestic soils varies between 4 and 6%, and according to Papp-Kümmel [24], the iron concentration in soils is 4%. According to measurements, the iron concentration of the soil samples from the sampling area and the soil samples from the control area was less than this (1.36%). The average iron concentration of the soil samples from the sampling site (factory) was 13892.4935 mg/kg d.m. (dry matter), while the average iron concentration of the soil samples from the control area was 11164.4692 mg/kg d.m.), and no significant difference was found between them by statistical analysis. The difference in the average iron content of the surface (12286.3164 mg/kg d.m.) and deep (14816.6645 mg/kg d.m.) soil samples from the sampling site is 2530.3481 mg/kg soil dry matter content. The average iron content is higher in the deep soil samples, as confirmed by the analysis of variance, and the iron concentration in the soil samples is significantly related to the sampling location and sampling depth (for factor A: $\text{LSD}_{5\%} = 962.903$; for factor B: $\text{LSD}_{5\%} = 481.452$). The iron content of the depth soil sample from sampling site 3 is more than twice the mean (33788.8231 mg/kg d.m.); otherwise, there are no outliers. No contamination limit is set for iron content in Joint Decree No 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management on the limit values necessary for the protection of the geological environment and



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groundwater against pollution and the measurement of pollution [22]. Table of variance analysis for iron content are given in Table 4.

Table 4: Table of variance of iron content

Factors	SS	df	MS	F	Sig.	LSD _{5%}
Corrected model	1.179E9	31	3.802E7	85.074	.000	
Correction factor	1.175E10	1	1.175E10	26297.361	.000	
Sample site	7.694E8	15	5.129E7	114.766	.000	962.903
Surface/depth	1.024E8	1	1.024E8	229.213	.000	481.452
Sample site; Surface/depth	3.069E8	15	2.046E7	45.772	.000	
Error	1.430E7	32	446932.48 9			
Total	1.295E10	64				
Corrected total	1.193E9	63				

a. $R^2 = 0.988$ (Corrected from $R^2 = 0.976$)

Manganese concentration in the study area

All soil samples have an average manganese content (Figure 5) of 0.2911 mg/kg soil dry matter. The difference in the average manganese content of the surface (0.2749 mg/kg d.m.) and deep (0.3072 mg/kg d.m.) soil samples from the sampling site is 0.0323 mg/kg soil dry matter.

This manganese content is well below the average. The average manganese content of soils in Hungary is between 100 and 1100 mg/kg [25]; according to Stefanovits et al. [26], this value is between 20 and 800 mg/kg and at some soil levels it can be up to 3000 mg/kg.

The average manganese concentration of the soil samples from the sampling area (factory) was 0.2942 mg/kg d.m. The average manganese concentration of the soil samples from the control area was 0.2689 mg/kg d.m.); statistical tests show no significant difference between them. The average manganese concentration in the depth soil samples is higher, as confirmed by the analysis of variance, and the manganese concentration of the soil samples is significantly related to the sampling location and sampling depth (for factor A: $LSD_{5\%} = 0.0297$; for factor B: $LSD_{5\%} = 0.0106$).



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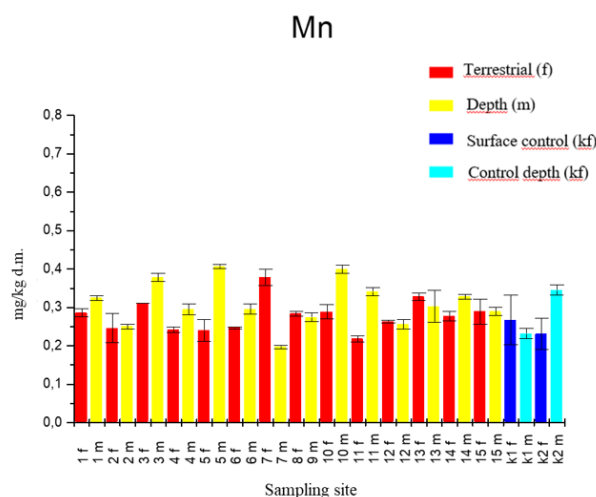


Figure 5: Manganese concentration in soil

There is no outlier between sampling sites for manganese content. No contamination limit for manganese is set in Joint Decree No 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management on the limit values necessary for the protection of the geological environment and groundwater against pollution and the measurement of pollution [22]. Tables of variance analysis for manganese are given in Table 5.

Table 5: Variance table of manganese content

Factors	SS	df	MS	F	Sig.	LSD _{5%}
Corrected model	.170 ^a	31	.005	12.719	.000	
Correction factor	5.423	1	5.423	12602.388	.000	
Sample site	.053	15	.004	8.259	.000	.0297
Surface/depth	.017	1	.017	38.885	.000	.0106
Sample site; Surface/depth	.100	15	.007	15.434	.000	
Error	.014	32	.000			
Total	5.606	64				
Corrected total	.183	63				

a. $R^2 = 0.925$ (Corrected from $R^2 = 0.852$)



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Copper concentration in the study area

The average copper content of all soil samples is 12.2194 mg/kg soil dry matter (Figure 6). The difference in the average copper content between the surface (12.0245 mg/kg d.m.) and the deep soil samples (12.4144 mg/kg d.m.) from the sampling site is 0.3900 mg/kg soil dry matter. Based on the analysis of more than 1,000 soil samples, the average soil copper content in Hungary is between 1 and 197 mg/kg d.m. [26], whereas Szabó et al. [23], referring to the work of Győri [27], found an average copper content of 3.2 to 38 mg/kg d.m. in Hungarian soils.

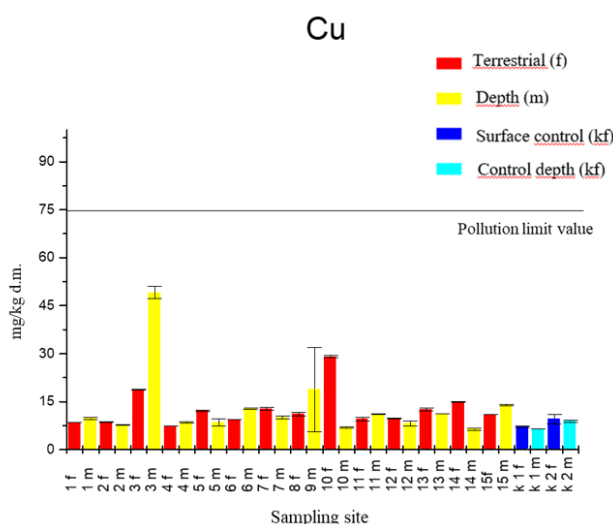


Figure 6: Copper concentration in soil

In soil samples, the copper content is present in average concentrations. The average copper content of the soil samples from the sampling area (factory) is 12.8137 mg/kg d.m., the average copper concentration of the soil samples from the control area is 8.0594 mg/kg d.m., and statistical tests show that there is no significant difference between them.

The average copper content is higher in the depth soil samples, which was confirmed by the analysis of variance, and the copper concentration in the soil samples is significantly related to the sampling location and sampling depth (for factor A: $LSD_{5\%}=3.444$; for factor B: $LSD_{5\%}=6.511$).

There are no exceptionally high or low copper concentrations among the sampling sites, except for the above-ground (29.1059 mg/kg d.m.) and deep (49.1339 mg/kg d.m.) soil samples from sampling sites 10 and 3, respectively, which have higher than average copper concentrations.

The contamination limit value is set by Joint Decree No 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management on the limit values necessary for the protection of the geological environment and groundwater against pollution and the measurement of pollution [22] at



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75 mg/kg d.m., so the area is not considered contaminated, and the limit value is not exceeded at any of the sampling sites. The result of the variance analysis for the copper content is shown in Table 5.

Table 5: Variance table of copper content

Factors	SS	df	MS	F	Sig.	LSD _{5%}
Corrected model	4066.538 ^a	31	131.179	22.942	.000	
Correction factor	9556.113	1	9556.113	1671.248	.000	
Sample site	2463.476	15	164.232	28.722	.000	3.444
Surface/depth	2.432	1	2.432	.425	.519	.511
Sample site; Surface/depth	1600.630	15	106.709	18.662	.000	
Error	182.974	32	5.718			
Total	13805.626	64				
Corrected total	4249.513	63				

a. $R^2=0.957$ (Corrected from $R^2=0.915$)

Zinc concentration in the study area

All soil samples had an average zinc content (Figure 7) of 42.8250 mg/kg d.m. soil dry matter. According to Papp-Kümmel [24], the typical zinc content of the soil is 60 mg/kg d.m. According to Szabó et al. [23], this value varies over a wide range, with the lowest zinc content (30 mg/kg d.m.) in sandy soils typical of both the sampling and control sampling areas.

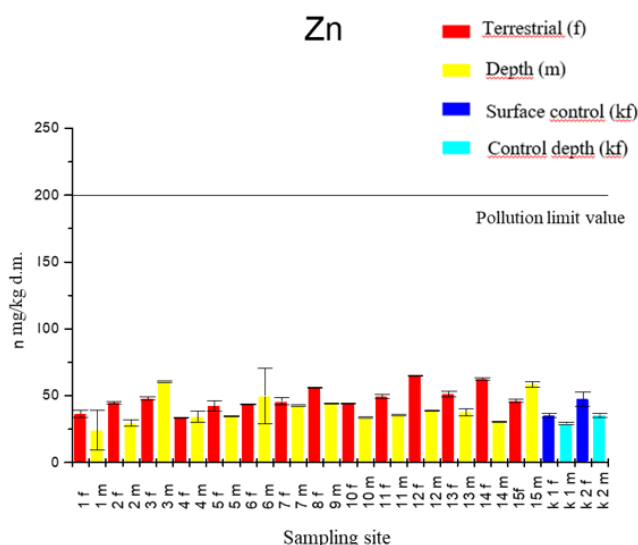


Figure 7: Zinc concentration in soil



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The measured results also support these statements. The average zinc concentration of the soil samples from the sampling area (factory) is 43.6835 mg/kg d.m., the zinc content of the soil samples from the control sampling area is 36.8151 mg/kg d.m., and statistical tests show that there is no significant difference between them. The difference between the average zinc content of the surface (46.9342 mg/kg d.m.) and deep soil samples (38.7158 mg/kg d.m.) from the sampling site is 8.2184 mg/kg d.m. soil dry matter content.

The zinc content is, on average, higher in the surface soil samples, which was confirmed by the analysis of variance, and the zinc concentration in the soil samples is significantly dependent on the sampling location and sampling depth (for factor A: $LSD_{5\%}=9.920$; for factor B: $LSD_{5\%}=2.481$).

There is no outlier between sampling sites for zinc content. The contamination limit value is set at 200 mg/kg d.m. by Joint Decree No 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management on the limit values necessary for the protection of the geological environment and groundwater against pollution and on the measurement of pollution [22], so the area is not considered contaminated. The results of the variance analysis for zinc are shown in Table 6.

Table 6: Table of variance of zinc content

Factors	SS	df	MS	F	Sig.	$LSD_{5\%}$
Corrected model	6506.588 ^a	31	209.890	8.848	.000	
Correction factor	117374.674	1	117374.674	4948.152	.000	
Sample site	3212.480	15	214.165	9.029	.000	9.92
Surface/depth	1080.659	1	1080.659	45.557	.000	2.481
Sample site; Surface/depth	2213.450	15	147.563	6.221	.000	
Error	759.069	32	23.721			
Total	124640.332	64				
Corrected total	7265.657	63				

a. $R^2 = 0.896$ (Corrected from $R^2 = 0.794$)



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Chromium concentration in the study area

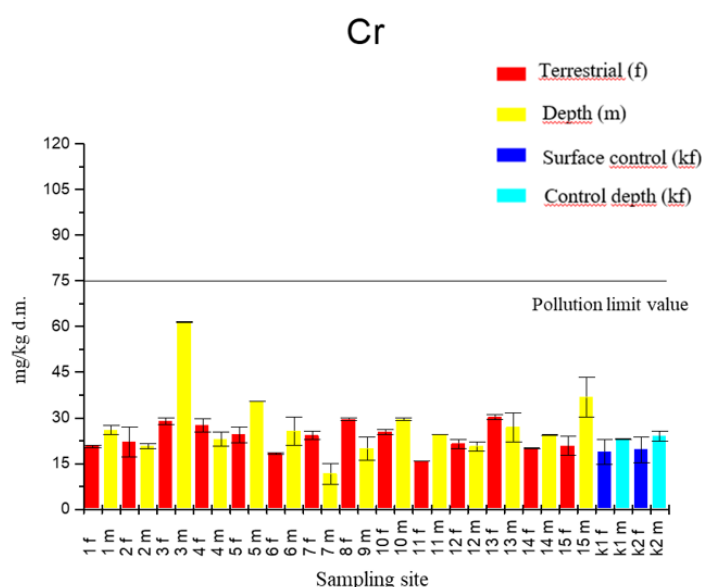


Figure 8: Chromium concentration in soil

All soil samples had an average chromium content (Figure 8) of 25.0634 mg/kg soil dry matter. According to Kádár [9], the regular chromium content of soils is between a few ppm (=mg/kg) and 100 ppm, but the chromium content of so-called serpentine soils can be 1000-3000 ppm, Pais [28] says that in most soils the chromium content is less than 1000 ppm, in serpentine soils it is 1-2%, so it can be concluded that the chromium content of the sampling sites is not extreme, reflecting the natural chromium content of the soil.

The average chromium concentration of the soil samples from the sampling area (factory) is 25.5924 mg/kg d.m. and the average chromium concentration of the soil samples from the control area is 21.3606 mg/kg d.m. and statistical tests show that there is no significant difference between them.

The difference in the average chromium content of the surface (23.0040 mg/kg d.m.) and deep soil samples (27.1228 mg/kg d.m.) from the sampling site is 4.1188 mg/kg soil dry matter content. The average chromium content is higher in the deep soil samples, which was confirmed by the analysis of variance, and the chromium concentration in the soil samples is significantly related to the sampling location and sampling depth (for factor A: $LSD_{5\%}=3.702$; for factor B: $LSD_{5\%}=1.308$).

The chromium content of the deep soil sample from sampling location 3 (61.4801 mg/kg d.m.) is higher than average but below the contamination limit, and the chromium content of the deep soil sample from sampling location 7 is lower than average (11.7137 mg/kg d.m.), except for these no exceptionally high or low values.



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Contamination limit values are set at 75 mg/kg d.m. for chromium in Joint Decree No 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management on the limit values necessary for the protection of the geological environment and groundwater against pollution and the measurement of pollution [22].

The results of the variance analysis for chromium are shown in Table 7.

Table 7. Table of variance of chromium content

Factors	SS	df	MS	F	Sig.	LSD _{5%}
Corrected model	4410.642 ^a	31	142.279	21.542	.000	
Correction factor	40203.508	1	40203.508	6087.231	.000	
Sample site	2463.397	15	164.226	24.866	.000	3.702
Surface/depth	271.438	1	271.438	41.099	.000	1.308
Sample site; Surface/depth	1675.807	15	111.720	16.916	.000	
Error	211.346	32	6.605			
Total	44825.497	64				
Corrected total	4621.989	63				

a. $R^2 = 0.954$ (Corrected from $R^2 = 0.910$)



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Cadmium concentrations in the study area

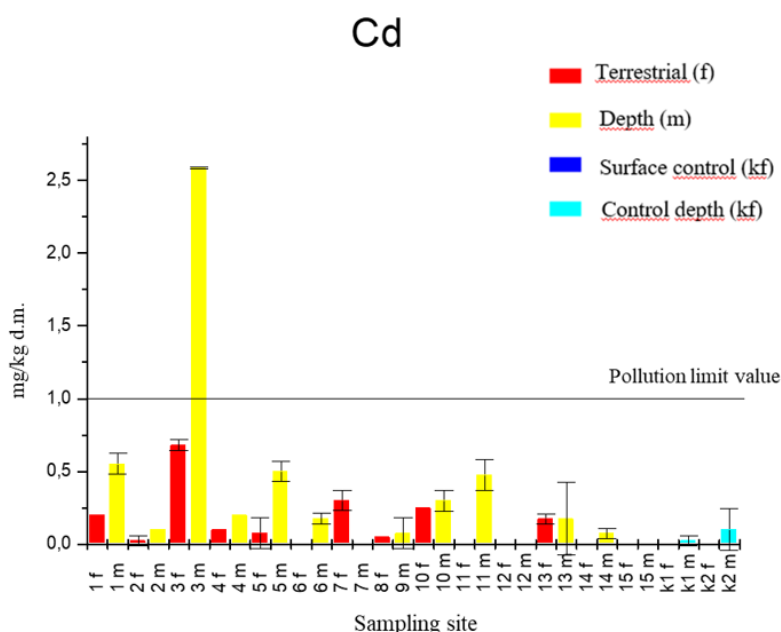


Figure 9: Cadmium concentrations in soil

All soil samples have an average cadmium content (Figure 9) of 0.2250 mg/kg soil dry matter. The difference between the average cadmium content of the surface (0.2250 mg/kg d.m.) and deep soil samples (0.1162 mg/kg d.m.) from the sampling sites is 0.2175 mg/kg d.m. expressed as soil dry matter, i.e. there is a huge difference between the cadmium content of the surface and deep soil samples, with the deep soil samples containing on average more cadmium (0.3338 mg/kg d.m.) than the deep soil samples (0.3338 mg/kg d.m.), than in the surface soil samples (0.1162 mg/kg d.m.), but the surface soil sample from sampling location 3 has a higher cadmium content compared to the average of the surface soil samples.

According to Stefanovits et al. [26], the average cadmium content of the soil is less than 1 mg/kg d.m., agreeing with Papp-Kümmel [24], the typical cadmium content of the soil is 0.6 mg/kg, thus concluding that the area investigated is on average not contaminated. However, the amount of cadmium in the deep soil sample from sampling site 3 (2.5832 mg/kg d.m.) is more than two and a half times the limit value. The average cadmium concentration in the soil samples from the sampling area (factory) is 0.2526 mg/kg d.m. The average cadmium concentration in the soil samples from the control area is 0.0315 mg/kg d.m. Statistical tests show no significant difference.

The contamination limit is set at 1 mg/kg d.m. cadmium in Joint Decree No 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management on the limit values necessary for the protection of the geological environment and groundwater against pollution and the



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measurement of pollution [22]. Sampling point 3 is therefore considered contaminated, exceeding the contamination limit. As the other sampling sites have Cd levels below the contamination limit, including in the surface soil sample from sampling site 3, a point source of contamination can be assumed.

The cadmium content in the depth soil samples is, on average, higher, which was confirmed by the analysis of variance, with the cadmium concentration in the soil samples significantly dependent on the sampling location and sampling depth (for factor A: $LSD_{5\%}=0.097$; for factor B: $LSD_{5\%}=0.034$).

The results of the variance analysis for cadmium content are shown in Table 8.

Table 8: Table of variance of cadmium content

Factors	SS	df	MS	F	Sig.	$LSD_{5\%}$
Corrected model	13.531 ^a	31	.436	97.627	.000	
Correction factor	3.240	1	3.240	724.567	.000	
Sample site	9.223	15	.615	137.528	.000	.097
Surface/depth	.757	1	.757	169.242	.000	.034
Sample site; Surface/depth	3.551	15	.237	52.952	.000	
Error	.143	32	.004			
Total	16.914	64				
Corrected total	13.674	63				

a. $R^2 = 0.990$ (Corrected from $R^2 = 0.979$)



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Lead concentrations in the study area

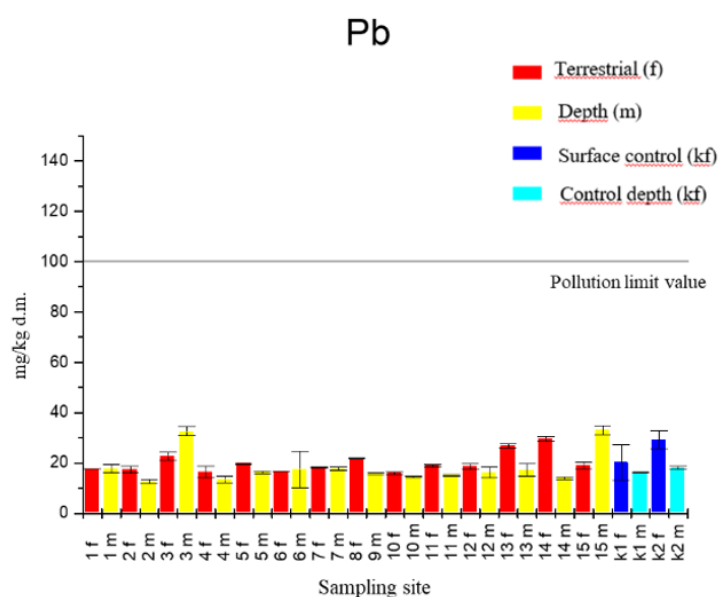


Figure 10: Lead concentration in soil

soil samples had an average lead content (Figure 10) of 19.2807 mg/kg soil dry matter. According to Stefanovits et al. [24], the lead concentration in uncontaminated soils ranges from 2 to 20 mg/kg (= ppm), while Pais [28] reports that in agriculturally cultivated soils, this value can be as high as 2 to 200 ppm.

The average lead content of the soil samples from the sampling area (factory) is 19.0470 mg/kg d.m., and the average lead content of the soil samples from the control sampling area is 20.9165 mg/kg d.m., and statistical tests show that there is no significant difference between them. Roads with little traffic border the control area (square), while the sampling area is slightly away from traffic. The difference in average lead content between surface (20.5651 mg/kg d.m.) and deep soil samples (17.9962 mg/kg d.m.) from the sampling sites is 2.5689 mg/kg soil dry matter. On average, the lead content is higher in the surface soil samples, which supports the low solubility and mobility of lead and was confirmed by the analysis of variance, with the lead concentration in the soil samples significantly dependent on sampling location and sampling depth (for factor A: $LSD_{5\%}=3.161$; for factor B: $LSD_{5\%}=1.117$).

There are no outliers between the lead contents of all sampling sites, with higher average values in the surface soil samples (factory) and higher average values in the surface soil samples of the control sampling sites (field), but no sample with an average lead content above the contamination limit.

The contamination limit value is set at 100 mg/kg d.m. in Joint Decree No 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management on the limit values necessary for the protection of the geological environment and groundwater against pollution and on the measurement



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of pollution [22], so the area is not considered contaminated. The results of the variance analysis for lead are shown in Table 9.

Table 9: Table of variance of lead content

Factors	SS	df	MS	F	Sig.	LSD _{5%}
Corrected model	1763.194 ^a	31	56.877	11.810	.000	
Correction factor	23791.559	1	23791.559	4940.036	.000	
Sample site	887.335	15	59.156	12.283	.000	3.161
Surface/depth	105.588	1	105.588	21.924	.000	1.117
Sample site; Surface/depth	770.270	15	51.351	10.662	.000	
Error	154.114	32	4.816			
Total	25708.866	64				
Corrected total	1917.308	63				

a. R² = 0.920 (Corrected from R² = 0.842)

Nickel concentration in the study area

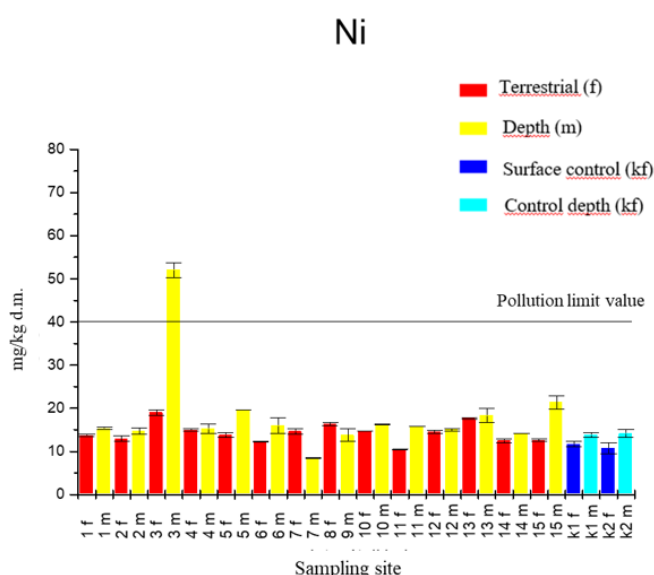


Figure 11: Nickel concentration in soil

All soil samples had an average nickel content (Figure 11) of 15.8210 mg/kg soil dry matter. According to Pais (1980), soils generally contain around 100 ppm of nickel, which can be as high as 5000 ppm in serpentine soils. Stefanovits et al. [26] report that uncontaminated soils generally contain 5-50



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mg/kg (ppm) nickel, and Kádár [9] states that the expected level of nickel in the soil is 5-500 ppm, with an average of 100 ppm.

The average nickel content of the soil samples from the sampling site (factory) is 16.2834 mg/kg d.m. The average nickel content of the control sampling site is 12.5836 mg/kg d.m. and statistical tests show no significant difference between them.

The difference in the average nickel content of the surface (13.8845 mg/kg d.m.) and deep soil samples (17.7574 mg/kg d.m.) from the sampling sites is 3.873 mg/kg soil dry matter content.

The average nickel content is higher in the deep soil samples, as confirmed by the analysis of variance, and the nickel concentration in the soil samples is significantly related to the sampling location and sampling depth (for factor A: $LSD_{5\%} = 1.172$; for factor B: $LSD_{5\%} = 0.414$)

There are no outliers of high or low values among the nickel contents of the sampling sites, except for the deep soil sample from sampling site 3, which exceeds the contamination limit of 52.0528 mg/kg dry matter content. The nickel content of the deep soil samples is, on average, higher than that of the surface samples.

A contamination limit value of 40 mg/kg is set in Joint Decree No 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management on the limit values necessary for the protection of the geological environment and groundwater against pollution and on the measurement of pollution [22], so the area is not considered contaminated, except for sampling location 3, where point source contamination is present.

The results of the variance analysis for the nickel content can be found in Table 10.

Table 10: Table of variance of nickel content

Factors	SS	df	MS	F	Sig.	$LSD_{5\%}$
Corrected model	3158.974 ^a	31	101.902	154.030	.000	
Correction factor	16019.427	1	16019.427	24214.075	.000	
Sample site	1836.173	15	122.412	185.031	.000	1.172
Surface/depth	239.990	1	239.990	362.756	.000	0.414
Sample site; Surface/depth	1082.810	15	72.187	109.114	.000	
Error	21.170	32	.662			
Total	19199.572	64				
Corrected total	3180.145	63				

a. $R^2 = 0.993$ (Corrected from $R^2 = 0.987$)

CONCLUSIONS

It is essential to know the composition of the soil being tested in order to reduce soil contamination. Soil is a complex filtering system for wastes and contaminants; physical, chemical and biological



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processes are involved, and the efficiency of this filtering system varies from soil type to soil type, so it is essential to know the soil's load-bearing capacity and the rate of degradation [29].

The parameters and properties of soils, natural interactions and the interactions between contaminants and soil must also be known and considered in remediation [30].

Several aspects must be considered when choosing soil remediation and treatment procedures, such as the urgency of the intervention, the size of the contaminated area and the costs involved.

Cleaning or remediation is not the only way to reduce contamination and risk; other options are not treating the area but removing or modifying the land use, localising the contaminated area so it cannot spread, or replacing the soil [31].

On average, the heavy metal content of the surface and deep samples taken from the study area does not exceed the limit values necessary to protect the geological environment and groundwater against pollution. For the measurement of pollution [22], there is no risk from possible agricultural use of the area, and plants grown in small gardens cannot accumulate levels of heavy metals that are dangerous to humans and animals, at least for the heavy metals tested.

However, in the depth sample of sampling point 3, cadmium exceeds the contamination limit of 1 mg/kg d.m. by more than two and a half times and is therefore considered contaminated.

Furthermore, the nickel content of this depth sample is also higher than the 40 mg/kg b.a. laid down in the Regulation, amounting to 52.0528 mg/kg dry matter content, and is considered contaminated regarding nickel content.

As the distance between the sampling points is 41.6 m, further investigations are needed to determine the spatial extent of the contamination. Sampling point 3 is in the factory previously located there.

In addition, it is necessary to sample from deeper depths and groundwater to investigate the depth extent of the contamination, and although all the samples taken had an alkaline pH at the time of sampling, leaching could have resulted in contamination in deeper layers or groundwater.

Overall, there are no obstacles to use the sampling area, so no soil decontamination is necessary, but this is not the case for sampling site 3, where soil decontamination or the area should be taken out of agricultural use. As the contamination is assumed to be a point source and there is no risk of wind-borne leaching due to the depth of the contamination, the possible solutions are either to build an object above the sampling point or, after excavation of the surface layer, to stabilise and localise the contamination layer and the layer below and above the contamination with magnesium oxide or bentonite as a possible solution. In addition, planting cultivated plants, especially fruit trees, should be avoided, as their deep-penetrating roots can damage the waterproofing layer, thus creating acidity in the root pH, making these heavy metals mobile and absorbable.

If further investigations show more extensive contamination, an ex-situ soil decontamination procedure may be applied, i.e., the soil excavation and cleaning or soil decontamination by soil replacement.



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EFFECTS OF LAND USES ON SOIL PROPERTIES – A SLOVAKIAN CASE STUDY

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ABSTRACT

Rock walls were used to mark the boundaries of the parcels, so they were easy to distinguish on the field. The rocks were collected from the parcels. Some parcels were used for meadows, some for pastures and/or meadows, and some for arable use. Two parcels were compared. One of them is a grassland, the other one is an arable field. Soil samples were taken in five replicates from the 0–20 cm depths. This depth is the maximum depth of the soil, below 20 cm there is a high proportion of rocks (80<%). We aimed to compare the arable area with the grassland, assuming that there were differences in the soil properties and the degradation caused by arable use can be proven. The soils were analyzed by the Near Infrared Scanner of Agrocates Ltd. (the Netherlands). Statistical analyses started with the Shapiro-Wilk normality test. The results with the Levene's test for normal distribution data show that there are significant differences for soil organic matter, P and K in favour of the grassland while the soil moisture was higher under arable use. The non-normal distribution data was analysed with the Mann-Whitney U-test and proved that the total N content is higher on the grassland, while pH values did not differ.

Keywords: arable field, grassland, near-infrared spectroscopy, soil organic matter, climate resilience



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INTRODUCTION

Historical and modern land use systems of agricultural soils influenced morphology, and chemical and physical properties of the soil in many ways [1]. However, they both considerably affect soil properties [2–4]. Despite research findings on climate changes at the global level, local studies indicate human activity as a key factor in soil erosion, particularly concerning land use [5]. Land use and cultivation strongly affect soil erosion and the potential for surface runoff and sediment delivery [6]. The alterations in the rates of soil erosion and their spatial distribution, which occur over an extended period, are predominantly linked to the conversion of agricultural land into forest or grassland [5]. Land use was historically altered due to the increasing need for arable land [7].

Terracing is a globally utilised land use strategy and an efficient measure to control soil erosion [8]. The terrace field is defined as the most prevalent landform developed following contour ploughing [9]. The transformation of Cambisols into cultivated soils, such as Cultisols [10] or Cambisolic Cultisols [11], has been well documented (see Landscape Atlas of the Slovak Republic [12]). Cultisols on terraces have higher percentages of organic materials and nutrients than non-cultivated soil on surrounding slopes [13].

Historically, farming on terraces was predicated on the principle of private ownership. Eastern European rural areas often had small, 1–2 hectares of land units for family farms in the past [14]. In special cases, a shortage in available arable parcels induced the formation of farming terraces, sometimes under severe slope steepness (20%<) [15]. These terraces provided soil erosion prevention that was crucial for their sustainable use [16].

At present, the agricultural sector of the Slovak economy is characterised by the prevalence of large-scale farming enterprises. Cooperative farms account for over 95% of the country's total agricultural land, with family farms accounting for the remaining 5% [17]. A considerable proportion of agrarian terraces underwent a transition into utilitarian spaces such as pastures, meadows, and extensive areas designated for ploughing following the implementation of the collectivization reforms during the Communist regime. This transition subsequently resulted in the onset of soil erosion [10]. The practice of traditional farming in terraces has remained mainly in remote, mountainous regions. This is primarily due to the challenges associated with conducting modern agriculture in such environments [18]. The impact of soil erosion in former Czechoslovakia was the focus of an evaluation of several studies [19, 9]. Following the Velvet Revolution in the 1990s, there was a significant decline in the cultivation of agricultural soils, including terraces.

Measurements with a hand-held near-infrared device have been used several times for multiple purposes in Hungary [20–26].

In the recent research, we hypothesised that measurable differences would be observed between the soil parameters of the grassland and arable land in the same slope position.

MATERIALS AND METHODS



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Description of the study area in Hriňová-Fangov Vrch, Slovakia

The village of Hriňová is located in central Slovakia (Figure 1). Hriňová has been an independent town since 1891 but the first written report dates to 1393. At first, it was part of the Očová cadastre together with Detva. Detva became independent in 1638 and Hriňová only at the end of the 19th century [27–28]. It falls within the geographical boundaries of the "Podpolanie" region, distinguished by the dispersed settlements, colloquially referred to as "lazy". The area is part of the traditional landscape, which includes the dispersed settlements of the Slovak Central Mountains and Krupinská Planina Mountains. The Poľana Mountain represents an individual sub-unit within the extensive area of traditional landscapes [28]. The specific characteristics of the Hriňová cadastral area are attributable to the persistence of dispersed settlements, which have retained their original landscape structure. The maintenance of the traditional form of farming system and unique landscape pattern is attributable to the fact that this area was unaffected by agricultural collectivisation following the Second World War [29]. The establishment of the glass and wood processing industry occurred in the late nineteenth and early twentieth century, marking a significant development in the region's economic landscape. The advent of heavy industry in the twentieth century led to a notable increase in population, as documented by [30]. Before and during the communist era, farmers organised themselves into associations of self-employed farmers, thereby shaping the management of the agricultural landscape, a practice that continues to the present day, as evidenced by [31]. The grasslands in the vicinity of dispersed settlements are cultivated following traditional practices, employing a three-field system and the utilisation of organic farmyard manure for fertilisation. Meadows are mown twice annually, and after the growing season, they are grazed by cattle. Grasslands consist of: wetlands, fens and springs; waterlogged meadows and associations of high herbs; mesophytic meadows; and associations of pastures and successive phases on pastures. The traditional husbandry practices include the breeding of beef cattle and sheep. Cropping in this region is focused on the cultivation of cereals (barley, oats and wheat), potatoes, cabbage and technical crops (flax and hemp) [32].

The geomorphological and climatic settings of the study area are compiled from the Landscape Atlas of the Slovak Republic [12]. The cadastral district of Hriňová, situated at an altitude of 500 metres above sea level (with a range of 450 to 1458 metres as documented in the cadastre), is predominantly located within the Zvolenská Kotlina basin, with a portion extending into the Poľana Mountain. The study sites 'a' and 'b' are located at altitude of 645 m ASL. The prevailing morphological-morphometric type of relief, as determined by terrain roughness, is characterised by strongly dissected hills and in the higher altitudes prevail strongly dissected upland and highland terrain. The climatic regions and districts are characterised by a slightly warm, very humid climate. The average temperature in July exceeds 16°C, with summer days reaching up to 50. The annual average precipitation for the period between 1969 and 1990 was recorded at 700–800 mm. The mean annual temperature for the period 1961–1990 is 4–6°C. The mean annual specific runoff for the period 1931–1980 was 5–10 l.s⁻¹.km⁻². The mean annual temperature of the active soil surface is 8–9 °C. The mean value of the climatic indicator of irrigation (mm) for the period 1961–1990 is -100 to -200 mm. The predominant natural vegetation type is the Carpathian oak-hornbeam forest.



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The geological substrate is predominantly composed of andesite volcanic rocks of central Slovakia. Typical materials are small epiclastic volcanic breccias to conglomerates of intermediate andesites [33] State Geological Institute of Dionýz Štúr, 2008). The soil type designated as 'H1' prevails. It includes Eutric Cambisols, Dystric Cambisols, Haplic Umbrisols and Skeletic Umbrisols, which are associated with Skeli-Eutric and Skeli-Dystric Leptosols and with Stagnic Cambisols. They are medium to light textured and stony weathering products of non-carbonate rocks [36].

Soil samples were collected from two terraces with different land uses. While the study site (a) has remained a mowed meadow to this day, the study site (b) has been cultivated, and crops are planted there (Figure 1). Based on the evidence presented by historical maps, the socio-economic context of the Communist land consolidation reforms, and published studies [33], it is assumed that both terraces were cultivated approximately 250 years ago (Figure 2).

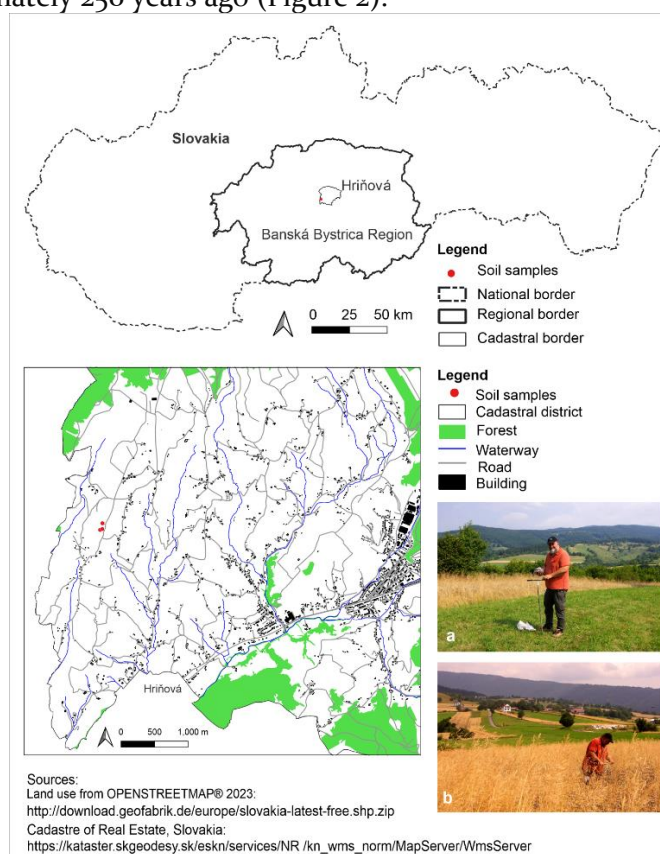


Figure 1: The study sites in Hriňová-Fangov Vrch encompass agricultural terraces situated on a grassland (Figure 1a: coordinates: 19.4672507/48.5807594) and arable land (Figure 1b: 19.4676989/48.5809095)

The terraces are believed to have likely been used as mowed meadows alternating with ploughed land, which was customary land use in the region during this period.



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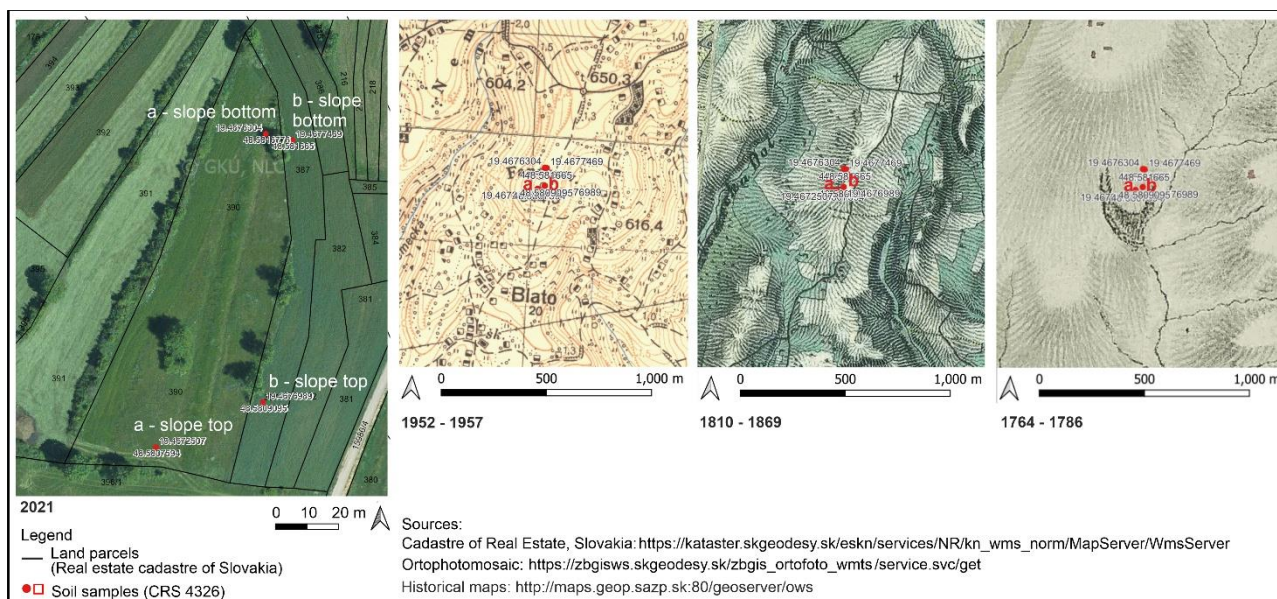


Figure 2: Historical and current use of the land on the terraces
(only slope tops are introduced in the recent article)

Soil sampling in the field and soil analyses

Soil samples were taken from the upper 0–20 cm layer. Five samples were collected from the arable field and 5 samples from the grassland (Figure 1).

Soil samples were cleaned from animal and plant residues, and measured with the Near-Infrared Device (Figure 3).



Figure 3: The Near Infrared Device, soil scanner of Agrocars Ltd. (The Netherlands)
The NIR device measured pH (H₂O), soil organic matter (%), total organic carbon (g/kg), total N (g/kg) and P (mg/kg), exchangeable K, Ca, Mg and CEC (Cation Exchange Capacity) (mmol/kg), total Al and



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Fe (g/kg) and soil moisture contents (%). NIR spectrometer uses a wavelength range of 1300–2600nm (MEMS technology). It is produced by the AgroCares company (The Netherlands) and works with the SoilCares mobile application.

STATISTICAL ANALYSES

The normality test was done by the Shapiro-Wilk Test. Only the pH and N are non-normally distributed. In these cases, we used the Mann-Whitney U-test, in the other parameters we calculated with the independent two-sample t-tests.

RESULTS AND DISCUSSION

The basic data of the measured soil parameters of the arable field and grassland can be seen in Table 1. Five-five samples were collected, and all data is shown.

Table 1. Raw measured soil data with the Near Infrared (NIR) device

Code	pH (H ₂ O)	SOM (%)	P (mg/kg)	Total N (g/kg)	K	Ca	Mg	OC	PMN	CEC	Al	Fe	Clay	Soil Moisture
2a1	6.8	2.4	34.5	1.3	8.8	130.8	41	14.1	47.4	184	50.3	41.3	35	33.1
2a2	6.7	1.8	50.9	1	5.6	74	22.9	10.4	35.5	104	44.1	23.4	17	29.1
2a3	7	1.9	31.4	1	8.6	126.9	35.6	11.2	36.8	178	47.3	35.5	26	29.1
2a4	7	1.8	45.3	1	5.5	110.1	26.5	10.6	36.4	143	45.2	25.6	21	25.9
2a5	7	3.1	85.3	1.7	10.6	131.9	34	18.1	61.7	182	49.9	34.4	27	29.6
2g1	6.6	2.4	112.1	1.4	9.1	80.3	22.4	13.9	53.4	106	35.9	21.2	14	23.6
2g2	7.2	4.6	139.5	2.5	16.1	218.8	49.8	27	97.9	259	53	37.6	26	28.8
2g3	7.2	3.1	85.4	1.7	11.3	171.6	38.3	18	62.5	202	51.5	36.7	21	26.3
2g4	7	3.2	125.8	1.9	12.3	140.4	30.2	18.4	72	169	41.7	25	15	24.3
2g5	7.3	5	78.8	2.6	16.8	273.1	68.6	28.9	100	334	59	48.7	33	21

SOM=Soil Organic Matter, OC=Organic Carbon, CEC=Cation Exchange Capacity

SOM ($p=0.029$) (Figure 4), P ($p=0.005$) (Figure 5), K ($p=0.017$) (Figure 6), total nitrogen ($p=0.016$) (Figure 7), organic carbon ($p=0.032$) (Figure 8) and potentially mineralizable nitrogen ($p=0.013$) (Figure 9) were significantly higher on the grassland, compared to the arable field. Soil moisture content also shows significant differences ($p=0.031$) but, in this case, it is higher on the arable field (Figure 10).



