ÓBUDA UNIVERSITY
REJTŐ SÁNDOR FACULTY OF LIGHT INDUSTRY AND ENVIRONMENTAL ENGINEERING

Proceedings Book (Part A)
12th ICEEE-2021
International Annual Conference

"Global Environmental Development & Sustainability: Research, Engineering & Management"

November 18, 2021 – November 19 2021

Óbuda University
Budapest, Hungary

12th ICEEE-2021

2-DAY EVENT Online

International Annual Conference on

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

PROCEEDINGS BOOK

(PROGRAM, ABSTRACT & Full Papers)

Venue:

Óbuda University
Budapest, Hungary

Date:

November 18 - 19, 2021

Editor-in-Chief

Prof. Dr. Hosam BAYOUMI HAMUDA

12th ICEEE–2021 International Annual Conference on

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

In light of 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 18th – 19th, 2021

RKK – Óbuda University

Budapest, Hungary

Content

INTRODUCTION

First of all, I wish to reflect on this year's achievements, and to thank all those who have contributed their time and effort to guarantee the quality of the content published in the Proceedings Book of the 12th ICEEE-2021 Conference.
The high quality of content published in this Proceedings Book of the 12th ICEEE-2021 has been reflected in the most successful of the recent volumes of the ICEEE Conferences since 2010.

The objective of the 12th ICEEE-2021 Conference is to analyse the issues of the global environmental development and sustainability management. The authors tried to answer the questions connecting to the above mentioned phenomenon on the basis of their experiences of selected global countries.

We have only one planet, and we are using its resources 50% faster than it can take. So, what about the future of the new and next generations! Future of humanity and the planet depends on successful resolution of the interconnected challenges of economic, social, cultural, and environmental sustainability. Our planet has a natural environment, known as 'Ecosystem' which includes all macrobiotas such as humans, plant and animal as well as microbiotas such as microorganisms, and non-living components such as atmosphere, hydrosphere and lithosphere including mountains, glaciers, rocks, galaxy, massive oceans and seas, etc. It also includes natural resources such as water, electric charge, fire, magnetism, and waste, etc.

Sustainable Engineering developments are resulting in resource depletion and environmental destruction. Modern technologies used in the engineering and manufacturing industry have a major impact on our life in past and present years. Due to the rapid changes in the engineering and manufacturing industry have been drastic changes in the environment. Human population has increased from 2.6 billion in 1950 to more than 7.5 billion, while the boundaries between people have shifted drastically due to advances in human knowledge, technique process & societal change. Human society requires protection and monitoring of the environmental quality. Environmental protection & waste management have effects on human health & ecosystems quality, requiring cooperation across different sectors to determine effective responses. By increasing the global population is rising at a staggering rate & demands ever more resources, while the bad management of environmental protection & waste management are making matters worse.

Integrating sustainable development is fully into higher education and research strategies.
Higher education and research institutions play a key role in achieving the 2030 Development

Agenda and related to the Global Sustainable Development Goals. "Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This time the Conference focus on the issues of "***Global Environmental Development & Sustainability: Research, Engineering & Management***".

Environmental Sustainability decided to restructure itself around six foci:

- Environmental Change Issues &; Assessments
- Environmental Change & Global Sustainability
- Ecosystem Dynamics & Sustainability;
- Sustainability Governance & Transformation;
- Sustainability Challenges; and
- Sustainability Sciences.

The pollutions of environment are widespread across planet Earth and frequently contaminate air, water and soil used for continuing the life on the Earth and distribution for human consumptions, and for irrigating crops.
The modern environmental engineer is dedicated to keeping our air, soil and water clean of pollutants and wastes and promoting good health for human, animal and plant and these days, protection against radioactive and toxic materials too; they also study the potential impacts of climate change and other environmental factors and pollution on theinfrastructure and environmental health.

The terms climate change and global warming are often used interchangeably, but climate change refers to both the rise in global temperatures because of human activities and the many impacts this rise has on the Earth—such as more intense and frequent droughts and storms, melting glaciers and ice sheets, rising sea levels, warming seas (which can cause coral reef bleaching and disrupt the marine food chain), and ocean acidification.

Today, people around the world can connect together online, and can access and disseminate vast amounts of knowledge and information quickly and easily. At the same time, increasing the availability of information & openness between these institutions has allowed greater understanding of the challenges facing the future of our global society with the increasing rate of the human population up-to-date.

The purpose of the 12^{th} ICEEE-2021 Conference is to facilitate interactions within the research community to discuss latest developments in this rapidly advancing field and find ways to respond to increasing demands of professionals, communities and industries across the worldwide. It allowed the participants to have different issues addressed on *Sustainable and development of the Environmental Protection* by recognized global experts who are up- to-date with the latest developments in this field. This scientific meeting gives a great opportunity for students, researchers, industrialists and academic professionals to share latestresearch results in Environmental sustainability and development, environmental healthy as well as environmental Protection and Management, network with their peers from aroundthe globe and foster new connections that strengthen research and development activities in field of environmental quality. The Conference provided a platform for all the participants tovoice their opinions and concerns as well as promoting discussions for collaborate in future.