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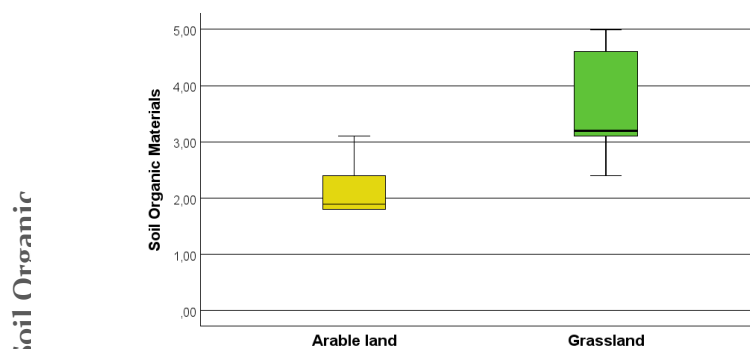


Figure 4: The comparison of the amount of soil organic matter

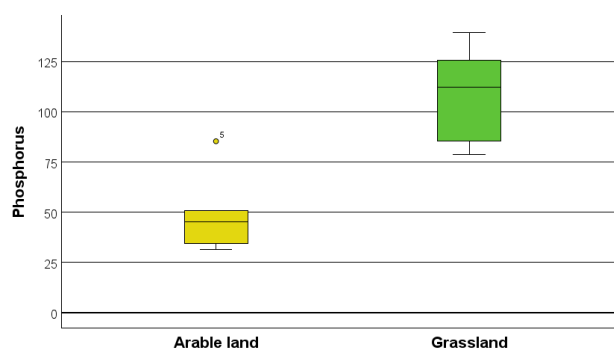


Figure 5: The comparison of the amount of phosphorous content

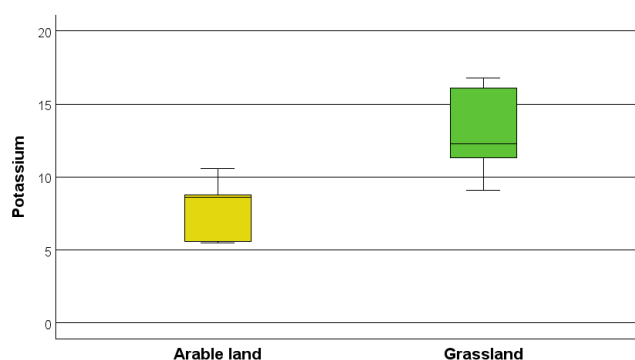


Figure 6: The comparison of the amount of potassium content



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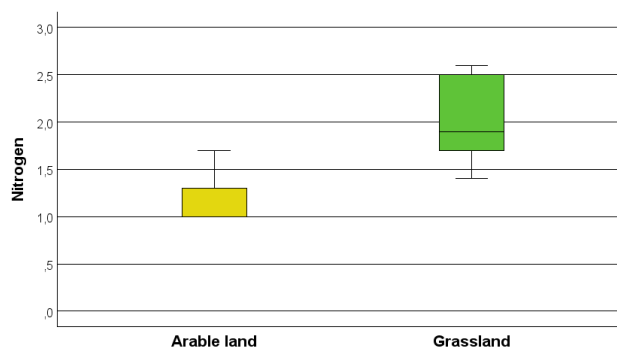


Figure 7: The comparison of the amount of total nitrogen content

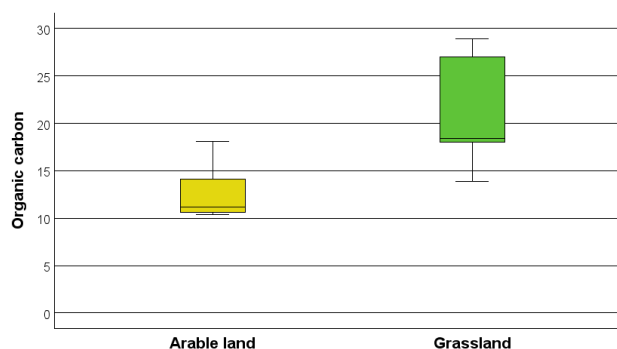


Figure 8: The comparison of the amount of total organic carbon content

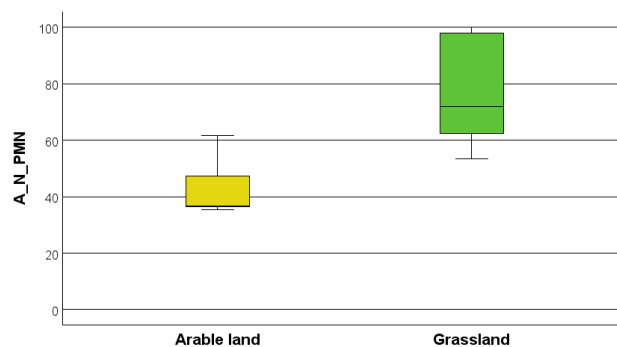


Figure 9: The comparison of the amount of potentially mineralizable nitrogen content



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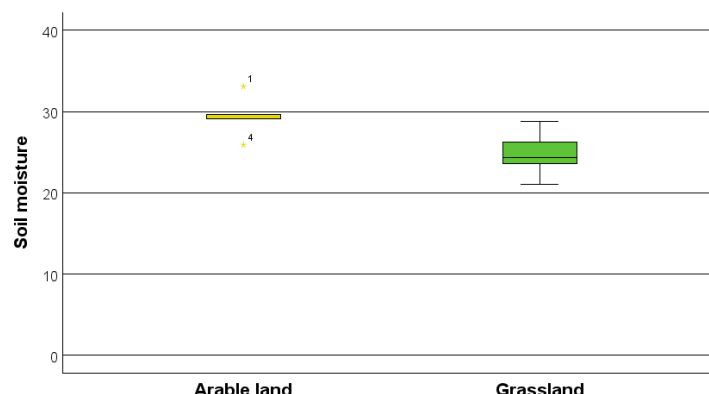


Figure 10: The comparison of the amount of soil moisture content

These results are against the findings of [34] who found no significant differences between a forest and a grassland on a nearby slope, a few kilometres away in the cadastral district of Dolný Tisovník (Slovakia). This can be because there were a forested and a grassland compared and their surface cover is more similar than those of the examined arable field versus grassland. In other words, we might conclude that arable agriculture has a considerably higher effect on soil properties than the close-to-natural grasslands and forests. This is quite an obvious assumption, even though all these areas were under arable agriculture for decades.

CONCLUSION

We can conclude that several soil parameters show differences under different land uses, such as soil organic matter, total N, P, K, organic carbon, potentially mineralizable nitrogen and soil moisture. We have to conclude that, since in a nearby area the results were not found at all, these differences are site-specific. However, in the present case, the null hypothesis, regarding that there are differences caused by land use was proved in the case of several soil parameters.

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HEALTH AWARENESS ON CAUSES AND PREVENTION OF DRUG ADDICTION FOR BIOLOGY STUDENTS IN TERTIARY INSTITUTION IN NIGERIA

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ABSTRACT

It was observed that drug addiction has gone a long way to create several health problems and dangers in our societies., also students in Nigeria like many other countries of the world are developing addiction to psychoactive substances. This paper tends to create health awareness on causes and prevention of drug addiction for Biology Students in Tertiary Institution in Nigeria. The Presentation involved the conceptual framework which includes meaning of drug, concept of drug addiction, classification/ kinds of drug addiction, factors that increase the risk of addiction, symptoms of drug addiction, causes of drug addiction, effects /consequences of drug addiction, prevention of drug addiction. While the theoretical framework includes theory of addiction, self-esteem theory, Psychosocial Theory, an ego/self-theory of substance dependence, somatosensory affectional deprivation (SAD) Theory of Drug Bad-habit theory, educational implication of drug addiction. Several recommendations were made among which are Parent should educate their children on effects of drug addiction on their health, society and human dignity, tertiary institution management, including the school counsellor should be involved in awareness programme that will prevent drug addiction in school, also government should set up rehabilitation centers to aid victims of drug addiction.

Keywords: health awareness, causes and prevention, drug addiction.

INTRODUCTION

A drug refers to a substance that could bring about a change in the biological function through its chemical actions It is also considered as a substance that modifies perceptions, cognition, mood, behaviour and general body functions. This could thus be considered as chemical modifies of the living tissues that could bring about psychological and behavioural changes. A drug is a chemical substance



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capable of altering the physical and psychological function of the body. It is any substance used as a medicine or used in making medicines for internal or external use, altering the body's actions. It is also a chemical substance used in the treatment, cure, prevention or diagnosis of disease or used to other wise enhance physical or mental well-being.

Drug addiction as defined in Division and Neal in Amao-Kehinde (2008) refers to physiological process by which the body responds to certain drugs. It is therefore the continuous use of drugs, which produce psychological and physiological habit formation in the process by which it responds to body mechanism.

A drug is a chemical substance capable of altering the physical and psychological function of the body. It is any substance used as a medicine or used in making medicines for internal or external use, altering the body's actions. It is also a chemical substance used in the treatment, cure, prevention or diagnosis of disease or used to other wise enhance physical or mental well-being.

The students in Nigeria like many other countries of the world are developing addiction to psychoactive substances. In 2012, the National Drug Law Enforcement Agency (NDLEA) collected drugs use and abuse data from schools, records of patients admitted at mental health institutions for drug related problems and interview of persons arrested for drug offenses. The result showed that students constitute the high-risk group for drug trafficking and abuse. Friends and school mates account for about 90% of the source of influence of the use and abuse of various psychoactive substances. In Nigeria, alcohol and cigarette are legal but these substances have also said to be "gateway drugs" to other more potent drugs like heroin and cocaine. Drug addiction has gone a long way to create several health problems and dangers in our societies. Such health problems include mental illness, cancer of the lungs, school dropouts, and juvenile delinquency.

OBJECTIVE

The Objective of this paper is specifically to create health awareness on causes and prevention of drug addiction for Biology Students in Tertiary Institution in Nigeria.

CONCEPT OF DRUG ADDICTION

Drug addiction is defined as a chronic, relapsing brain disease that is characterized by compulsive drug seeking and use, despite harmful consequences. It is considered a brain disease because drugs change the brain, it changes the structure and how it works. These brain changes can be long-lasting and can lead to the harmful behaviour seen in people who abuse drugs (Volkow, 2013).

"Drug addiction" is the continuous uncontrolled, compulsive use of a drug not only to include intoxication but also to avoid the tortures of withdrawal. Despite the unrelenting effort of individuals, agencies, mass media and the government at different levels against drug addiction, the prevalent practice among post-primary school students, tertiary institutions, teenagers and even adults in the



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community have not decreased but rather continued to increase geometrically. Drug addiction (also called substance use disorder) is a brain disease. The addict becomes dependent on the drug. The addict becomes dependent on the drug. The addict uses it, despite having full knowledge of its harmful effect on health. The young generation, particularly teenagers are the most victims of evils of drug addiction. (Nnachi, 2007)

CAUSES/ REASONS FOR DRUG ABUSE

The major causes/reasons for abuse of drugs by our undergraduates may include the following amongst others:

- (1) **Peer Group Influence:** The peer group is second only to the parents in socializing the child. Parents and peer group seem to extent almost equal importance by the time children are well grown up into adolescence. Thus, the peer group provides the providing child with a broad range of behaviours and cultural and sub-cultural values
- (2) **The Need to Feel High:** University undergraduate in Nigeria especially in Calabar abuse drugs or alter the way they feel "to feel happier or better, to avoid pains stress or frustration". They want to forget or to remember, to be accepted or be sociable sometimes to escape from burden or just to satisfy curiosity. However, in the long run, people who abuse drugs in the hope of solving one problem or the other run the risk of getting trapped in a spiral of increasing drug use that created new problems and finally leads to drugs dependence which worsens already worse situation.
- (3) **Social Structural Influence:** The factor is associated with relentless harshness of life. In this case, life itself is one big hell of hand ball to kick. Academic frustration, rivalry, poverty, family problem, inherent physical deformities, widening gap between the rich and the poor make life one long stretch of mental future. Hence, to summon up courage to face such situations and the task ahead. "University undergraduates find solutions in smoking, drinking, drug taking of all sorts on the firm conviction that these drugs provide euphoria release, great spur and a monetary escape from reality because of this, taking drugs becomes a habit to face life.
- (4) **The Craze for Easy Wealth:** Another reason often cored for undergraduates' indulgence in drug abuse is that drug abuse/trafficking is a quick and easy way to make money. Trafficking of drugs has become a multi-millionaire business.
- (5) **The Mass Media:** Evidence abounds that children, youths and undergraduates who watch a lot of television programme learn to rely on stereotypes of the various groups presented by the media. These children then transfer what they have learned from television to real life situations. This, if the stereotype was presented and always watched by a child favours drugs taking the child will imbibe the culture of drug taking.
- (6) **Personality Factors:** Finally, it appears that personality factor is another main factor responsible for the canker worm on Nigeria society. In this aspect, it relates to distinctive



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personality traits associated with drug abuse. The “independent personality” is a major element in profiles of drug addicts, a drug abuser, that is a drug dependent person, has difficulty handling frustration, anxiety and depression.

TYPES OF DRUGS ABUSED IN NIGERIA

In Nigeria, the most common types of abused drugs according to NAFDAC (2000) as cited by Haladu (2003) are categorized as follows:

1. **Stimulants:** These are substances that directly act and stimulate the central nervous system. Users at the initial stage experience pleasant effects such as energy increase. The major source of these comes from caffeine substance.
2. **Hallucinogens:** These are drugs that alter the sensory processing unit in the brain. Thus, producing distorted perception, feeling of anxiety and euphoria, sadness and inner joy, they normally come from marijuana, LSD etc.
3. **Narcotics:** These drugs relieve pains, induce sleeping and they are addictive. They are found in heroin, codeine, opium etc.
4. **Sedative:** These drugs are among the most widely used and abused. This is largely due to the belief that they relieve stress and anxiety, and some of them induce sleep, ease tension, cause relaxation or help users to forget their problems.
5. **Miscellaneous:** This is a group of volatile solvents or inhalants that provide euphoria, emotional disinhibition and perpetual distortion of thought to the user. The main sources are glues, spot removers, tube repair, perfumes, chemicals etc.
6. **Tranquilizers:** They are believed to produce calmness without bringing drowsiness, they are chiefly derived from Librium, Valium

FACTORS THAT INCREASE THE RISK OF ADDICTION

Volokow, (2013) identified some factors that increase the risk of addiction to drugs. They include the following:

1. **Home and Family:** The influence of the home environment, especially during childhood, is a very important factor. Parents or older family members who abuse alcohol or drugs, or who engage in criminal behaviour, can increase children’s risks of developing their own drug problems.
2. **Peer and School:** Friends and acquaintances can have an increasingly strong influence during adolescence. Drug-using peers can sway even those without risk, factors to try drugs for the first time. Academic failure or poor social skills can put a child at further risk for using or becoming addicted to drugs.



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3. **Biological Factors:** Scientists estimate that genetic factors account for between 40 and 60 percent of a person's vulnerability to addiction, this includes the effects of environmental factors on the function and expression of a person's genes. A person's stage of development and other medical conditions they may have are also factors. Adolescents and people with mental disorders are at greater risk of drug abuse and addiction than the general population

OTHER FACTORS THAT INCREASE THE RISK OF ADDICTION

1. **Early Use:** Although taking drugs at any age can lead to addiction, research shows that the earlier a person begins to use drugs, the more likely he or she is to develop serious problems. This may reflect the harmful effect that drugs can have on the developing brain; it also may result from a mix of early social and biological vulnerability factors, including unstable family relationships, exposure to physical or sexual abuse, genetic susceptibility, or mental illness. Still, the fact remains that early use is a strong indicator of problems ahead, including addiction.
2. **Method of Administration:** Smoking a drug or injecting it into a vein increases its addictive potential. Both smoked and injected drugs enter the brain within seconds, producing a powerful rush of pleasure. However, this intense "high" can fade within a few minutes, taking the abuser down to lower, more normal levels. Scientists believe this starkly felt contrast drives some people to repeated drug taking to recapture the fleeting pleasurable state.

PHYSICAL AND BEHAVIOURAL INDICATORS OF DRUG ADDICTION

There is no single indicator for a diagnosis of alcohol or drug addiction. If an indicator is present, then others are usually present also.

Personal

- Deteriorating personal hygiene
- Multiple physical complaints
- Accidents
- Personality and behaviour changes
- Many medication prescriptions for self and/or family members
- Emotional or mental crises
- Deceit, lying, or denial
- Using behaviours excused by family and friends

Home and Family

- Drinking or using activities are a priority
- Emotional outbursts, arguments or violence



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- Hiding use of alcohol or drugs
- Fragmentation of family and eventual withdrawal from family
- Neglect or abuse of children
- Abnormal, illegal, or anti-social actions of impacted children
- sexual problems or misbehaviour
- Unexplained absence from home
- Extramarital affairs
- Separation of divorce
- Observable decline in physical or emotional health

Medical / Physical

- Atypical weight changes
- Pupils either dilated or constricted, face flushed or bloated
- Drug seeking behaviours, such as seeking medical treatment for migraines, back or other pains or illnesses.
- Emergency-room treatments: overdose, cellulitis, gastrointestinal problems, systematic infections, unexplained injuries and accidents.
- Inability to mentally focus and keep track of a conversation
- Shakiness, tremors or hands, agitation
- Slurred speech
- Unsteady gait, falls
- Runny nose and constant sniffing
- Nausea, vomiting, diarrhea
- Isolation from normal social relationships

Friends and Community

- Embarrassing social behaviour
- Driving while intoxicated or drug impaired
- Alcohol/drug related legal problems
- Neglect of social commitments
- Unpredictable behaviour, such as impulsive spending or missing dates with friends
- Workable behaviour

Office/ Health Care Practice Setting

- Disorganized schedule
- Unreasonable workplace behaviour
- Inaccessibility to patience and staff
- Frequent trips to the bathroom or other unexplained absence
- Decreased workload or workload intolerance



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- Excessive drug prescriptions and supplies
- Excessive ordering of drug supplies
- Frequent complaints by patients or clients regarding the professional's behaviour, such as professional manners or treatment disputes
- Prolonged Breaks from workstation or work setting
- Frequent absence or illness
- Sporadic punctuality
- Unsatisfactory documentation performance
- Withdrawal from professional committees or organizations
- Defensive if questioned or confronted
- Less creativity, coasting on reputation from previous work
- Questionable practice judgment
- Short absence from the work setting followed by inadequate or elaborate explanations
- Alcohol on breath with attempts to cover with mints or mouthwash
- Observed occurrences of intoxication, drowsiness, or hypersensitivity during work hours
- Deadline barely met or missed altogether
- Increased interest in patient pain control
- Patient complaints of ineffective pain medications
- Frequent incorrect medication or narcotics count
- Appearing at the workplace on days off
- Frequent job changes or relocations

Other Professional Problems

- Unusual medical history
- Vague letters of reference
- Inappropriate or inadequate qualifications
- Deterioration of professional reputation
- Increasing malpractice claims
- Licensures issues

How Drug Addiction Can Develop

There is a fine line between regular use and drug abuse and addiction. Very few addicts are able to recognize when they have crossed that line. While frequently or the number of drugs consumed do not necessarily constitute drug abuse or addiction, they can often be indicators of drug-related problems

- **Drug Abuse may Start to Socially Connect:** Commonly, people try drugs for the first time in social situations with friends and acquaintances. A strong desire to fit into the group can make it feel like doing the drugs with them is the only option.
- **Problems can Sometimes Sneak up on you,** as your drug use gradually increases over time. Smoking a joint with friends over the weekend, or taking ecstasy at a rave, or cocaine at an



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occasional party, for example, can change from using drug's couple of days a week to using them every day. Gradually, getting and using the drug becomes more important to you.

- **If the Drug Fulfill a Valuable Need**, you may find yourself increasingly relying on it. You may take drugs to calm or energize yourself or make you more confident. You may start using prescription drugs to cope with panic attacks or relieve chronic pain. Until you find alternative, healthier methods for overcoming these problems, your drug use will likely continue. If you are using drugs to fill a void in your life, you're more at risk of crossing the line from casual use to drug abuse and addiction.
- **As Drug Abuse takes hold**, you may miss or frequently be late for work or school, your job performance may progressively deteriorate, and you may start to neglect social or family responsibilities. Your ability to stop using is eventually compromised. What began as voluntary choice has turned into a physical and psychological need.
- **Eventually Drug Abuse Can Consume** your life, stopping social and intellectual development. This only reinforces the feelings of isolation that led to the drug use in the first place

Signs and Symptoms of Drug Addiction

Although different drugs have different physical effects, the symptoms of addiction are similar. If you recognize yourself in the following signs and symptoms of substance addiction, consider talking to someone about your drug addiction. (Eze et al, 2000).

SYMPTOMS OF DRUG ADDICTION

Scholars identified the following signs and symptoms of people who abuse drugs:

1. **Seduction:** Addicts prefer being secluded or in a company of friends. They prefer the privacy of their inner rooms, uncompleted buildings or secluded places.
2. **Drowsiness:** Addicts feel drowsy always. Parents are therefore advised to constantly check on their children/adolescents. If they display this characteristic.
3. **Constant feeling of apparent intoxication.** The third characteristic symptom is apparent intoxication without evidence of alcohol in a person but with reddish eyeball.
4. **Loss of appetite, weight and sudden change in mood:** when there is sudden loss of appetites, weight and mood without any disease symptoms is indication of addiction.
5. **Loss of interest in the opposite sex:** sudden loss of interest in the opposite sex is another symptom of addiction but before suspicion is made, careful observation must be made on the behavioural and physical changes of the individual.
6. **Poor personal cleanliness in appearance:** Addicts exhibit poor personal hygiene and careless appearance.
7. **Inability to regulate sleeping hours:** Addicts are unable to regulate their sleeping and prefer sleeping in the day while staying up at night



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THEORETICAL FRAMEWORK

Different theories and proposals have been put forward by psychologist scientist to explain drug addiction These theories include:

i. Theory of Addiction

Addiction to a given drug is not constant from culture to culture. For example, debilitating alcoholism is almost unknown in certain rural Mediterranean societies. The evidence is that a culture's attitudes toward a drug influence whether the drug will be abused. Societies which have high alcoholism rates are those in which a premium is placed on power but in which its intoxication leads to fantasist of personal domination over other people . Behaviours which occur in line with this drinking are fighting, crime, reckless driving and other aggressive and antisocial acts. (Odejide,2002).

ii. Self Esteem Theory

Low self-esteem provide the basis for continuation of drug use since such use could be a coping mechanism for the inferiority, feelings marked by inadequate interpersonal relations are prime targets because they use drugs as a way of relating to each other, drugs are the bond for camaraderie, the cultural item around which the group revolves in this instance, the behaviour defeats the very purpose for which it was intended because their already, fragile contact with reality will further impaired by the drug. Drug could move quickly, towards drug abuse and addicted.

iii. Bad-habit theory of drug abuse

The drive behind continued heavy, destructive use of a substance results from the “addictive cycle” in which the individual is constantly seeking to relieve aversive effects from the substance rather than to reproduce initial positive reinforcing effects. In fact, continues use may be motivated by a need to do both “feel good and stop from feeling bad. The essential point is that continued abuse of a drug producing harmful effects suggest “addiction” and one theory of addiction is that the person uses the drug more to relieve bad feelings from the drug than to achieve food. In other words, during the period of drug use and for a time afterwards, the abuser is experiencing a series of mini-hangovers and what drives the use to destructive levels is the repeated attempt to relieve sub-clinical withdrawal symptoms (Thomas, 2003).

iv. An ego/self-theory of substance dependence

Drug dependence is tied intimacy to an individual's attempt to cope with his or her internal emotional and external social and physical environment viewed from a contemporary psychoanalytic perspective, drug dependency can best be understood by examining how such a person's ego organization and sense of self service or fail the individual's attempts to cope and how the specific effects of various substances facilitate or impede such attempts. Although



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early psychoanalytic investigators appreciated the presence of underlying depression tension and distress in addicts, most of the early psychoanalytic formulations of substance dependence emphasised the instructive, pleasure aspects of drug use to explain the complying nature of addiction. More recent psychoanalytic formulations have placed greater emphasis on problems in adaptation ego and self-disturbances and related psychopathology as etiological factors in drug dependence (Borrifica, 2006).

V. Psychosocial Theory of Drug Abuse

Psychosocial theory has increasingly tended to reduce emotional illness to the consequences of social factors such as poverty, sex and race. In the case of drug problem social variables ranging from sexual activity to association with friends who use drugs have been shown to be related to drug use

WHY DO SOME PEOPLE BECOME ADDICTED WHILE OTHERS DO NOT

No single factor can be predicted whether a person will become addicted to drugs. Risk for addiction is influenced by a person's biology, social environment, and age or stage of development. The more risk factors and individual has, the greater the chance that taking drugs can lead to addiction. For example:

i. Biology:

The genes that people are born within combination with environmental influences account for about half of their addiction vulnerability. Additional, gender, ethnicity and the presence of other mental disorders may influence risk for drug abuse and addiction.

ii. Environment

A person's environment includes many different influences from family and friends to socio-economic status and quality of life in general. Factors such as peer pressure, physical and sexual abuse, stress and parental involvement can greatly influence the course of drug abuse and addiction in a person's life to affect addiction vulnerability, and adolescents experience a double challenge. Although taking drugs at any age can lead to addiction, the earlier than drug use begins, the more likely it is progress to more serious abuse.

iii. Prevention is the key

Drug addiction is a preventable disease. Results from National Institute of Drug Abuse (NIDA, 2003) funded research have shown that prevention programs that involve the family, school, communities and the media are effective in reducing drug abuse trends, when youths perceive drug abuse as harmful, they reduce their drug taking. It is necessary therefore, to help youth and general public to understand the risks of drug abuse and for teachers, parents and health



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care professionals to keep sending the message that drug addiction can be prevented if a person never abuses drugs.

According to Ivowi (2010) in order to prevent drug addiction among students in any tertiary institution of learning: the student, parent and society must contribute their quota by laying their following roles:

- Student role: The student should say no to negative influence and self esteem, choose friends wisely and introduce to their parent, avoid watching bad films and reading bad novel.
- Parental role: Parent should establish and maintain good communication with their children, be a role model to their children and spend time with their children.
- Societal role: Government, schools and NGO should provide counseling service, structured and educative leisure programmers for the youth establishment, anti-drug abuse group in schools and proper enforcement of drug laws.

In conclusion, drug addiction constitutes one of the major social problems in Nigeria because of the hazardous effect on the health of people and also psychologically, physically, socially, educationally etc. The problem appears to be endemic in Nigeria society to the extent that scholars, professionals, social workers, academicians, psychologists, sociologist have been trying to find solutions to the problem. Drug addiction is a social problem basically associated with young people. These young people involve themselves in taking hard drugs and excessive taking of some drugs which may alter the body system or may cause damage to the health. (Odejide, 2002)

RECOMMENDATION

Based on the finding the following listed below are recommended suggested to proffer a solution to curb drug addiction among tertiary institution students in Nigeria.

- Parent should give educate their children on effects of drug addiction on their health, society and human dignity, since charity, they say begins at home.
- The Ministry of Education (Federal and State) should ensure the teaching of drug related issue should be introduced in the curriculum in order to educate the students on the adverse effect of drug addiction
- Tertiary institution management, including the school counsellor should be involved in awareness programme that will prevent drug addiction in school
- Also, the media should create awareness through film shows for the Nigerian youth on the adverse effects of drug addiction.
- National Drug Law Enforcement Agency (NDLEA) must also intensify their anti-drug campaigns to have a drug free society with special focus on the Nigerian youths because they are the future leaders of this great country even beyond African countries.



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- Government should set up rehabilitation centers to aid victims of drug addiction.
- The Non –Governmental Organization should also support in creating health awareness on danger of drug addiction
- Churches and mosques should be involved in educating people on the effects of drug addiction
- The health sector should also play a vital role to educate the youth on effects of drug addiction through seminar, workshop or conference on health programme.

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THE SOIL IS RICH, THEN SO IS THE NATION: A FARMER IS A MAGICIAN WHO PRODUCES MONEY FROM THE MUD?

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ABSTRACT

Soil is not only mother for the ecosystem, but it is real means of MOTHER for all organisms for their survival. Just a moment thinks out of soil. We will feel our existence is nothing means the end.

It is great to hear from soil lovers that we should took initiative to protect the soil communities and even through different ways we can welcome back to the migrated the microbial communities in the soil for its health. Our aim to introduce the new remedy-based projects for the farming communities, we must attract and engage the youth interest in the agriculture for the sustainable development, otherwise no one will leave for the agriculture innovation, on all living and non-living are based.

Population will keep growing, but soil productivity will help determine how much food and fibre can be provided for the world's increasing population of humans. Some soils are naturally productive, others are not, some respond to cultural soil management practices and can be made more productive. Others will not respond and could be best be left in their natural state. In any case, however, without proper knowledge of your soil nature, properties and management, it is not possible to predict or dictate your soil health or to know how your soil should be managed and conserved.

Research is demonstrating that proper soil management is a critical factor in agricultural productions, not only in underpinning good crop yields but also in sustaining long term productivity. The future of our planet is in our hands, and it is up to each and every one of us to take action to protect it. Let us remember that the choices we make today will have a lasting impact on the world we leave for future generation.

We, proudly say, who loves soils, nature, plants, birds, animals, agriculture, but we feel bad and defeated when realized "what we do to our soils". Yes, our duty is to fix it, but how can our leaders be so irresponsible to contaminate a good soil to pub of pollution. War all over world enriching chemicals, heavy metals and arms wastes in soil bodies. And then ask us-what do you think? We just do not understand their egoism??



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Key words: Soils, soil health, survival of living beings, soil nutrients management

INTRODUCTION

NITROGEN:

- **Atmospheric Nitrogen (N_2):** Nitrogen is an essential element found abundantly in nature. It constitutes about 78% of the Earth's atmosphere. However, in this gaseous form (N_2), it's unusable by most organisms due to its strong triple bond. Nitrogen needs to be transformed into different compounds for uptake by living organisms. Nitrogen-fixing bacteria convert atmospheric nitrogen into ammonia or nitrates through a process known as nitrogen fixation.
- **Ammonium (NH_4^+):** Plants can directly absorb and utilize this form of nitrogen. It's a common component in various nitrogen-based fertilizers.
- **Nitrates (NO_3^-):** Nitrates are a primary source of nitrogen for many plants. They are absorbed through the roots and used in various metabolic processes.

NITROGEN FIXATION:

Biological Fixation: Certain bacteria, like Rhizobium in legumes and free-living bacteria in the soil, convert atmospheric nitrogen into ammonium.

Industrial Fixation: Humans have developed methods (such as the Haber-Bosch process) to convert atmospheric nitrogen into ammonia for fertilizer production.

NITRIFICATION:

- **Ammonification:** Organic matter decomposition by bacteria releases ammonium ions into the soil.
- Nitrification: Ammonium is converted by nitrifying bacteria into nitrates, a more readily available form for plant uptake.

ASSIMILATION:

- **Uptake by Plants:** Root systems absorb ammonium and nitrates from the soil.
- **Conversion:** Nitrates are converted back into ammonium ions, which are then assimilated into amino acids, proteins, and other essential compounds within the plant.



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ROLE IN PLANT GROWTH:

- **Building Blocks:** Nitrogen is a crucial component of amino acids, proteins, chlorophyll, and DNA, essential for plant structure and function.
- **PHOTOSYNTHESIS:** It aids in the production of chlorophyll, enabling plants to conduct photosynthesis efficiently.
- **Enzyme Activity:** Nitrogen is a key element in various enzymes that regulate metabolic processes within plants.
- **Protein Synthesis:** Nitrogen is a vital component of proteins, enzymes, chlorophyll, and nucleic acids, essential for plant growth and development.
- **Photosynthesis:** Chlorophyll, containing nitrogen, enables plants to absorb sunlight and produce sugars, vital for energy production.
- **Regulatory Role:** Nitrogen influences various metabolic processes and enzyme activities, regulating plant growth, flowering, and fruit development
- **Fertilization:** Different crops have varying requirements for nitrogen. Understanding the forms and conversion process helps in selecting appropriate fertilizers.
- **Soil Health:** Proper nitrogen management maintains soil fertility and minimizes environmental impacts like nitrogen runoff, which can lead to water pollution.

IMPORTANCE FOR SOIL HEALTH AND SUSTAINABLE AGRICULTURE:

- **Phosphate Rich Organic Manure (PROM) and Potash derived from molasses (PDM),** are natural and environmentally friendly alternatives to chemical fertilizers. These specialized organic fertilizers are designed to provide essential nutrients to plants in a balanced and sustainable manner, improving soil health and promoting sustainable agriculture practices.
 - **Phosphate Rich Organic Manure (PROM)** is an organic fertilizer that contains a high concentration of phosphorus in combination with organic carbon & micronutrients.
 - **PROM: Replacement to expensive phosphatic Chemical Fertilizers:**
 - **Phosphorus** is a vital nutrient for plant growth, essential for processes like energy transfer, root development, and flower and fruit production.
- PROM improves soil structure, water retention, and nutrient-holding capacity, promoting overall soil health and fertility.
- Unlike chemical fertilizers, which can lead to nutrient imbalances and soil degradation over time, PROM releases nutrients slowly, reducing the risk of nutrient leaching and runoff into water bodies. Chemical fertilizers are often water-soluble and quickly release nutrients, which can lead to excess nutrient runoff, causing environmental pollution and eutrophication. PROM's slow-release nature reduces these environmental impacts.
- By using PROM, farmers can reduce their dependence on synthetic phosphorus fertilizers, which are usually derived from non-renewable phosphate rock reserves.



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As PROM is made from organic waste materials, its production contributes to recycling and managing organic waste, reducing landfill waste and greenhouse gas emissions.

POTASH DERIVED FROM MOLASSES (PDM)

▪Potassium is a crucial for plant growth and plays a key role in processes like enzyme activation, photosynthesis, and water uptake.

PDM enhances soil structure, improves cation exchange capacity, and helps plants withstand drought and diseases.

Unlike some chemical potash fertilizers that can harm soil microbial activity, PDM

Water quality parameter	Symbol	Molecular or atomic weight	Unit	Usual ranges in irrigation water
Electrical conductivity	EC _w	-	dS/m	0 - 3
Total dissolved solids	TDS	-	mg/l	0 - 2000
Calcium	Ca ⁺⁺	40.1	mg/l	0 - 400
Magnesium	Mg ⁺⁺	24.3	me/l	0 - 60
Sodium	Na ⁺	23	me/l	0 - 920
Carbonate	CO ₃ ⁻⁻	60	me/l	0 - 30
Bicarbonate	HCO ₃ ⁻	61	me/l	0 - 610
Chloride	Cl ⁻	35.5	me/l	0 - 1065
Sulphate	SO ₄ ⁻⁻	96.1	me/l	0 - 961
Nitrate-Nitrogen	NO ₃ -N	62	mg/l	0 - 10
Potassium	K ⁺	39.1	mg/l	0 - 0.05
Acid/Basicity	pH	-	1 - 14	6 - 8.5
Sodium Adsorption Ratio	SAR	-	(meq/l)	0 – 15

QUALITY OF IRRIGATION WATER

It affects crop growth and the soil environment in vegetable production systems. Water quality criteria include salinity, sodium hazard, pH, alkalinity, particulate matter, and the presence of microorganisms. Irrigation water Quality is defined by certain physical, chemical and biological characteristics.



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WATER QUALITY: PROBLEMS AND RECLAMATION:

- i. Salinity: Salts in soil or water reduce water availability to the crop to such an extent that yield is affected. A salinity problem exists if salt accumulates in the crop root zone to a concentration that causes a loss in yield. Yield reductions occur when the salts accumulate in the root zone to such an extent that the crop is no longer able to extract sufficient water from the salty soil solution, resulting in a water stress for a significant period of time.
- ii. pH and Alkalinity: The pH of irrigation water should be between 5.0 and 7.0. Highly acidic or highly basic irrigation water can affect the availability of nutrients in the soil solution, leading to nutrient deficiency and toxicity problems.
- iii. Water infiltration rate:
- iv. Relatively high sodium or low calcium content of soil or water reduces the rate at which irrigation water enters soil to such an extent that sufficient water cannot be infiltrated to supply the crop adequately from one irrigation to the next.
- v. Specific ion toxicity: Certain ions (sodium, chloride, or boron) from soil or water accumulate in a sensitive crop to concentrations high enough to cause crop damage and reduce yields. Toxicity problems occur if certain constituents (ions) in the soil or water are taken up by the plant and accumulate to concentrations high enough to cause crop damage or reduced yields. The degree of damage depends on the uptake and the crop sensitivity. The permanent, perennial-type crops (tree crops) are the more sensitive.
- vi. Microorganisms: Irrigation water can also become contaminated with microorganisms that cause human illness, typically from contact with human and animal feces. As with plant pathogens, human pathogens are most likely to be found in surface water sources, less likely in well water, and even less likely in municipal water sources. The proximity of water sources to wastewater discharge areas and livestock operations should be noted when selecting sources of irrigation.
- vii. Miscellaneous: This problem is most serious for wells and pumps, but in some areas, a poor-quality water may also damage irrigation equipment and canals. Excessive nutrients reduce yield or quality. These include high nitrogen concentrations in the water which supplies nitrogen to the crop and may cause excessive vegetative growth, lodging, and delayed crop maturity; unsightly deposits on fruit or leaves due to overhead sprinkler irrigation with high bicarbonate water, water containing gypsum, or water high in iron.

SOIL ORGANIC CARBON MONITOR IN AGRICULTURE

SOC refers to the carbon content present in the organic matter of the soil, such as dead plant and animal materials in various stages of decomposition.

◆ Nutrient Cycling: SOC acts as a reservoir of nutrients, including nitrogen, phosphorus, and sulphur. It undergoes decomposition by soil microorganisms,



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releasing these essential nutrients for plant uptake, thereby supporting crop growth.

◆ **Soil Fertility:** SOC is vital for maintaining soil fertility. It enhances the cation exchange capacity of the soil, allowing it to retain and supply nutrients to plants. Additionally, organic matter contributes to a favourable soil pH and provides favourable conditions for beneficial soil organisms.

◆ **Water Retention and Drainage:** SOC improves soil structure, enhancing its ability to hold water. Soils rich in organic carbon can retain moisture, ensuring better water availability for plants during dry periods. Moreover, it promotes proper drainage, preventing waterlogging and associated problems.

◆ **Soil Erosion Prevention:** Soils with adequate SOC have improved aggregate stability, reducing erosion caused by wind and water. The organic matter binds soil particles together, preventing them from being carried away by erosive forces.

Unfortunately, soil organic carbon levels have been decreasing globally due to various reasons, mainly intensive farming practices like excessive tillage, monocropping, and overuse of chemical fertilizers and pesticides can accelerate the breakdown of organic matter and decrease SOC levels.

ADVANCED AGRONOMIC PRACTICES TO ENHANCE ORGANIC MATTER

◆ **Organic Matter Addition:** Incorporate organic materials, such as compost, crop residues, green manure, or animal manure, into the soil. These inputs enhance SOC content and provide additional nutrients.

◆ **Minimize Chemical Inputs:** Reduce the excessive use of chemical fertilizers and pesticides, as they can negatively affect soil organisms responsible for organic matter decomposition.

◆ **Conservation Tillage:** Reduce or eliminate tillage operations to minimize disturbance to the soil structure and decrease organic matter decomposition.

◆ **Crop Rotation & Diversification:** Planting diverse crops and implementing crop maintaining soil organic carbon levels for long-term soil health and sustainable crop production.

THE COOL MARKET OF SOIL

As we know that plant ecosystems have their own market, where a complex web of symbiotic relationships thrives? In this market, plants are resourceful merchants with a wide range of goods to offer, such as carbohydrates produced through photosynthesis.

But they're not alone - beneficial bacteria act as savvy traders, specialising in the direct and indirect benefits for plants. They convert nutrients and release hormones and secondary metabolites - all sought-after commodities for growth. And mycorrhizal fungi are like expert brokers, extending their vast network of hyphae deep into the soil, gathering essential nutrients like phosphorus, and delivering them to the plants.



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What's more, arbuscular mycorrhiza fungi (AMF) species are skilled chemical processors that hydrolyse organic phosphorus, thereby increasing soil organic P turnover. And there are many converging interests, as beneficial bacteria interact with the extraradical mycelium to mobilise nutrient resources. In this lively soil market, the traders benefit mutually, ensuring their prosperity and profits.

Mitigation Measures: To mitigate the risk of liquefaction, engineers can use several techniques, such as densification of loose soils through compaction or vibro-replacement, installing drainage systems to accelerate pore water dissipation, and constructing deep foundations that reach past the liquefiable layer. These measures help increase the soil's resistance to liquefaction and improve overall stability.

The farmers are entire community. It's a fascinating and intricate world that deserves our attention and appreciation. We can advocate them following visions:

1. Alert about of your strengths and weaknesses. You are power of country.
2. Never be afraid to seek help when needed from your country
3. Habitat to be humble and appreciative to people of nation
4. Keep openness to the fact that other people's opinions could be better than yours.
5. Citation appreciation for constructive criticism and positive feedback from stakeholders
6. Accept the moral responsibility for your mistakes and try to learn from them.

HOW FARMER IS DOCTOR OF HIS CROPS

Farmers and gardeners can utilise the knowledge of the intricate relationships between plants, beneficial bacteria, and mycorrhizal fungi to improve their crops in several ways:

- i. Biofertilizers: Farmers and gardeners can use biofertilizers, which contain beneficial bacteria and mycorrhizal fungi, to enhance the microbial activity in the soil. This can improve the availability of nutrients to the plants, leading to better growth and yield.
- ii. Crop rotation: Crop rotation can help to maintain a diverse soil microbial community, which can support the growth of plants. This is because different plants support different types of microbes, and by rotating crops, farmers and gardeners can ensure that the soil microbial community remains diverse.
- iii. Cover crops: Cover crops, such as legumes, can fix atmospheric nitrogen, increasing the availability of nitrogen in the soil for other plants. Cover crops also support the growth of beneficial bacteria and mycorrhizal fungi.
- iv. Tillage: Reduced tillage can help preserve the soil structure and the microbial community, leading to better soil health and improved nutrient availability for plants.

Wastewater but also grey water produced by the gallons per unit of dehumidifiers. If each air conditioning were tweaked to improve their dehumidifying function, they would then become atmospheric water harvesters. That water can be collected at the city level just like with recycling bins or directly recirculated into a household's tank to be used for washing and garden hoses. It's a pity not to use this precious byproduct.



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Soil and Water Conservation for Sustainable Food Production, biodiversity conservation, and ecosystem services should be given top priority in the prevalent climatic anomaly related disaster management. In this regard, soil science requires integration of studies on massive soil mass to soil particles and colloidal clay micelle, soil microbial community, soil organic matter, soil nutrients, soil moisture and their uptake by plants, and also management of aquatic environment.

Moreover, it requires reviews of the works done on physical, chemical, microbial and biochemical properties of soils and their interactions with climate and hydrological conditions towards application of soil and water conservation methods on priority basis for successful crop cultivation, and achieving 15 Sustainable Development Goals of the United Nations.

Consequently, the agricultural research and field works should be targeted on application of soil and water conservation methods in individual agricultural plots and further development of soil and water conservation as a full-fledged stream of science. Water is a source of life. But 80% of wastewater flows back into the ecosystem without being treated or reused - causing irreversible harm.

CONCLUSION

may provide some solutions for health soil body. The combination of nanobiotechnology and its advances provides an efficient approach for using green chemistry and using plant growth stimulants, to evaluate the increase in growth and development of plants in the presence of copper heavy metal stress. Due to the excessive use of copper compounds in sanitary industries and industrial wastes, and pollution of agricultural land in the suburbs.

We can suggest that it's a very serious and practical challenge for this research area. However, the findings showed that the use of synthesized Fe_3O_4 -NPs, spermine, coating of Fe_3O_4 -NPs by spermine, hyper branch spermine, and coating of Fe_3O_4 -NPs by hyper branch spermine all have a positive effect on increasing seed germination and seedling growth rate. Also, plants often try to maintain ideal circumstances under environmental stress. As a result, when exposed to environmental stress, antioxidant enzyme activity, and plant metabolites both respond to stress.

On the other hand, under copper oxide stress conditions, the use of Fe_3O_4 -HS reduced H_2O_2 content. We are not sure if this is an example of soil liquefaction or not, as the soil liquefaction requires dynamic loading and some duration in which the soil changes its behaviour from solid to something similar to liquid. Here, it appears that there is a water body below the grass formation.

Soil liquefaction is a phenomenon in which saturated soil loses its strength and stiffness, behaving more like a liquid than a solid during seismic events or other dynamic loading conditions. It occurs primarily in loose, saturated, and cohesionless soils, such as sands and silts. This process can have severe consequences on the stability of structures.

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BRIEF DISCUSSION OF ORGANIC MATTER IN SOIL AND THE CARBON CYCLE

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ABSTRACT

The importance of organic matter to the crop cannot be overstated. Up to 0.5% of the soil in India includes organic materials. When it is present in the soil, it enhances its physical, chemical, and biological qualities while also increasing productivity per hectare. The 'O' horizon, which is visible as a dark brown structure on the soil's upper surface, increases the soil's fertility. Plants develop more quickly as a result of its action, which also helps the carbon cycle. The importance of organic matter in crops, as well as its composition, function, decomposition, and human formation, have all been briefly discussed in this chapter. All of the significant organic matter aspects have been briefly covered in this chapter.

Key Words: Soil Organic Matter, Properties, Function, Decomposition, Carbon Cycle.

INTRODUCTION

Ordinarily, the decay of plants and animals produces organic matter. They are broken down by several microorganisms, including fungus, actinomycetes, and bacteria. It typically exists in the soil's topmost layer, also known as the "o horizon." Organic horizon is another name for O horizon. The physical, chemical, and biological qualities of the soil are improved when organic matter is present. In India, organic matter typically makes roughly 0.5% of the total. Organic matter is frequently influenced by



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environmental factors. If a soil is cultivated and comes from a temperate zone, organic matter will be present there to a degree of 5–10%. In contrast to temperate regions, tropical regions have a higher concentration of organic carbon. These 'factors of soil formation' have been identified as the causes of these variations in organic matter levels and are depicted as relation (ISSS):

OM= F (cl, t, v, p, T,...)

Where:

- OM –Organic matter.
- cl – Climate.
- t – Time.
- v – Vegetation
- p – Parent material.
- T – Topography.

Definition: - “Organic matter is often made up of organic chemicals that are created through the breakdown of plant and animal matter. It looks like a dark, brown, and clay-colored structure at first glance. It enhances the soil's biological, chemical and physical characteristics. Referred to as organic stuff”.

Composition of Soil organic matter: -

Organic matter in the soil frequently has a major impact. The growth of plants and the production of crops both require different kinds of nutrients. The three elements nitrogen, phosphorus, and sulfur are thought to be the primary generators of soil organic matter. The following table lists the two components of soil organic matter. (Mehra,2011)

1. Composition of organic residues.
2. Composition of plant tissues.

1. Composition of organic residues- According to their residues, soil organic matter is categorized in this. Plant residues are made up of 25% dry matter and 75% moisture. Different forms of carbon, oxygen, hydrogen, mineral matter, nitrogen, and so on are present in 25% of the dry matter. The following is how they have been shown.



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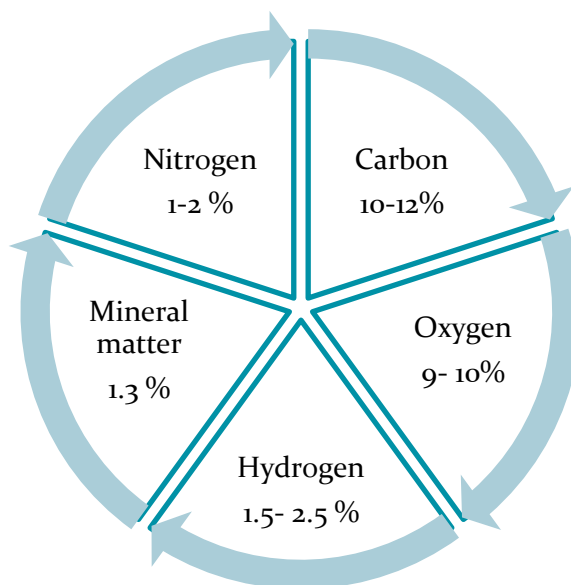


Fig 1- Composition of Soil organic matter based on organic residues.

2. Composition of plant tissues: -

According to this, soil organic matter has been categorized according to plant tissue. This comprises sugars, lipids, waxes, tannins, and lignins, among other things. The breakdown of their makeup is given below.

S. NO.	Composition	Plant tissues %
1.	Carbohydrate	
	Celluloses	20-50 %
	Hemicelluloses	10-30 %
	Starch	1-5%
	Proteins	1-15 %
	Sugar	1-6 %
2.	Fats	1-10 %
3.	Lignin	10-30%
4.	Waxes	1-10%

Function of soil organic matter-

The organic elements of the soil are known as soil organic matter. It is made up of organic matter from plants and animals as well as material that has been broken down by soil microbes at various stages of decomposition. The direct advantages of soil organic matter for agricultural and agroforestry output



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are that healthy soil with consistent amounts of organic carbon is also better able to fend off and treat diseases that are transmitted through the soil. On three levels, soil organic matter is essential for improving soil fertility and quality:

1. chemical properties:

The capacity of the soil to store and deliver vital nutrients like N, P, K, Ca, Mg, etc., as well as retaining harmful components, is greatly enhanced by soil organic matter. This also enables the soil to adapt to variations in soil acidity and speeds up the breakdown of soil minerals.

- a) When organic matter breaks down, different organic acids and CO₂ are released into the soil as a result, helping to lower the soil's alkalinity.
- b) Organic matter has a great capability for adsorbing cations. Compared to mineral soil colloids, it has a capacity for cation absorption that is two to thirty times greater. In addition, organic matter contributes 30 to 90% of the adsorbing capacity of mineral soils. Organic matter has several functional groupings. According to estimates, carboxyl (-COOH) groups account for 54% of the exchange locations in soil organic matter, phenolic and enolic hydroxyl groups for 36%, and imide nitrogen groups for 10%.
- c) Additionally, soil organic matter serves as a barrier. As a result of this buffering action, the soil pH stabilises, and there is less chance that excessive acids, alkalies, or salts, whether naturally occurring in the soil or applied to it in the form of fertilisers, may harm plant roots.
- d) Various soil-based mineral substances are solubilized by organic matter. The plant's root exudates (such as carbon dioxide and organic acids) and various products derived from microbial activity that finally result in the transformation of a range of chemical compounds into forms accessible to plants are the simplest means for organic substances to interact with the mineral portion of the soil.
- e) Organic matter can be thought of as a reservoir for different nutrients that are necessary for plant growth. In unfertilized soils, 90 to 95 percent of the nitrogen comes from organic matter. Additionally, organic matter boosts the soil's nutrient regime and promotes its health by supplying the soil with readily available phosphorus, sulphur, and several other micronutrients, including Fe, Mg, Cu, and Zn. Organic matter ought to be seen as a benefit for high crop output.
- f) Heavy pollutants (lead, cadmium, etc.) that are often obtained by applied waste fluids used for irrigation are momentarily absorbed by organic matter. Pollutant adsorption aids in the purification of dirty water.
- g) Organic material serves as a chelate. Any organic chemical that may create a circular or cyclic structure when bonded to a metal (often Fe, Zn, Cu, Mn, etc.) by more than one bond is referred to as a chelate. Such micronutrients may be helped to move about by the soluble chelates, enhancing soil mobility and accessibility to plants.



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2. Physical properties:

Organic matter in the soil enhances soil structure. In the end, this aids in reducing soil erosion and promotes water absorption and storage, providing plant roots and soil organisms with a living environment.

- a) Organic matter affects the colour of the soil. The colour of the soil will range from light brown to dark brown or black due to the existence of an adequate amount of organic matter.
- b) Soil constituents (sand, silt, and clay) are joined together into structured groups known as aggregates by organic matter. Such aggregates support the maintenance of a porous, open, and granular state. Thus, organic matter has a significant impact on improving soil structure and preserving the soil's advantageous aeration and permeability conditions. Polysaccharides, or long-chain sugars, are provided by organic matter and aid in the development of good soil structure.
- c) By adding organic matter to the soil, water will infiltrate and percolate at a faster pace. The incorporation of organic matter can help soils drain more effectively.
- d) Application of organic matter increases water retention efficiency. When organic matter is added to sandy and loamy soils, the quantity of water readily available rises.
- e) In soil that contains a sizable amount of clay, organic matter lessens the flexibility, cohesiveness, adhesiveness, etc.
- f) Organic matter improves the soil's capacity to fend off erosion. Additionally, it decreases runoff from the surface by allowing effective filtration.
- g) Organic matter has a positive impact on soil densities, particularly bulk density, which in fact influences the porosity of the soil.
- h) Through the formation of granules of soil fragments, organic matter minimises the loss of surface soil due to wind erosion.
- i) The mulching effect that coarse organic matter has on the soil's top layer helps to keep the soil warmer in the winter and cooler throughout the summer. Additionally, it slows the transfer of heat from the atmosphere to the soil by acting as an insulator.

3. Biological properties:

The main source of carbon, energy, and nutrients for soil organisms is soil organic matter. Because it increases the activity of soil microbes and can increase biodiversity while reducing the release of CO₂ into the environment and simulating changes in climate, this promotes soil functionality.

- a) Organic matter serves as an energy source for both macro- and microorganisms and aids in several useful functions in the soil, such as mineralization and nitrogen fixation.
- b) Diverse microorganisms generate diverse organic molecules during the breakdown of various kinds of organic matter, including vitamins, antibiotics, and growth-promoting compounds like auxin. Auxin influences seed germination, root growth, and other aspects of plant development to promote growth. Disease incidence could be reduced by fungitoxic compounds made from organic materials.
- c) Organic matter interacts with natural pesticides and has the ability to absorb atmospheric nitrogen and sulphur oxide, and this has implications for crop plant yields and the environment, respectively.



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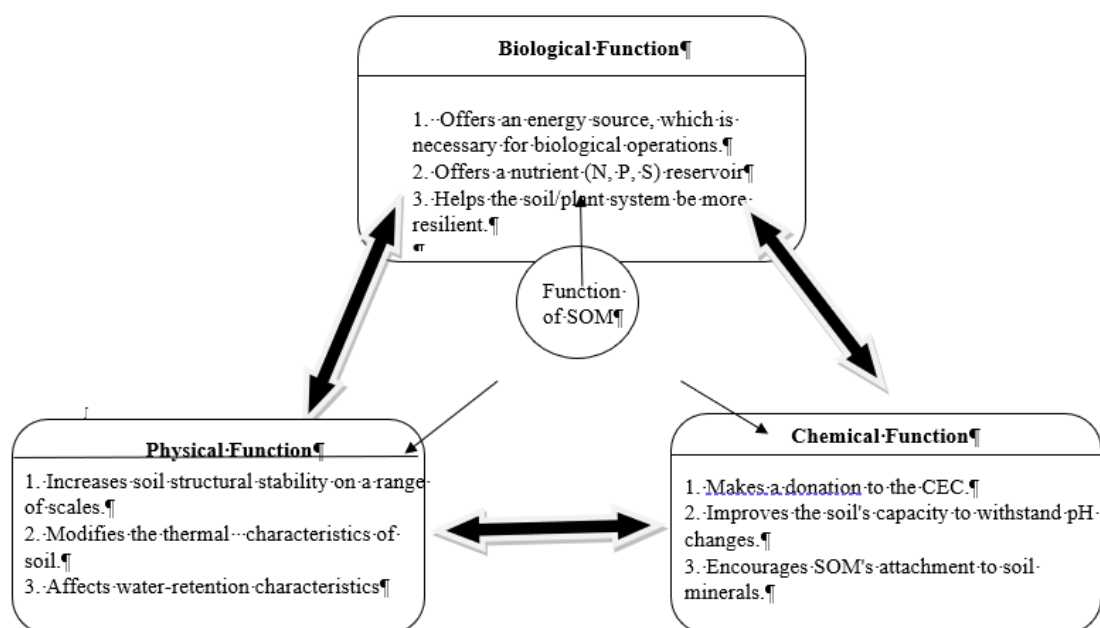


Fig 2: - Function of Organic Matter in Soil

Source: - Residue Management, Soil Organic Carbon, and Crop Performance, GRDC Project No. CSO 00029. (Biala, 2011).

Formation of Humic Substances: -

Microorganisms break down leftover plants and animal matter to create humic compounds. They are polymeric, colloid-sized compounds with dark colors ranging from black to brown black to yellow. Humic compounds are polymeric mixtures made primarily of aromatic units. Phenols, quinines, and aromatic carboxylic acids are some of its key structural constituents. Humic compounds also contain the functional groups carboxyl, phenolic hydroxyl, amino, quinine, and ketone. Humic acid's molecular weight can range from 10,000 to over 200,000, although fulvic acid's molecular weight is substantially smaller. The three humic substance fractions are as follows:

1. Humic acid
 2. Fulvic acid
 3. Humin
1. **Fulvic acid:** - Its small molecular weight, fulvic acid is soluble in both acids and alkalis. And it is golden to brownish-yellow colour.
 2. **Humic acid:** -Humic acid has a modest molecular weight and is only soluble in alkalis; it is insoluble in acids. Its color ranges from dark brown to black.
 3. **Humin:** -High molecular weight humin acid is insoluble in both alkali and acids.



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The functional group and composition of organic soil matter: -

If we were to discuss their makeup and traits, they would be as follows: The composition described below is expressed as a percentage:

Table - Composition of humic compounds' elements and their functional categories.

Table 1. Composition of humic compounds: elements and their functional categories				
S.NO.	Elemental Composition (%)			
	Element	Humic acids	Fulvic acids	
1.	Carbon %	53.8- 58.7	40.7- 50.6	
2.	Sulpher %	0.1-1.5	0.1- 3.6	
3.	Oxygen %	32.8- 38.3	39.7-49.8	
4.	Nitrogen %	0.8- 4.3	0.9- 3.3	
Functional Groups (cmol/kg)				
	Humic substances	Total acidity	-COOH	Phenolic- OH
1.	Humic acid	500-900	150-600	200-600
2.	Fulvic acids	700-1400	500-1100	100-600

DECOMPOSITION OF SOIL ORGANIC MATTER-

Different chemical compounds can be found in various organic wastes. The rate at which organic wastes decompose varies greatly. Simple proteins, carbs, and sugars degrade relatively quickly. Conversely, the decomposition of fats, waxes, and lignins occurs relatively slowly. Protein, cellulose, and hemicellulose are in the middle. Although the content may differ, the end products are essentially the same.

1. Enzymatic oxidation of the bulk, which releases CO₂, water, energy, and heat, is one of the general reactions occurring during decomposition.
2. A sequence of reactions releases and immobilises essential components (N, P, S, etc.).
3. The formation of substances that are immune to microbial attack.

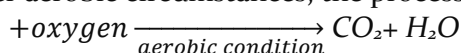
Extremely resistant compounds to microbial activity are generated by chemical modification or microbial synthesis.

Products produced in aerobic circumstances include CO₂, NH₄, NO₃, H₂PO₄, SO₄, H₂O and vital plant nutrients like Ca, Mg, Fe, Cu, and Zn etc.

Under anaerobic conditions: CH₄, NH₄⁺, different amine residues (R-NH₂), H₂S, ethylene (CH₂=CH₂), organic acids such as lactic, propionic, and butyric, etc and humic compounds are formed. Proteins and other nitrogen compounds are converted into elemental nitrogen.

A. Soluble substances decomposition:

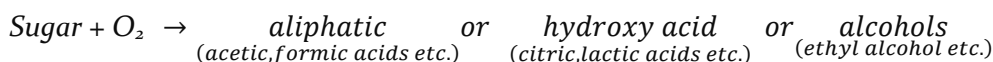
When glucose breaks down under aerobic circumstances, the process occurs as follows:



In restricted supply of oxygen and nutrients:

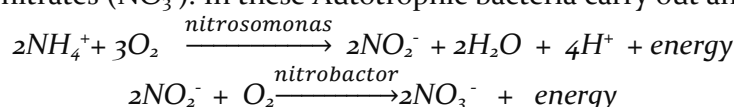


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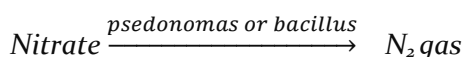


Ammonification: Ammonification is the conversion of organic nitrogen (amino acids, amides, ammonium compounds, nitrates, etc.) into ammonia. This mechanism happens as a result of heterotrophic microbes of hydrolytic and oxidative enzymatic reactions in aerobic circumstances.
organic N compounds → polypeptides → amino acids → NH₃ or NH₄⁺

Nitrification: The nitrification process consists of two steps. It converts ammonia to nitrites (NO₂⁻) and nitrites (NO₂⁻) to nitrates (NO₃⁻). In these Autotrophic bacteria carry out an aerobic process.



Denitrification: Denitrification is the process by which soil nitrate is converted into gaseous nitrogen or nitrous oxide. Waterlogging and high pH will hasten nitrogen loss via denitrification.

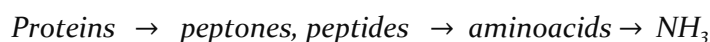


B. Insoluble Substances Decomposition

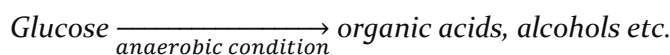
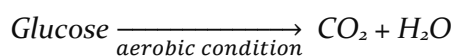
Protein Breakdown: Protein is made up of an extended chain of amino acids. In protein molecules, amino acids are bound together by peptide bonds (CO—NH). Enzymes proteases hydrolyze the peptide bonds and release the free amino acids through peptones and peptides.

Aminization is the process by which proteins are converted into amino acids.

Ammonification is the process by which amino acids and amides are converted to ammonia.



cellulose breakdown: cellulose is carbohydrate consisting of thousand units of glucose in long linear chain by β -(1,4) glycosidic linkage.





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This process takes longer in acidic soils than in neutral or alkaline soils. It moves quickly in well-aerated soils and slowly in less-aerated soils.

Hemicellulose breakdown: Hemicellulose is a type of polysaccharide that is water insoluble. Decompose quicker than cellulose and must first be hydrolysed to provide sugars and uronic acids. Sugars are attacked by microbes, which convert them to organic acids, alcohols, carbon dioxide, and water. *Hemicellulases* are enzymes that break down hemicellulose.

Polysaccharides (e.g. hemicellulose) → oligosaccharides → simple sugars

Simple sugars → CO₂ + H₂O

simple sugars → organic acids, alcohols etc.

Starch breakdown: Starch is a glucose polymer that functions as a storage product for plants. As so, it serves as the primary reserve carbohydrate. Plant starches are typically composed of two components: amylose and amylopectin. Amylose molecules are joined together by -1,4-glycosidic bonds, while amylopectin molecules are joined together by -1,4-glycosidic bonds and -1,6-glycosidic bonds. Starch decomposes more quickly than celluloses and hemicelluloses. Starch may be hydrolyzed by a variety of microorganisms, including fungi, bacteria, and actinomycetes. The enzymes α -amylase and β -amylase are in charge of starch (amylose and amylopectin) degradation.

starch $\xrightarrow{\text{amylase}}$ maltose $\xrightarrow{\alpha\text{-glucosidase}}$ glucose
(glucose)_n

Lignin decomposition: Lignin decomposes slowly, much slower than cellulose. Lignin is resistant to most bacteria's destruction, and its principal function in the wood cell wall is to shield the carbohydrates from microbial attack. In nature, lignin is effectively destroyed mostly by white-rot fungi, which include several litter-decomposing basidiomycetes. CO₂ and H₂O are produced during complete oxidation.

FACTORS AFFECTING DECOMPOSITION: -

Temperature: Cold periods retard plant growth and organic matter decomposition. Warm summers may permit plant growth and humus accumulation.

Soil moisture: extremes of both arid and anaerobic conditions reduce plant growth and microbial decomposition. Near or slightly wetter than field capacity, moisture conditions are most favourable for both processes.

Nutrients: Lack of nutrients, particularly N, slows decomposition.

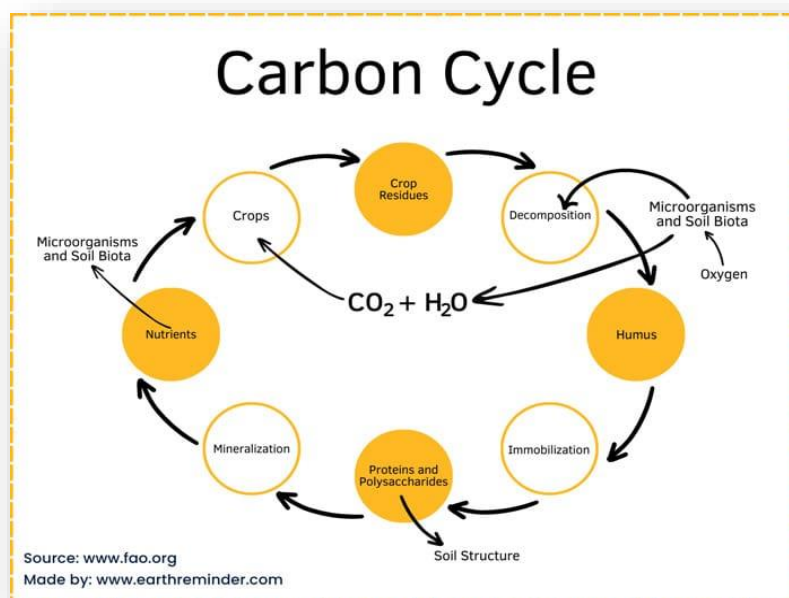
Soil pH: Most of the microbes grow best at pH 6 to 8, but are severely inhibited below pH 4.5 and above pH 8.5.



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Carbon Cycle

carbon is an integral part of all organic matter (plant and animal residues). Carbon continually gets fixed in organic form via photosynthetic organisms under the influence of light, and once linked, the carbon becomes unavailable for use in the generation of new plant life, so it is critical for carbonaceous substances to be decomposed and returned to the atmosphere in order for higher organisms to survive.



Plant and animal decomposition in soil constituents is an essential step in biology in which carbon (C) is recirculated to the atmosphere as CO_2 , nitrogen (N) is made available as NH_4 and NO_3 , and other associated nutrient elements such as P, S, Fe, Mn, Cu, and Zn, among others, appear in plant-accessible forms. Parts of the nutritional components are digested by microorganisms and integrated into microbial tissues (soil biomasses) throughout the process. Mineralization is the transformation of organic forms of C, N, P, and S to inorganic or mineral forms, whereas immobilisation is the conversion of inorganic forms of those elements to organic forms. CO_2 and its fixation and regeneration are crucial to the carbon cycle. Chlorophyll-containing plants use the gas as their only carbon source, and the carbonaceous matter produced serves to deliver preformed organic carbon to the animal world. Following the death of a plant or animal, the microbiological world produces organic carbon. Following the death of a plant or animal, microbial metabolism takes over as the major process in the circular process. The decaying deceased tissue is changed into microbial cells and an enormous quantity of heterogeneous carbonaceous substances known as humus, which compose the soil organic component.



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With the ultimate breakdown and creation of CO₂ from humus and decaying tissues, the cycle completes, and carbon is made accessible.

HOW TO IMPROVE SOIL ORGANIC MATTER: -

Practices that improve soil organic matter are as follows:

1. **crop rotation:**

varied crops with varying root systems and nutrient requirements result in a more balanced use of soil resources. This decreases nutrient depletion and avoids soil deterioration, eventually increasing soil organic matter. Certain crops, such as legumes, may fix atmospheric nitrogen via a symbiotic association with nitrogen-fixing bacteria. When nitrogen-rich crops are added to the rotation, they not only increase plant growth but also replenish the soil with organic matter as their leftovers decay. Crop rotation disturbs pest and disease life cycles that may be peculiar to certain crops. This lowers the need for chemical treatments, which can be detrimental to soil health.

2. **Organic matter amendments:**

Organic matter amendments are an effective strategy for boosting soil organic matter content and overall soil health. These amendments entail adding organic elements to the soil, such as compost, well-rotted manure, cover crops, or leaf litter. Organic matter additions are a rich supply of carbon, which feeds beneficial soil bacteria. As these microbes degrade organic molecules, they produce byproducts that transform into stable organic matter, replenishing the soil. Second, through enhancing aggregation, these supplements enhance soil structure. Organic matter works as a glue, glueing soil particles together and improving water retention and aeration. Organic matter decomposition releases critical nutrients such as nitrogen, phosphate, and potassium, making them available for plant absorption. This nutrient enrichment promotes healthy plant development while also increasing organic matter, which plant residues contribute too.

3. **Reduced tillage:**

Reduced tillage, often known as no-till farming, promotes soil organic matter by minimising soil disturbance. Organic matter decomposition slows as the soil structure stays intact when tillage is minimised or abolished. This helps to retain current organic matter while also encouraging the buildup of new organic material from agricultural waste and cover crops. Furthermore, lower tillage encourages the establishment of earthworms and beneficial microbes, both of which are essential in the breakdown of organic materials. This strategy improves soil fertility, water retention, and general soil health over time, making it a sustainable way to increase soil organic matter levels while minimising erosion and conserving soil structure.



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4. **Mulching:**

Mulching is a beneficial practice that increases the organic matter content of the soil. Organic mulch, such as straw or wood chips, acts as a protective barrier on the soil's surface. By minimising evaporation, this layer conserves soil moisture, maintaining a stable and favourable habitat for soil microbes. Over time, these microbes break down the mulch, contributing organic matter to the soil. Mulch also moderates soil temperature, providing a perfect environment for beneficial soil organisms that help in organic matter breakdown. Mulching, in general, promotes organic matter enrichment, improves soil structure, and adds to increased soil fertility and health.

5. **Afforestation:**

The growth of wood on previously unforested land, known as afforestation, can dramatically boost soil organic matter content. Through falling leaves, branches, and decaying root systems, trees and woody plants contribute to organic matter. This organic material enhances the soil, increasing fertility, water retention, and microbial activity. Mycorrhizal fungi, which help in nutrient intake and organic waste breakdown, are also found in trees. The steady accumulation of organic matter enhances soil quality while also mitigating erosion, sequestering carbon, and sustaining a healthy ecosystem, eventually helping both the environment and agriculture.

6. **Composting:**

By turning organic waste products into nutrient-rich, stable humus, composting increases soil organic matter. Microorganisms break down organic materials such as kitchen leftovers, yard debris, and plant residues during the composting process. As these items degrade, essential nutrients and organic carbon are released into the compost, enriching it. When nutrient-rich compost is mixed into soil, it increases organic matter levels. This organic matter increases soil structure, moisture retention, and beneficial microbial activity, resulting in healthier, more fruitful soil. Composting on a regular basis helps to preserve and increase soil organic matter, which is vital for sustainable agriculture and enhanced plant growth.

7. **Green manure crops:**

Green manure crops, such as mustard or buckwheat, increase soil organic matter by adding new organic material to the soil. These crops are planted with the intention of being integrated into the soil before maturity. Their organic leftovers degrade swiftly due to their low carbon-to-nitrogen (C:N) ratio. They enhance the soil by releasing carbon-rich organic materials when they decompose. This additional organic matter not only improves soil structure and water retention, but it also provides nutrients to microorganisms. Green manure therefore encourages microbial activity, which assists in organic matter breakdown and, as a result, improves soil fertility and health.



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ALGORITHMIZATION OF RESEARCH AND SOLVING OPTIMIZATION PROBLEMS

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ABSTRACT

This paper proposes a system approach to solving optimization problems based on algorithmic methods. Theoretical prerequisites and principles for constructing systems for solving classes of optimization problems are developed. Based on the system approach, issues of the internal organization of such systems, functions of individual blocks and modules, end-to-end automation of the process of solving optimization problems from formulation to obtaining numerical results are studied.

Key words: automation, formalization, algorithmization, system approach,

INTRODUCTION

Automation of creative work using computer technology is an extremely relevant area of modern informatics. Today, this problem has grown into a problem of informatics of creating human-machine systems. Here we are talking about identifying the formalizable part of a person's mental work, formalizing it in the form of logical and analytical dependencies, as well as analyzing these dependencies with subsequent implementation on a computer. This is how the idea of algorithmization arose as a generalization of the theory of algorithms [1,2].

Currently, extremely urgent problems of algorithmization are the development of algorithmic methods for proving theorems, both on the basis of classical theory and on the basis of the Soft Computing apparatus, formalization of the necessary sections of mathematical and functional analysis, computational mathematics. Algorithmic foundations of question-answer systems manipulating information in natural language are being built. This also includes the problem of algorithmic



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programming associated with the transition from one language to another, and the construction of algorithmic foundations for creating intelligent systems, etc. Here, the most voluminous work is filling in information parts in algorithmic banks and developing software support for their operational parts. The problem is aimed at developing algorithmic methods for constructing knowledge in intelligent systems and their logical-mathematical and software support. The creation of such a methodology is associated with the following problem. Existing traditional intelligent systems, such as systems such as natural language understanding systems, automatic theorem proving, expert systems, were developed using Hard Computing technology, i.e. using computer technology that defines a program as a sequence of operators that are not subject to modification under the action of an intelligent procedure (training) aimed at achieving the necessary functioning. For many classes of tasks, this direction will continue to develop, which requires the creation of new algorithmic software systems.

To solve the problem of a new class of tasks, the solution of which by traditional methods is impossible, therefore, prof. L. Zade proposed Soft Computing technology (theory and means) of creating intelligent systems, which is an intelligent combination of such intelligent paradigms as fuzzy logic, artificial neural networks, evolutionary programming, chaos theory and learning theory. The tasks of algorithmization in this new direction have not yet been considered. Taking into account what is stated above, it is necessary to develop methodological foundations for the algorithmization of computer and information technologies in relation to the theory of intelligent systems.

Here it is necessary to analyze the algorithmic methods of formalization. In this area, the fundamental basis of which are mathematics and computer science, to determine the composition and structure of algorithmic banks, to build knowledge bases using algorithmic banks (i.e. to analyze the methodology for filling the main algorithmic banks based on one of the modern forms of knowledge representation and their combinations). An important task is to create software support for the main algorithmic banks (operational parts of algorithmic banks) and to build a statement bank and an operational bank in the theory of intelligent systems. The developed theoretical results on the algorithmization of computer information technologies can be used in the construction of information and intelligent systems in various subject areas. With this, a new problem arose associated with the creation of machines that summarize human decision making in a fuzzy and uncertain environment. In most cases, for many areas there are no exact models, methods of algorithms for solving problems that are characterized by uncertainties. Despite the great successes of traditional approaches in building intelligent systems in the classical sense, new problems have arisen in creating a wide range of solutions for various problems, automatic proofing of theorems, game systems, expert systems, systems for understanding natural language. The traditional approach did not provide a complete solution to the problems. Therefore, at the global level, the task of increasing the level of machine intelligence has arisen, which is met by the theory of intelligent systems based on Soft Computing technologies proposed by Professor L. Zadeh, the constituent components of which are: the theory of fuzzy sets and the logic of artificial neural networks, genetic algorithms and chaos theory.



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Modern management problems lead to new tasks in creating software systems that operate not only with databases, but also with knowledge using the rules of automatic theorem proving, automatic hypothesizing, reasoning by analogy of object-oriented approaches, etc. In intelligent systems, a special role is played by the development of methods for formalizing the representation and construction of knowledge bases. If such a universal and flexible intelligent system with corresponding knowledge banks is created, focused on the automated selection of optimal algorithms for performing various computational and logical experiments, then it would be possible to put the process of creating intelligent automated control systems on an industrial basis. All this requires deep research and development of economical computational and logical algorithms and their formalization for solving problems of modeling and managing various processes with their subsequent presentation in the form of a knowledge base through algorithmic banks.

The demands of natural science, economics and engineering practice, along with solving direct problems of science and technology, require consideration of various optimization problems, which attract many researchers, both theorists and practitioners. The essence of optimization is finding the best solution from a certain set of possible solutions. Such problems include, in particular, programming problems covering a wide range of problems in control theory, economics, the theory of optimal design of systems, etc. Optimization problems, in particular, optimization problems of engineering structures, involve the use of a wide class of mathematical programming methods [3-6,8-10].

Automated systems designed to solve optimization problems, which are parts of CAD, as well as separate subsystems, are mainly invariant with respect to classes of objects. This circumstance has two sides. The positive side is that the invariance of automated systems allows them to be connected to other systems (or to optimize other classes of objects when working in an individual mode) essentially without modifications. The negative sides of the invariance of automated systems are that it does not take into account the features of objects, which in some cases allow for a significant strengthening of algorithms designed to optimize a particular class of objects [3,12].

From this we can conclude that the unification of problem statements, model research, and the use of model research results for the automatic selection and adjustment of optimal algorithms are currently given unjustifiably little attention. The theory and practice of algorithmization are widely used today in a wide variety of areas of human activity, and when automating the process of researching various objects can be divided into seven successive stages: experience – laws – tasks – mathematical modeling – algorithms – software – computational experiment, which represent a cybernetic chain with feedback. In essence, it is a process of control with feedback, and can be considered as complex human-machine multi-loop, multidimensional control systems with feedback, requiring the collection, transmission, processing and use of information to achieve the goal.



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When setting optimization problems in the mechanics of a deformable solid, there is no need to develop a mathematical model for each problem. This process can be successfully formalized and automated: based on the general laws of conservation of mass, energy, etc., systems of equations are derived using computers that describe any mathematical model of the mechanics of a deformable solid, which was convincingly demonstrated by the works of V.K. Kabulov and his students [1-3,8,12].

To automate the solution of optimization and inverse problems (let's call them extreme problems) of engineering structures, an entire intelligent system is required that automates all solution processes according to a sequential scheme of algorithmization stages: experience - laws - problems - models - algorithms - programs - computational experiment.

It should be noted that the stages of algorithmization are a general scheme for the automation of creative work in general when building automated systems for scientific research, which was proposed by Academician V.K. Kabulov [1-3]. Here the stages experience - law - task are inherent in the objects. At the "experience" stage, it is assumed that information banks will be created and experiments will be widely automated with the development of means for collecting, transmitting and processing data. At the "laws" stage, the accumulated experience is transformed into general laws of mechanics - conservation laws, etc. In algorithmization, known laws are encrypted and entered into the computer's memory. New laws are formulated based on the results of automated experiments. Based on general laws, problems belonging to different classes are solved (for example, elasticity theory, deformation theory of plasticity, rheological problems, etc.). Classification of these problems and automatic recognition of classes are performed at the "problem" stage. For each specific problem, systems of equations are automatically derived at the "model" stage according to known laws, which are mathematical models of the problems.

Thus, there are n problems $Z = \{Z_1, Z_2, \dots, Z_n\}$ and for them there correspond m models $M = \{M_1, M_2, \dots, M_m\}$. For numerical implementation, they correspond to t algorithms $A = \{A_1, A_2, \dots, A_t\}$, which are implemented using k programs $P = \{P_1, P_2, \dots, P_k\}$. Consequently, for complete automation of the processes of solving the given problem, it is necessary to implement successive transitions: $Z \rightarrow M \rightarrow A \rightarrow P$. The next task is to determine the mechanism for the practical implementation of the algorithmization stages. Algorithmization of research and solution of engineering structure optimization problems is implemented on a computer in the form of an algorithmic optimization system (AOS) developed in the works [3,8,11-13].

The system consists of six algorithmic banks and two auxiliary B_0 and B_7 , as well as an experimental setup connected to the system by communication channels. In the scheme: B_0 is a problem setting bank; B_1 is a data bank; B_2 is a law bank; B_3 is a feature bank; B_4 is a model bank; B_5 is an algorithm bank; B_6 is an application program bank; B_7 is an operational bank. The algorithmic banks (AB) of the optimization system must satisfy certain conditions. System management involves ensuring communication between ABs, transferring intermediate information between them, and establishing the AB work sequence. The



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operating principle of B_7 can be built on both automatic and interactive modes. In automatic mode, the system operates according to the following sequence. From B_0 , information is entered into B_7 . Based on the values of the attributes generated in B_3 , the corresponding equations, formulas, and boundary conditions are copied from B_2 to B_7 , and the procedures of the operational part of B_2 are called, which form a mathematical model of the problem. At the next stage, using the contents of B_4 , the model is studied and identified, after which B_5 is turned on and the work is turned on. Based on the results of B_5 , the corresponding initial data from B_1 and modules from B_6 are called into B_7 , and a working program is formed, which is transferred to the account.

The use of interactive mode makes the system more flexible, since depending on the characteristics of the tasks, it will be possible to change the course of the system's work (in other words, turn off part of the AB if they are not needed).

In addition, when solving optimization problems, it will be possible for the researcher to intervene at any stage of the search for an extremum. In some cases, this circumstance will speed up the solution process, since There is no formalized method for selecting the optimal optimization algorithm, and often the intuition and experience of the researcher are the decisive factors in determining the algorithm for the various stages of the search. However, it should be noted that the use of the interactive mode is possible only with the presence of highly qualified specialists in the field of solid mechanics and mathematical programming.

Thus, the specified system allows for maximum automation of the researcher's creative work, starting with setting up an experiment and ending with processing the numerical results of the calculation, leaving him with the non-formalizable part of creativity.

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“GLOBAL ENVIROMENTAL DEVELOPMENT AND SUSTAINABILITY: ROLE OF DEVELOPING COUNTRIES”

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ABSTRACT

Billions of people in developing countries continue to suffer from preventable diseases because of environmental change, causing unnecessary suffering and increasing poverty. Whereas unorganized rapid economic development in developing countries proved as a gateway to many health and wellbeing problems which are potentially linked to environmental threats, from air pollution and physical deterioration to global climate change. Sustainable development seeks to reduce environmental impact and have less impact on environmental health than traditional practices. Carefully assessed “Green Economy” could serve solution to economic and environmental sustainability problems while taking key players on board like human and their relationships, including financial institutions, formal roles in the natural environment, and the performance of business and industry. This research aimed to drive the solutions against environmental and sustainability problem within developing countries like Pakistan to contribute to have sustainable future and making the World a better place to live.

Keywords: Environmental Health, Sustainable development, Climatic Changes

BACKGROUND

Did you know that Pakistan is considered as-most climate-vulnerable among top 5 countries, in the World. As the situation in the country worsen. It is important to assess the capacity of the health system to respond beyond talk. Pakistanis are already feeling the effects of climate change through extreme weather, glaciers, heat, rainfall and earthquakes. Pakistan was hit by flood in 2022 that killed millions, displaced people and caused billions of dollars in economic losses. This climatic vulnerability is not only affecting economy but placing deep rooted effects on socio economic and health system and adapt to climate risks, prevent public health wastage and recover from extreme weather events to strengthen



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international efforts to mitigate and prevent climate change to develop health system that are resilient to climate change a consider current and future climate projections. This is important to protect public health from the impacts of climate change (<https://www.thelancet.com/infographics-do/climate-countdown-2022>)

For Health sustainability COP26 more than 60 countries, including Pakistan. It's committed to achieving five key targets agreed to address climate change and its impacts health targets agreed to address climate change and its impacts on health.

- Deepening adaptation research for health
- Build a safe health system
- Raise the voices of health professionals to advocate for climate change empowerment
- Developing low-carbon sustainable health systems
- Including health priorities in Nationally Determined Contributions (NDCs)
- Raising the voice of health professionals as advocates for stronger ambition on climate change.

The smog resultant pollution that has recently covered large parts of the Pakistan has captured the attention of the media and government circles. It is encouraging to see the discussion moving from the daily political issues to more important issues affecting people's lives and livelihoods. In discussing the causes and effects of smog, one important factor is overlooked: the significant impact of Pakistan's growing population. The relationship between population growth and environmental degradation is undeniable. As the population grows, fossil fuel consumption increases, resulting in emissions and pollution. According to the World Health Organization, poor air quality is a major factor in Pakistan's health. The World Health Organization estimates that air pollution is responsible for 42% of annual deaths from stroke and ischaemic heart disease in Pakistan. In addition, the country's air quality falls short of World Heal the Organization guidelines, with problems often ten times greater than recommended. These reports highlight the need to address the root causes of air pollution. On the other hand, Pakistan lacking in achieving SDG goals are also a big threat to the socio-economic sustainability of country itself rather in allies too. Pakistan's agriculture sector accounts for 24% of GDP and employs 37.4% of the population, forming the backbone of the country's economy. However, soil degradation, water scarcity, deforestation and climate change threaten its sustainability. According to the economic survey 2023, around 57.88 million hectares of land in Pakistan are estimated to be degraded by problems such as salinization, erosion and loss of productivity. Water availability has also declined, with rainfall. Falling by 29.8% in 2022,23-to-72.7-million-acre feet (MAF). These issues are affecting food security and livelihoods. Sustainable Development Goal (SDG) 15 villages, which focus on ecosystem protection and land restoration, offer one way to address these issues. In recent years, the increasing risk of climate change has led the world community to unite in many areas importantly to support developing countries like Pakistan. These efforts initially included a commitment to reduce carbon emissions, mainly to reduce carbon emissions. This is also a term related to sustainable development (SD), which aims to address carbon emissions and prevent water scarcity, disease and biodiversity. In addition, SDG was initially initiated to meet the needs of people. In recent years, the



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concept of politics and the general recognition of Green Growth (GGR) have been established to ensure that low carbon, which is the value of SDG. But is not limited to job creation, poverty reduction and high economic well-being. All efforts to bring developing country like Pakistan back on SDG track, rich economics must play end to result accountability role as the un-fulfilment of SDG by any country who participates in the Globalization phenomenon could impact worst to rest of the world. This research aimed to drive the solutions against environmental and sustainability problem within developing countries like Pakistan to contribute to have SDGS for sustainable future and making the World a better place to live.

MATERIALS AND METHODS

• Literature Review

As the global climate crisis worsens, its impact on people's health and well-being will continue to accelerate. No one is immune to its global reach; in fact, millions of people are the most vulnerable especially women, children, older people, marginalized groups, displaced refugees, people with preexisting health conditions and people living in poverty. By changing disease transmission patterns, making diseases more deadly and contagious. Climate change also puts pressure on health systems, increasing demand for health services and reducing the body's ability to respond. Climate change is also rapidly affecting access to basic human needs such as food security, safe and clean water and clean air. According to new data from the World Bank, climate change could increase health care costs in low-and middle-income countries by at least \$21 trillion by 2050, equivalent to 1.3 percent of GDP (Bank & World, 2024). Pakistan is facing major challenges due to climate change that affect the health and wellbeing of its people. Through strategic planning, we can develop an effective health system that is safe and lifesaving. Prioritizing climate protection in health policy, strengthening leadership, strengthening research and investing in modern technology are important. Together, we can solve the problem of climate change and ensure a healthier and safer future for the people of Pakistan. (Rebuild for Resilience, 2023). The medium-term impact of climate change on a society's economy should be small, but the long-term impact should be large. The impact of global warming is small when its below 2°C, but larger when it exceeds 2°C. This suggests that limiting global warming to below 2°C will improve health outcomes, including health and wellbeing; There are several studies showing that the impact of climate change on socio economic indicators varies spatially and temporally. This highlights the need to take societal factors into account when developing climate change adaptation, a (Arndt, 2015) and mitigation measures, and to take rapid action to reduce the impacts of climate change. (Adom, Feb 2024). Extreme weather events are increasing in frequency and intensity and are having a significant impact on nature. For example, they reduce biodiversity, with evidence of population collapse and local extinctions (de la Fuente, 2022).