The program of the 12th ICEEE-2021 Conference contains 83 presentations (2 plenarylectures, 12 Keynote Speakers, 22 poster and 47 lectures) with 11 sessions (1 Plenary, 1 Keynote, 2 Posters and 7 oral technical). The research papers presented in this Proceedings Book volume cover the latest developments and findings in the fields of environmental sustainable, environmental health, safety, energy, waste management, reclamation and rehabilitation and environmental protection.

Authors from over 20 countries with backgrounds in environmental sustainability, air, water, soil, energy, food, (bio)chemistry, (bio)engineering, (bio)technology and waste management, human and environmental health and environmental monitoring and hailing from the government, industry and academia, have contributed to this Proceedings Book. The contents of this Proceedings Book will be of interest to scientists, engineers, consultants and government personnel who are responsible for the development and implementation of innovative approaches, techniques and technologies in the environmental industries. It will also benefit academic researchers, as it addresses the latest advances in fundamental research.

Participants in the Conference are contributed to the development of this Proceedings Book agreed on different key conclusions from their deliberations: Information that defines the scope of environmental sustainability, protection, development and waste management due to the human activities, their transport in the environment and the potential exposure of human's wastes is available in some detail. Intervention and prevention approaches for reducing exposures to hazard materials.
Of the methods for identifying sources of contamination, currently comparative risk assessment provides the most reliable tool for ranking risk and making judgments about where significant economic benefits might be realized. Methods and procedures for benefit: cost and environmental health effectiveness: cost analysis exists to support decision making taking economic benefits into account.

This Proceedings Book describes the latest advances, innovations and applications in the field of environmental protection and waste management as presented by leading researchers, engineers and practitioners at the International Annual Conference on *Global Environmental Development & Sustainability: Research, Engineering & Management (*12th ICEEE-2021), held now in Budapest, Hungary during November 18-19, 2021.

This Proceedings Book providing a unique overview of new directions and opportunities for sustainable and resilient design approaches to protect the environment, it discusses diverse topics related to environmental protection and management of waste, through the eco-friendly re-use and processing of waste materials, the management and disposal of residual wastes, to water treatments and technologies.

It also encompasses strategies for reducing waste through better design, improved recovery, re-use, more efficient resource management and the performance of materials recovered from wastes.

The contributions were selected by means of a rigorous peer-review process and highlight many exciting ideas that will spur novel research directions and foster multidisciplinary collaboration among different waste management specialists.

I hope that this event will make a fruitful discussion within the participants and you are the support and cooperation of all.

Let us hope to meet personally in VI. International Symposium-2022 during May 5 – 6, 2022 and in the 13th ICEEE-2022

18th November 2021
Óbuda University
Budapest, Hungary

Prof. Dr. Hosam Bayoumi Hamuda
Editor-in-Chief & Chairman, ICEEE

BIBLIOGRAPHIC INFORMATION

Editor and affiliation	Prof. Dr. Hosam E.A.F. Bayoumi Hamuda President of ICEEE Institute of Environmental Engineering & Natural Sciences, Óbuda University
Organizations	International Council of Environmental Engineering Education (ICEEE)
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Publication Date	30th of November 2021
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Proceedings Book Title	Global Environmental Development & Sustainability: Research, Engineering & Management
ISBN	**978-963-449-256-6**
Number of Pages	513 pages
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Websites:	– https://www.iceee.hu – https://www.kti.rkk.uni-obuda.hu
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12th ICEEE-2021

CONFERENCE: ORGANIZATION AND COMMITTEES

Principal Organisers:

- International Council of Environmental Engineering Education
- Institute of Environmental Engineering & Natural Sciences
- Rejtő Sándor Faculty of Light Industry & Environmental Engineering
- Óbuda University

This Conference is carrying out under the patronage of:

Prof. Dr. Levente KOVÁCS	Rector, Óbuda University
Dr. László KOLTAI	Dean, Rejtő Sándor Faculty of Light Industry & Environmental Engineering
Dr. Rita BODÁNÉ-KENDROVICS	Director, Institute of Environmental Engineering & Natural Sciences
Prof. Dr. Hosam BAYOUMI HAMUDA	President, International Council of Environmental Engineering Education Chairman of the Conference