The interaction between climate, biodiversity, ecosystems and human society (J.T. Houghton, 1995,1996) suggests that climate change will also have a significant impact on humans. Studies such as (16. Batte 2018) (IPCC Report, 2014) show that climate change has multiple impacts on many domains,



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including the economy, human health and water resources. Climate change impacts food (von Braun, 2023) (Miron, 2023). The multifaceted impacts of climate change mean that there is no single strategy that will help countries limit the negative consequences. There is also little consensus about the relative and real nature of the effects of interventions and the evolution of outcomes. Doubts about climate change decision making. This study will use existing knowledge and needs about the impact of climate change on economic and political differences in the hope of helping people develop climate change action plans. Since concerns about the effects of climate change the first arose in the 1990s. Many studies have been conducted to assess the effects of climate change on crops. Some notable studies include: (Cline, 1992) (Fankhauser, 1995) and (Tol, 1995) (Pretis, 2018) combined economic with the (HAPPI) study to simulate the impact, assessing the impact of 1.5°C and 2°C global warming targets on the global economy. Pakistan can replicate this practice in disaster-prone areas like Punjab and Khyber Pakhtunkhwa, educating and encouraging farmers to use good techniques. Water scarcity is another major concern, as agriculture uses more than 90% of Pakistan's freshwater. India has addressed this issue with initiatives like micro irrigation and more crop per tree, which promote water efficiency, Pakistan could use similar programs to aid and training to farmers, especially in dry region like Sindh and Baluchistan. Climate change poses a threat to crops like rice and cotton. Kenya has successfully grown drought tolerant crops like sorghum and millet, while Bangladesh has introduced salt tolerant rice to the saline alkaline region. Pakistan could invest in safe crops for crops suitable for its climate zones and support their adoption through research and awareness programs. Deforestation further undermines agriculture sustainability, reduces biodiversity, and increases soil erosion and flooding. Pakistan Economic Survey 2023-24 on renewable energy and biodiversity conservation. South Korea engages local communities in largescale tree planting projects, while Indonesia engages in agroforestry by combining crops with trees. Pakistan's Green Pakistan program could be expanded to include such strategies that promote crop production and encourage community participation (Kamboyo, 2024) Pakistan's population has more than doubled since 1990, and there are currently approximately 245 million people living in the country. This rapid growth has led to unprecedented urban growth, with large populations in major cities such as Lahore, Faisalabad, and Karachi. The pressure on resources, infrastructure, and the environment has led to more violence. Urban expansion, combined with poor planning, is increasing pollution and creating environmental and public health challenges. (Mir, 2024) Pakistan is currently in great need of education as 115.52 million out of 188.2 million people live in rural areas and another 21.04% live below the poverty line. It is worth mentioning here that this is an obvious (newspaper,2014) compromise in an underdeveloped country like Pakistan today. While rapid economic development is quickly realized, natural compensation seems more attractive to others, perhaps the rich in the Western World. This makes it difficult for them to survive given their current situation. The SD and GG may have no alternative but to pay lip service to southern development (Mazhar, 2014). It should contain information about the materials and the methods adopted to carry out the research work like animals, chemicals and animal ethical committee permission, software used, and procedures followed etc. The units and dimensions should be expressed according to the metric system and SI units.



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Design/Method/Approach

This paper followed a Hybrid qualitative and quantitative research technique. Initially, which mainly depends on the secondary source of data. In coordinating with key technical approach of qualitative research, the secondary sourced data was also an area under discussion from which facts and assumptions were derived to undertake the current study. Where to get deep insight and desired solutions regarding matter field research through close ended questionnaire where simple data analysis had been done through SPSS, as in quantitative research we coded close ended question as No=0 and Yes=1 to get simple frequency of the responses by respondents who are majorly from the people living in highly polluted cities of Pakistan like Karachi, Lahore, Islamabad where random and convenient sampling technique had been used.

Research Limitations/Implications

This study is limited by the author's understanding of the key issues and concerns regarding SD and DD development in developing countries. The author's understanding will not necessarily impact on all countries most interested in the topic. Only one research method was used in this study. More is needed in this area to acknowledge and document all the important motivations of Third World countries in promoting sustainable development and governance worldwide. The author's understanding will not affect all the countries that are most interested in the subject. Also, more work is needed in this area to acknowledge and document all motivations in the Third World when promoting SD and GG policies. Global governance focuses on sustainable development and the longstanding reality that the core issues of sustainable development put pressure on poor countries in the South. Most are affected by commercial transactions. Since most of the population lives below the poverty line, they cannot comply with SD and GG rules. Their only way to overcome existing poverty is through emergency services. Furthermore, the development of SD and GG can lead to conflicts in poor countries.

RESULTS AND DISCUSSION

Research Analysis

Fig 5.1. Do you think climatic changes due to unsustainable practices is the mother of all interlinked problems like health and economic issues

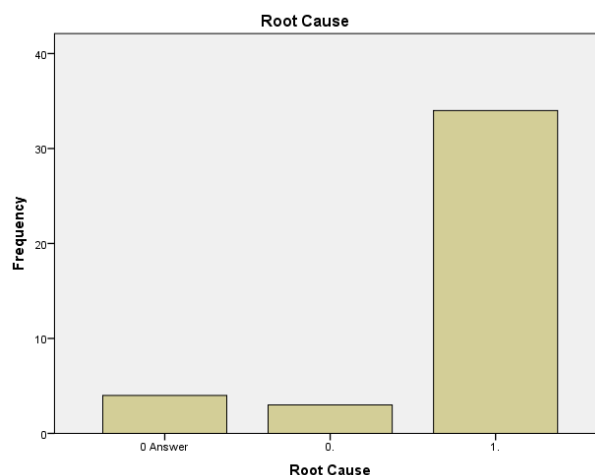


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Root Cause

	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	4	9.8	9.8	9.8
Valid o.	3	7.3	7.3	17.1
1.	34	82.9	82.9	100.0
Total	41	100.0	100.0	



In Fig 1. most of the respondents picked code 1=Yes and agreed that climatic changes due to unsustainable practices is the mother of all interlinked problems like health and economic issues

Fig 2. Do you think sustainability crises in developing country like Pakistan is a heavy burden for developed nations also Heavy burden for developed

	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	3	7.3	7.3	7.3
Valid o.	16	39.0	39.0	46.3
1.	22	53.7	53.7	100.0
Total	41	100.0	100.0	



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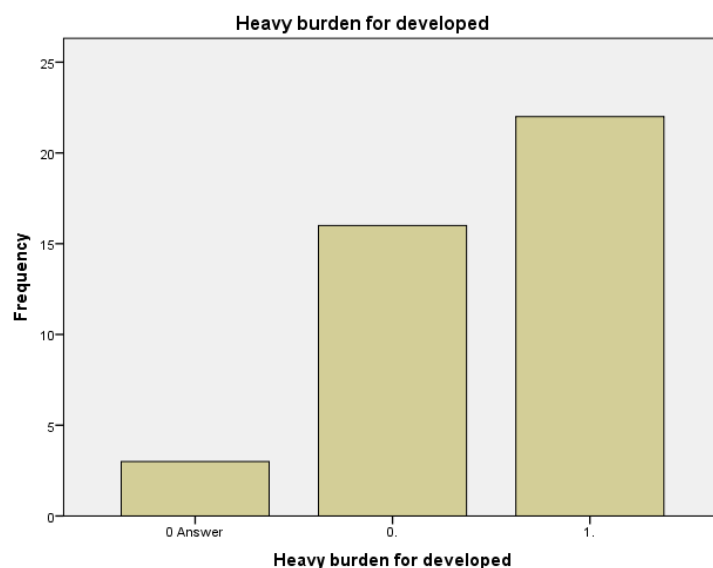


Fig 2. most of the respondents picked code 1=Yes and agreed that sustainability crises in developing country like Pakistan is a heavy burden for developed nations also.

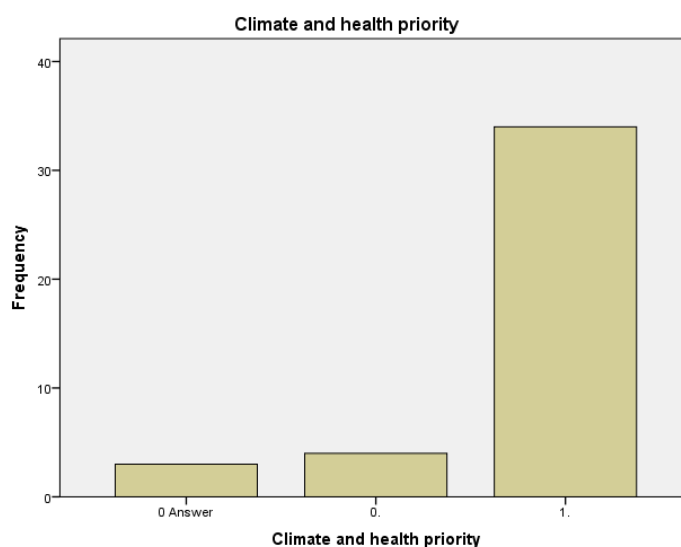


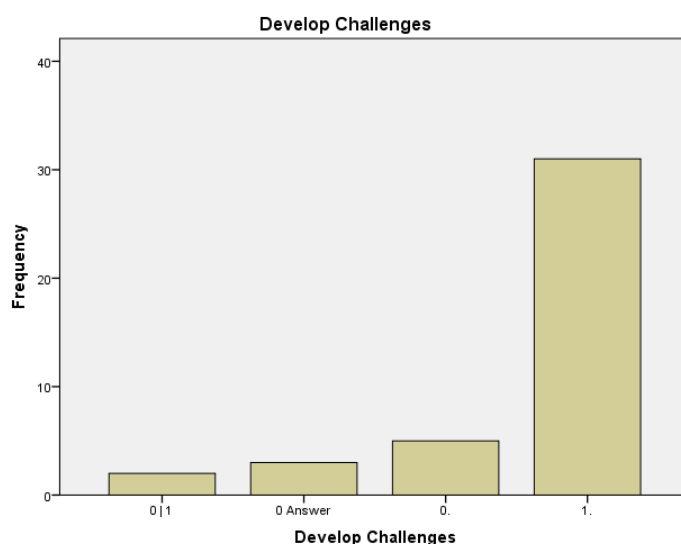
Fig 3 Do you think main cause of sustainability crises leading to development challenges is government negligence



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Develop Challenges

	Frequency	Percent	Valid Percent	Cumulative Percent
o 1	2	4.9	4.9	4.9
o Answer	3	7.3	7.3	12.2
Valid o.	5	12.2	12.2	24.4
1.	31	75.6	75.6	100.0
Total	41	100.0	100.0	



In Fig 4 most of the respondents agreed to code 1= Yes that illiteracy and lack of awareness is another reason of sustainability crises

Fig 5 Do you think climate and health adaption must be a priority in national adaption agenda by lawmakers.



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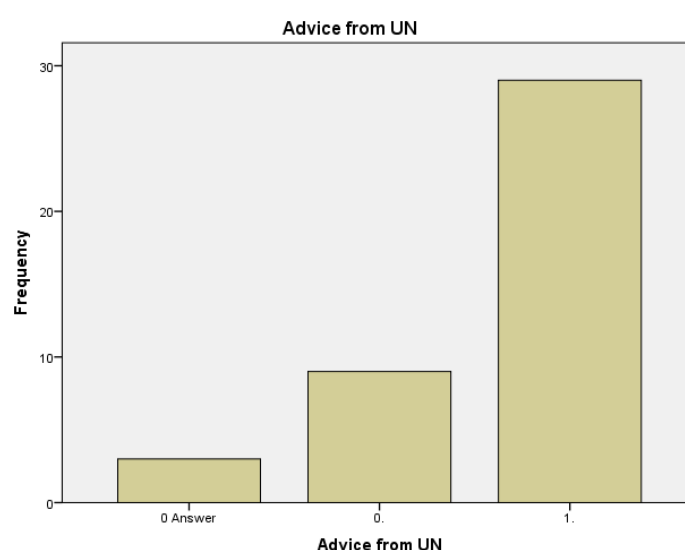
Climate and health priority

	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	3	7.3	7.3	7.3
Valid o.	4	9.8	9.8	17.1
1.	34	82.9	82.9	100.0
Total	41	100.0	100.0	

In Fig 5 most of the respondents agreed to code 1= Yes that climate and health adaption must be a priority in national adaption agenda by lawmakers

Fig 6 Do you think policy advice from UN to developing countries on climate change issue must be on top priority.

	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	3	7.3	7.3	7.3
Valid o.	9	22.0	22.0	29.3
1.	29	70.7	70.7	100.0
Total	41	100.0	100.0	



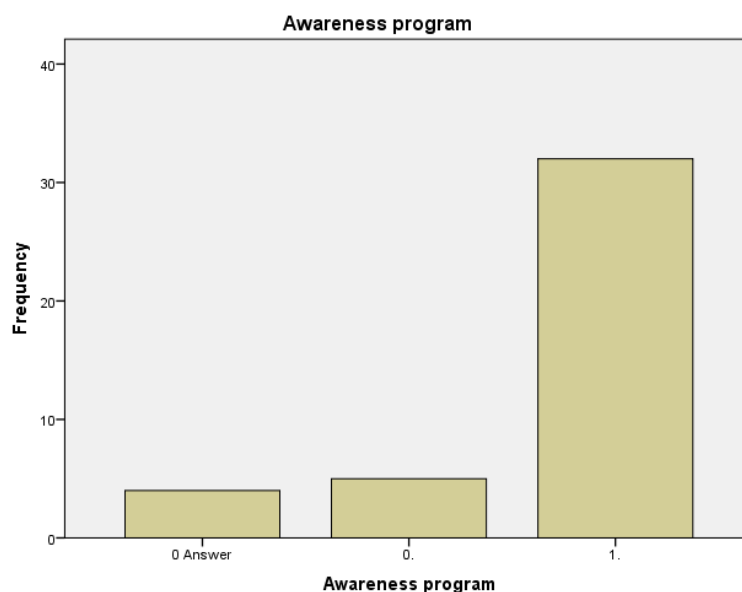
In Fig .6 most of the respondents agreed to code 1= Yes that policy advice from UN to developing countries on climate change issue must be on top priority.



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Fig 7 Do you think illiteracy and lack of awareness is another reason of sustainability crises

Awareness program				
	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	4	9.8	9.8	9.8
Valid o.	5	12.2	12.2	22.0
1.	32	78.0	78.0	100.0
Total	41	100.0	100.0	



In Fig 7 most of respondent agreed to code 1= Yes that illiteracy and lack of awareness is another reason of sustainability crises

Fig 8 Do you think agr based economy like Pakistan sustainable livestock practices like renationalized grazing can prevent overgrazing improve pasture productivity and reduce emission

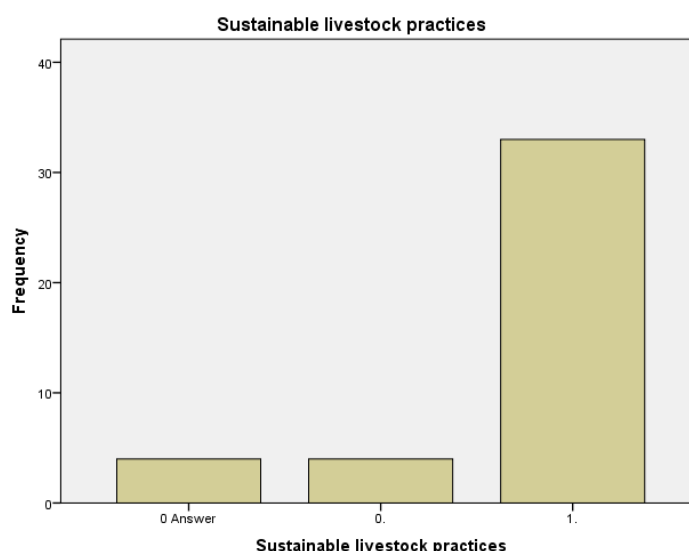


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Sustainable livestock practices

	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	4	9.8	9.8	9.8
Valid o.	4	9.8	9.8	19.5
1.	33	80.5	80.5	100.0
Total	41	100.0	100.0	



In Fig 8 most of the respondents agreed to code 1= Yes that agr based economy like Pakistan sustainable livestock practices like rationalized grazing can prevent overgrazing improve pasture productivity and reduce emission.

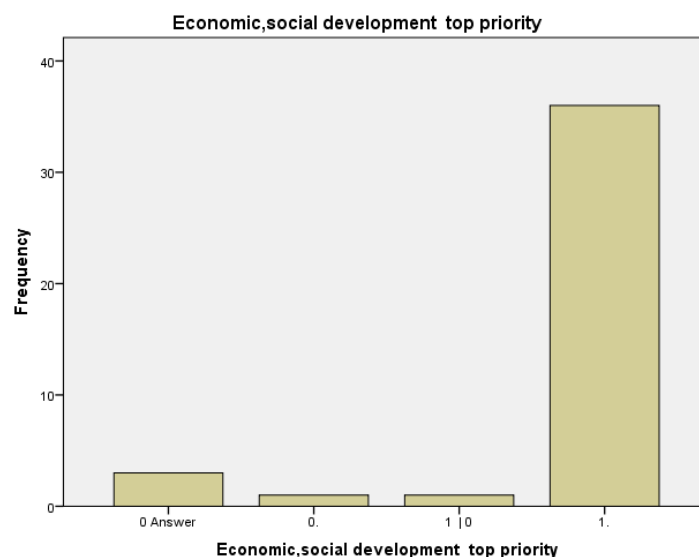
Fig 9 Do you think Economic and social development should be top priority for developing countries

Economic, social development top priority

	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	3	7.3	7.3	7.3
o.	1	2.4	2.4	9.8
Valid 1 o	1	2.4	2.4	12.2
1.	36	87.8	87.8	100.0
Total	41	100.0	100.0	



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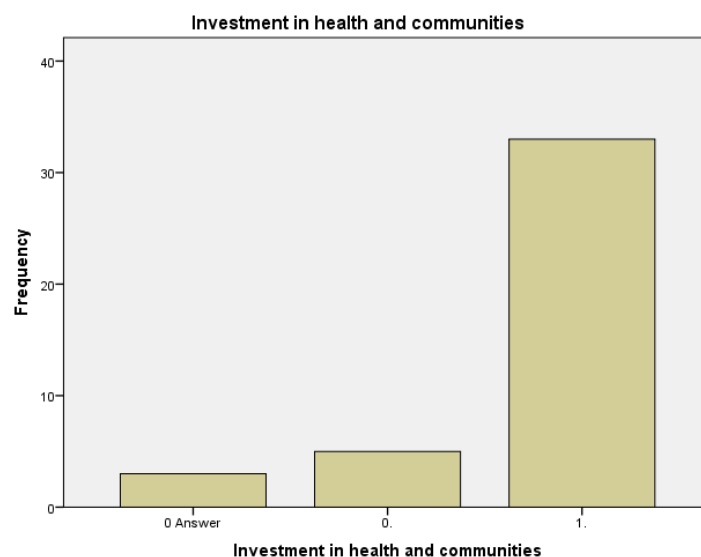
In Fig 9 most of the respondents agreed to code 1= Yes that Economic and social development should be top priority for developing countries

Fig 10 Do you think actions like Financing and Investment in health sector and communities are required to prevent and detect and respond to climate related health threats

Investment in health and communities				
	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	3	7.3	7.3	7.3
Valid 0.	5	12.2	12.2	19.5
1.	33	80.5	80.5	100.0
Total	41	100.0	100.0	



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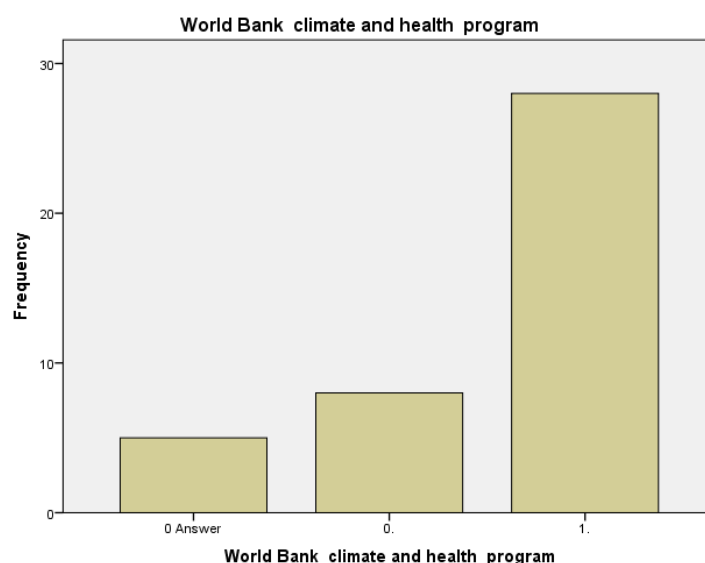
In Fig 10 most of respondents agreed to code 1= Yes that actions like Financing and Investment in health sector and communities are required to prevent and detect and respond to climate related health threat

Fig 11 Do you think the climatic health action of the World Bank integrating through its climate and health program is good to tackle climate driven health crises.

World Bank climate and health program				
	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	5	12.2	12.2	12.2
Valid 0.	8	19.5	19.5	31.7
1.	28	68.3	68.3	100.0
Total	41	100.0	100.0	



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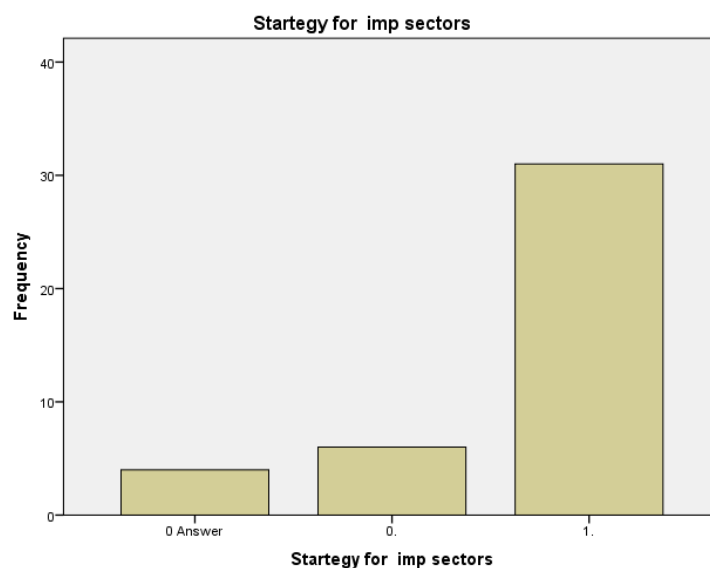
In Fig 11 most of the respondents agreed to code 1= Yes that the climatic health action of the World Bank integrating through its climate and health program is good to tackle climate driven health crises.

Fig 12 Do you think adaption and mitigation strategy must be developed for sector such as energy, transport, land use, Industry and waste management.

Strategy for imp sectors				
	Frequency	Percent	Valid Percent	Cumulative Percent
o Answer	4	9.8	9.8	9.8
Valid o.	6	14.6	14.6	24.4
1.	31	75.6	75.6	100.0
Total	41	100.0	100.0	



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In Fig 12 most of the respondents agreed to code 1=Yes that adaption and mitigation strategy have to be developed for sector such as energy, transport, land use, Industry and waste management.

DISCUSSION

Ecological change is seen to have a negative impact on the poor, with economic development being the basis for poverty reduction. SD and GG are asked to recognize the need to promote growth to eliminate poverty while ensuring that environmental costs are controlled. However, there is little or no mention in the discussion of sustainable development and how GG can understand the language of sustainable development. But it relies only on general measures to embody and advance externalities. Little is also said about the possibility of poverty reduction through various strategies to manage the economy in an ecologically sustainable way. They cannot be expected to act according to rational and more judgments. They grow their businesses at the highest rate while consuming most of their primary resources. Countries do not care about anything that happens unless it leads to their economic success. The world economy still controls the major decisions in international affairs. It has created new structures to control the rights and will of other countries around the world that are still struggling with high poverty, unemployment and illiteracy. The undeniable fact is that the rich countries of the North cannot afford to compromise the interests of the poor people of the South in the anarchic global environment. Law in the form of financial penalties. SD is a real oxymoron that often ignores many of the important of the poor. This study also argued that the SD and GG discourses are not suitable for the important economic needs of underdeveloped countries. SD and GG policies supporting new countries are essentially designed to limit their economic success, as they are an anti-development measure. The



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main point against growth is that important resources are used in a way that will provide economic growth, which is the basis of all SD and GG discussions. This situation makes it difficult for new countries to follow the principles of sustainable development because they do not have the opportunity and ability to follow other development methods to grow in security. Therefore, limiting development while supporting the process of exploiting natural resources is the key to impoverishing/impoverishing countries. The impact of climate change on health is also significant, particularly in developing economies. The role of climate change in morbidity and mortality is widely recognized. The impact depends on the duration and severity of climate change. The adverse health effects of climate change are greater in extreme climate events than in non-extreme events. Long term adverse health effects also appear to be significant. Economies with weak health systems will be affected by climate change. By 2030, health losses from climate change could exceed \$2 billion. The impact has been reported on the demand side, where global warming is widely believed to increase energy consumption. However, on the supply side, the evidence is mixed and dependent on location and power. There is general agreement on the negative impact of climate change on the energy production potential of some energy sources, such as solar, wind, and thermal energy, but there is no consensus on the potential impact of weather conditions on the energy production of other energy sources, such as hydropower and bioenergy. The impact of climate change, especially on solar energy, is minimal. There may be winners and losers in the medium term, but in the long term, the entire economy is likely to lose in terms of both growth and development. We note that the literature provides mixed results on the spatial and temporal effects of climate change on economic indicators in developing economies. This is mainly because these studies differ in their initial conditions (temperature, wealth, disease severity, crop output, etc.) and estimation methods. For many indicators, the negative impacts of climate change appear to have a greater impact on developing economies, especially poor economies like Pakistan, than on developed economies. These spatial heterogeneities suggest that local conditions need to be considered in the design of climate change interventions. Therefore, affected regions should often be prioritized when developing climate change assessments. Studies on the impact of climate change on agriculture agree that the sector is vulnerable to the threat of climate change. Food insecurity and loss of agricultural land prices are some of the reasons for the impact of future global warming trends on agriculture and production. When it comes to the impact on rice production, the evidence seems strong that major producing countries will be more harmed by climate change. However, for crops such as maize, sorghum and millet, the evidence is very fragmented and there does not seem to be a clear pattern. Interestingly, both developed and developing economies are at risk of crop losses due to climate change. However, it is observed that the incidence is higher in developing economies.

CONCLUSION

In-order to play its key role in promoting SDGs Pakistan needs development, support and strategies from law makers and World leaders, as with current conditions it's difficult for any developing country like Pakistan to impact rationally. Keeping above literature and responses in view following strategies



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could help in coping sustainability crises in Pakistan could be modeled for other developing countries later too so that their role could be positive towards achieving sustainability goals and making the World a better place to live:

- With the help of clear and focused government SD policies.
- Literacy and Public awareness programs on national level could help in achieving SDGs
- Policy advice from the UN to developing countries on climate change issues must be a top priority.
- Climate and health adaption must be a priority in national adaption agenda by lawmakers in Pakistan.
- Financing and Investment in health sector and communities are required to prevent and detect and respond to climate related health threats.
- Climatic health action of the World Bank integrating through its climate and health program is good to tackle climate driven health crises.
- Adaption and mitigation strategy must be developed for sector such as energy, transport, land use, Industry and waste management.
- Economic and social development should be top priority for developing Pakistan towards SDGs.
- Sustainable livestock practices in Pakistan like renationalized grazing can prevent overgrazing improve pasture productivity and reduce emission.
- Market based sustainable development policies could support achieving sustainability goals.

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A RELATION BETWEEN EXTREME DAILY PRECIPITATION AND EXTREME SHORT-TERM PRECIPITATION

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ABSTRACT

The Royal Netherlands Meteorological Institute (KNMI) has published the KNMI'o6 climate scenarios in 2006. These scenarios give the possible states of the climate in The Netherlands for the next century. Projections of changes in precipitation were made for a time scale of 1 day. The urban drainage sector is, however, more interested in projections on shorter time scales. Specifically, time scales of 1 hour or less. The aim of this research is to provide projections of precipitation at these shorter time scales based on the available daily scenarios. This involves an analysis of climate variables and their relations to precipitation at different time scales. On the basis of this analysis, one can determine a numeric factor to translate daily projections into shorter time scale projections.

Keywords: correlation, extreme, precipitation, ratio, urban, variables

INTRODUCTION

Rising temperatures are generally expected to be accompanied by increases in rainfall intensities at mid- and high latitudes [1], [2]. Urban areas are especially vulnerable to increased rainfall intensities, especially during convective summer storms [3], [4], [5]. Regional impacts will differ from average climate predictions, which make regional studies necessary, such as this one for The Netherlands. The goal of this study is to examine the impact of possible climate change on rainfall intensities at a time scale of 1 h.



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The Royal Netherlands Meteorological Institute (KNMI) developed four KNMI'o6 climate scenarios that provide information on projected changes in daily precipitation. These scenarios are based on many global and regional climate models. For urban drainage design, daily precipitation is less relevant; critical response times of storm sewerage and surface drains are in the order of minutes to hours [3], [6]. Regional climate model output on peak precipitation for shorter time scales is not (yet) reliable enough to allow for a publishable estimate. Therefore, a new method was developed to study the relation between daily and shorter time interval precipitation from historical data. The objective is to use variables available in the KNMI'o6 scenarios to obtain conditional relations between daily and shorter interval precipitation. If it can be assumed that these relations will remain more or less the same in the future, estimates could also be made for short term peak precipitation in the future.

MATERIALS AND METHODS

The applied methodology involves selection of climate variables that are likely to affect rainfall intensities at the desired short time scales, acquisition and selection of historical data, and the analysis of correlations between variables available in the KNMI'o6 scenarios and the ratio of 1 h and daily precipitation. The selection of the KNMI'o6 scenarios is based on two steering parameters: change in global mean temperature and change in air circulation pattern. This resulted in four scenarios shown in Fig. 1. The scenarios span a large part of the uncertainty about our future climate, and they are a translation of larger scale climate change projections to climate change in The Netherlands. It was first assumed at KNMI in 2007 that extreme hourly rainfall would change in the same way as the extreme daily rainfall. This research aimed at checking this hypothesis and providing a further elaboration of the KNMI'o6 scenarios with information about hourly precipitation extremes and quantification thereof. Explanatory climate variables that could be linked to the steering parameters in the KNMI'o6 scenarios were selected to this end. These variables were then analyzed with hourly and daily precipitation.

Selection of climate variables

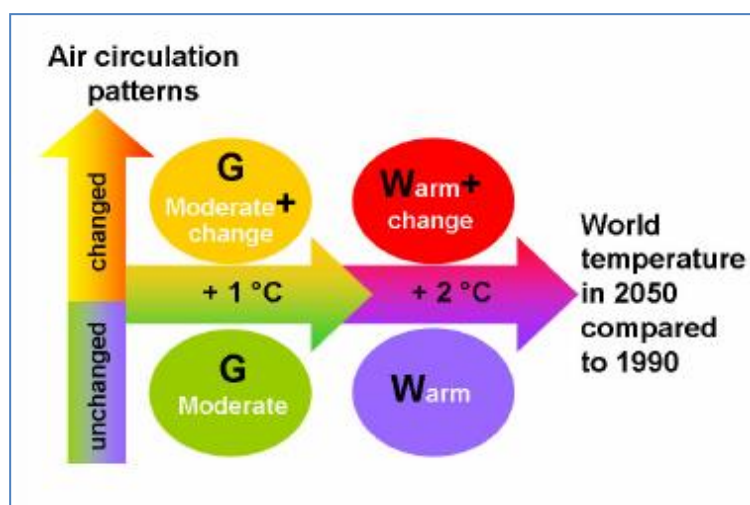
The main variables that, *a priori*, could have an influence on extreme precipitation include:

- wind (speed, direction) or wind at higher altitudes
- air temperature
- humidity
- air pressure



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- sea-surface temperature (The Netherlands)



Based on literature study and expert consultation, wind direction and maximum daily air temperature were chosen to be used for further analysis.

Some studies conducted in the Iberian Peninsula and the British Isles have led to the conclusion that a correlation exists between wind or atmospheric circulation and extreme precipitation [8], [9], [10]. KNMI concluded that wind direction but not wind velocity was an indicator for precipitation [11]. Wind direction or, better, geostrophic circulation (wind at higher altitudes) could be an explanatory climate variable linked with differences between the KNMI'o6 scenarios. The wind direction at higher altitudes determines from where air masses are transported to The Netherlands, for example from over the ocean (generally moist) or over land (in summer often dry and warm). Rain cloud formation is often caused by south-westerly circulation, corresponding to a limited range of G-West values. Under such circulation patterns, warmer air from the Mediterranean region is transferred to The Netherlands after absorbing moisture over the North Sea. At the surface the wind direction can be different, due to friction. G-west is a measure used at KNMI to quantify geostrophic wind from westerly direction. G-West is the magnitude of the velocity of the wind coming from the west at 270°. A negative value of -2.6 m/s would correspond to a wind coming from the east at 90° with a speed of 2.6 m/s. G-west is thought to be an important explanatory variable for precipitation. A data series was compiled based on data from the ERA-40 database [12] for The Netherlands and they are available from 1958. G-west is determined six times daily and is derived from surface pressure. For this study, average daily values are used.



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Warm weather has been found to be key for short duration, high intensity rainstorms [3], [13], [14]. Former analysis showed that the annual maxima for 24 h and 4 h mostly occurred during the months May-September. KNMI experts also indicated that maximum daily temperature could be an explanatory climate variable that can be linked with differences between the KNMI'o6 climate scenarios. Warmer air can contain more moisture which is favorable for precipitation. Maximum daily temperature can be used instead of average daily temperature because it can easily be linked to KNMI'o6 climate scenarios, which provide average daily temperature. Based on observations over the last 30 years, the difference between maximum, minimum, and average daily temperature did not really change. It is assumed that this relation between maximum, minimum, and average temperatures will not change in the future.

Selection and validation of historical data

KNMI has an automatic and manual rain gauge network to record precipitation. Until the 1970s, mechanical pluviographs were used as automatic rain gauges. Pluviographs have since then been replaced by electronic rain gauges. At the automatic stations, each hour recordings are made, at the manual stations only once per day. The 60-min precipitation data used in this paper were recorded with automatic rain gauges because the 60-min precipitation data recorded before 1980 have not yet been digitized. The quality of the 60-min automatic measurements was checked by comparing their daily sums with 24-h manual measurements. At KNMI in The Netherlands, historical precipitation data is available for daily, 1-h and 10-min observational time segments. Many years of historical data are available for precipitation amounts on a daily basis. In comparison, fewer years of data are available on an hourly basis. Less than 25 years of data are available for shorter time intervals including 15-min or less. Five to 10 min data is the most interesting for urban drainage and urban water management. Urban water managers wish to have information about 10-min precipitation recordings as the characteristic time of urban runoff processes is of that order of magnitude [3], [15]. However, 10-min recordings are not validated and/or the available number of years is too limited to cover most of the natural variability.

That is why it was decided to use validated 60-min precipitation data recorded at the station De Bilt in The Netherlands for this research. The station De Bilt was chosen for the long (>50 years) time series available for both daily and hourly precipitation. A minimum of 30 years of data is generally used to describe most of the natural variability, but for extreme values preferably even larger time series are used [16]. In addition, De Bilt is a non-coastal location where there is hardly or no effect of seawater temperatures on extreme precipitation therefore making it easier to link extreme precipitation to air temperature and G-west. It is also recognized that urban areas may exacerbate formation of summer storms [6] due to the urban heat island and that this effect is also not reflected in the time series of De Bilt.



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RESULTS

The analysis consists of three parts. First, an exploratory analysis of the correlation between temperatures and precipitation extremes is put forward. Second, a similar analysis concerning the correlation between circulation patterns (G-west) and precipitation extremes is given. Finally, the ratio between daily and hourly precipitation as a function of maximum daily temperature and G-west is given, which allows for temporal downscaling based on climate projections.

Temperature and precipitation extremes

A visual technique was used to obtain a first idea of how maximum daily temperature and G-west correlate with daily precipitation. Scatter plots were made using other climate variables to obtain a sense of when and under which circumstances extreme precipitation occurs. Raw data hardly show a relation between daily precipitation and maximum daily temperature. Based on the data series 1958–2006, Fig. 2 presents a scatter plot of maximum daily temperature versus maximum hourly precipitation per day. It shows no clear relation between precipitation and temperature. However, the maximum values seem to have some relation with temperature. An interesting point is that extreme hourly precipitation amounts of more than 20 mm (shown in Fig. 2) do indeed occur during warmer temperature days of 20°C and above. However, in a plot of the annual maximum precipitation against temperature, there is no clear relation. Annual maxima often occur during the summer half of the year with relatively high temperature [17]. The main focus of this research is extreme precipitation and therefore these months will be analyzed further.

Circulation and precipitation

The second explanatory variable for climate change in The Netherlands is G-west. As mentioned earlier, G-west is derived from surface pressure. Fig. 3 shows a scatter plot of G-west and daily precipitation for De Bilt during summer months June, July, and August. Fig. 4 is a plot of G-west and maximum hourly precipitation per day.

Both Fig. 3 and Fig. 4 show that extreme daily precipitation and extreme maximum hourly precipitation per day occurred with a G-west value close to 0 m/s. This suggests that daily maxima and hourly maxima may occur during the same or similar meteorological conditions. Correlation between maximum daily temperature and G-west was not significant (>95% confidence). Therefore, we can assume for the remainder of this analysis that maximum daily temperature and G-west are independent of each other.



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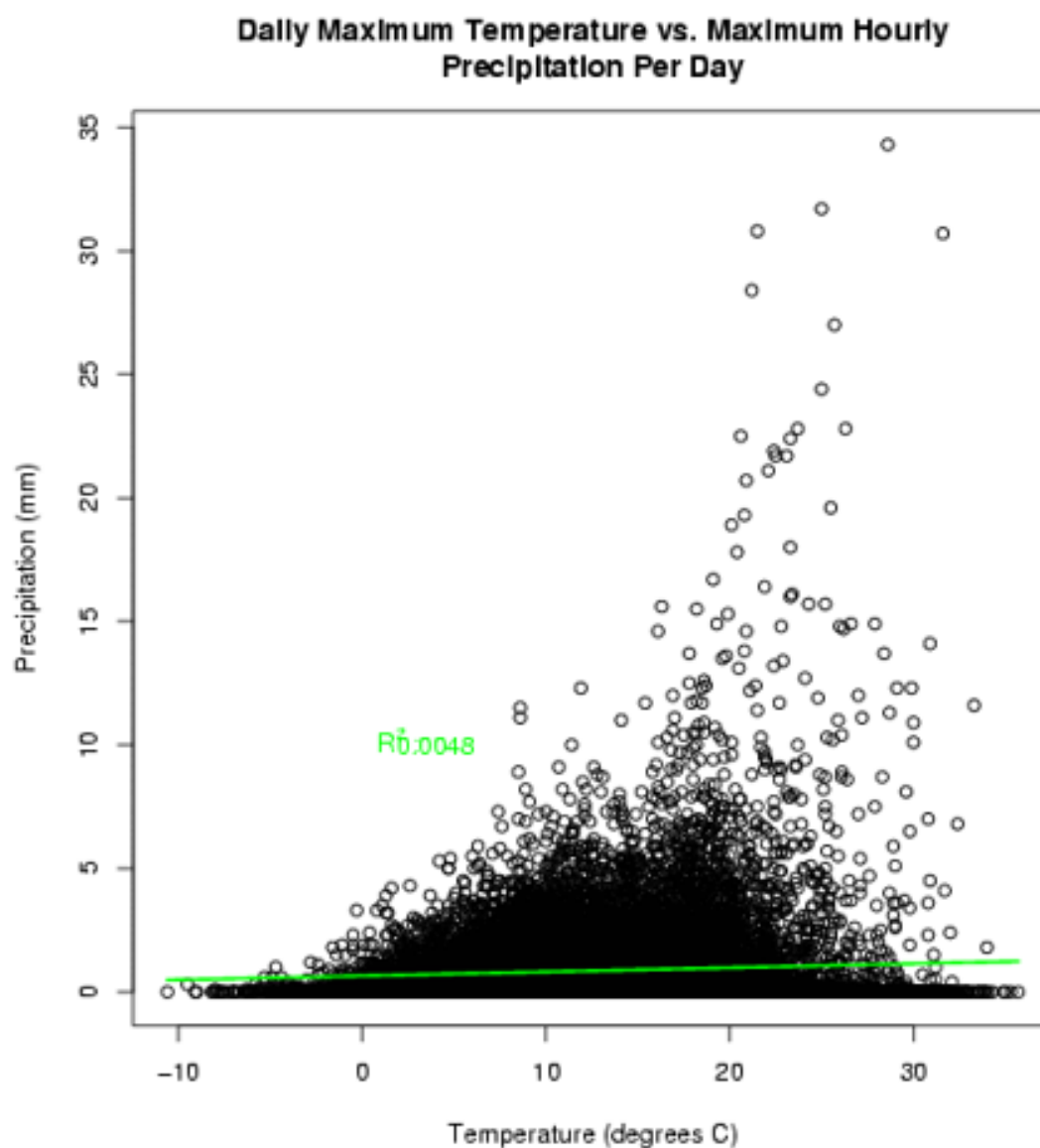


Figure 2: Maximum daily temperature vs. maximum hourly precipitation per day for De Bilt 1958-2006. Green line is the linear regression value of 0.0048



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Daily Average G-west vs. Daily Precipitation (JJA)

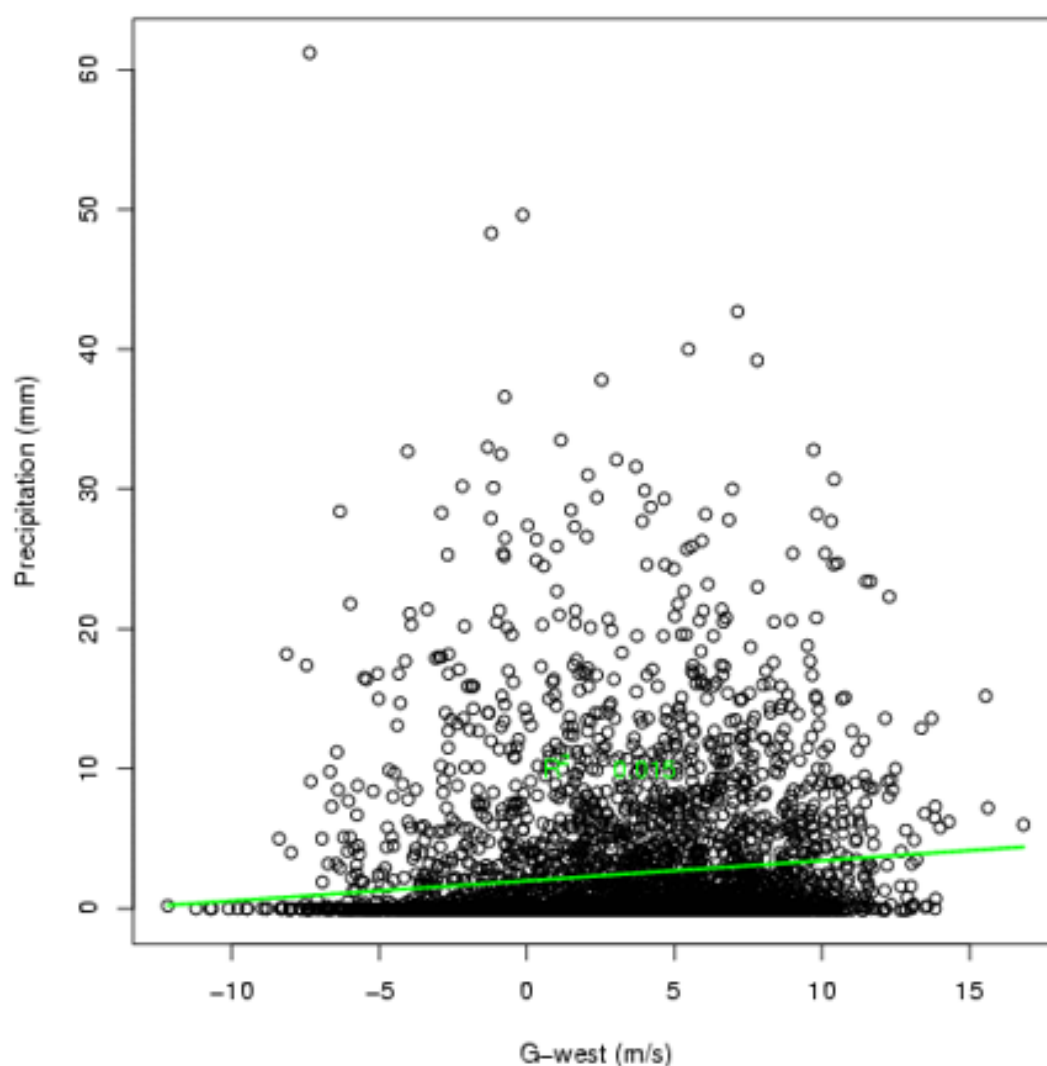


Figure 3: Daily average G-west vs. daily precipitation for summer months (De Bilt 1958-2006).
Green line is the linear regression with a regression coefficient $r^2=0.015$



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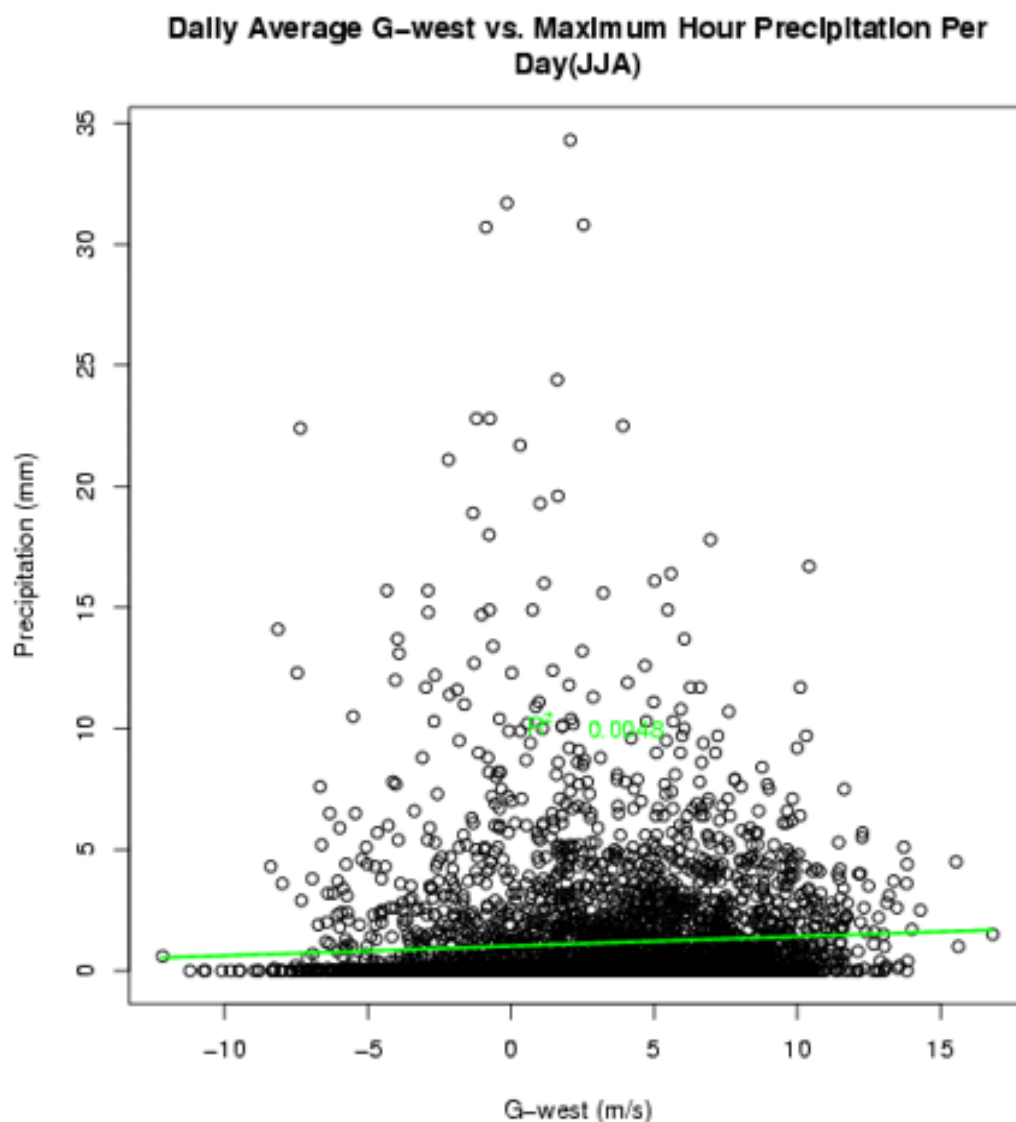


Figure 4: Daily average G-west vs. maximum hourly precipitation per day for summer months (De Bilt 1958-2006). Green line is the linear regression value with a regression coefficient $r^2=0.0048$

Correlations between daily and hourly precipitation and climate variables

Since we are interested in extreme hourly rainfall and we only have information about the change of extreme daily rainfall in case of climate change we decided to investigate the ratio



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between maximum hourly versus daily rainfall in relation to temperature and G-west. We also determined the quantiles. Primarily the upper quantiles: 90%, 95%, and 99% are of interest to us, as these indicate extremes of the recorded daily and hourly precipitation versus maximum daily temperature and versus G-west respectively.

Fig. 5 shows a frequency representation (lower part of figure) of two climate parameters: maximum daily temperature and amount of precipitation (only wet days). The data represent the summer months May, June, July, August, and September for the years 1958-2006. In the upper half of Fig. 5, lines indicate the percentage of data that are below the line (90% quantiles equals 90% below, 10% above). Fig. 6 shows maximum daily temperature versus maximum hourly precipitation per day. Both figures allow for a comparison of maximum daily temperature with hourly and daily precipitation.

Below the horizontal axis, a histogram represents the frequency of the data. For both figures, more hours or days of precipitation occur with a maximum daily temperature value between 15°C and 20°C, at higher temperatures maximum hourly precipitation seems to increase with temperature. This is not clearly the case for daily precipitation. This is in line with our expectation that extreme precipitation is generally occurring during warmer days.

Fig. 7 presents a frequency representation of daily G-west and precipitation (only wet days). Fig. 8 shows G-west versus maximum hourly precipitation per day. Both plots show that more hours or days of precipitation occur with a G-west value of approximately 5 m/s.



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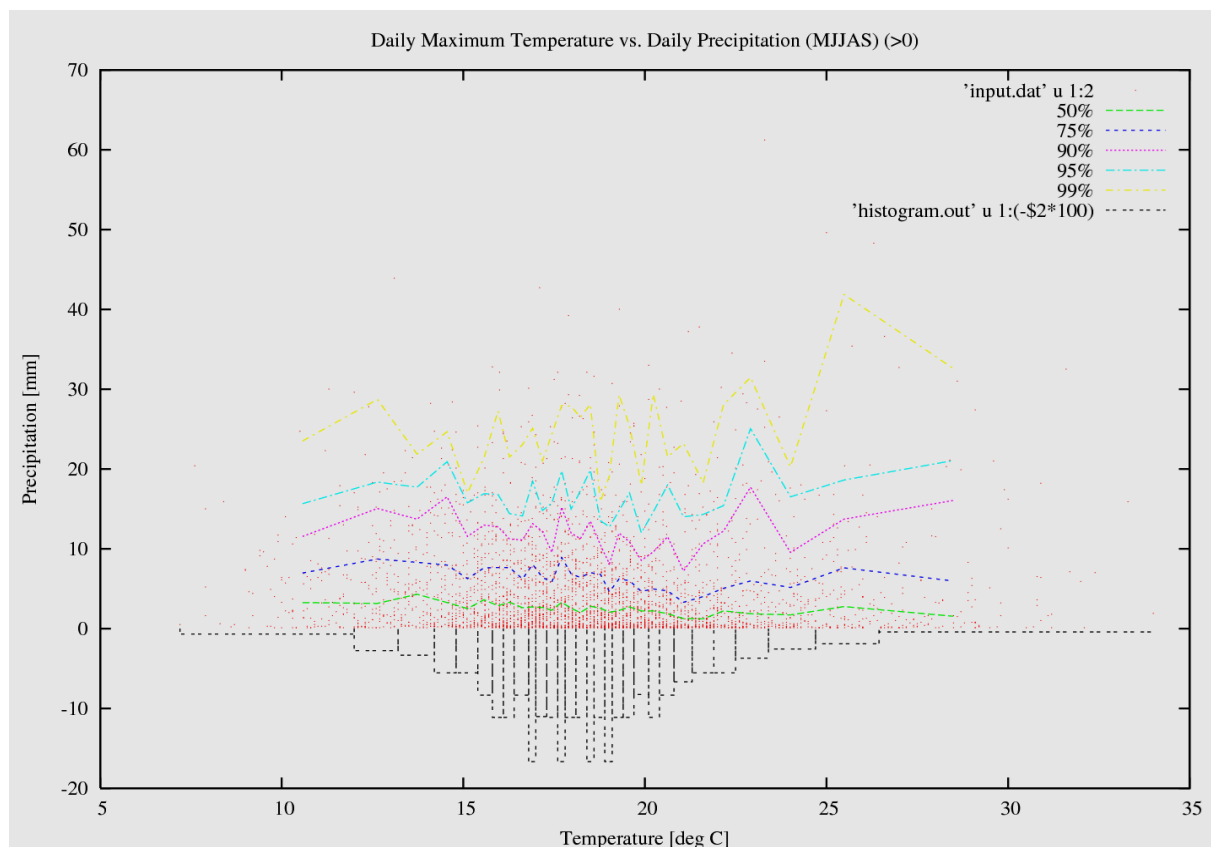


Figure 5: Maximum daily temperature vs. daily precipitation for summer months (May-September)



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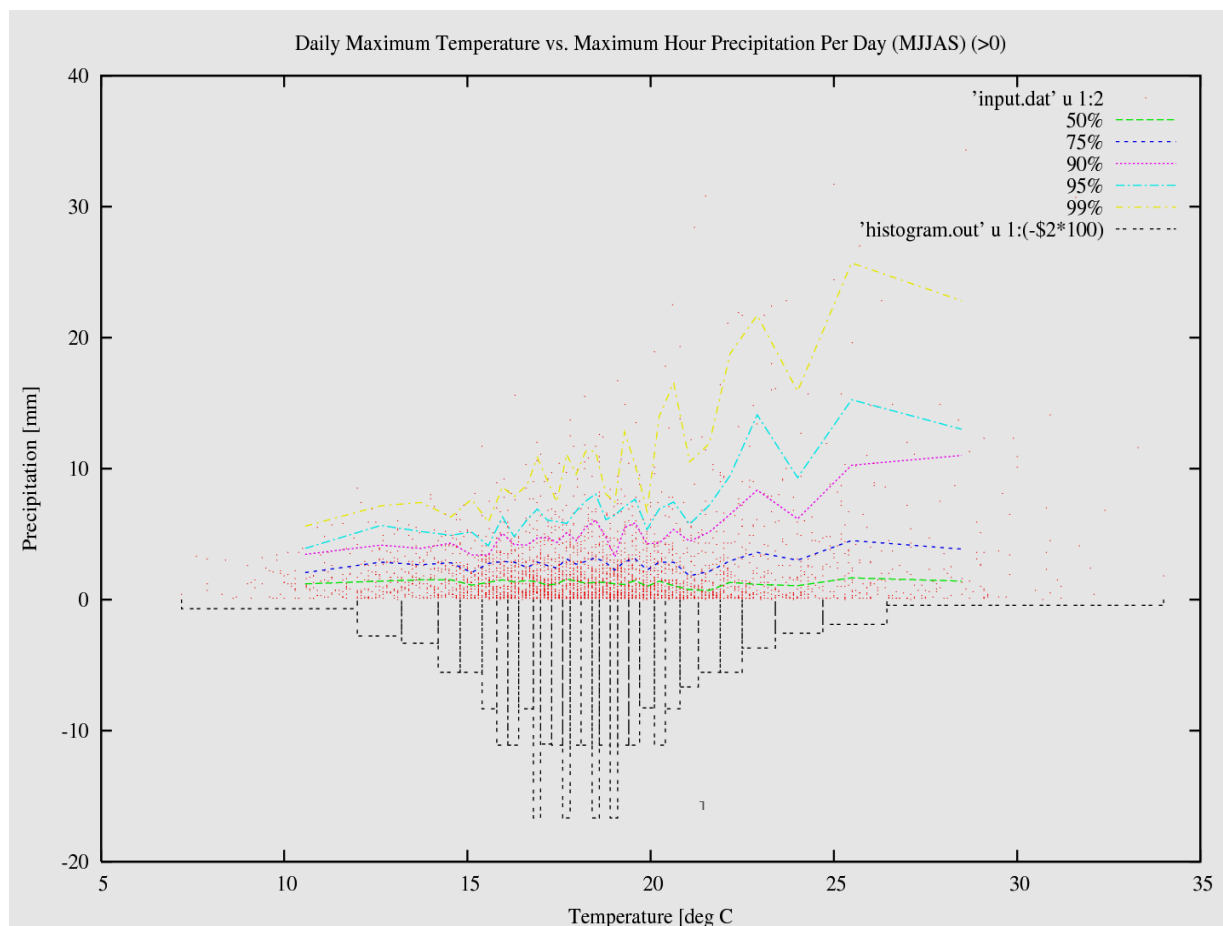


Figure 6: Maximum daily temperature vs. maximum hourly precipitation per day for summer months (May-September)



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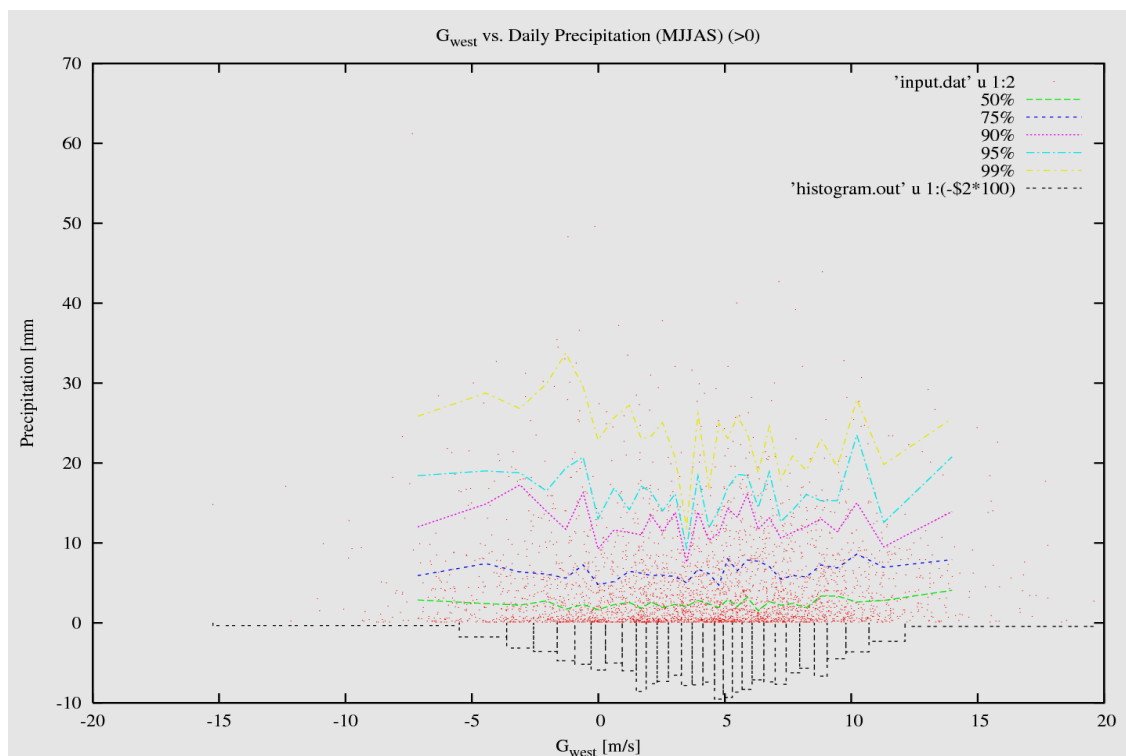


Figure 7: G-west vs. daily precipitation for summer months (May until and including September)



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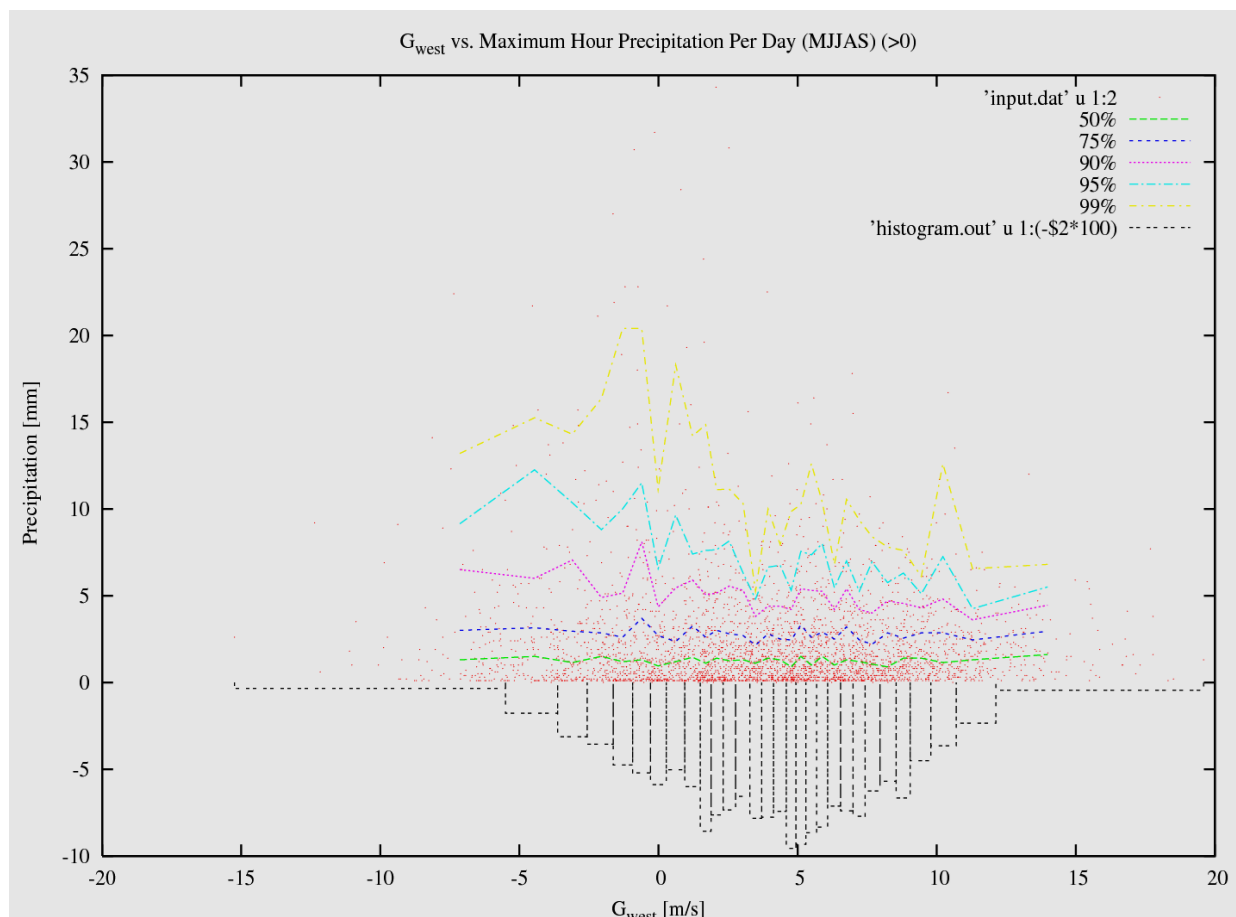


Figure 8: *G-west vs. maximum hourly precipitation per day for summer months (May until and including September)*

In the next step of our analysis, we started comparing points on the percentile lines for daily versus hourly precipitation. So, we took the value of e.g. the 95% line of Figs. 5 and 6 for the same temperature and determined the ratio of daily versus hourly rainfall. We did this for the whole range of temperatures from 10-29°C. And a similar analysis was made for G-west.

Fig. 9 is a plot of the relation between daily and maximum hourly precipitation in relation to maximum daily temperature plotted in Fig. 5 and Fig. 6. The thin-dashed line is the 95% ratio. This was constructed by dividing the 95% percentile line for daily precipitation (Fig. 5) by the 95% percentile line for hourly precipitation (Fig. 6). If we assume a linear relation between these data points, the result is the bold-dashed line which gives the ratio of daily to maximum hourly precipitation versus maximum daily temperature. A change in ratio indicates a different



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relation with maximum daily temperature and therefore a different relation between daily and hourly precipitation. The linear equation for the bold-dashed line in Fig. 9 is,

$$y_{95} = -0.16x_{95} + 5.59$$

x = maximum temperature in °C
 y = ratio of daily to hourly precipitation

A similar calculation was made for the 99% percentile line ratio, which is represented by the solid line. The linear equation for the solid line is,

$$y_{99} = -0.18x_{99} + 5.78$$

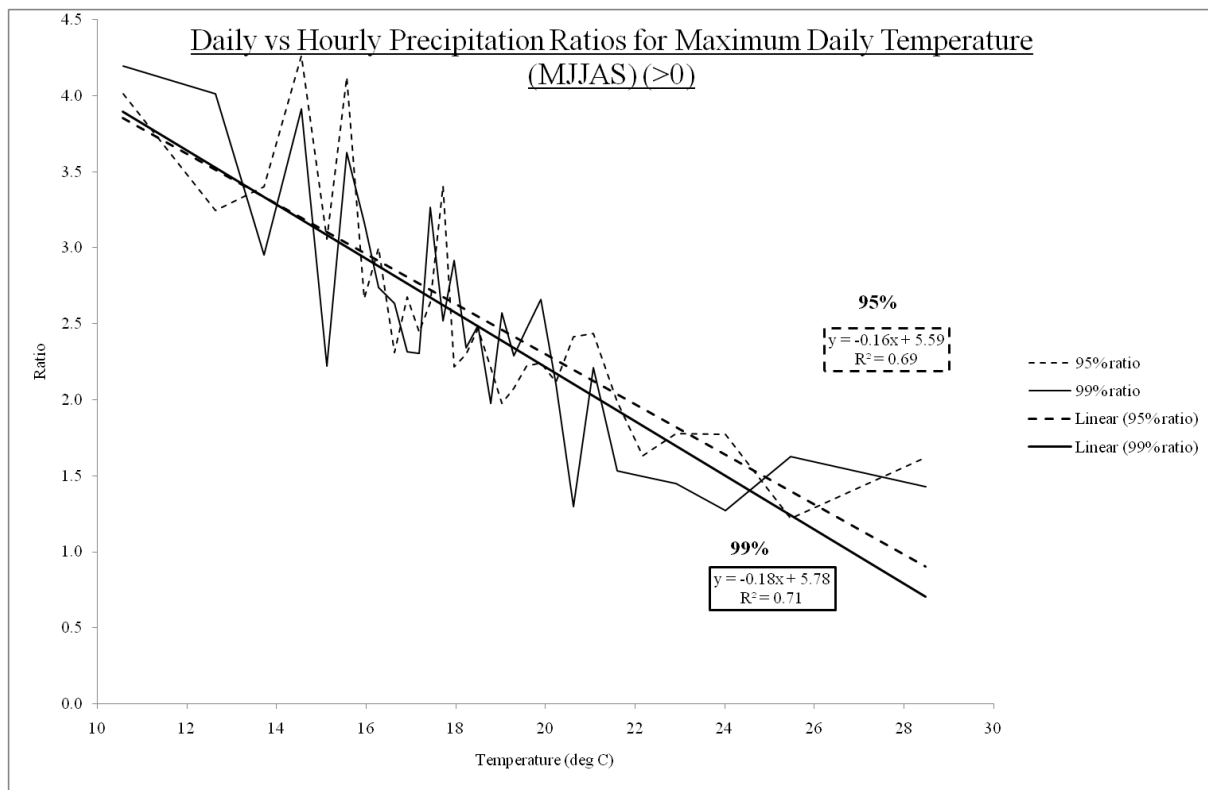


Figure 9: Daily/maximum hourly precipitation ratio in relation to maximum daily temperature for summer months (May-September). The bold-dashed line is the regression value of 0.69. The solid line is the regression value of 0.71



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Fig. 10 is a similar representation as shown in Fig. 9, but now in relation to G-west. The bold-dashed line gives the ratio of daily to hourly precipitation for 95% percentile line versus G-west.

$$y_{95} = 0.09x_{95} + 1.99$$

$$x = \text{G-west in m/s}$$

$$y = \text{ratio of daily to hourly precipitation}$$

The same was done for the 99% percentile line ratio (solid line);

$$y_{99} = 0.08x_{99} + 1.92$$

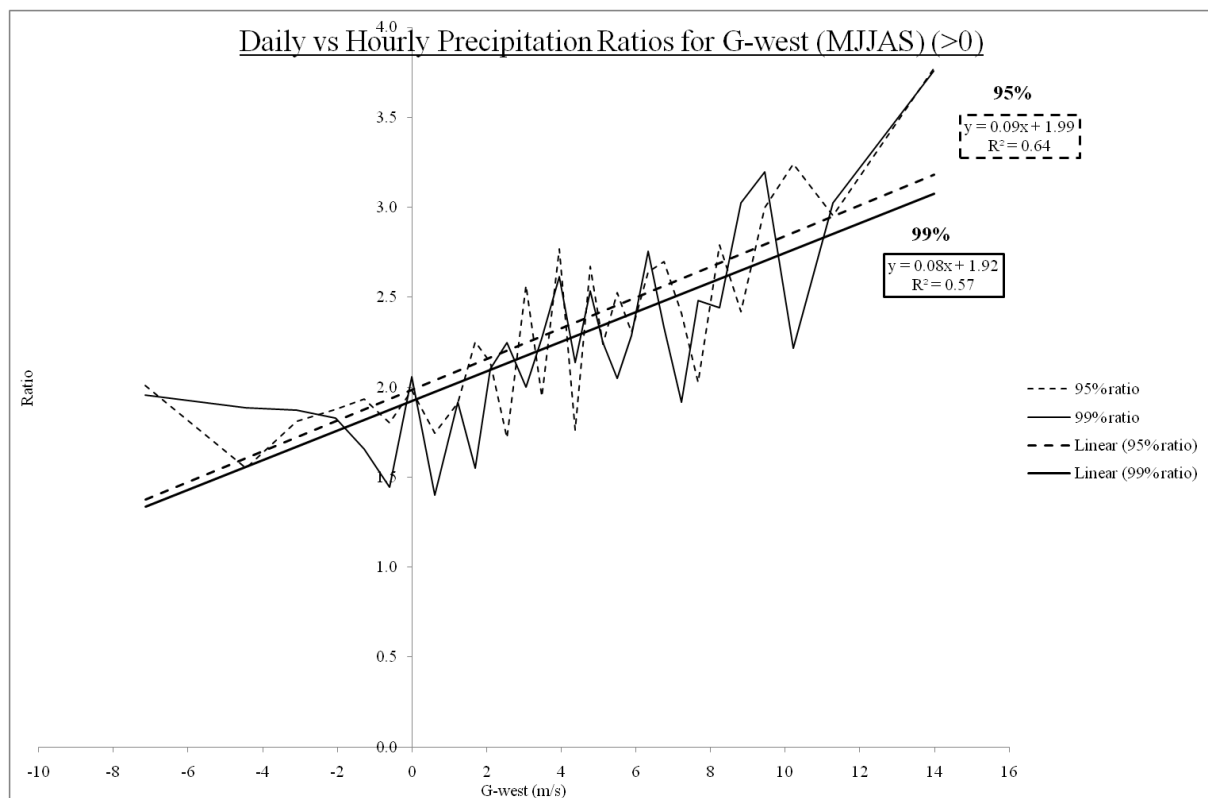


Figure 10: Daily/maximum hourly precipitation ratios in relation to G-west for summer months (May-September). The bold-dashed line is the regression value of 0.64. The solid line is the regression value of 0.57



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Fig. 9 and Fig. 10 show that the ratios of extreme daily to hourly precipitation for temperature and G-west are certainly not constant. The higher the temperature the closer this ratio between daily and maximum hourly rainfall approaches the value 1 (which means that all daily rainfall occurs within 1 h). With strong westerly winds, daily rainfall is much higher than the maximum hourly rainfall.

Now, a relation has been established for extreme daily and hourly precipitation with the explanatory climate variables average daily temperature and G-west. These relations allow us to transform design storms and existing time series of hourly rainfall to new, synthetic series of rainfall under the assumption of a certain climate change scenario. Synthetic series or design storms can now be produced with the aid of the four KNMI'o6 climate scenarios using projected daily precipitation, G-West, and maximum daily temperature.

CONCLUSION

Based on the KNMI'o6 climate scenarios, projections have been made for daily precipitation events for the time horizons 2050 and 2100. The methodology described above enables us to project these daily precipitation events into maximum hourly precipitation events. By examining historical data and analyzing the relationships between precipitation, at both daily and maximum hourly time scales, and explanatory climate variables, it was possible to determine a ratio to apply to daily precipitation projections that result in maximum hourly precipitation projections. Interestingly, although correlations between explanatory variables and precipitation were relatively weak, the correlation between explanatory variable and the daily/hourly precipitation ratio is strong. This strong correlation is the main finding of this paper.

A useful extension of this research would be construction of synthetic maximum hourly precipitation. This extension would allow us to transform design storms and existing time series of hourly rainfall into new synthetic series taking into account climate change scenarios. Eventually, as a second extension, these synthetic data can be used as input for an urban drainage model. With such a drainage model and synthetic data for design storms or design series the effects of climate change on the systems' performance can be assessed and the efficiency of adaptive measures can be investigated.

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THE POTENTIAL ROLE OF WILD GAME FEEDING IN THE SPREAD OF INVASIVE ALIEN SPECIES BASED ON RELATED INTERNATIONAL AND HUNGARIAN LITERATURE

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ABSTRACT

Wild game feeding is a widespread but very controversial practice all over the world. Most studies focused on the effect of supplementary feeding on animal populations or tree damage. At feeding sites, a large amount of fodder is used, and since these are typically contaminated with weed seeds, alien species can easily enter the natural environment. We conducted a literature review of studies investigating the effects of game feeding on herbaceous vegetation. Related studies are very sporadic in both international and national literature. Most of the papers were conducted in America and Europe and they examined the effects of winter supplementary feeding. In this case, the forage is mainly hay and silage, and almost no invasive species were found. However, in some Central European countries, where hunting feeding grounds operated with mixed feeds are the most common, the occurrence of invasive species proved to be higher. In Hungary, for example, many studies showed a significant number of invasive species at feeding sites, in many regions of the country. At some sites, up to 8-9 invasive species may appear. Review of botanical data reports showed similar results. Authors mention almost only weed species, primarily alien species, in the surroundings of hunting establishments, and in addition, among the sources found, they also name foreign species in connection with feeders that are taxa newly appearing in the Hungarian flora. Based on the overview, it can be said that a total of 21 invasive plant species are mentioned in the country in connection with game feeders. Consequently, the type of feeding and the quality of feed could be important factors in the spread of invasive species. Considering that game feeding is very intensive in European countries, in addition to the effects of climate change, these can even be focal points for biological invasion.



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Keywords: *supplementary feeding, bait sites, degradation, weed species*

INTRODUCTION

Artificial feeding of wild game species is an extremely widespread but also very controversial management tool [1]. The effects can be very wide-ranging, however mainly animal species and their populations were examined [2]. The effect on vegetation has hardly been investigated, even though most of the feed used during game feeding is of plant origin, which are well known to be typically contaminated with weed seeds [3]. The applied feeding materials can be a significant source of foreign seeds, which can be further strengthened by the effect that both wild species and humans can have a prominent role in spreading the seeds [4]. Consequently, there is a greater chance that alien species will invade natural ecosystems.

The purpose of this study is therefore to review the national and international literature on the effects of game feeding on forest ecosystems, primarily on vegetation, regarding the role it plays in the spread of invasive alien plants.

MATERIALS AND METHODS

Previous investigation was carried out in Hungary in connection with the appearance of invasive plant species at feeding sites [5]. In the summer of 2020-2024, we examined the degree of infestation by invasive plants in 5 mountainous regions (Gödöllői-dombság, Cserhát, Börzsöny, Mátra, Bükk) and 2 lowland (Kiskunság, Hortobágy) landscape units, including 3 different habitat types (forest, clearing, road).

The survey was carried out at 10 locations per landscape; thus, we examined a total of 70 locations across the country. In the 20-meter area of the feeding sites, we determined the abundance of the individual invasive taxa using a frequency scale and then evaluated the obtained data per landscape unit and per species.

We also conducted a literature review, in connection with 'wild game feeding', 'bait site', 'vegetation', herbaceous layer, underground vegetation used Google Scholar. We selected only those studies that also investigated herbaceous vegetation. During the assessment, we examined the number of feeding sites examined in each study, the type of feeding materials used, and the number of non-native plant species found at each bait site.

RESULTS AND DISCUSSION



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Research specifically examining the appearance of non-native and/or invasive alien species at wild game feeding sites can only be found sporadically in both national and international literature. In connection with the complex effects of wildlife feeding, there have been many large review studies, but in these the problem of alien plant species introduced by feeding does not usually appear, or only sporadically, and most of them only refer to case studies, observations or even oral reports. For many years, the most frequently cited study in the related literature is a North American study that showed a significant mass of smooth brome (*Bromus inermis*), known as an invasive species, originating from hay in the winter supplementary feeding sites of reindeer [6]. Most of the studies examined the browsing damage on shrubs and seedlings in relation to winter supplementary feeding [7]. Herbaceous vegetation is only secondarily considered in other cases, for example when testing different types of feed (e.g. [8]) or examining completely different populations affected by feeding activities (e.g. small mammals [9]). These studies typically only showed the presence of a few alien species, not invasive plant species. However, it was quite different in Central and Eastern European locations, especially in the case of bait sites, where feeding sites are established for hunting purposes. In these countries a much larger number of invasive plant species was detected (Table 1).

In Poland, for example, Jaroszewicz et al. [10] were able to show significant changes in the soil seed bank and vegetation in relation to the feeding of bison, and they found the presence of more invasive species compared to the previously mentioned studies. In the following years, several studies were published in Europe that specifically dealt with the effects of hunting feeding sites on vegetation, and all of them were able to demonstrate a very large number of invasive plant species. Research published in Slovakia [11, 13], for example, clearly showed an increased number of weeds and alien plant species at the feeding sites, often a significant abundance of them.

Table 1. Summary of the research results of herbaceous vegetation changes related to game feeding published in national and international literature in relation to the emergence of invasive plant species.

References	Country	Type of feeding site	Used feed	No. of feeding sites examined	No. of invasive alien species
Mathisen et al. (2010) [7]	Sweden	winter suppl. (moose)	hay, silage	8	0
Rinella et al. (2012) [6]	USA	winter suppl. (moose)	hay	37	1
Turunen et al. (2013) [8]	Finland	winter suppl. (reindeer)	hay, silage, pellets	50	0
Pedersen et al. (2014) [9]	Norway	winter suppl. (moose)	hay, silage	11	0
Jaroszewicz et al. (2017) [10]	Poland	winter suppl. (bison)	straw	8	7



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Eliaš (2018) ^[11]	Slovakia	bait site	mixed feed	55	8
Rusvai (2018) ^[12]	Hungary	bait site	mixed feed	9	6
Kochjarová et al. (2023) ^[13]	Slovakia	bait site	mixed feed	82	8
Miskolczi (2023) ^[14]	Hungary	bait site	mixed feed	40	12
Rusvai (2023) ^[15]	Hungary	bait site	mixed feed	12	12
Rusvai et al. (2024) ^[5]	Hungary	bait site	mixed feed	70	16

*Mixed feed: coarse fodder, grain feed and various fleshy feed are also used

According to the authors, it is likely that the presence of these species largely depends on the repeated supply of diaspores, so most of them may not be able to permanently exist in the mountainous environment. However, since this supply is continuous with the operation of the feeders, the presence of alien species, although local, remains constant. In addition, based on the related vegetation data of the country, it was also determined that alien plant species appear at higher and higher altitudes over the years, which may be the result of climate change and intensive feeding activities. They also found that the fewest alien species are present in hay feeders, and the most at bait sites operated with mixed feeds. Similar results were previously obtained by Turunen et al. [8], who showed that there is a difference between the effect of each type of feed in Finland, in the case of winter supplementary feeding places. In this survey pellet containing less viable seeds caused the least degradation in the vegetation. Our literature review also showed the same tendencies (see Table 1). Bait sites operate with mixed feeds had much more invasive alien plant species than winter supplementary feeding sites, where only straw, hay or pellets are used. In Hungary, almost only bait sites were examined, where many invasive species were found. Our previous study [5] showed that at least one invasive species was detected at almost more than 70 feeding sites included in the study covering 7 landscape units of the country. In the case of one of the bait sites located in Gödöllő Hillside, there was also an example of 9 invasive species appearing in a single location.

In addition, important information is also provided by the data appearing in domestic floristic data communications. In this case, it can be said that the authors mention almost exclusively weed species and mostly alien and/or invasive species in connection with the various hunting establishments, and moreover, these appear in almost all landscape units of the country (Table 2).

In relation to the list, it should be emphasized that in most cases the species that appear are named using terms such as "introduced by wild game feeding sites" and "bait sites at several points in the region", which indicate a wide distribution. In addition, it can be said that there are also species in connection with feeding sites, which were named by the authors only among the new taxa that appeared in the Hungarian flora recently (e.g. *Sporobolus neglectus*, *Erigeron sumatrensis*).

Table 2. References in national floristic data communications in relation to the plant species appearing in the environment of feeding sites.



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References	Species mentioned	Conservation status
Harmos & Sramkó (2000) ^[16]	<i>Ambrosia artemisiifolia</i> L.	invasive alien
Nagy (2000) ^[17]	<i>Camelina microcarpa</i> Andr. ex DC.	native weed
Molnár (2001) ^[18]	<i>Ambrosia artemisiifolia</i> L.	invasive alien
Bauer et al. (2002) ^[19]	<i>Echinochloa crus-galli</i> (L.) P.B.	alien
	<i>Abutilon theophrasti</i> Medik.	invasive alien
	<i>Ambrosia artemisiifolia</i> L.	invasive alien
	<i>Chenopodium album</i> L.	alien
	<i>Amaranthus retroflexus</i> L.	invasive alien
	<i>Datura stramonium</i> L.	alien
	<i>Conyza canadensis</i> (L.) Cronquist	invasive alien
	<i>Bidens tripartita</i> L.	native weed
	<i>Polygonum aviculare</i> L.	native weed
	<i>Plantago major</i> L.	native weed
Pinke et al. (2003) ^[20]	<i>Bifora radians</i> M.B.	native weed
Bauer et al. (2004) ^[21]	<i>Abutilon theophrasti</i> Medik.	invasive alien
Csáky et al. (2004) ^[22]	<i>Abutilon theophrasti</i> Medik.	invasive alien
Pifkó & Barina (2004) ^[23]	<i>Abutilon theophrasti</i> Medik.	invasive alien
Virók et al. (2004) ^[24]	<i>Ambrosia artemisiifolia</i> L.	invasive alien
Barina (2008) ^[25]	<i>Xanthium italicum</i> Moretti	invasive alien
	<i>Abutilon theophrasti</i> Medik.	invasive alien
Mészáros & Simon (2009) ^[26]	<i>Leonurus marrubiastrum</i> L.	native weed
Farkas (2011) ^[27]	<i>Ambrosia artemisiifolia</i> L.	invasive alien
Voigt & Somay (2013) ^[28]	<i>Crepis pannonica</i> (Jacq.) K.Koch	native weed
Schmotzer (2015) ^[29]	<i>Xanthium italicum</i> Moretti	invasive alien
	<i>Xanthium strumarium</i> L.	alien
	<i>Datura stramonium</i> L.	alien
	<i>Abutilon theophrasti</i> Medik.	invasive alien
Király (2016) ^[30]	<i>Sporobolus neglectus</i> Nash	alien (new species!)
Csiky et al. (2018) ^[31]	<i>Solanum nigrum</i> L.	native weed
Matus et al. (2019) ^[32]	<i>Abutilon theophrasti</i> Medik.	invasive alien
Schmidt & Haszonits (2021) ^[33]	<i>Erigeron sumatrensis</i> Retz.	alien (new species!)
Vojtkó & Farkas (2021) ^[34]	<i>Ambrosia artemisiifolia</i> L.	invasive alien
Szentgyörgyi & Bátori (2022) ^[35]	<i>Abutilon theophrasti</i> Medik.	invasive alien
	<i>Xanthium saccharatum</i> Wallr.	invasive alien

During the review a total of 21 invasive plant species are mentioned throughout the country in connection with the different wild game feeding sites (Figure 1).



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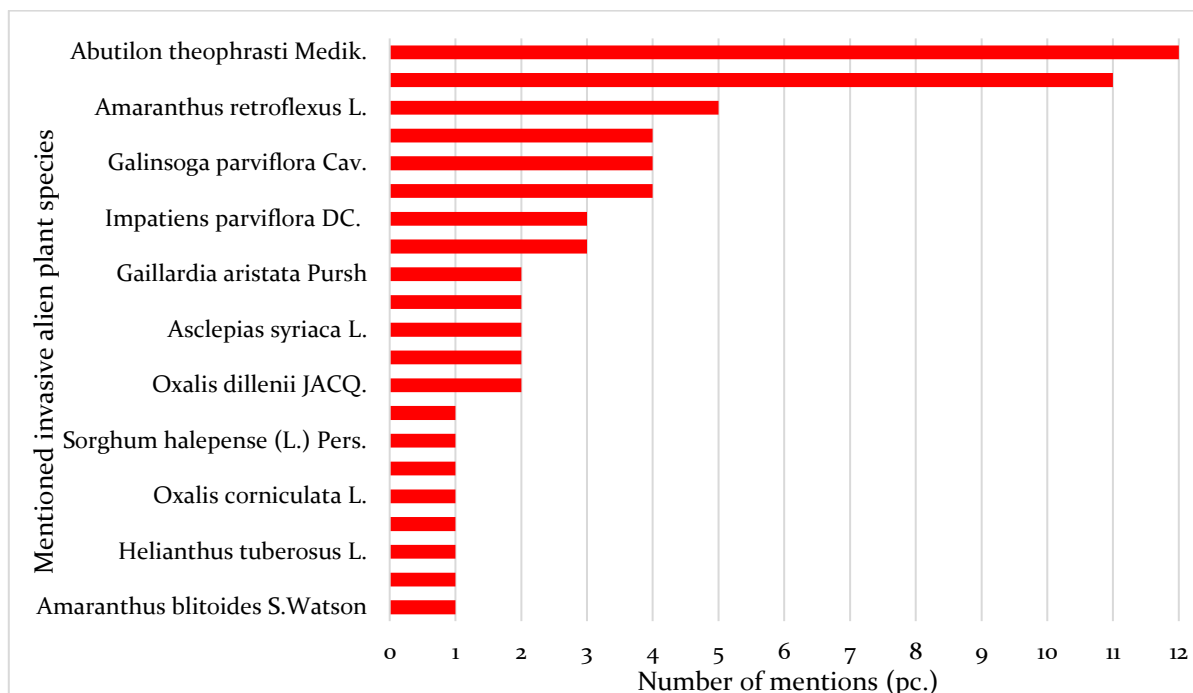


Figure 1. The list of invasive alien species found at different wild game feeding sites in Hungary based on literature review.

The most frequent species were *Abutilon theophrasti*, *Ambrosia artemisiifolia*, *Amaranthus retroflexus* and *Xanthium spinosum*. During the mentioned previous field investigations, we found many invasive species that have not been named in any national literature (e.g. *Iva xanthiifolia*, *Gaillardia aristata*) which means that probably even more invasive species can be present at feeding places.

CONCLUSION

The occurrence of non-native and invasive species at wild game feeding sites has been shown in many habitat types throughout the country, especially in our forested landscapes rich in big game. In addition to climate change and the current domestic practice of feeding, these locations can be focal points of invasion even in closed forest conditions due to their close connection with forest road networks and their significant number.

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EXAMINATION OF SOIL DEGRADATION IN A HUNTING GROUND LOCATED IN A CONSTRUCTION WASTE LANDFILL SITE IN HUNGARY

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ABSTRACT

Wild boar is increasingly present in periurban and urban areas, which makes wild game management interventions necessary in these areas as well. In Hungary, especially bait sites used for wild boar hunting are widespread, they are found in all parts of the country. Since feed is usually placed directly on the soil surface at these sites, this can significantly affect soil properties. We examined soil characteristics of a bait site located in a construction waste landfill site in the capital agglomeration of Hungary. Soil samples were collected from the 0–10 cm layer of the soil at a wild boar bait site. We also designated two nearby control areas (within approx. 50 m), a grassland and a forest site. Soil properties were measured by a near-infrared device (Agrocares Ltd., The Netherlands). Soil characteristics were compared. We hypothesized that the soil nutrients (e.g. N, P, K, Ca, Mg) are the highest at the bait site due to the continuous supply of fodder plus the manure produced by the animals. However, according to the results, this proved to be true only in relation to the grassland site. The amount of soil organic matter, organic carbon, Ca, cation exchange capacity and total and potentially mineralizable nitrogen were the highest at the forest site. Results show that feeding can cause changes in soil properties, but such anthropogenic habitats like landfill sites, there are other soil-degrading effects on a much larger scale. Thus, further research in similar habitats is needed to better understand the effects.

Keywords: supplementary feeding, bait sites, degraded habitats, nutrient enrichment



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INTRODUCTION

Wild boar is increasingly present in periurban and urban areas, which makes wild game management interventions necessary in these areas as well [1]. In Hungary, especially bait sites used for wild boar hunting are widespread, they are found in all parts of the country [2]. Since feed is usually placed directly on the soil surface at these sites, this can significantly affect soil properties, especially soil nutrient content [3,4].

The aim of the study was to examine how the soil properties change directly at the feeding grounds and in their surroundings. We hypothesized that the soil nutrients (e.g. N, P, K, Ca, Mg) are the highest at the bait site due to the continuous supply of fodder plus the manure produced by the animals.

MATERIALS AND METHODS

The study area is located in the Tétény Plateau, near Budatétény in Central Hungary. The average annual temperature is 9.5–10 °C. The amount of annual precipitation is 600 mm. The soil type in the area is rusty brown forest soil.

We examined soil characteristics of a bait site located in a construction waste landfill site in the capital agglomeration of Hungary. Soil samples were collected from the 0–10 cm layer of the soil at a wild boar bait site. The feeding site is located in a degraded grassland; it has been operated with mixed feed for at least 4-5 years (Fig.1-3.).



*Figure 1. Photos from the examined feeding site near Budatétény in Hungary
(Photo: Csaba Centeri, 2024)*



*Figure 2. The soil surface was very degraded at the feeding site
(Photo: Katalin Rusvai, 2024)*



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Figure 3. Very mixed feeds are used at the feeding site (for example baked goods)
(Photo: Katalin Rusvai, 2024)



Figure 4. Soil sampling at the control grassland site (Photo: Csaba Centeri, 2024)

We also designated two nearby control areas (within approx. 50 m), a grassland (Fig 4.) and a forest (*Pinus nigra* plantation) site. Soil properties were measured by a near-infrared device (Agrocares Ltd., The Netherlands). Soil characteristics were compared used average data and two-sample t-test.

RESULTS AND DISCUSSION

Our hypothesis, according to which we will be able to detect greater nutrient richness at the feeding site, was not confirmed. The amount of soil organic matter, organic carbon, Ca, cation exchange capacity and total and potentially mineralizable nitrogen were the highest at forest site. However, it was true in relation to the grassland site, main soil nutrients proved to be higher at feeding site (Table 1-2.).

Table 1-2. Average data of the soil samples in relation to bait site and forest, as well as bait site and grassland.

Soil parameters	Bait site	Forest
pH (H ₂ O)	8,04	8,32
SOM (%)	2,52	9,02
P (mg/kg)	13,9	10,44

Soil parameters	Bait site	Grassland
pH (H ₂ O)	8,04	8,16
SOM (%)	2,52	1,8



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N (g/kg)	1,48	4,18
K (mmol/kg)	5,7	4,44
Ca (mmol/kg)	220	387,2
Mg (mmol/kg)	19,68	23,38
Organic C (g/kg)	14,6	52,26
A_N_PMN	53,6	170,8
CEC (mmol/kg)	184,6	277
Al (g/kg)	42,26	18,76
Fe (g/kg)	26,3	12,86
Clay (%)	23,8	22,2
Soil moisture (%)	18,12	18,1

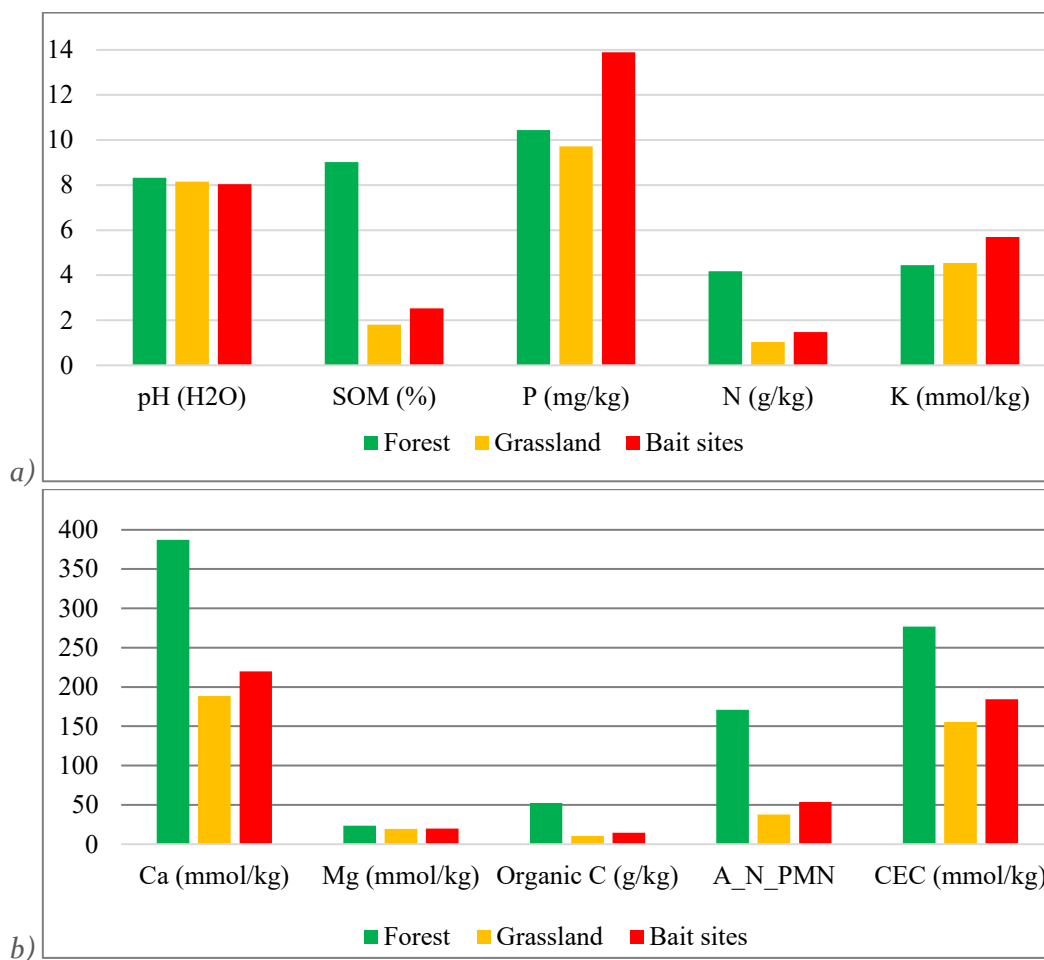
P (mg/kg)	13,9	9,72
N (g/kg)	1,48	1,04
K (mmol/kg)	5,7	4,54
Ca (mmol/kg)	220	188,38
Mg (mmol/kg)	19,68	19,5
Organic C (g/kg)	14,6	10,42
A_N_PMN	53,6	37,74
CEC (mmol/kg)	184,6	155,6
Al (g/kg)	42,26	40,58
Fe (g/kg)	26,3	23,02
Clay (%)	23,8	21,8
Soil moisture (%)	18,12	19,38

A_N_PMN: potentially mineralizable nitrogen, CEC: cation exchange capacity; Bold letters: larger values, grey colour: significantly higher value based on two-sample t-test.

Even in the comparison of the three different locations, the highest nutrient richness was observed at the forest location (Fig. 5 a,b,c). Especially soil organic matter and Ca proved to be high at the forest site, only K, Al and Fe were lower in the forest.



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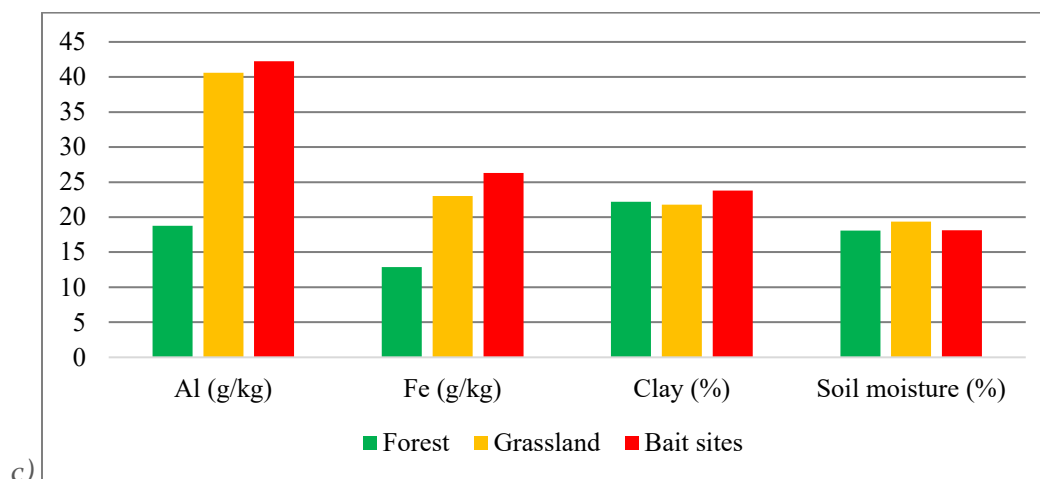


Figure 5. The average data of soil samples at the feeding site and on grassland and forest site.

CONCLUSION

Results show that feeding can cause changes in soil properties. The amount of soil nutrients was high at all examined sites due to the continuous supply of fodder plus the manure produced by the animals. A previous study showed that the amount of soil nutrients was significantly (more than 10 times) higher in the clearings than in forest sites [3,4]. However, we only found this tendency in case of the grassland site. At forest site a very high amount of soil nutrients was detected, the cause of which is presumably not related to the feeding activity. The reason may be that the needle litter can considerably higher than the amount of decomposing litter of grasslands. In that way *Pinus nigra* plantations should express higher humus content and better nutrient supply [5]. Results show that feeding can cause changes in soil properties, but such anthropogenic habitats like landfill sites, there are other soil-degrading effects on a much larger scale. Thus, further research in similar habitats is needed to better understand the effects.

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IMPACTS OF CLIMATIC CHANGE AND THE FUTURE OF THE HEALTH OF BIOSPHERE

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ABSTRACT

Climate change poses significant challenges to global stability, despite contributing minimally to global emissions, facing disproportionate climate impacts. The Earth's temperature is rising rapidly due to human driven greenhouse gas (GHG) emissions, primarily from burning. This has led to significant changes in the world's climate and consequently intensified hydro-climatic extremes such as heavy rainfall, droughts, floods, sea level rise, and cyclones around the world fossil fuels. Climate change profoundly impacts the biosphere and human health, disrupting ecosystems, causing species migration and extinction, and increasing disease outbreaks through shifting weather patterns and habitat destruction. Achieving sustainability requires protecting the biosphere by reducing GHG emissions, preserving natural habitats like forests and wetlands that act as carbon sinks, and fostering ecosystem-based strategies to adapt to changing conditions. These actions are essential for maintaining the delicate balance of life on Earth and ensuring human well-being by safeguarding food and water security and reducing health risks. Climate change severely harms the biosphere by disrupting ecosystems, threatening biodiversity, and creating conditions for new and intensified disease outbreaks. Impacts include shifting species' geographic ranges, altered life cycles, the loss of vital habitats like coral reefs, and an increase in extreme weather events that devastate ecosystems and livelihoods. Environmental change poses a serious threat to well established frameworks of the ecosystem, while the increase in the average temperature of the Earth's atmosphere, known as global warming, is a primary driver of these ecological disruptions. In 2017, human-caused warming increased by around 1 C (between 0.8 C and 1.2°C) over pre-industrial levels, with an increase of 0.2°C (between 0.1 C and 0.3°C) per 10 years. Climate change and variability limit farmers' capacity to make strategic agricultural decisions. Local knowledge plays a crucial role in establishing climate change mitigation and adaptation strategies in areas with limited hydrometeorological data. Subsistence farmers are sensitive to climate change but also have extensive knowledge of local weather patterns and past extremes. Climate change poses significant challenges to



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global stability, which, despite contributing minimally to global emissions, face disproportionate climate impacts. Climate change is one of the most urgent and complex global challenges, affecting nearly every aspect of life including health, ecosystems, infrastructure, food systems, and economic stability. In the era of climate change, optimizing both photosynthesis and radiation use efficiency is essential to meet the growing global food demand and minimizing environmental impacts. Climate change poses significant challenges to photosynthesis and radiation use efficiency through increased temperatures, altered precipitation patterns, and elevated atmospheric CO₂ levels. These changes can disrupt plant metabolic processes, reduce water availability, and increase the frequency of extreme weather events, thereby affecting crop productivity. However, there is a lack of comprehensive documentation on the understanding of relationship between photosynthesis and radiation use efficiency in this era of climate change. Changes in the frequency and intensity of drought and floods could be a threat to food security. All features of the environment are affected by climate changes. For instance, ecological alteration causes temperatures to rise on certain parts of the planet. This results to more decrease in temperature during colder months. The production of plants and animals are directly affected by variations in weather conditions, such as temperature and precipitation, as well as by the frequency and severity of extreme occurrences, such as droughts, floods, and storms. Therefore, it is imperative to address the threat and effects of climate change, as they have a significant impact on crop productivity and production. There is an urgent need to assess how well global society is doing at increasing agricultural production while simultaneously conserving biodiversity and associated ecosystem services in an era of climate change, energy costs and financial instability.

Keywords: Climatic variations, biosphere health, biodiversity, land degradation, sustainability of life on earth

INTRODUCTION

The biosphere refers to the part of the Earth and its atmosphere where life exists. It includes all living organisms, from the smallest bacteria to the largest animals and plants, as well as the physical environmental factors in which they live and interact. There are many visions on how to achieve a sustainable agriculture that provides enough food and ecosystem services for present and future generations in an era of climate change, increasing costs of energy, social unrest, financial instability and increasing environmental degradation. The biosphere is a complex and interconnected system, with living organisms and their environment constantly interacting and influencing each other. For example, plants absorb carbon dioxide (CO₂) from the air and release oxygen (O₂) through photosynthesis, while animals breathe in O₂ and exhale CO₂. Microorganisms play important roles in nutrient cycling and decomposition, while larger animals can act as predators or prey. Human activities, such as pollution, deforestation, climate change, and others, significantly impact the health of biosphere. Understanding and protecting the biosphere is important for maintaining the health of humans and other living organisms. The biosphere is also closely interconnected with other



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Earth systems, such as the atmosphere, hydrosphere, and geosphere (lithosphere). The atmosphere provides the O₂ and other gases that living organisms need to survive, while the hydrosphere offers water for drinking and other purposes. The geosphere provides nutrients and minerals that support the growth of plants and other living organisms.

Biodiversity, or the variety of living organisms in the biosphere, is vital for maintaining ecosystem health and functioning. Loss of biodiversity can have significant ecological and economic impacts, such as reduced crop yields, increased susceptibility to disease, and loss of ecosystem services.

One of the key challenges facing the biosphere today is climate change. Rising temperatures, changing precipitation patterns, and other effects of climate change can significantly impact the distribution and abundance of different species and the functioning of ecosystems. Climate change is linked to other environmental problems, such as habitat loss and pollution, which can further exacerbate the impacts on the biosphere. Protecting the biosphere requires a combination of strategies, including conservation of natural habitats and biodiversity, sustainable use of natural resources, and reduction of GHG emissions to mitigate the impacts of climate change. Scientific research, public education, and policy initiatives are important for raising awareness and promoting action to protect the biosphere.

The objective of this review is to deepen understanding of how climate change intersects with development, particularly in contexts with economic and institutional constraints. The special issue seeks to advance knowledge in five core thematic areas:

1. Climate Change and Resource Constraints:

How do limited resources in low- and middle-income countries (LMICs) constrain adaptation and mitigation strategies? What are the implications for resilience across sectors such as agriculture, industry, and energy?

2. Institutional Challenges in Climate Policy:

What roles do weaker administrative capacities play in environmental and emission regulation, enforcement of environmental policies, and managing climate-related risks?

3. Opportunities in Energy Transition:

How can LMICs leverage minimal legacy infrastructure to leapfrog toward clean energy systems? What economic and institutional conditions support such transitions?

4. Economic and Social Disparities in Climate Impacts:

How does climate change deepen inequalities? What policy solutions are viable in different socioeconomic contexts? Health and infectious disease.

5. Innovative Approaches to Climate Challenges:

What new frameworks, methodologies, or interdisciplinary insights can help address climate challenges in the unique contexts of LMICs?



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IMPACTS OF CLIMATIC CHANGE ON THE BIOSPHERE AND HEALTH

- **Ecosystem Disruption:**
Climate change changes temperature and precipitation patterns, which can lead to the migration of plants and animals to cooler regions or higher altitudes, affecting biodiversity and ecosystem functions.
- **Species Loss and Extinction:**
Species that cannot adapt quickly enough to these changing conditions face reduced populations or extinction, further diminishing the planet's biodiversity.
- **Increased Disease Risk:**
Shifts in climate can create new opportunities for viruses and disease vectors, such as mosquitoes and ticks, to spread to new populations and regions, intensifying the risk of diseases like malaria, dengue fever, and Lyme disease.
- **Food and Water Insecurity:**
Extreme weather events, including droughts and floods, caused by climate change, threaten food and water supplies, leading to increased rates of malnutrition and insecurity.

INTERCONNECTEDNESS OF CLIMATE, BIOSPHERE, AND HEALTH

- Human health is deeply connected to the health of the biosphere and the climate. When these systems are healthy, human populations are more resilient.
- Degrading the biosphere, such as through habitat destruction, can weaken the Earth's natural defense and exacerbate health problems for people.
- Addressing climate change is therefore essential for the future health of the planet and its inhabitants, requiring global cooperation to protect biodiversity and ensure a sustainable future.

Most researchers agree that a basic attribute is the maintenance of agroecosystem diversity and the ecological services derived from beneficial ecological interactions among crops, animals and soils. Increasingly, research suggests that the level of internal regulation of function in agroecosystems is largely dependent on the level of plant and animal biodiversity present in the ecosystem and its surrounding environment.

Biodiversity performs a variety of ecological services beyond the production of food, including recycling of nutrients, regulation of microclimate and local hydrological processes, suppression of undesirable organisms, detoxification of noxious chemicals, etc. (**Figure 1**).

It may be argued that transgenic crops can enhance productivity and reduce agrochemical loads. But can it do so by emitting less GHGs, without eroding soils or reducing genetic diversity, etc. under



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allowed threshold values? Others may argue that while organic farming may conserve biodiversity and natural resources and tends to be carbon neutral, it may not yield enough to produce an abundant food supply. Estimates of the economic, social and ecological consequences of transgressing a threshold would suggest that the agricultural strategy should not be deployed and would force the farmers, organization or enterprise promoting the strategy to refine the production system or technology so that when deployed its impacts remain within the acceptable threshold bounds.

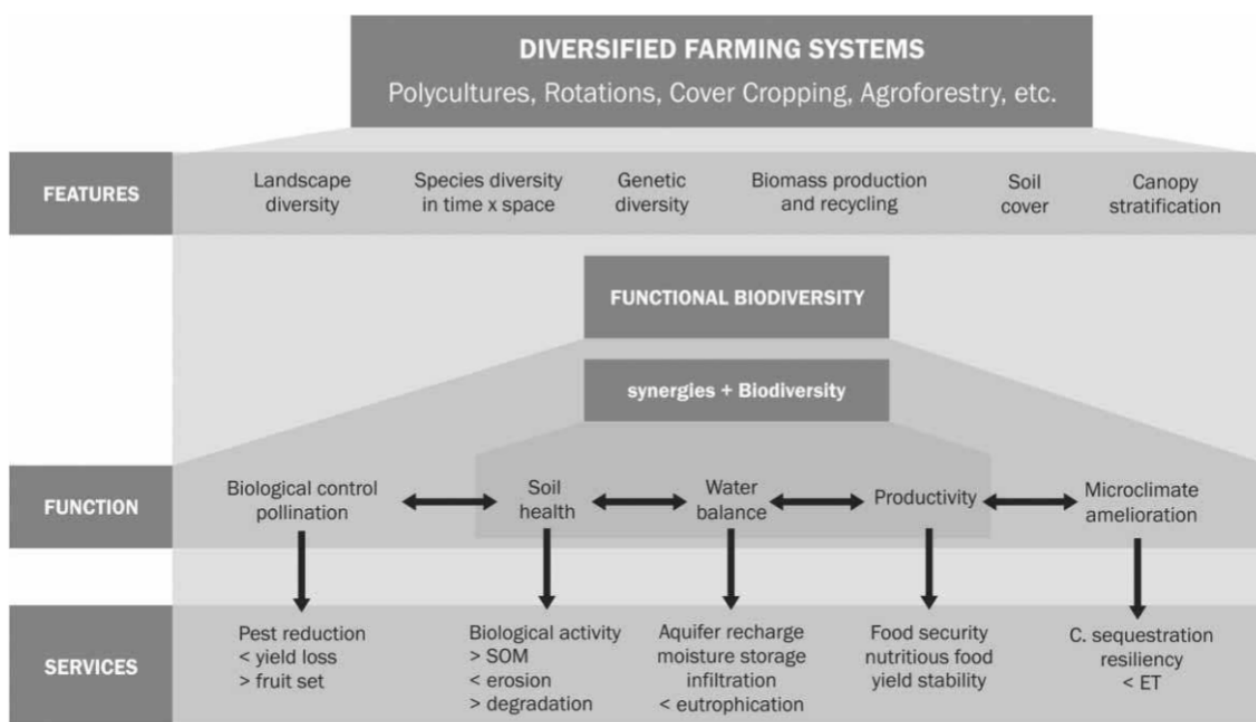


Figure 1. The ecological role of biodiversity in agroecosystem function and the provision of ecosystem services by diversified farming systems (Source: [1])

A threshold-based assessment approach can

1. provide early warnings of impending damages or losses in the healthfulness of the socio-ecological system before a threshold is surpassed,
2. monitor actual system changes once the technology is deployed and
3. suggest alternatives on how the launched technologies can remain within the established thresholds.

As depicted in Figure 2, in order for an agricultural strategy to fit within the Green Agriculture criteria, it must contain the basic requirements of a viable and durable agricultural system capable of confronting the challenges of the 21st century while carrying out its productive goals within certain limits in terms of environmental impact, land degradation levels, input and energy use, GHG emissions,



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etc. Defined threshold indicators are site or region specific; thus, their values will change according to prevailing environmental and socio-economic conditions.

Because biodiversity-mediated renewal processes and ecological services are largely biological, their persistence depends on the maintenance of biological integrity and diversity in agroecosystems. Traditional farmers as well as a generation of agroecologists offer a wide array of management options and designs that enhance functional biodiversity in crop fields.

Today, most food and agriculture experts agree that food production will have to increase substantially by 2050. Almost 90% of the projected 70% increases in food production are expected to come from intensification, including ones where land and water are already scarce.

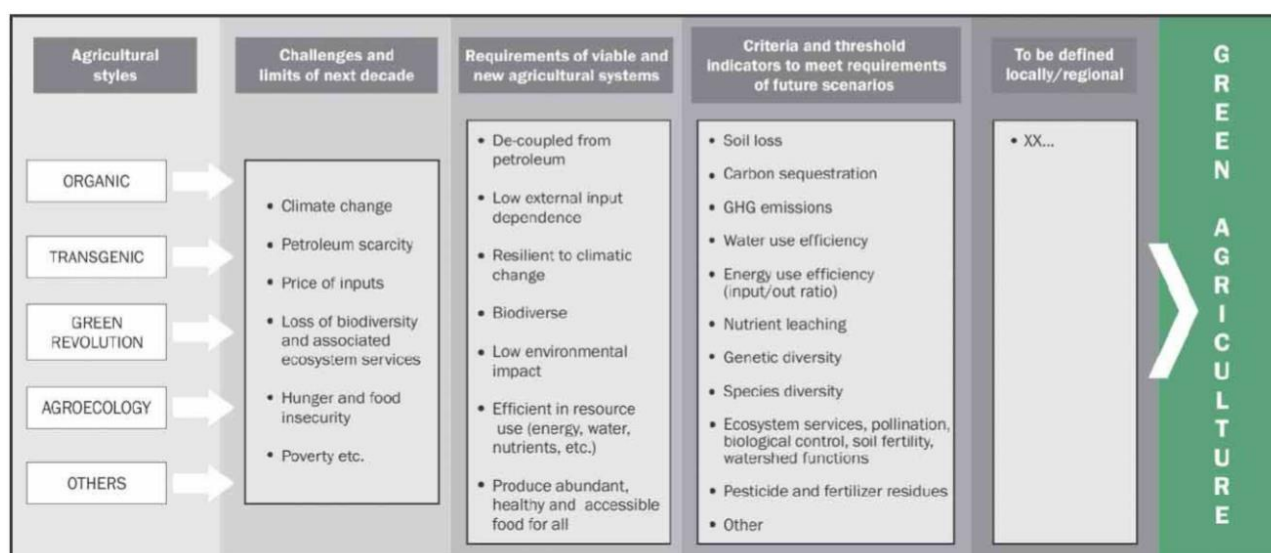


Figure 2. The basic requirements of a viable and durable agricultural system capable of confronting the challenges of the 21st century while carrying out its productive goals within certain thresholds established locally or regionally. (Source: [1])

Rising global temperatures, sea-level rise, and increasingly frequent extreme weather events pose significant threats to both current and future generations. In response, the global community has adopted cooperative frameworks to limit GHG emissions, most notably through the 2015 Paris Agreement. Signed by 193 parties, the Paris Agreement aims to keep global warming well below 2°C above pre-industrial levels, with a preferred target of limiting the rise to 1.5°C.

The Conference of the Parties (COP) is the group of nations that have signed the UN Framework Convention on Climate Change (UNFCCC), which was put together in 1992. It commits them to act together to stabilize greenhouse gas concentrations “at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system”. Since then, the Parties, or nations, have met almost annually. The most recent COP, COP28, was held last year in Dubai and was



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the largest attended climate COP in history, convening 97,000 delegates, and more than 150 heads of state, along with negotiators, business leaders and nonstate actors. The conclusion of the first ever Global Stock Take (a mid-term review of progress towards the 2015 Paris Agreement) was the event's key outcome and the conference emphasized the need for determined action to make progress on renewable energy, a just transition and more. The 27th Conference of the Parties (COP27), highlighted the region's priorities in advancing adaptation, climate finance, loss and damage, and low-carbon development. Yet, translating these high-level commitments into practical, implementable long-term strategies remains a major challenge.

The understanding of climate change as a global hazard is complex and multifaceted, presenting substantial challenges to societies worldwide. While its universal impacts are undeniable, perceptions of climate change as an immediate risk vary significantly across cultures, geographies, and knowledge systems [2]. This variability is particularly pronounced in developing countries, where climate risks intersect with socio-economic vulnerabilities and diverse epistemologies.

The climate change manifests through glacial retreat, erratic monsoons, and biodiversity loss, yet adaptation strategies often prioritize global narratives over hyperlocal realities.

Today, about 8 billion people rely on the biosphere to supply them with a multitude of essential ecosystem services. Global climate change is directly affecting the main environmental components: water, air, weather, and ecosystems. Changes in precipitation, temperatures, and melting of ice caps have already occurred and will create new changes in the availability and quality of environmental elements and the human health.

As per the Food and Agriculture Organization (FAO), feeding the world's 9 billion people by 2050 will need a roughly 70% rise in food production. In the next fifty years, every hectare of cereals must feed twice as many people as it does now to prevent malnutrition. The development of stress-tolerant plants and increased crop productivity are necessary to meet food demands in the face of several challenges, such as growing global population, a decline in arable land area or a lack of agriculture, resource constraints, and climate change. While new farming methods and agronomic practices, like breeding high-yield staple crops, intercropping, and improved fertilizers, pesticides, water, and nutrition supplies, have increased grain yields to some extent, they are still insufficient to meet the increasing demand of the population [7]. Plant photosynthesis and radiation use efficiency are one of those processes which must be well understood and optimized to put these techniques into effect.

The primary source of carbon and energy needed to produce the organic compounds for plant growth and development is photosynthesis. Increasing the amount of CO₂ assimilated by photosynthesis per leaf or land area could be the best approach to increase agricultural productivity. In the upcoming decades, the growing population of the world and the uncertainties surrounding climate change will necessitate higher photosynthetic efficiency to ensure food security. It is crucial to address the issues around sustainable crop productivity.

Biosphere across the world is under increasing pressure from man-made climate change and humanity's use of land for agriculture. While countries have agreed to limit climate change to less than 2°C in the 2015 Paris Agreement the success of climate protection is currently uncertain.



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With the Paris Agreement, the international community has committed to holding global warming below 2°C above preindustrial levels, yet current pledges by countries to reduce GHG emissions appear insufficient to achieve that goal. At the same time, the sustainable development goals strive to reduce inequalities between countries and provide sufficient food, feed, and clean energy to a growing world population likely to reach more than 9 billion by 2050. Taking the Paris Agreement into account, three outcomes for the 21st century can be imagined:

1. assuming a full success, global warming will be limited to well below 2°C above preindustrial,
2. emissions will be reduced, but not enough to limit global warming to 2°C,
3. in case of a widespread failure of the Paris Agreement emissions continue to rise unabated.

At the same time, continued population growth is causing demand for food and bioenergy to rise. Computer simulations were used to explore which ecosystems are at risk of major change due to climate change and land use by the end of the 21st century. It was found that climate change could transform between 16% and 65% of biosphere substantially, depending on how successful GHG emissions can be reduced. 11% to 25% of biosphere may experience severe impacts from land use, depending on how much land is needed for agriculture. In the worst case we studied, climate change and land use change risk transforming up to 80% of the land biosphere into a completely new state, putting many species at risk of extinction if they cannot adapt to their rapidly changing environment.

Given that global population and its food demand is still on the rise and considering the inertia of the climate system, pressure on the biosphere from land use change and climate change is likely to increase over the course of the 21st century even in the best of these three cases.

Continuous in climate change will drastically alter the biosphere, potentially transforming many ecosystems and threatening biodiversity. The extent of these changes depends on future GHG emissions and the effectiveness of mitigation efforts. Without significant reductions, up to 80% of the land biosphere could experience significant transformations. This includes shifts in species distribution, increased risk of extinction for many species, and potential disruptions to ecosystem services.

Intergovernmental Panel on Climate Change attempts to limit warming to below 2°C. Usually, these scenarios rely on bioenergy with carbon capture and storage to deliver a carbon sink in the order of magnitude the global ocean sink. As such, reducing one pressure on the biosphere may directly exacerbate the other and impacts on biosphere have been documented for every continent and major biome, quantifying them in a comprehensive, consistent and comparable manner across the globe for both past and future changes still pose methodological challenges.

The purpose is to support the common understanding of ecosystem research and anthropogenic impacts in the context of climate change, biodiversity loss and other stressors to ecosystems worldwide to accelerate transformations of society. The purpose of this discussion is to understand the impacts of global climate change on human health and how the world manages both mitigate and adapt of climatic changes on the biosphere.

Also, it is organized around the categories of human health consequences of global climate change such as asthma, respiratory allergies, air quality diseases, cancer, cardiovascular disease and stroke, food-, water-borne, vector- borne and zoonotic diseases, nutrition, weather and heat-related morbidity and mortality, human developmental impacts, mental health and stress-related disorders, neurological



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diseases and disorders, etc. These risks give early warnings and greater public awareness of population's health risk from global climate change, which should translate into more successful mitigation and adaptation strategies. For food security, human health and environmental safety, organic agriculture is a holistic concept of land and livestock management that pays particular attention to nature's boundaries and processes. Conventional chemical farming is costly, depletes soil fertility after overuse, and worsens environmental pollution- all of which put global food security at risk. This farming enhances environmental pollution due to the excessive use of chemical fertilizers and pesticides that cause a serious threat worldwide. Its continuous use in the soil is responsible for the loss of microbial diversity or microflora.

Under the climatic change and variations in the air quality which affect the productivity of the agriculture, the aim of the Workshop session of the 15th ICEEE-2024 issue is to enhance our understanding of how the organic food market operates.

A better understanding of the drivers and mechanisms of the organic food market is crucial to understand how different trends and policies will affect market actors (producers, consumers, traders, etc.) in future. To this end, the proposed session will cover all stages from production, trade, retail to consumption. It would include analyses on the economic modelling of organic production systems, the flow of goods within the organic agri-food system, the role of trade of organic food, demand preferences for organic food (also vs. conventional food), the estimation of demand systems, as well as the impact and scenario analyses of policies designed to expand the share of organic food. Instead of using synthetic pesticides or mineral nitrogen fertilizers, organic farmers apply a systemic approach targeted at maximizing nutrient recycling and resource efficiency, minimizing losses and prioritizing the use of on-farm and regional inputs and means of production.

The existing environmental problems in agriculture, such as climate change and loss of biodiversity, the question of environmental impacts caused by applications of agrochemicals to the agricultural soil have a great impact on the quality of food production and human health.

The climate change mitigation performance of organic farming is strongly influenced by geographical (soil, climate, exposure and slope) and management factors. Studies show that impacts of organic farming on the environment are less harmful than those from conventional farming. Furthermore, organic farming practices require fewer fossil resources and use them in a more sustainable way.

Today, human community need a coordinated global approach will bring the unique skills, capacities, and missions of the various agencies together to maximize the potential for discovery of new information and opportunities for success in providing key information to support responsive and effective decisions on climate change and health. This may allow new visions of sustainable soil use including new technologies and management practices based on the climatic changes (temperature, drought etc. stresses). Also, a further expansion of organic farming, it will be important to focus research on yield optimisation (quality and quantity) based on organic principles and by altering their relevance through changes in consumption. This may allow new visions of sustainable soil use including new technologies and management practices based on the climatic changes (temperature, drought etc. stresses).



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Against this backdrop, more recent efforts to link social protection outcomes more closely to climate change adaptation objectives in the globe, while promising, need to become more rooted in evidence of what determines success or failure. Challenges, which include chronic poverty and social inequalities that are hindering socio-economic programs, are worsened by the effects of climate change.

Rising temperatures, along with frequent droughts and floods, have a devastating impact on agriculture and livestock, and displace millions annually. Land degradation and water scarcity, often a result of unsustainable land use practices, are further limiting the resource base of farming and herder communities, and, in some instances, by the displacement of whole communities.

Volatile global food markets and pricing present further risks to local food security. The 2023 lean season was particularly severe, leaving over millions of people facing food insecurity. In this context, social protection plays a crucial role, often through community-based support systems. Such mechanisms work for small crises but may fail with recurring disasters, significant and long-term environmental degradation, and chronic poverty when resources across the community are severely eroded.

The global review and regional studies found that linking social protection instruments with climate-smart practices, such as climate risk analysis and land restoration, holds much potential for accelerated positive impacts.

Climate and environmental change, including land degradation, is sometimes referenced in national social welfare policies and in chapeau text of social protection programs in the biosphere, but associated risks are not usually explicitly considered in the design of the instruments used. For example, data on the expected impacts of climate change in specific locations, such as increased flood risk and associated damage to assets, or drought risk and related loss of livelihoods and income, is critical but can be hard to collect and make sense of for strategic and time-sensitive planning. Understanding better what type of data on climate-related vulnerability and exposure is required would be essential. In addition, information on the risks emerging from land degradation and the potential benefits from landscape restoration practices is a critical piece that is largely missing in assessments used as a basis for planning. Social protection interventions in the biosphere are often delivered against a backdrop of high levels of insecurity and socio-economic deprivation. In addition, the impacts of increasingly harmful environmental and climate change can be expected to further intensify pressures on existing social protection programs, even as limited resources mean that shock buffering through improved preparedness and humanitarian response becomes prioritized over long-term and social assistance and resilience-building programs.

Globally, less than half of the population is covered by one or more social protection benefits. Considering these facts, ambitious goals for global social protection may be unrealistic, and community-based approaches as well as programs anchored in broader local development strategies may be a good starting point for developing national systems. At the global level, this would respond directly to a recognized need to assess progress against individual Sustainable Development Goals, from poverty to climate action to life on land, in a connected manner, providing a basis for more cohesive planning.



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Social protection measures, though not specifically designed for long-term climate resilience, may nevertheless contribute to the strengthening of adaptation capacities and resilience to shocks. For this to happen, more research on what types of context-specific and pragmatic yet potentially transformative approaches can be developed, and what data systems must support them, is needed. Also, a further expansion of organic farming, it will be important to focus research on yield optimisation (quality and quantity) based on organic principles and by altering their relevance through changes in consumption.

Climate change has had an impact on human, physical, natural, and social capital, and these adverse effects have significantly influenced the financial capital of respondents. Climate change is intensifying cyclones, causing wind damage, coastal flooding, and erosion. This, combined with rising sea levels, adds to increasingly severe storm surges. Moreover, sea level rise, frequent flooding, and the intrusion of saline water into agricultural land have negatively impacted their agricultural livelihoods. However, understanding how coastal communities perceive climate change and its associated impacts is crucial for informing national discourse and the creation and execution of livelihood improvement plans.

Climate change, with its impact on agricultural production and natural resources has brought greater fluctuation in crop production, food supplies, and market prices and aggravated the situation of food insecurity and poverty. However, the capacity of communities to manage their livelihood and ecosystems against climate change depends on their experiences, knowledge, and perceptions of climate change-livelihood-coastal natural resource nexus.

There are knowledge gaps regarding the impact of climate change on regular weather phenomena (e.g., seasonal change) and biophysical (e.g., cyclone, flood, salinity, leaf fall) features, thus associated livelihood assets and resources. For instance, how coastal people experience the impacts of climate-induced disasters on livelihood capitals from their long experiences of working and living on the coast, is a site-specific study. There is an increasing concern that peasants in the least developed and developing countries are the most severely affected by the impact of climate change and the agriculture sector is at high risk.

Rapid economic and population growth over the last centuries have started to push the Earth out of its Holocene state into the Anthropocene. In this new era, ecosystems across the globe face mounting dual pressure from human land use change (LUC) and climate change.

Biosphere across the world is under increasing pressure from man-made climate change and humanity's use of soil for agriculture. While countries have agreed to limit climate change to less than 2°C in the 2015 Paris Agreement the success of climate protection is currently uncertain. At the same time, continued population growth is causing demand for food and bioenergy to rise.

Computer was used for the simulations to explore which ecosystems are at risk of major change due to climate change and land use by the end of the 21st century. It was found that climate change could transform between 16% and 65% of all ecosystems worldwide substantially, depending on how successful GHG emissions can be reduced. 11% to 25% of ecosystems may experience severe impacts from soil use, depending on how much soil is needed for agriculture. In the worst case it was studied, climate change and soil use change risk transforming up to 80% of the soil on biosphere into a



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completely new state, putting many species at risk of extinction if they cannot adapt to their rapidly changing environment [2].

Given that global population and its food demand is still on the rise and considering the inertia of the climate system, pressure on the biosphere from land use change (LUC) and climate change is likely to increase over the course of the 21st century even in the best of these three cases. Furthermore, as pointed out by Rockström et al. [3], negative GHG emissions are a key requirement of most recent scenarios assessed by the Intergovernmental Panel on Climate Change (IPCC) that attempt to limit warming to below 2°C (IPCC, [4]). Usually, these scenarios rely on bioenergy with carbon capture and storage (BECCS) to deliver a carbon sink in the order of magnitude of the global ocean sink [3]. As such, reducing one pressure on the biosphere may directly exacerbate the other (LUC). Although impacts of climate change and LUC on ecosystems have been documented for every continent and major biome, quantifying them in a comprehensive, consistent and comparable manner across the globe for both past and future changes still pose methodological challenges.

CLIMATE CHANGE IMPACTS

It is increasingly likely that the next century will be characterized by shifts in global weather patterns and climate regimes, according to current climate predictions which although containing wide latitudes of potential outcome, are all pointing the same way:

- Changes in weather patterns
- Increases in mean temperatures
- Changes in patterns of precipitation
- Increasing incidence of extreme climatic events
- Increasing sea level

These changes are likely to be sudden and unpredictable as to timing and intensity. However, even if immediate, concerted, and decisive action is taken, dramatic and significant changes are inevitable in the next 20–30 years. The ecological consequences of such changes are increasingly discussed in the literature (e.g., Hulme [5]; King [6]). There is mounting evidence that the impacts of climate change on plant and animal species and ecosystems can already be detected [7,8]. Even without the predicted changes in climate over 50 years, the direct impacts of increasing CO₂ concentrations in the atmosphere would themselves have important implications for restoration practices. Although future climate change scenarios vary in intensity of impact, such as change in mean annual temperatures and changes in patterns of precipitation. There is the hazard of becoming more comfortable with serving as active agents in ecosystems to the extent where historical fidelity is almost entirely abandoned. It is one matter to watch change happen in ecosystems and wonder how and how much to intervene, and quite another to become a determining agent in that change.

At present, there is a clarification call for action on climate change across the global health landscape. Over the last decades, a consensus among researchers from very diverse disciplines has been emerging



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about the future of our planet and our society and provides a grim picture of how global warming will affect the biosphere in multiple ways and across scales [9].

Regional, continental and planetary-scale changes are taking place at an accelerated pace. GHGs are the most obvious example of such a trend, with CO₂ displaying a fast increase that has no equivalent over the past 500 Myr. This rise is a consequence of industrialization and parallel population growth, particularly in urban areas (Figure 3).

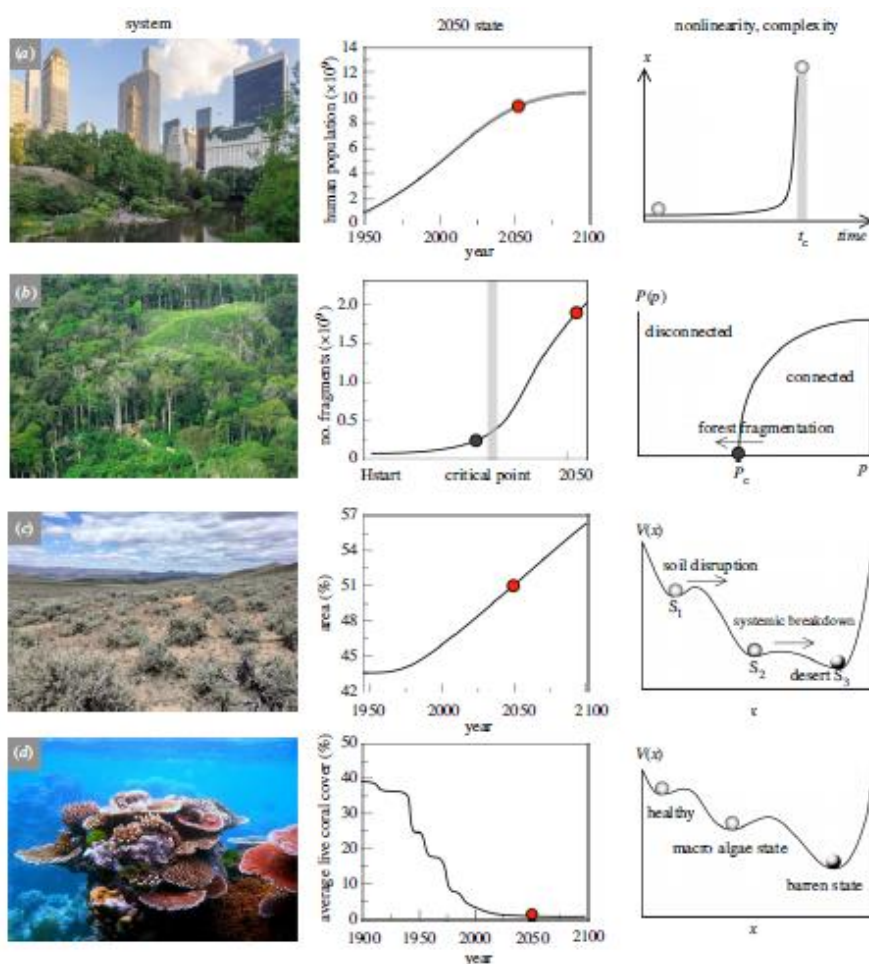


Figure 3. Ecological complexity challenges for 2050. (Source: [10])

Description of Figure 3.:

With the rise of global temperatures, population growth and the resulting pressure on resources and habitats, biodiversity will face major threats. One crucial role of science is to develop reliable predictions of future trends. Here, 4 examples are chosen (left) along with current forecasts (central



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column, estimated 2050 states indicated with a red circle) and examples of the complex ecosystems approaches used (right).

- a) Urban centres (image of Central Park, New York, by Ajay Suresh, Creative Commons) are rapidly expanding as massive migrations occur towards cities. Human population growth (centre) is slowly decelerating, but two extra billion humans will be added to the current numbers, reaching 9.7 billion by 2050. The current trend is a consequence of the nonlinearities associated with hyperbolic dynamics, which predicts a singularity at a given finite time t_c (right).
- b) Rainforests (left image by Gleilson Miranda, Creative Commons) are experiencing rapid loss and fragmentation of their habitats, with predicted critical points (centre plot, grey bar) to be reached in a few decades. These critical points correspond to percolation thresholds (right panel).
- c) Drylands (image courtesy of David Huber) are expanding and will grow from the current 40% to more than 50% in just 3 decades. Models of drylands involving vegetation cover as a key variable predict sharp transitions between alternative states, connected through 3 different shifts. Here 2 of them are indicated.
- d) Marine ecosystems, and coral reefs (left image by Toby Hudson, Creative Commons) in particular, are being affected by warming ocean temperatures, eutrophication, pathogens and overfishing. Reef cover is rapidly shrinking and might experience massive decays in the next decades. Here, the previous and predicted time series of coral reef cover in Hawaii is shown (centre, data from https://19january2017snapshot.epa.gov/cira/climate-action-benefits-coral-reefs_.html). Multiple alternative states have been identified (right) with different sources of stress causing jumps from one state to another.

By 2050, 70% of humankind will live in cities. Despite the deceleration of this process (largely due to reduced fertility rates and changes in women's status), the predicted expansion gives a staggering 9.7 billion people. The ultimate reason for this explosive growth must be found in the mathematics of population dynamics. The historical record of modelling in climate science and conservation studies started long ago. In many cases, predicted outcomes were tied to theory (either mathematical or computational) that would help quantify future scenarios of change, decay and recovery. A common goal (and a nontrivial problem) in all these approaches is prediction. The understanding of climate change as a global hazard is complex and multifaceted, presenting substantial challenges to societies in the biosphere. While its universal impacts are undeniable, perceptions of climate change as an immediate risk vary significantly across cultures, geographies, and knowledge systems. To examine the link between climate change perceptions and environmental behaviour, respondents' self-reported ecofriendly practices were analyzed. These practices included recycling waste, use of public transport, water conservation, electricity saving, tree planting, and participation in environmental campaigns. Global warming, habitat loss and overexploitation of limited resources are leading to alarming biodiversity declines. Ecosystems are complex adaptive systems that display multiple alternative states and can shift from one to another in abrupt ways. Global warming, habitat loss and overexploitation of limited resources are leading to alarming biodiversity declines.



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Ecosystems are complex adaptive systems that display multiple alternative states and can shift from one to another in abrupt ways. Moreover, multiple scales are involved, and potential mitigation or intervention scenarios are tied to levels of complexity, from cells to human–environment coupled systems. In dealing with a biosphere where humans are part of a complex, endangered ecological network, novel theoretical and engineering approaches need to be considered. At the centre of most research efforts is biodiversity, which is essential to maintain community resilience and ecosystem services.

Climate change perceptions are shaped by the interplay between formal knowledge and lived experiences of direct environmental impacts. Environmental change poses a serious threat to well established frameworks of the ecosystem, while the increase in the average temperature of the Earth’s atmosphere, known as global warming, is a primary driver of these ecological disruptions.

In 2017, human-caused warming increased by around 1°C (probably between 0.8°C and 1.2°C) over pre-industrial levels, with an increase of 0.2°C (probably between 0.1°C and 0.3°C) per ten years [11]. Increases in temperature affects the biophysical relationships with crops, farmed animals, fisheries, and timberlands. These relationships may include reduced crop growing seasons, modified species relationships, increased susceptibility to heat and moisture stress, altered water requirements, altered soil characteristics, and increased risk of disease outbreak [12, 13].

Changes in the frequency and intensity of drought and floods could be a threat to food security. Over the past 10 years, scientists have shown that rising temperature will likely make these dry seasons much worse, reducing water supplies and, in certain cases, it can lead to wildfires [14]. All features of the environment are affected by climate changes.

For instance, ecological alteration causes temperatures to rise on certain parts of the planet [15]. This results in a decrease in temperature during colder months. The production of plants and animals is directly affected by variations in weather conditions, such as temperature, precipitation, and by the frequency and severity of extreme occurrences, such as droughts, floods, and storms [16]. Therefore, it is imperative to address the threat and effects of climate change, as they have a significant impact on crop productivity and production.

Feeding the world’s 9 billion people by 2050 will need a roughly 70% rise in food production. In the next 50 years, every hectare of cereals must feed twice as many people as it does now to prevent malnutrition. The development of stress-tolerant plants and increased crop productivity are necessary to meet food demands in the face of several challenges, such as growing global population, a decline in arable land area or a lack of agriculture, resource constraints, and climate change. While new farming methods and agronomic practices, like breeding high-yield staple crops, intercropping, and improved fertilizers, pesticides, water, and nutrition supplies, have increased grain yields to some extent, they are still insufficient to meet the increasing demand of the population [17].

The primary source of carbon and energy needed to produce the organic compounds for plant growth and development is photosynthesis. Increasing the amount of CO₂ assimilated by photosynthesis per leaf or land area could be the best approach to increase agricultural productivity. In the upcoming decades, the growing population of the world and the uncertainties surrounding climate change will necessitate higher photosynthetic efficiency to ensure food security [18]. The photosynthesis process,



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in which green plants, algae, and cyanobacteria convert radiant energy into chemical energy is essential to the survival of life on Earth. The primary factors influencing this process are temperature, water, CO₂, and sun radiation.

CLIMATE CHANGE AND ITS IMPACT ON AGRICULTURE

The agriculture industry is particularly vulnerable to climate change because of its vast scope and sensitivity to weather patterns, which will have a big effect on the economy. Variations in meteorological events, such as temperature and rainfall, are the key factors affecting crop productivity (Table 1). Although rising temperatures have been shown to reduce yields, increased precipitation is probably going to offset or mitigate these impacts. Crop production is affected by several factors, including crop type, capacity for crop adaptability, climate, and the effects of CO₂ fertilization [19]. It is established that a decrease in precipitation or an increase in temperature significantly lowers farmers' net income. In addition, the prevalence of illness and insect pests is higher in humid and warmer regions. Other variables including humidity, wind speed, temperature, and rainfall all have an impact on crop yields. With a 0.3% yearly loss of projected global gross domestic product by 2100, crop yield decreases have the potential to drive up food costs and have a major influence on agricultural welfare globally [20].

Plant-water interactions are significantly affected by fluctuations in temperature and precipitation, and rapid changes in these variables are more likely to have an impact on physiological changes than variations in the average climate. The way that different plant species and developmental stages react to climate change is evident. The adverse impacts of climate change factors viz. global warming, increased CO₂, extreme weather, and high rainfall intensity lead to soil erosion, nutrient loss, reduced photosynthesis, increased pests and diseases, and lower crop yields, ultimately threatening food security and sustainability. Different plant species have distinct thresholds, and different plant species respond differently to these thresholds. These responses can include root elongation, perturbation of the root's growth angle, and yield loss [21].

Climate changes also have an impact on the microbial population and enzymatic activity of the soil. In a temperature gradient tunnel with a 4–5°C higher temperature than in outdoor conditions, it was discovered that the microbial population was significantly greater. The population of nitrogen-fixing and P-solubilizers bacteria and fungus, as well as enzymatic activity, were considerably increased under a wide range of temperatures, even though the highest microbial population was seen on or around the ideal temperature. On the other hand, the growth of endophytic fungi and bacteria that support plant growth might have affected according to temperature range [22].

The primary GHG in the atmosphere is CO₂, which is produced by 65% of industrial processes and fossil fuels, 11% by forestry, and the remaining 2% by fluorinated gases, 6% by nitrous oxide, and 16% by methane.

The rising temperature of the atmosphere is influenced by the rising levels of GHGs. These infrared active gases (CO₂, ozone (O₃), and water vapour (H₂O)) absorb thermal radiations emitted by the



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earth's surface and atmosphere, raising the planet's temperature. The average global temperature has risen dramatically from the base period's average. The global average temperature has increased by 1.1 to 1.2°C since 1850 [23]. It's expected that in the foreseeable future, climate change will worsen. The average maximum temperature and average lowest temperature in the rainy season are predicted to rise by 1–3 °C and 2–3 °C, respectively, based on models carried out over the forthcoming mid-century (2040–2069). In contrast, the average temperature in winter season is anticipated to increase by 2.1–3.5°C. Furthermore, estimations of the changes in rainfall in the areas have been produced; the rainfall varies most during the rainy season (25–35%) and least during the winter [24].

CLIMATE CHANGE AND INFECTIOUS DISEASE

Recently, WHO-sponsored conference on health and climate (Geneva, Switzerland, 2014) and the UN Climate Summit (New York, USA, [29]), and participants were encouraged to act decisively to change the current trajectory of climate disruption [30]

Health inequalities, including those related to infectious diseases, have now been pushed to the centre stage. This approach represents a step-change in thinking. But as we are urged toward collective action [31] is it time to rethink our approach to research, especially in relation to climate change and infectious disease?

For a long time, climate change has been the proverbial unwanted guest at the global health table. Causal relations remain elusive to many researchers, even for infectious diseases with clear climate effects such as vector-borne, arboviral, and parasitic disease [32].

An equally prevalent view was that climate change was the crucial game changer in terms of our understanding of infectious disease. Part of the problem is that much of the early research into climate change and infectious disease focused on proving how “coupled” or “decoupled” diseases are with climate effects [33]. Thus, climate change was often viewed as a unique and discreet driver of disease. Unsurprisingly, this conceptualisation forged an evidence base that is both highly specific and often polarised. Yet climate change is clearly an embedded context in which changes to the susceptibility and infectiousness of human and animal diseases—and thereby their emergence or transmission—occur.

It is known that climate change has direct and indirect effects on a range of diseases. Furthermore, climate disruption is likely to have multiplier effects between both diseases and drivers. Finally, climate warming could potentially forge a cascade of both biotic and abiotic events or factors leading to disease emergence and re-emergence. Such a cumulative or cascade effect could clearly set the scene for collective disease events in global health. These notions are not entirely new. In 1999, the International Red Cross predicted that climate change and poverty would trigger a decade of so-called super disasters, including disease epidemics [34]

More than 2 decades later, extreme weather events have caused a range of humanitarian crises. Although a cumulative or multiplier effect merging such events into a single super-disaster has not come to pass, the increasing frequency of these events raises the threat of such an occurrence. Similarly, the emergence of a range of global pandemics or panzootics from severe acute respiratory syndrome to



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highly pathogenic avian influenza enables us to envision the potential effects on health services of multiple emerging infectious disease events. From the outset, the identification of the forces behind such potential multiple disease events is likely to demand a deeper understanding of the interrelationships and synergies between the myriads of factors important to change within the context of both human and animal health. Clearly in the context of multiple emerging infectious disease events, the additive effects of climate on a range of other drivers are what matters.

The recognition of key gaps in our knowledge has led to a call for trans-disciplinary inquiries across global health [35]. However, such an approach is necessary, it is unlikely to be sufficient. Rather, to explore climate change as an embedded context demands that we explicate the synergies and interrelations between drivers, between diseases, and between both drivers and diseases. Ascertainment of the scope and direction of these interactions is an essential first step towards better elucidating the effect of climate change on infectious disease.

Therefore, perhaps it is time for a new "normal" in global health that views the human, wildlife, and livestock disease burden in any given geographical area as greater than the sum of its parts. In this approach, understanding the absence of a disease might be as important as identifying the specific factors driving disease emergence and transmission. Explorations of the collective disease burden across species might better explain the role and interaction of climate than the current focus on specific drivers and individual diseases. In this approach, assessments of risk, vulnerabilities, and interactions across these collective versus absent disease states could begin to forge a wider understanding of the role and effect (both present and future) of climate change on disease [36].

To ascribe to such a wider framework is likely to only enhance, rather than limit, our understanding of the dynamics of infectious disease and climate change. Such an approach can certainly work in tandem with the recommendations from global conferences, meetings, and researchers. However, the creation of this new episteme will depend on our inherent flexibility to reach beyond existing constructs and explore absences in addition to emergences and synergies, and the direct drivers of infectious disease. The future is in our hands; is it time to forge a new normal?

CLIMATE CHANGE AND INFECTIOUS DISEASES

Previously, it was considered how short-term variations in climatic conditions and extreme weather events can exert direct effects on human death rates, physical injury, mental health and other health outcomes. Changes in mean climatic conditions and climate variability can affect human health via indirect pathways, via changes in biological and ecological processes that influence infectious disease transmission and food yields.

For centuries humans have known that climatic conditions affect epidemic infections—since well before the basic notion of infectious agents was understood late in the 19th century. The Roman aristocracy took refuge in their hill resorts each summer to avoid malaria. South Asians learnt early that in high summer, strongly curried foods were less prone to induce diarrhoeal diseases. In the southern United States one of the most severe summertime outbreaks of yellow fever (viral disease transmitted



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by the *Aedes aegypti* mosquito) occurred in 1878, during one of the strongest El Niño episodes on record. The economic and human cost was enormous, with an estimated death toll of around 20 000 people. In developed countries today it is well known that recurrent influenza epidemics occur in mid-winter. Infectious disease transmission should be viewed within an ecological framework. Infectious agents obtain the necessary nutrients and energy by parasitization of higher organisms. Most such infections are benign, and some are even beneficial to both host and microbe. Only a minority of infections that adversely affect the host's biology are termed “infectious disease”.

During the long processes of human cultural evolution; population dispersal around the world; and subsequent inter-population contact and conflict; several distinct transitions in human ecology and inter-population interactions have changed profoundly the patterns of infectious disease in human populations. Since the early emergence of agriculture and livestock herding around 10 000 years ago, three great transitions in human/microbe relationships are readily recognizable [37]:

1. Early human settlements enabled enzootic infective species to enter *H. sapiens*.
2. Early Eurasian civilizations came into military and commercial contact around 2000 years ago, swapping dominant infections.
3. European expansionism over past five centuries caused transoceanic spread of often lethal infectious diseases.

This may be the fourth great transitional period. The spread and increased lability of various infectious diseases, new and old, reflects the impacts of demographic, environmental, technological and other rapid changes in human ecology. Climate change, one of the global environmental changes now under way, is anticipated to have a wide range of impacts upon the occurrence of infectious disease in human populations.

Disease classification

Broadly, infectious diseases may be classified into two categories based on the mode of transmission: those spread directly from person to person (through direct contact or droplet exposure) and those spread indirectly through an intervening vector organism (mosquito or tick) or a non-biological physical vehicle (soil or water). Infectious diseases also may be classified by their natural reservoir as anthroponoses (human reservoir) or zoonoses (animal reservoir).

Climate sensitivities of infectious diseases

Both the infectious agent (protozoa, bacteria, viruses, etc) and the associated vector organism (mosquitoes, ticks, sandflies, etc.) are very small and devoid of thermostatic mechanisms. Their temperature and fluid levels are therefore determined directly by the local climate. Hence, there is a limited range of climatic conditions within which each infective or vector species can survive and reproduce. It is particularly notable that the incubation time of a vector-borne infective agent within its vector organism is typically very sensitive to changes in temperature, usually displaying an exponential relationship. Other climatic sensitivities for the agent, vector and host include level of precipitation, sea level elevation, wind and duration of sunlight.



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CLIMATE/INFECTIOUS DISEASE LINKAGES

The seasonal patterns and climatic sensitivities of many infectious diseases are well known; the important contemporary concern is the extent to which changes in disease patterns will occur under the conditions of global climate change. Over the past decade or so this question has stimulated research into 3 concentrations:

1. Can the recent past reveal more about how climatic variations or trends affect the occurrence of infectious diseases?
2. Is there any evidence that infectious diseases have changed their prevalence in ways that are reasonably attributable to climate change?
3. Can existing knowledge and theory be used to construct predictive models capable of estimating how future scenarios of different climatic conditions will affect the transmissibility of infectious diseases?

Modifying influences

Climate is one of several important factors influencing the incidence of infectious diseases. Other important considerations include sociodemographic influences such as human migration and transportation; and drug resistance and nutrition; as well as environmental influences such as deforestation; agricultural development; water projects; and urbanization. In this era of global development and land-use changes, it is highly unlikely that climatic changes exert an isolated effect on disease; rather the effect is likely dependent on the extent to which humans cope with or counter the trends of other disease modifying influences. While recognizing the important role independent of these non-climatic factors, the focus of this section is to examine the extent to which they may compound the effects of climatic conditions on disease outcomes.

Disease classifications relevant to climate/health relationships

Several different schemes allow specialists to classify infectious diseases. For clinicians who are concerned with treatment of infected patients, the clinical manifestation of the disease is of primary importance. Alternatively, microbiologists tend to classify infectious diseases by defining characteristics of microorganisms, such as viruses or bacteria. For epidemiologists the two characteristics of foremost importance are the method of transmission of the pathogen and its natural reservoir, since they are concerned primarily with controlling the spread of disease and preventing future outbreaks [38].

Climate variability's effect on infectious diseases is determined largely by the unique transmission cycle of each pathogen. Transmission cycles that require a vector or non-human host are more susceptible to external environmental influences than those diseases which include only the pathogen and human. Important environmental factors include temperature, precipitation and humidity (discussed in more detail in the following section). Several possible transmission components include pathogen (viral, bacterial, etc.), vector (mosquito, snail, etc.), non-biological physical vehicle (water, soil, etc.), non-human reservoir (mice, deer, etc.) and human host. Epidemiologists classify infectious diseases broadly



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as anthroponoses or zoonoses, depending on the natural reservoir of the pathogen; direct or indirect, depending on the mode of transmission of the pathogen. Figure 4 illustrates these four main types of transmission cycles for infectious diseases. The following is a description of each category of disease, discussed in order of probable increasing susceptibility to climatic factors [39].

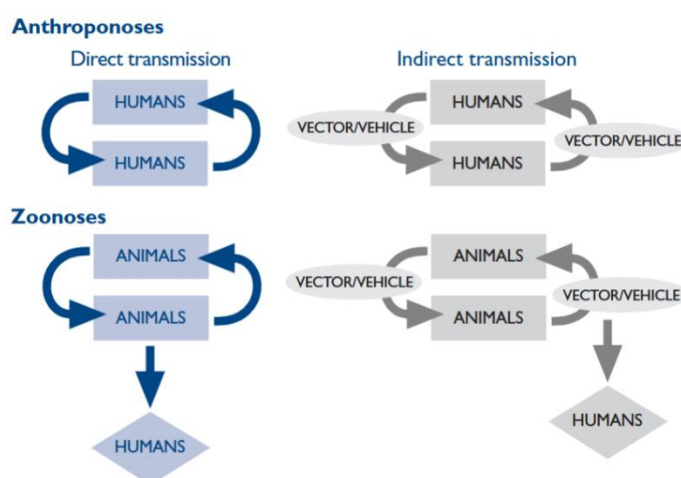


FIGURE 4. Four main types of transmission cycle for infectious diseases.
Source: reproduced from reference [39].

Directly transmitted diseases

Anthroponoses

Directly transmitted anthroponoses include diseases in which the pathogen normally is transmitted directly between two human hosts through physical contact or droplet exposure. The transmission cycle of these diseases comprises two elements: pathogen and human host. Generally, these diseases are least likely to be influenced by climatic factors since the agent spends little to no time outside the human host. These diseases are susceptible to changes in human behaviour, such as crowding and inadequate sanitation that may result from altered land-use caused by climatic changes. Examples of directly transmitted anthroponoses include measles, TB, and sexually transmitted infections such as HIV, herpes and syphilis [39].

Zoonoses

Directly transmitted zoonoses are like directly transmitted anthroponoses in that the pathogen is transmitted through physical contact or droplet exposure between reservoirs. However, these agents are spread naturally among animal reservoirs, and the infection of humans is a result of an accidental human encounter. The persistence of these pathogens in nature is largely dependent on the interaction of the animal reservoir and external environment which can impact the rate of transmission, host immunity, rate of reproduction, and species death, rendering these diseases more susceptible to effects of climate variability. Hantavirus is a directly transmitted zoonosis that is naturally maintained in



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rodent reservoirs and can be transmitted to humans at times of increased local abundance of the reservoir [40].

Rabies is another directly transmitted zoonosis that naturally infects small mammals, although with very little opportunity for widespread transmission, being highly pathogenic to its vertebrate host [39]. Several of today's anthropogenic diseases, e.g. TB and HIV, originally emerged from animals.

Indirectly transmitted diseases (anthroponoses & zoonoses)

Indirectly transmitted anthroponoses are a class of diseases defined by pathogen transmission between two human hosts by either a physical vehicle (soil) or a biological vector (tick). These diseases require three components for a complete transmission cycle: the pathogen, the physical vehicle or biological vector, and the human host. Most vectors require a blood meal from the vertebrate host to sustain life and reproduce. Indirectly transmitted anthroponoses include malaria and dengue fever, whereby the respective malaria parasite and the dengue virus are transmitted between human hosts by mosquito vectors (vector-borne disease). Indirectly transmitted water-borne anthroponoses are susceptible to climatic factors because the pathogens exist in the external environment during part of their life cycles. Flooding may result in contamination of water supplies, or the reproduction rate of the pathogen may be influenced by ambient air temperatures [39]. Cholera is an indirectly transmitted water-borne anthroponose that is transmitted by a water vehicle: the bacteria (*Vibrio cholerae*) reside in marine ecosystems by attaching to zooplankton. Survival of these small crustaceans in turn depends on the abundance of their food supply, phytoplankton. Phytoplankton populations tend to increase (bloom) when ocean temperatures are warm. As a result of these ecological relationships, cholera outbreaks occur when ocean surface temperatures rise [40].

Indirectly transmitted zoonoses are like indirectly transmitted anthroponoses except that the natural cycle of transmission occurs between nonhuman vertebrates: humans are infected due to accidental encounters with an infected vehicle or vector. This class of disease involves four components in the transmission cycle: the pathogen, biological vector or physical vehicle, animal reservoir, and human host. These diseases are highly susceptible to a combination of ecological and climatic factors because of the numerous components in the transmission cycle, and the interaction of each of these with the external environment [39].

Complex cycles of disease transmission also exist for several diseases which cannot be classified simply by method of transmission or natural reservoir. Such a disease is Rift Valley fever where the virus is primarily a zoonotic disease, spread among vertebrate hosts by the mosquito species *Aedes*. Primarily under flood conditions, *Culex* mosquitoes may feed upon infected ungulate hosts. This vector is referred to as a bridge species because it feeds on humans also, resulting in spread of the virus outside its normal zoonotic cycle [39].

Climate sensitivity of infectious disease

Seasonality of infectious disease

Here, a discussion patterns of winter mortality and infectious disease using the example of cyclic influenza outbreaks occurring in the late fall, winter and early spring in North America. This disease



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pattern may result from increased likelihood of transmission due to indirect social or behavioural adaptations to the cold weather such as crowding indoors. Another possibility is that it may be attributed directly to pathogen sensitivities to climatic factors such as humidity. In addition to influenza, several other infectious diseases exhibit cyclic seasonal patterns, which may be explained by climate.

In diverse regions around the world, enteric diseases show evidence of significant seasonal fluctuations. In Scotland, campylobacter infections are characterized by short peaks in the spring [41]. In Bangladesh, cholera outbreaks occur during the monsoon season [40]. In Peru, cyclospora infections peak in the summer and subside in the winter [42]. Similarly, some vector-borne diseases (e.g. malaria and dengue fever) also show significant seasonal patterns whereby transmission is highest in the months of heavy rainfall and humidity. Epidemics of other infections (e.g. meningococcal meningitis) tend to erupt during the hot and dry season and subside soon after the beginning of the rainy season in sub-Saharan Africa [43]. Seasonal fluctuations of infectious disease occurrence imply an association with climatic factors. However, to prove a causal link to climate, non-climatic factors must be considered. Furthermore, to assess long-term climate influences on disease trends, data must span numerous seasons and utilize proper statistics to account for seasonal fluctuations.

Vector-borne diseases

Important properties in the transmission of vector-borne diseases include:

- survival and reproduction rate of the vector
- time of year and level of vector activity, specifically the biting rate
- rate of development and reproduction of the pathogen within the vector [44].

Vectors, pathogens, and hosts each survive and reproduce within certain optimal climatic conditions and changes in these conditions can modify greatly these properties of disease transmission. The most influential climatic factors for vector-borne diseases include temperature and precipitation but sea level elevation, wind, and daylight duration are additional important considerations. Table (1) gives an overview of the impact of climatic change on each biological component of both vector and rodent-borne diseases. The following paragraphs discuss several of these effects in greater detail.

Table 1. Effects of weather and climate on vector and rodent-borne diseases

Vector-borne pathogens spend part of their life cycle in cold-blooded arthropods that are subject to many environmental factors. Changes in weather and climate that can affect transmission of vector-borne diseases include temperature, rainfall, wind, extreme flooding or drought, and sea level rise. Rodent-borne pathogens can be affected indirectly by ecological determinants of food sources affecting rodent population size, floods can displace and lead them to seek food and refuge.

Temperature effects on selected vectors and vector-borne pathogens

Vector

- survival can decrease or increase depending on species.
- some vectors have higher survival at higher latitudes and altitudes with higher temperatures.



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- changes in the susceptibility of vectors to some pathogens e.g. higher temperatures reduce size of some vectors but reduce activity of others.
- changes in the rate of vector population growth.
- changes in feeding rate and host contact (may alter survival rate);
- changes in seasonality of populations.

Pathogen

- decreased extrinsic incubation period of pathogen in vector at higher temperatures
- changes in transmission season
- changes in distribution
- decreased viral replication.

Effects of changes in precipitation on selected vector-borne pathogens

Vector

- increased rain may increase larval habitat and vector population size by creating new habitat
- excess rain or snowpack can eliminate habitat by flooding, decreasing vector population
- low rainfall can create habitat by causing rivers to dry into pools (dry season malaria)
- decreased rain can increase container-breeding mosquitoes by forcing increased water storage
- epic rainfall events can synchronize vector host-seeking and virus transmission
- increased humidity increases vector survival; decreased humidity decreases vector survival.

Pathogen

Few direct effects but some data on humidity effects on malarial parasite development in the anopheline mosquito host.

Vertebrate host

- increased rain can increase vegetation, food availability, and population size
- increased rain can cause flooding decreases population size but increases human contact

Increased sea level effects on selected vector-borne pathogens

Alters estuary flow and changes existing salt marshes and associated mosquito species, decreasing or eliminating selected mosquito breeding-sites (e.g. reduced habitat for *Culiseta melanura*) grounds. In addition, increased precipitation may support a growth in food supplies which in turn support a greater population of vertebrate reservoirs. Unseasonable heavy rainfalls may cause flooding and decrease vector populations by eliminating larval habitats and creating unsuitable environments for vertebrate reservoirs. Alternatively, flooding may force insect or rodent vectors to seek refuge in houses and increase the likelihood of vector-human contact. Epidemics of leptospirosis, a rodent-borne disease, have been documented following severe

Temperature sensitivity

Extreme temperatures often are lethal to the survival of disease-causing pathogens but incremental changes in temperature may exert varying effects. Where a vector lives in an environment where the mean temperature approaches the limit of physiological tolerance for the pathogen, a small increase in temperature may be lethal to the pathogen. Alternatively, where a vector lives in an environment of low mean temperature, a small increase in temperature may result in increased development, incubation and replication of the pathogen [48,49]. Temperature may modify the growth of disease carrying vectors by altering their biting rates, as well as affect vector population dynamics and alter the rate at



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which they meet humans. Finally, a shift in temperature regime can alter the length of the transmission season [50].

Disease carrying vectors may adapt to changes in temperature by changing geographical distribution. An emergence of malaria in the cooler climates of the African highlands may be a result of the mosquito vector shifting habitats to cope with increased ambient air temperatures [51]. Another possibility is that vectors undergo an evolutionary response to adapt to increasing temperatures. There is recent evidence to suggest that the pitcher-plant mosquito (*Wyeomia smithii*) can adapt genetically to survive the longer growing seasons associated with climate change. Bradshaw and Holzapfel demonstrated this by documenting a change in the photoperiodic response between two different time periods in two populations of pitcher-plant mosquitoes. The change in response was correlated to a marked genetic shift within the mosquito species. More microevolutionary response was associated with mosquito populations inhabiting higher latitudes; the hypothesis is that because these populations have greater selection pressure, they have also a greater ability to evolve genetically. Although this study was limited to one specific species of mosquito, it suggests that other mosquitoes, perhaps disease carrying vectors, may undergo an analogous microevolution which would allow adaptation to altered seasonal patterns associated with global climate change [52].

Precipitation sensitivity

Variability in precipitation may have direct consequences on infectious disease outbreaks. Increased precipitation may increase the presence of disease vectors by expanding the size of existent larval habitat and creating new breeding flooding in Brazil [53]. In the wet tropics unseasonable drought can cause rivers to slow, creating more stagnant pools that are ideal vector breeding habitats.

Humidity sensitivity

Humidity can greatly influence transmission of vector-borne diseases, particularly for insect vectors. Mosquitoes and ticks can desiccate easily, and survival decreases under dry conditions. Saturation deficit (like relative humidity) has been found to be one of the most critical determinants in climate/disease models, for example, dengue fever [54,55] and Lyme disease models [56].

Sea level sensitivity

The projected rise in sea level associated with climate change is likely to decrease or eliminate breeding habitats for salt-marsh mosquitoes. Bird and mammalian hosts that occupy this ecological niche may be threatened by extinction, which would also aid the elimination of viral endemic to this habitat (19). Alternatively, inland intrusion of salt water may turn former freshwater habitats into salt-marsh areas which could support vector and host species displaced from former salt-marsh habitats [57].

Water-borne diseases

Human exposure to water-borne infections can occur because of contact with contaminated drinking water, recreational water, coastal water, or food. Exposure may be a consequence of human processes



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(improper disposal of sewage wastes) or weather events. Rainfall patterns can influence the transport and dissemination of infectious agents while temperature can affect their growth and survival [58].

Temperature sensitivity

Increasing temperatures may lengthen the seasonality or alter the geographical distribution of water-borne diseases. In the marine environment, warm temperatures create favourable conditions for red tides (blooms of toxic algae) which can increase the incidence of shellfish poisoning [59]. Increasing sea surface temperatures can indirectly influence the viability of enteric pathogens such as *Vibrio cholerae* by increasing their reservoir's food supply. Ambient air temperatures also have been linked to hospital admissions of Peruvian children with diarrhoeal disease [60].

Precipitation sensitivity

Heavy rains can contaminate watersheds by transporting human and animal faecal products and other wastes in the groundwater. Evidence of water contamination following heavy rains has been documented for cryptosporidium, giardia, and *E. coli* [61]. This type of event may be increased in conditions of high soil saturation due to more efficient microbial transport [60]. At the other extreme, water shortages in developing countries have been associated with increases in diarrhoeal disease outbreaks that are likely attributed to improper hygiene [62].

CLIMATE AND INFECTIOUS DISEASE LINKS

Research investigating possible links between temporal and spatial variation of climate and the transmission of infectious diseases can be categorized into one of three conceptual areas:

1. evidence for associations between short-term climate variability and infectious disease occurrence in the recent past.
2. evidence for long-term trends of climate change and infectious disease prevalence.
3. evidence from climate and infectious disease linkages used to create predictive models for estimating the future burden of infectious disease under projected climatic conditions.

MODIFYING INFLUENCES

Climate is one of several factors that can influence the spread of infectious disease. Human activities and behaviours also are critical determinants of disease transmission. Sociodemographic factors include (but are not limited to): increasing trends in travel, trade, and migration; erratic disease control efforts; emerging drug or pesticide resistance; and inadequate nutrition. Environmental influences include changes in land-use, such as the clearing of forested land, agricultural development and water projects, urban sprawl; as well as ecological influences. These sociodemographic and environmental influences



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may act in synergy or antagonistically with climatic factors, exacerbating or lessening the impact on infectious disease transmission of either factor acting independently.

Preventing new diseases by tackling Climate Change

Climate change and its effects

The damages mankind inflicted in nature, be it by over exploitation of resources, burn of fossil fuels, deforestation, an increase in industrial activity, lead to an unbalance in the environment where the concentration of GHGs in the atmosphere rose well above the natural level on the planet causing a global warming, which is the main driver of climate change.

The topic has been one of the topics that has been growing in discussion and attention since 1972, with the Conference of Stockholm., and more so with the Kyoto Protocol, the Paris Agreement and recent youth protests for effective actions by governments worldwide. In 2020, the focus changed when a pandemic hit the world and forced countries to look at themselves in an individual manner, so they could fight this new disease, putting aside major climate talks and conferences.

The coronavirus pandemic forced a major lockdown and isolation worldwide, slowing down economies all around the world, but that does not mean that climate change has also slowed down. There is still and ongoing investigation to determine the source of the virus, conducted by international organizations and experts. Some studies are researching if there is a correlation between climate change and the emergence of new diseases, and if yes what is that correlation. This is a hard journey to embark on, since establishing a link like this is very difficult, a disease emerges due to several factors that might have a connection with climate change effects or not. According to Epstein [37] climate is a key determinant of health.

Climate constrains the range of infectious diseases, while weather affects the timing and intensity of outbreaks. A long-term warming trend is encouraging the geographic expansion of several important infections, while extreme weather events are spawning 'cluster' of disease outbreaks and sparking a series of surprises [37]. Climate change has many environmentally changing effects, which affects the health of humans.

A warmer climate worldwide enables diseases contained in tropical areas to reach new territories, advancing into places unprepared to deal with them. As Sfectu points out in his article, "Climate change is affecting ecosystems and allowing diseases to cross their invisible borders. As the tropical climate expands, diseases such as malaria and the Zika virus will become a threat in new locations." (Sfectu, 2020) [39], and this may stress health systems across the world when handling new diseases on top of the familiar ones. The growing displacement of people in relation to environmental disasters leads to larger groups living in one place, which makes it harder to ensure all necessary conditions for adequate life, that might result in several diseases related to poor water quality, low food quality or intake, and other factors. Also, there is the issue of the continued growth of human population, which is stressing urban areas and creating a need from these people to expand urban frontiers, which leads to an invasion of wild territories.

This shortened the bridge between people and wild animals that carry pathogens unknown to humans, which disrupts the existing balance for human bodies defense system and may lead to the spread of



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infectious diseases beyond the control of sanitary agencies. With a greater concern, the scientific community is investigating the potential hazard the melting of glaciers and ice caps might have for human health, given that this defrosting is happening in places that were somehow considered stable or safe and might release ancient pathogens in a world unprepared to deal with it, making it possible that diseases new to this age create an epidemic or even a pandemic.

Following on the arguments made in the previous sections, one can say that to guarantee better health conditions for all people, climate change must be dealt with. With all the links discussed between climate change and the spread of diseases, and studies being conducted on the matter, the fight against climate change gains another dimension, one where it is treated not only because of human action, but also as a cause for new diseases emerging posing a great threat to mankind and to health. Epstein [37] talks about prevention through the linkage with environmental and energy policies, he claims that it is necessary to reduce vulnerabilities to climate to mitigate the effects of climate change and minimize the damage to human health. And speaks about the pressing issues concerning human health, in the sense that there is a need to minimize the damages done to it through the existence of a strong network of technologies designed to survey changing patterns in the health of the population that may stress the health system.

All of this is only possible if, among other factors, there is necessary energy resources to maintain all systems working, which may stress the environment once governments pursue to increase their energy production. Epstein [37] points out that “Meeting energy needs with non-polluting sources can be the first step towards the rational use of Earth’s finite resources and a reduction in the generation of wastes [37]. This leads to a point that scholars and specialists will unlikely disagree, dealing with climate change or health issues requires cooperation between nations, a more comprehensive cooperation, that encourages the exchange of investments, technologies and expertise. These problems are not restrained to a single territory, the recent COVID-19 pandemic proved it, a disease diagnosed in China spread to the six continents, killing many people and infecting many more.

Climate change is a result of decades of countries pursuing their own interests, disregarding they are a part of a larger system, the depletion of the ozone layer, the increasing air pollution, the biodiversity loss, all those problems relate to individual actions performed by States, with consequences that affect more than those State citizens, since they unbalance all ecosystems. To really tackle climate change, States cannot act individually, because one will do its part and the other will not, and the ones who will do something will pay the price for those that won’t do something.

To be efficient when dealing with climate change and its effects on human health, there is a necessity to be adaptive to adjust to different situations and issues, assertive to tackle them efficiently and effectively, and cooperative to share solutions and best practices.

To say without a shred of doubt that climate change is the cause of some events is incredibly troublesome, especially when talking about diseases, climate change does not create diseases, rather it makes it possible that new diseases appear on nature, be them completely new or new for modern days. The arguments laid out in previous sections intended to investigate these possibilities. Here, it can be said that “we need to treat the health of humans, animals, the economy and the planet as one.”



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Climate change must be viewed in a more comprehensive way, as to encompass analysis and studies for its effects on all fronts, one of the ones that will impact greatly humans is regarding health issues. So, for civilization to continue to inhabit this planet in an adequate manner climate change must be dealt with, to prevent or mitigate stresses in the environment that can threaten to spread or expose pathogens, either known or unknown to humans. From that understanding and from the notion that adaptation and cooperation are imperative, one can look at international conferences and summits as a platform for leaders to dialogue and decide on several matters and even form coalitions that will exert pressure for some situations to change.

However, cooperation in the field of climate change does not and must not occur only in the international level, it also needs to encompass national and subnational levels, as well as the private sector, civil society and society, to be effective. The actions and discussions must be based on scientific knowledge, take into consideration traditional knowledge of the traditional people and communities that have a great understanding of the communion between man and nature and encompass strategies of adaptation and mitigation. If all those actors are on board, understanding what is at stake for them in the short and long-term, it is possible to change things for the better.

Those impacts, however, will be different from the areas one is looking at, will affect different people in different ways, which bears the necessity that the responses to events that are taking place are adequate to each scenario and situation. This does make the task of dealing with climate change a bit harder but, at the same time, it makes it urgent, pressing, to deal with it, considering all the impacts that are happening and that might happen.

CLIMATE CHANGE AND GLOBAL POPULATION HEALTH

In 2023, World Health Assembly (WHA), global leaders recognized climate change as the greatest health challenge of the 21st century. Leaders have called on the global health community – frontline health workers, ministries of health, intergovernmental and nongovernmental health organizations, health academics, foundations and donors, and wider public and private health sector organizations – to address climate change through:

- **Advocacy and Partnership** – coordinating with international and regional public health agencies, including those within the United Nations system, to ensure health is appropriately represented in the climate change agenda and disseminating information of the threats that climate change presents while promoting opportunities to cut carbon emissions.
- **Monitoring science and evidence** – conducting reviews to define the link between climate change and health.
- **Supporting countries to protect human health from climate change** – investing in and strengthening the resilience and adaptive capacity of health systems to ensure optimal health care provision in an ever-evolving landscape and directly tackling the diverse array of health repercussions stemming from the climate change crisis to safeguard human well-being. Health system resilience can be defined as the capacity of health actors, institutions and populations



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to prepare for and effectively respond to crises, maintain core functions when a crisis hit, and, informed by lessons learned during the crisis, reorganize if conditions require it.³

- **Building capacity to mitigate climate change** – reduce health vulnerability to climate change and promoting health while reducing carbon emissions.

Before this global call to action, many private health sectors companies took initial steps to address climate change, as the industry witnessed a cascade of climate mitigation strategies and C neutrality commitments. However, as a result, many private health sectors companies’ strategies are heavily concentrated on climate mitigation activities⁴ – making the impact of climate change less severe by reducing the emission of GHGs in the atmosphere and/or enhancing the storage of these gases. Thereby, companies existing strategies neglect activities for climate adaptation, or embed a climate lens across the full scope of the health care business. Climate adaptation, alongside climate mitigation activities, is an essential element of holistic climate action to foster sustainable and equitable impact for our populations via its health investments.

THE CLIMATE CHANGE AND HEALTH CHALLENGE

There is growing evidence demonstrating the direct and indirect impact of climate change on health outcomes, with strong relevance to many priorities’ therapeutic areas and client’s product portfolios, including:

- cardiovascular and other cardiometabolic diseases
- HIV/AIDS
- infectious diseases
- sexual and reproductive health and maternal health
- oncology
- mental health

Between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths/year from malnutrition, malaria, diarrhea and heat stress. Additionally, climate change influences wider social networks, socio-economic and environmental determinants of health, and health systems – including supply chains and global security systems as well as general health system resilience – exacerbating negative population health outcomes and health disparities and inequities.

Case Study – Diabetes & Climate Change

Due to impaired responses to heat stress (including compromised vasodilation and sweating, insulin resistance and chronic low-grade inflammation) people with diabetes are particularly vulnerable to climate-related environmental risk factors (extreme weather events, heat waves and air pollution) and are at an increased risks of morbidity and mortality.

Additionally, the impact of climate change will exacerbate health inequities between and within high and low- and middle-income countries, as climate change exacerbates access barriers and social determinants of health.



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Populations within countries that are struggling to implement climate adaptation strategies and strengthen the resilience of their local health systems and economies remain vulnerable to climate change’s impact. For example, some healthcare systems remain vulnerable to climate-related shocks and crises, increasing the risk of inconsistent access to cold chains to safely deliver insulin amid rising temperatures and heatwaves.

Moreover, despite decades of climate mitigation efforts, climate change is worsening. Outcomes of worsening climate will increase in frequency and severity over time and have more significant impacts on the human population in the short and long-term. For example, new research released in 2023 noted that Earth’s temperature will likely pass the 1.5°C threshold between now and 2027, when earlier projections predicated hitting this threshold by 2050. This threshold of warming remains a key tipping point, as chances of extreme flooding, drought, fires and food shortages increase dramatically. Temperature rises over 2°C will likely bring catastrophic and potentially irreversible impacts, including pushing 3 billion people into “chronic water scarcity” – we are expected to reach this point by mid-century if dramatic changes do not occur.

The global population must increase its investment in climate adaptation strategies to limit the impact of climate change on populations around the world, while maintaining committed invest in climate mitigation approaches.

EXAMPLE STRATEGIES AND PROGRAMS ADDRESSING CLIMATE CHANGE AND HEALTH

Many private sector companies are already working to implement comprehensive climate action strategies, as they understand priority consumer populations require tailored support as climate change continues to worsen and impact their everyday lives. While these companies are not necessarily early adopters, as the cry for climate action reigns decades long, these companies currently set themselves apart in the wider climate action & innovation landscape.

Gaps in knowledge indicate that future initiatives are required in the following areas:

Increase in active global disease surveillance. The lack of precise knowledge of current disease incidence rates makes it difficult to comment about whether incidence is changing because of climatic conditions. Incidence data are needed to provide a baseline for epidemiological studies. These data also will be useful for validating predictive models. As these data are difficult to gather, particularly in remote regions, a centralized computer database should be created to facilitate sharing of these data among researchers [40].

Continuation of epidemiological research into associations between climatic factors and infectious diseases. To draw a causal relationship between climate change and patterns of infectious disease, research needs to prove consistent trends across diverse populations and geographical regions.

This will best be accomplished by implementing rigorous study designs that adequately control for social and environmental confounders [40].



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International collaboration between researchers is important [36].as well as interdisciplinary collaboration between specialists such as epidemiologists, climatologists and ecologists, to expand the breadth of information. A comprehensive study of mosquito-borne diseases, for example, requires a combination of entomologists, epidemiologists and climatologists to work together to examine the associations of changing vector habitats, disease patterns and climatic factors. Epidemiological data can be shared with policymakers to make preventive policies [36]. Further development of comprehensive models. Models can be useful in forecasting likely health outcomes in relation to projected climatic conditions. Integrating the effects of social and environmental influences is difficult but necessary [40].

CLIMATE CHANGES: IMPACT ON EMERGING INFECTIOUS DISEASES AND NEW TECHNOLOGIES TO COMBAT THE CHALLENGE

Improved sanitation, increased access to health care, and advances in preventive and clinical medicine have reduced the mortality and morbidity rates of several infectious diseases. However, recent outbreaks of several emerging infectious diseases (EIDs) have caused substantial mortality and morbidity, and the frequency of these outbreaks is likely to increase due to pathogen, environmental, and population effects driven by climate change. Extreme or persistent changes in temperature, precipitation, humidity, and air pollution associated with climate change can, for example, expand the size of EID reservoirs, increase host–pathogen and cross-species host contacts to promote transmission or spillover events, and degrade the overall health of susceptible host populations leading to new EID outbreaks.

It is therefore vital to establish global strategies to track and model potential responses of candidate EIDs to project their future behaviour and guide research efforts on early detection and diagnosis technologies and vaccine development efforts for these targets. Multi-disciplinary collaborations are demanding to develop effective inter-continental surveillance and modelling platforms that employ artificial intelligence to mitigate climate change effects on EID outbreaks. In this review, we discuss how climate change has increased the risk of EIDs and describe novel approaches to improve surveillance of emerging pathogens that pose the risk for EID outbreaks, new and existing measures that could be used to contain or reduce the risk of future EID outbreaks, and new methods to improve EID tracking during further outbreaks to limit disease transmission.

EFFECTS OF CLIMATE CHANGE ON EMERGING INFECTIOUS DISEASES (EIDS) TRANSMISSION

Climate change-a threat to public health

Climate change is unequivocally acknowledged as an urgent global public health menace by the World Health Organization (WHO), as profound and enduring shifts in temperature, precipitation, humidity, and air and water quality are already exacting a devastating toll on human health, amplifying morbidity



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and mortality rates worldwide [5, 6]. Climate change can enhance transmission of food-, water- and vector-borne diseases (FBDs, WBDs and VBDs) by increasing the area in which or length of time when conditions remain favourable for outbreaks and transmission of emerging or reemerging infectious disease through effects on pathogen or host health, replication, and dissemination or migration [7]. One recent modelling study of 3000 mammalian species found that their predicted migration patterns could lead to more than 4000 instances of cross-species viral transmission in the next 50 years if the world warms by 2°C, and thus climate change could easily become the dominant anthropogenic force in viral cross-species transmission [46]. In fact, climate change-induced mortality and morbidity associated with infectious diseases are expected to rise globally [47]. The impact of climate change on fungal infections has been reviewed elsewhere [48], which also emphasizes the association of climatic factors and fungi-associated outbreaks. Here, we review the mechanisms of climate change altering the landscape of EIDs. At a global glance, we propose measures that have or could be taken to prevent or limit initial and subsequent transmission events. We also discuss emerging technologies that can be applied to generate more effective surveillance systems for early control of EID outbreaks.

A diverse array of factors can influence EID spillover and outbreak, including new mutations and viral recombination and reassortment events that alter the species-specificity of a pathogen, changes that affect the geographic ranges of environmental pathogens or animal vectors, and human migration and habitat destruction events that can lead to new geographic overlaps between a human population and a pathogen or its vector(s) [49]. Repeated direct or indirect contact between a human population and a pathogen or a pathogen reservoir are usually required to permit sufficient cross-species transmission and mutation and selection events to allow a pathogen to evolve a capacity for efficient human-to-human transmission [50]. Spillover events leading to population-based transmission in humans can occur through periodic or continuous exposure to reservoirs of pathogens or via cyclic vector-host-vector transmission routes. Environmental encroachment events, due to climate change or other anthropogenic causes, and the inherent mutation rates of pathogens present in the affected regions create fertile opportunities for infectious agents to adapt to new ecological niches, interact with and adapt to new hosts through repeat exposure to promote zoonotic infection, host shift, and population-based transmission (Figure 5)



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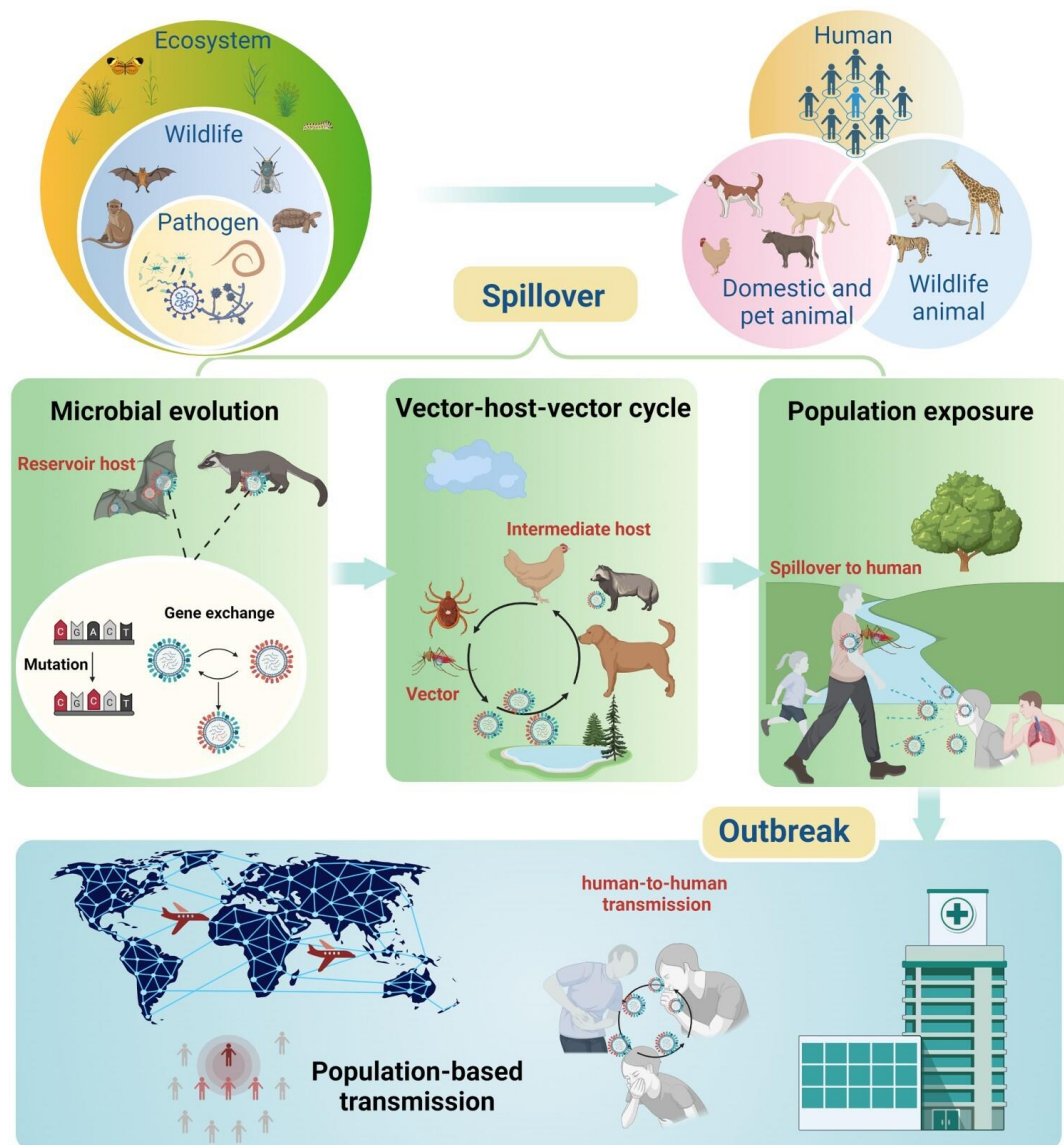


Figure 5. The processes of pathogen spillover and emerging infectious diseases (EIDs) outbreak: pathogens, including bacteria, virus, fungi, parasite and protozoan from wild animals move into domestic, pets, wild animals or directly to humans. This spillover process is further detailed in steps including long-term evolution of the pathogen itself to gain the ability to jump from the original reservoir host to intermediate host, formation of cyclic vector-host-vector transmission cycle and the population-based transmission after initial exposure event, and expansion of the pathogen's geographical range beyond the region of spillover enabled by human-to-human transmission that leads to the EID outbreak. Figure created with Biorender.com.



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Environmental modifications associated with climate change can expand the size of a pathogen reservoir or its host population(s), alter or increase their geographic range through ecosystem damage, increase the likelihood of EID spillover events, and decrease the health of host populations to enhance the risk of successful spillover events and outbreaks (Figure 6).

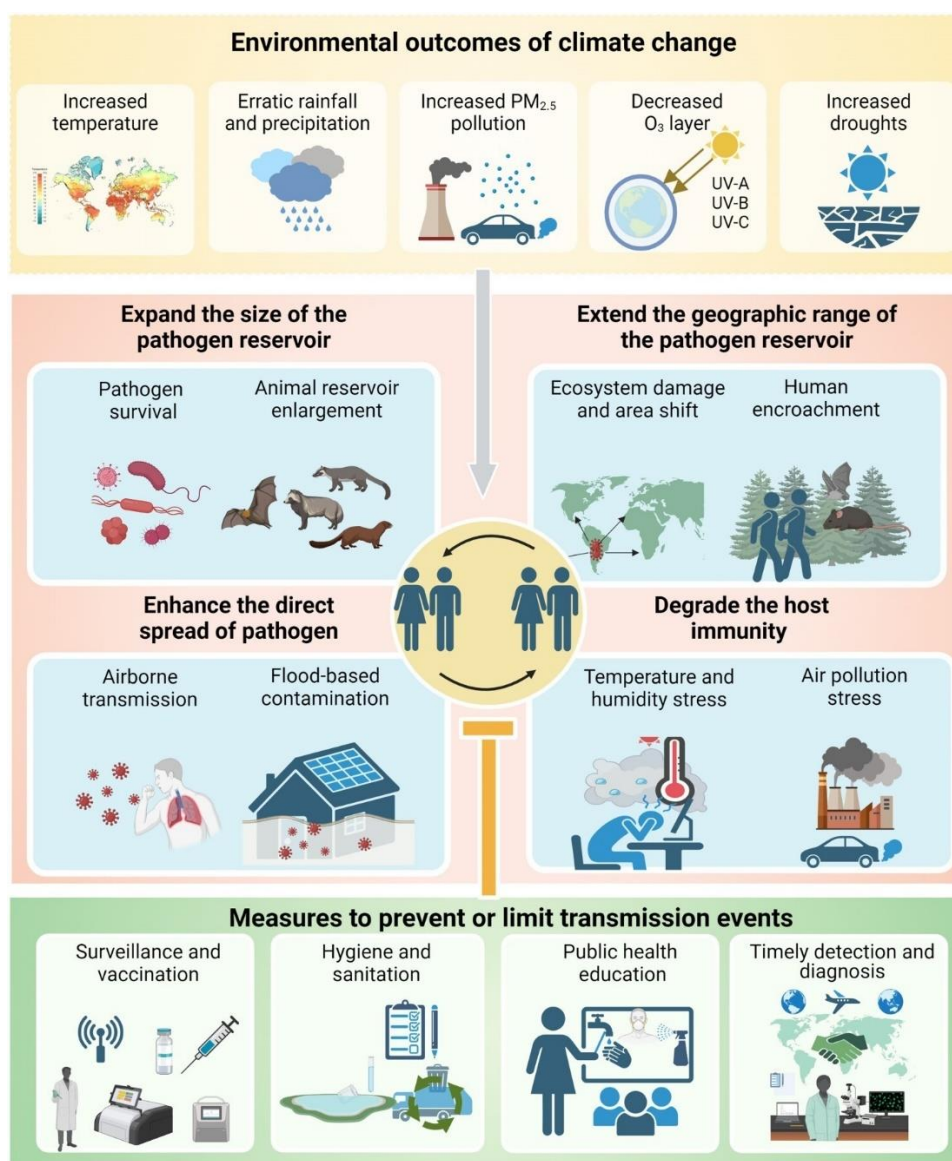


Figure 6. Environmental outcomes of climate change, potential climate-regulated mechanisms effects that can promote EID outbreaks, and measures that can be taken to prevent or limit EID transmission events. Figure created with Biorender.com.



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Climate change can increase pathogen abundance by enhancing the survival and reproduction of pathogens or their hosts in existing environmental niches or expanding the number, size, or reproductive potential of these niches in an existing or expanded geographic range. Changes in temperature, precipitation, and humidity can alter the size and distribution of pathogen and host populations to influence pathogen and host development, replication and survival [51].

Respiratory virus transmission may provide the best documented evidence for temperature- and humidity-mediated effects on pathogen transmission in human populations, since endemic influenza A, respiratory syncytial virus (RSV) and coronaviruses all exhibit clear seasonal transmission peaks. This may be due to sunlight, UV, temperature and humidity that affect virus survival in aerosols and on surfaces, as well as behavioural changes with increased close contacts arising from individuals spending more time indoors during the winter season [52]. Interestingly, Mordecai EA *et al.* revealed that mosquito-borne pathogens have peak transmission at a temperature range of 23–29°C and decline to zero below 9–23°C and above 32–38°C. By analysing the reproductive number (R_0) of pathogens from the aspect of thermal biology, such findings provide direct evidence of how climate change could affect the transmission of ectothermic vectors and parasites [53]. In addition, extreme temperature increases can expand the risk of EID outbreaks in human populations, as demonstrated by the surge in SARS-CoV-2 cases observed worldwide during the summer of 2022, which appears to have been at least partially due to individuals congregating in climate controlled areas, such as shopping malls, particularly in regions where residential climate control was not widespread [54].

Climate change can have multiple effects to increase pathogen burden and disease transmission within animal reservoirs leading to disease spillover into human populations. For instance, variable seasonal extremes in temperature and rainfall associated with climate change can lead to rapid increases in the food supply of a disease reservoir, leading to a population explosion that cannot be controlled by its predators. Such changes may promote the risk for spillover events if they increase the geographic range or population density of a disease reservoir to promote *de novo* or existing direct or indirect interactions with susceptible human populations. The 1990s Hantavirus epidemic in the southwestern United States represents one such example, as it was linked to indirect human contact with a deer-mouse reservoir that experienced a 10-fold population density increase due to a short-term climate induced fluctuation that increased its food supply and suppressed its predator populations [55]. Similar long-term effects should also be possible if long-term climate change continues to favour increased interaction between a disease reservoir and a human population in a manner that is not adequately suppressed by a predator population.

Climate change can also extend or alter the geographic range of a pathogen reservoir via positive or negative effects on food supply, predator populations, and other factors that affect its current range and adjacent locales. For example, ecosystem damage may force a host population or its predators to range further to meet their basic environmental needs or to avoid increased competition or predation resulting from ecosystem changes. This may increase the number of infected hosts, their individual pathogen burden, and the chance for contact with a susceptible human or human-adjacent host population. Ecosystem damage can also have similar effects on human populations and domestic animals that may serve as gateway populations. In both cases, however, increased contact between a



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stressed host or susceptible host-candidate population may augment the risk for close contacts that lead to spillover events. For example, higher temperatures and meteorologic shifts associated with climate change can reduce surface water availability by decreasing the amount of rainfall or increasing the extent of evaporation, causing wildlife to frequent water source that they might otherwise avoid due to their frequent use by human or domestic animal populations, leading to direct or indirect contact between these groups [56]. However, such resource competition may not be necessary to promote spillover events. Research indicates that climate change has caused the Australian black flying fox population, a key reservoir of Hendra virus, to migrate 100 km south over the past 100 years, likely leading to observed spillover events in southern horse populations that led to human infections [57]. Climate change has also been linked to changes in the El Niño southern oscillation that have been linked to the geographic distribution of endemic cholera, in a manner that is not directly linked to increased rainfall and flooding [58]. EID species diversity increases as one proceeds from the poles to the equator [59], and environmental parameters that promote pathogen transmission at lower latitudes (e.g. increased temperature and precipitation) are hypothesized to drive this pattern [60]. A recent study modelling potential connections between climate variables and pathogen prevalence has also suggested that elevated temperatures and greater precipitation will accelerate the transmission of bird- and bat-associated bacteria or viruses to wild and domesticated animals and humans [61]. One example of the potential impact of this process was the recent COVID-19 pandemic, where a SARS-CoV-2 progenitor virus that probably originated in southeast Asian horseshoe bats (*Rhinolophus* sp.) is proposed to have spread to humans through an as-yet-unknown bridge host [62].

Changing climate conditions can affect EID transmission chains and routes by altering the geographic range and population sizes of potential pathogen and host species, leading to novel interactions between these species that can lead to establishment of a new pathogen reservoir and increase the risk for subsequent zoonotic disease transmission to a human population [58]. VBDs spread by blood-feeding arthropods such as mosquitoes, ticks, and fleas, are responsible for substantial morbidity and mortality as they transmit diseases (malaria, dengue, West Nile, and Lyme disease) that account for 22.8% of EID events worldwide [1]. These insect vectors are sensitive to environmental changes (rainfall, temperature and severe weather events) associated with climate change [63]. For example, temperature changes can affect the transmission period or the growth rate an insect vector (or its pathogen), by an analysis of mosquito-based transmission of dengue fever or *Plasmodium falciparum* malaria [64].

Drinking water safety is a key factor affecting EID transmission. Climate change can increase rainfall and flooding to contaminate water supplies of a human or human-adjacent host populations leading to an increased risk for outbreaks of WBDs caused by enteric bacteria and parasites such as *Salmonella* and *Cryptosporidium* [65]. In climate-vulnerable areas, for example, Bangladesh, drinking water safety could be threatened by climatic hazards, which leads to the prevalence of multiple WBDs and VBDs, such as cholera, dengue, and malaria [66].

Climate effects can also worsen air pollution, and both these factors can cause and synergically exacerbate detrimental effects on the host immune system. This can enhance respiratory disease transmission by affecting the lifetime of air-borne respiratory droplets and the pathogens they carry and via detrimental effects on the respiratory mucosa and immune system of at-risk populations.



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Chronic exposure to air pollution can induce inflammation and oxidative stress and impair immune function to increase infectious respiratory disease burden, particularly in vulnerable populations such as young children and older adults and individuals with pre-existing respiratory disorders. Excessive exposure to small particulate matter (PM_{2.5}) pollution, for example, can magnify the adverse effect of climate change on respiratory health by altering the immune response and exacerbating the development of existing respiratory disease [67].

Chronic exposure to temperature and humidity changes can also influence innate and adaptive immunity by altering the regulation of specific immune responses. For example, extended exposure to elevated temperature can decrease the production of antigen-specific CD8⁺ T cells and antibodies [68]. However, excess disease risk associated with air pollutants and meteorological factors can be complex, as evident from a study that found that excess risk for TB was positively associated with NO₂ level and windspeed; negatively correlated with O₃ level, temperature, and relative humidity; and was not detectably associated with PM_{2.5} or SO₂ concentration or sunshine duration [69]. Several steps should be taken at the individual, regional and global scale to prevent future EID outbreaks.

- First, surveillance of animal populations that could serve as potential EID reservoirs by effective surveillance system should be considered a key measure for the early recognition of pathogens that demonstrate potential for spillover events in human populations. Early identification of changes in such candidate EID reservoirs can permit interventions to prevent or attenuate an outbreak. These can include identification of candidate transmission routes and potential preventative measures, new pathogen targets for surveillance in at-risk regions, and for vaccine or drug development efforts.
- Second, substantial effort should be made to improve sanitation efforts in at-risk regions, particularly in areas most likely to have interactions with a pathogen reservoir that could lead to spillover or transmission events. This approach should focus on proper waste management and the safety of the water supply, particularly in low-income or underdeveloped regions.
- Third, significant effort should be applied to public education efforts that raise awareness of and provide information about the disease and its transmission routes in an accessible format, and suggest behavioural modification that can limit disease transmission (e.g. proper hand hygiene, mask usage, isolation of laboratory-confirmed patients, and quarantine of symptomatic individuals or those who were close contact of actively infected patients).
- Finally, since considering infectious diseases can readily spread across national borders, international organizations, governments and scientists should collaborate on approaches to detect EID pathogens in wastewater from major urban travel hubs (homes and hotels) and major sites of regional or international travel (bus/train stations and airports) to detect entry of these pathogens into new regions.

Technologies for EID monitoring and screening

Sensitive new surveillance approaches that can detect new EID pathogens and diagnose new EID cases are needed to address the growing threat of climate-sensitive infections. Previous experience indicates that successful efforts to prevent or contain future EID outbreaks, epidemics, and pandemics require



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multidisciplinary and inter-continental collaboration, and the integration of an array of innovative approaches on multi-platforms (Figure 7).

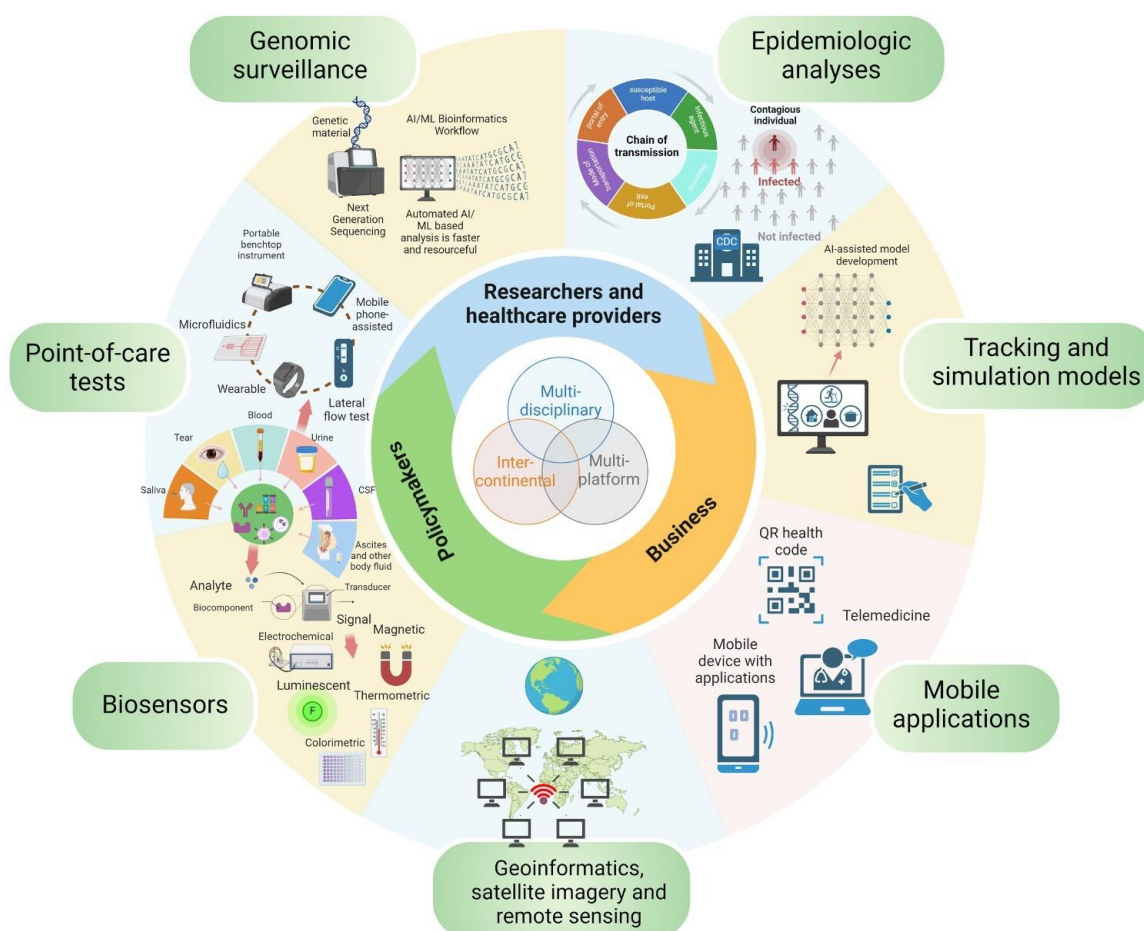


Figure 7. Multi-disciplinary, inter-continental and multi-platform-based approaches to prevent or contain EID, outbreaks, epidemics, and pandemics. Figure created with Biorender.com.

FUTURE PERSPECTIVES

Climate change is expected to change the incidence, prevalence, and distribution of EID outbreaks and to degrade host immunity in human and human-adjacent species, raising the potential for more frequent and severe epidemics by these pathogens.



There is a growing need to forecast the future burden of specific EIDs under different climate change scenarios through models that integrate retrospective information from past epidemic or pandemics and climate conditions data [70]. It is vital to establish global strategies to track and model potential responses of candidate EIDs to altered climate conditions to project their future behaviour and guide research on early detection and diagnosis technologies and vaccine development for these targets.

The diagram illustrates the complex interactions between various environmental factors and human health. The central node is **Human health**. Other nodes include **Stratospheric ozone depletion**, **Climate change**, **Land degradation**, **Biodiversity loss and ecosystem function**, and **Freshwater decline**. Arrows indicate the direction of influence, with some pathways labeled:

- Stratospheric ozone depletion** influences **Climate change** and **Human health**.
- Climate change** influences **Stratospheric ozone depletion**, **Land degradation**, **Human health** (via *Diverse pathways* and *Altered precipitation*), and **Biodiversity loss and ecosystem function** (via *Declines in phenotypic, genetic materials and diverse 'goods and services'*).
- Land degradation** influences **Climate change** and **Human health** (via *Agroecosystem productivity*).
- Biodiversity loss and ecosystem function** influences **Climate change** (via a dashed feedback loop) and **Freshwater decline**.
- Freshwater decline** influences **Human health** (via *Water quantity and safety*) and **Biodiversity loss and ecosystem function**.
- Human health** is also influenced by **Conflict** and **Water quantity and safety**.

Multi-disciplinary collaborations will be required to develop effective inter-continental surveillance and modelling platforms that employ AI to mitigate climate change effects on EID outbreaks through interventions targeting all levels of this process, from the host reservoir onwards. Necessary changes will require coordinated responses, and adequate funding supports from policymakers, businesses, and



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healthcare providers that may be needed to permit effective action from the community level to integrated regional, national, and international efforts.

THE ROLE OF SUSTAINABILITY AND NATURE-BASED SOLUTIONS

- **Protecting Natural Carbon Sinks:**
Ecosystems like forests and wetlands absorb CO₂, helping to regulate global temperatures. Conserving these habitats is vital for mitigating climate change.
- **Adopting Sustainable Practices:**
Sustainable management of natural resources and efforts to reduce GHG emissions are crucial for protecting the biosphere.
- **Nature-Based Solutions:**
Ecosystem-based approaches, or nature-based solutions, offer ways to both mitigate climate change and adapt to its impacts. These solutions leverage the power of natural systems to build resilience.
- **Integrated Climate and Health Policies:**
Integrating climate and health policies is necessary to build resilient health systems that can withstand the impacts of climate change.

IMPLICATIONS FOR PRACTICE.

We end by listing a series of important but perplexing issues that need more detailed and considered discussion within restoration theory and practice:

- The ecosystems we manage and restore are complex systems that often have nonlinear and unpredictable behaviour. Our understanding of how systems work under current conditions is often rudimentary, and we often must learn as we go.
- To this complexity and lack of understanding, we now must add the fact that environments are changing, and the rate of change is unprecedented. The past is no longer a prescriptive guide for what might happen in the future. There is a large component of ecological restoration that still places considerable value on past ecosystems and seeks to restore the system's characteristics to its past state. Valuing the past when the past is not an accurate indicator for the future may fulfill a nostalgic need but may ultimately be counterproductive in terms of achieving realistic and lasting restoration outcomes. The past should serve as a guide and should temper our ambitions toward unfettered design and development.



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- Hence, a key question for everyone involved in restoration is the proper balance between rebuilding past systems and attempting to build resilient systems for the future. Perhaps in some cases, both goals are achievable, but the prognosis seems to be that this may not always be the case. We must tread very carefully. A consequence of rapid climate change may be the loss of public interest in conservation and restoration goals. Inured to the change, the idea of supporting painstaking restoration goals will give way to functional, emergent, and designer ecosystems. Clear discussion and debate are required on the question of when traditional restoration goals are appropriate and when more functional and design-driven goals are necessary.

WHICH WAY TO THE FUTURE?

Ecological restoration is increasingly used as a primary component of humanity's toolbox, which will be required to respond and adapt to the anticipated changes in global and regional climate. For ecological restoration to realize its potential as a key tool in managing the challenge of climate change, conventional approaches that rely exclusively on historical references are insufficient. Among our goals should be the continued protection of species and ecosystems at risk, with an understanding that the latter is a more realistic approach than the former, as well as the reinstatement of natural capital with the explicit aim of enhancing ecosystem service provision at local, regional, national, and global scales.

HOW REDD PROTECTS THE BIOSPHERE?

Forests are essential to life on Earth, providing clean air, regulating water cycles and supporting biodiversity. From wild fruits, nuts and medicinal plants to soil fertility and pollination, forests are fundamental to global food systems. At the same time, reducing deforestation and managing forests sustainably are key to mitigating climate change and ensuring long-term food security.

Reducing Emissions from Deforestation and forest Degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks (REDD+), is an essential part of the global efforts to mitigate climate change. FAO supports developing countries in their REDD+ processes and in turning their political commitments, as represented in their Nationally Determined Contributions, into action on the ground.

At the core of this work are forests and the fundamental role they play in climate change mitigation, by removing CO₂ from the atmosphere and storing it in biomass and soils. This also means that when forests are cleared or degraded, they can become a source of GHG emissions by releasing that stored carbon. It is estimated that globally, deforestation and forest degradation account for around 11 percent of CO₂ emissions. Halting deforestation is a cost-effective action that has a clear impact in reducing global GHG emissions. FAO's support also helps countries during the later implementation phase of REDD+. Reducing Emissions from Deforestation and Forest Degradation (REDD) + protects the



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biosphere to conserve forests, thereby reducing GHG emissions from deforestation and degradation and increasing C storage. This conservation effort protects a wide array of ecosystem services, including biodiversity conservation, watershed protection, soil conservation, and provision of forest products. By keeping forests standing, REDD+ safeguards critical habitats and the livelihoods of forest-dependent communities, ensuring greater resilience to climate change effects and fostering sustainable development.

REDD + Protecting the world’s forests is crucial for the climate. Forests absorb vast amounts of CO₂ and can be a source of GHGs emissions when destroyed or damaged. Countries established the ‘REDD+’ framework to protect forests as part of the Paris Agreement. ‘REDD’ stands for ‘Reducing emissions from deforestation and forest degradation in developing countries. The ‘+’ stands for additional forest-related activities that protect the climate, namely sustainable management of forests and the conservation and enhancement of forest carbon stocks. Under the framework with these REDD+ activities, developing countries can receive results-based payments for emission reductions when they reduce deforestation. This serves as a major incentive for their efforts.

KEY MECHANISMS BY WHICH REDD+ PROTECTS THE BIOSPHERE:

- **Financial Incentives:**
REDD+ provides financial payments to countries and communities for reducing forest loss, making forest conservation more profitable than unsustainable practices.
- **Carbon Storage:**
Forests act as vital carbon sinks, absorbing CO₂ from the atmosphere. REDD+ activities help preserve and enhance these carbon stocks by halting deforestation and degradation.
- **Biodiversity Conservation:**
Protecting forests and their carbon stocks directly benefits the vast array of species and ecosystems they support, maintaining habitats and preventing biodiversity loss.
- **Ecosystem Services:**
Standing forests provide numerous benefits beyond carbon, such as regulating water cycles, conserving soil, and supplying timber and other forest products.
- **Sustainable Forest Management:**
REDD+ promotes sustainable management practices that allow for forest use without destruction, ensuring long-term forest health and benefits.
- **Livelihood Support:**



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The program aims to support the livelihoods of indigenous peoples and forest-dependent communities, ensuring their involvement in conservation efforts and ensuring they benefit from keeping forests intact.

– **Climate Change Mitigation:**

By reducing deforestation and forest degradation, REDD+ contributes significantly to slowing and reversing climate change, which is a major threat to biodiversity. Atmospheric circulation, large-scale movement of air in the earth's atmosphere, is the dominant forcing of mass and energy transportation from field to global scales and has multi-scale impacts on plant-soil systems [71]. Variation in atmospheric circulation patterns significantly changes global C and water cycles, as well as atmospheric chemistry, profoundly affecting plant-soil-microbe interactions across spatial and temporal scales ([71]; [72]; [73]). Given the complexity of these interactions and their significant implications for climate change adaptation, ecosystem sustainability, and agricultural productivity, a deeper understanding of how atmospheric circulation influences plant-microbe-soil interactions remain essential. The effects of atmospheric circulation on plant-microbe-soil interactions from the large-scale response, the effect of extreme climate events and nutrient cycling dynamics.

Nature as an ally in the fight against climate change.

The conservation of nature is also essential in mitigating climate change, with a particular emphasis on preserving ecosystems. Many areas, such as forests and oceans, are rich in biodiversity and serve as sources of well-being and climate regulation for countless communities. Therefore, protecting nature is one of the most important strategies to combat climate change. Actions such as promoting ecological connectivity or restoring degraded habitats can significantly contribute to mitigating its consequences.

The importance of sustainability.

Sustainability is not just about reducing emissions. It also means rethinking our consumption habits, how we produce energy, and how we manage natural resources. In this sense, every person, business, or institution can contribute in some way to the planet's sustainability. From everyday habits—like starting to recycle—to major strategic decisions—such as investing in renewable energy or adopting circular economy models—every action counts in helping reduce the effects of climate change.

Biosphere helps you move toward a more sustainable future.

On the path to sustainability, there are various initiatives that help structure and measure the impact of our actions on the world.

Biosphere Sustainable is a certification and management system that enables destinations, companies, and organizations to align their regular practices with the 17 United Nations Sustainable



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Development Goals (SDGs). What makes Biosphere unique is that it doesn't follow a one-size-fits-all model. Instead, it adapts to the reality of each organization, offering a flexible roadmap. Through measurable indicators and a process of continuous improvement, Biosphere Sustainable promotes real transformation toward sustainability.

A commitment that unites us all

World Climate Day should not remain a symbolic celebration. It is a call to action—to demand responsible policies and to be part of the change needed to overcome this global challenge. The future of the planet doesn't depend solely on decisions made by governments and large corporations. It also lies in the small, everyday choices we all make.

CLIMATE CHANGE AND THE BIOSPHERE₁ OPTION: MOVING TO A SUSTAINABLE FUTURE

The Biosphere option for GHG management involves:

- Optimizing CO₂ uptake from the atmosphere through plant photosynthesis and storage of the C in plant or soil biomass. This can provide a verifiable offset for GHG emissions from fossil fuels while enhancing agriculture, forestry and natural ecosystems.
- Optimizing the use of the biomass as a renewable energy, chemical and material resource, thereby relieving demand for fossil fuels.
- Ensuring that the rate of biosphere C sequestration either exceeds the rate of biomass utilization to offset fossil fuel emissions, or equals the rate of utilization, thereby renewing the resource.

In this strategy, biosphere C sequestration plays an extremely important ‘transitional role’ in moving towards sustainability of our energy systems. It provides the nation with a low cost, ‘green’ option to reduce its net GHG emissions while building a cost-effective energy source for the future. Uncertainties with the Kyoto Protocol. Some would argue that research or implementation of the biosphere option is not worthwhile at present because the rules surrounding C sequestration remains unresolved in the Kyoto Protocol. Many possibilities associated with C sequestration have not been considered and there are controversies over the nature and definition of C credits. However, the BIOCAP Network would argue that to not act now would be shortsighted and unproductive. Regardless of the success or failure of the Kyoto Protocol, there are important environmental and policy reasons for exploring opportunities and initiating programs related to the biosphere option.

One thing is very likely: there will be other ‘Kyoto-style’ agreements in the future and Canada needs to be prepared with both understanding and experience in the scientific, technological and policy options associated with GHG management.

Also, among efforts to remedy the GHG challenge, the biosphere option is ‘green’ in that it promotes enhanced forest growth, biodiversity and soil C reserves, with beneficial effects on forestry, recreation, agricultural production and rural development. Concerns have also been expressed that biosphere C sequestration will relieve the pressure on industries to fundamentally change their behaviour and



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drastically reduce energy use. It was recognized that this to be a complex issue which cannot be fully addressed here, but argue that we must move ahead with C sequestration for reasons which include:

- Reducing GHG emissions is too important
- leave to one strategy - we must use whatever resources we have.
- Fundamental changes in our energy systems will be expensive. We need healthy, globally competitive industries to implement these changes
- If biomass is to become a more important source of energy and material resources in Canada, we must begin to build that resource now.
- There are other significant environmental benefits associated with biosphere C sequestration.

We should work to enhance biosphere C even in the absence of a climate change imperative.

BIOMASS FOR ENERGY, CHEMICALS AND MATERIALS

When expressed as the energy per C released on combustion, biomass has 85% of the energy in coal, 69% of that in oil and 54% of that in natural gas. Although fossil fuels are more highly reduced, and have more energy per C than biomass, biomass is renewable, so its C emissions are not considered as GHGs if the biomass used is replaced by new biomass. Biomass-derived products would include liquid fuels such as bioethanol, commodity chemicals, biopolymers, fine chemicals and solvents. In some cases, it is possible to produce from biomass, the identical chemicals currently produced by the petrochemical industry. In other cases, it may be possible, or more desirable, to produce suitable substitutes.

WHAT DOES THE ADVISORY OPINION (OA) MEAN FOR COP 30 AND THE LONG-TERM LEGAL MOMENTUM FOR CLIMATE ACTION?

Opinion is an important signal ahead of COP 30 to strengthen the rule-based order and international law to address climate change. COP 30 is expected to deliver strengthened climate plans in the form of Nationally Determined Contributions (NDCs 3.0). Here, the International Court of Justice (ICJ) provides a powerful legal foundation for demanding more ambition. First, it clarifies that States need to act with due diligence. This means that simply formulating an NDC is insufficient; countries genuinely need to strive to achieve and implement their commitments. While countries have discretion in determining how they cut emissions, the ICJ confirms that NDCs are subjected to scrutiny in terms of their robustness. Second, the ICJ formulates that it is a legal duty to present NDCs in line with the 1.5°C temperature goal. Third, it defines the failure to take appropriate action regarding climate change as legally wrongful acts, including actions such as investing in fossil fuel production, granting fossil fuel exploration licenses or the provision of fossil fuel subsidies. All strengthen the scope and relevance of NDCs also as a legal instrument and further enhance climate policy. The ICJ Advisory Opinion



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transforms the climate crisis from primarily a political or ethical challenge into a clear legal obligation for States. It provides a robust legal foundation that will accelerate climate action, strengthen legal challenges in international and domestic courts and shape the future of international climate law.

CONSCIOUS ACTIONS FOR A MORE SUSTAINABLE PLANET

Climate change is no longer a future threat but a global reality that demands urgent solutions. On March 26, World Climate Day we explore how protecting nature, adopting sustainable habits and aligning actions with the UN Sustainable Development Goals can shape a more resilient future.

The one of the main aims is to raise awareness about the importance and influence of the climate, as well as the future impact of climate change on humanity at a global level. Climate change is a reality that directly affects us. Some of the consequences we can already observe in our daily lives include rising temperatures, sea level rise, and biodiversity loss, among many others. These adverse phenomena are causing various health problems and affecting the economic stability of millions of people. In this context, World Climate Day has become a powerful opportunity to highlight the urgent need for a transition toward more sustainable ways of living.

CONCLUSIONS AND RECOMMENDED FUTURE STEPS

Sustainability of natural resource management systems is defined by seven general attributes: productivity, stability, reliability, resilience, adaptability, equity and self-reliance. Sustainability is not measured per se but is measured through the comparison of two or more systems. The comparison is made either cross-sectionally (e.g. comparing an alternative and a reference system at the same time) or longitudinally (e.g. by analysing the evolution of a system over time). Climate change is one of the most urgent and complex global challenges, affecting nearly every aspect of life including health, ecosystems, infrastructure, food systems, and economic stability. Rising global temperatures, sea-level rise, and increasingly frequent extreme weather events pose significant threats to both current and future generations. In response, the global community has adopted cooperative frameworks to limit GHG emissions, most notably through the 2015 Paris Agreement. Signed by 193 parties, the Paris Agreement aims to keep global warming well below 2°C above pre-industrial levels, with a preferred target of limiting the rise to 1.5°C.

We need to raise ambition (not only because every fraction of a degree of warming matters), but also because these plans can be blueprints for stronger economies and societies. Decarbonizing economies, cutting emissions and building resilience to climate impacts, are profoundly positive. Finance is rightly a key focus. A headline goal of this conference is to agree on a new financial target to support developing countries in their climate actions after 2025. Developing countries need trillions of dollars to support their mitigation, adaptation, and loss and damage efforts. To meet these demands, the climate finance architecture (both international and domestic) must be reformed. The new collective quantified goal



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expected from COP29 is not only about numbers; it is a matter of solidarity and justice and a vital step toward building trust. There is also a need to incentivize and involve the private sector and to effectively connect decisions, policies, and actions at local, national, and international levels.

There is an urgent need to assess how well society is doing at increasing agricultural production while simultaneously conserving biodiversity and associated ecosystem services in an era of climate change, energy costs and financial instability. There are many visions on how to achieve a sustainable agriculture that provides enough food and ecosystem services for present and future generations in an era of climate change, increasing costs of energy, social unrest, financial instability and increasing environmental degradation.

About 90% of the global economy is now covered by pledges to cut climate-changing emissions to net-zero by around mid-century, according to the non-profit Net Zero Tracker. But turning those pledges into action will be a far harder challenge, requiring stepped-up global cooperation, stronger monitoring, more finance and ensuring vulnerable people are not left behind in the process. "No one is moving fast enough. Peak energy emissions are here, but we still have a long way to go before aligning with the targets of the Paris Climate Agreement.

2024 is poised to be a pivotal year, marking the peak of global energy-related CO₂ emissions. DNV's forecast indicates that by 2050, global CO₂ emissions will be halved from current levels, but this trajectory falls significant short of the targets set by the Paris Agreement, requiring us to reach net zero in 2050. The consequential anticipated warming of 2.2°C by the end of the century therefore also starkly contrasts with the goal of limiting temperature rise to well below 2°C. The 1.5°C target can only be achieved with a significant temporary temperature overshoot. But we cannot give up, and the importance of achieving the 'well below 2°C' ambition of the Paris Agreement is more important than ever. It should inspire us towards continued efforts; even more so now that peak energy emissions finally look to be achieved.

The IPCC has confirmed that the world is not reacting fast enough to the climate crisis and is on course to breach the critical barrier of 1.5°C warming within the next 2 decades. This sets us on a path to cascading climate tipping points, from the melting of carbon-rich permafrost in the poles to the loss of almost all mountain glaciers – with up to 10 tipping points triggered below 2°C warming. With 50% of the emissions reductions needed for net zero emissions by 2050 set to come from technologies not yet available at scale – this critical climate target of 1.5°C can only be reached if new decarbonizing technologies are developed and scaled at speed.

The climate crisis underscores the urgent need to transition from extractive capitalism to a sustainable model that respects nature's limits. Fighting climate change requires a transformative shift in capitalism to value nature beyond profit, encouraging a healthier relationship with the environment.

The climate crisis shows no sign of abating, with 2024 seeing more record-breaking temperatures and the year counting among the hottest years on record. June 2024 surpassed previous records as the hottest June ever documented, with a heat dome and subsequent wildfires destroying large parts of southern Europe. Natural landscapes have been transformed into inhospitable zones, leading to a stark reality – the commitment to curbing global temperature rise to 2°C remains a tough reach. In this



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ongoing crisis, governments are underestimating the gravity of the situation. They urgently need to summon the courage to allocate resources to avert an even grimmer future.

The purpose of this review is to highlight the evidence linking climatic factors such as temperature, precipitation, and sea level rise, to the lifecycles of infectious diseases, including both direct and indirect associations via ecological processes. Many studies demonstrate seasonal fluctuations in infectious diseases, but few have documented long-term trends in climate-disease associations. A variety of models has been developed to simulate the climatic changes and predict future disease outbreaks although few have controlled successfully for important sociodemographic and environmental influences.

Future researches are required includes more systematic and multi-year impact evaluations of existing social protection programs that claim to integrate climate change adaptation objectives into their instruments; a combination of qualitative and quantitative assessments of vulnerability as well as opportunities for at-risk groups to improve targeting; studies on how to successfully integrate climate risk information and early warning into social registries; research on innovative financing mechanisms and the scalability of project-based approaches; and the documentation of governance gaps and opportunities at local, national and international levels.

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