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12th ICEEE-2021

Conference Main Themes

- Applied Biochemistry & Biotechnology
- Assessment of Air, Groundwater & Soil Quality
- Agricultural & Environmental Ethics
- Bioengineering & Healthcare
- Biomass Conversion & Biorefinery
- Biogas Recovery in Municipal Solid Waste
- Biosecurity Strategy for Agricultural & Food Industry
- Bioeconomy Industry
- Bioremediation of Soil & Water Sectors
- Clean Technologies
- Climate Change & Ecological Migration & Human Health
- Climate Change & Environmental Sustainability
- Desalination & Water Treatment
- Education for Sustainable Development
- Energy & Matter Balance
- Environmental Engineering, Sustainable Production & Eco-Innovations
- Environmental Epigenetics & Human Healthcare
- Environmental Pollution: Impact Assessment, Mitigation & Prevention
- Environmental Management, Strategy, Standards & Social Responsibility
- Environmental Economics, Policy, Resources & Strategy
- Environmental Degradation & Composting
- Environmental Monitoring & Assessment
- Environmental Studies & Education
- Food, Soil & Water Security
- Food Waste Generation & Prevention Measurement
- Geosciences & Mining
- Greenhouses & Gas Emissions
- Hydrobiology Sustainability
- Landscape Functional Zoning of Urban Protected Areas
- Lichenoindication & Evaluation of Air Quality
- Local, Regional & Global Sustainability Initiatives
- Man-Made & Natural Environmental Problems
- Meteorological Patterns & Environmentally Stress
- Population Growth & Human Activities
- Residues of Biomass. Environmental Impact & Recycling
- Risk Management & Healthcare & Environmental Problems
- Sewage Sludge & Soil Constituents & Quality

- Species Distribution Modelling under Global Climate Change
- Strategy for Conservation of Biodiversity & Landscape
- Sustainable Energy Research & Applications,
- Sustainable Food Processing
- Sustainable Consumption & Education
- Sustainable Development: Applied & Natural Sciences
- Sustainable Development: Bio/Nano-(Bio)Technology
- Sustainable Development: Energy Use & Global Climate Change
- Sustainable Development: Environmental Engineering
- Sustainable Development: Healthcare
- Sustainable Development: Role of Education & Public Awareness
- Sustainable Development: Role of National & International Agencies
- Sustainable Development: Society & Environmental Interactions
- Sustainable Development: Use of Land, Water, Energy & Natural Resources
- Sustainable Energy Strategies
- Sustainable Tourism & Environment
- Sustainability Indicators: Development & Application
- Urban ecosystems & ecosystem services
- Water & Energy Footprints
- Water & Wastewater Management

The Conference welcomes scientific research, review and discussion papers dealing with environmental sustainability and development issues from such fields as the biological sciences, agriculture, geology, meteorology, energy, food sciences, soil and water sciences, geography, nutrition, physical sciences, economics, law, etc. The Conference particularly welcomes papers that highlight more than one dimension of sustainable development.

The Conference offers a platform for worldwide young and professional researchers and scientists from educational institutions, academia, industry and government to discuss proposals and disseminate results on ***Global Environmental Development & Sustainability***. The formation of lasting productive partnerships between the participants is also an objective of this Conference. This research Conference is open to all in the research and scientific community to discuss the Future Challenges and Directions regarding to the ***Global Environmental Development & Sustainability.***

ACKNOWLEDGMENT

Dear Guests and Colleagues

Thank you very much for your attendance in the 12th ICEEE-2021 International Annual Conference dealing with the Global Environmental Development & Sustainability: Research, Engineering & Management which was in Budapest during November 18-19, 2021 online in Budapest at Óbuda University, Hungary.

12th ICEEE-2021 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 12th ICEEE-2021 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 life-style.

The 12th ICEEE-2021 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 themesreflect 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 Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering (RKK), Institute of Environmental Engineering and Natural Sciences had the great pleasure towelcome all of you as a speaker and contributor for our conference **the *12th ICEEE-2021*** International Annual Conference on "*Global Environmental Development & Sustainability: Research, Engineering & Management*" which is going online here in Budapest today November 18th to 19th 2021 in Hungary.

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 the 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 efforttowards environmental health systems.

The organizing committee of the conference has the opportunity to thanks 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.

Organizing Committee
of the Conference

12th ICEEE-2021

IMPRESSUM

For the Program, Abstracts and the Proceedings Book of the papers of the 12th ICEEE-2021 International Annual Conference titled: "*Global Environmental Development & Sustainability: Research, Engineering & Management*"

– The official language was English.

– The Program, Abstracts and Full papers of the Conference is provided to all registered participants in online (electronic) form.

– All the received papers were reviewed by two of the members of the International Committee of the Conference.

– All reviewed papers for the 12th ICEEE-2021 International Annual Conference are published in the Conference Proceedings Book with the ISBN **978-963-449-256-6**. in CD-ROM format and online (electronic) in 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.

– Individual authors at their manuscripts shell be responsible for any possible errors

– The Publisher of the Program, Abstracts and the Proceedings Book of the International Annual Conference is the ICEEE, Institute of Environmental Engineering and Natural Sciences, Sándor Rejtő Faculty of Light Industry and Environmental Engineering and Natural Sciences, Óbuda University, Budapest, Hungary.

– Publication year of the Proceedings is 2021.

– 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 have to mention your wish to us.

November, 2021.

Prof. Dr. Hosam Bayoumi Hamuda
President of ICEEE, Conference Chairman

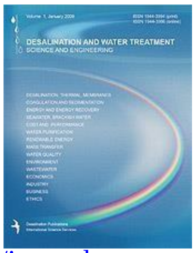
Publication:

All accepted and presented papers will be published in the Proceedings Book Part “A” and Part “B” of the Conference with IBSN: 978-963-449-256-6.

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:

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



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

- Selected papers by the Scientific Committee will be submitted for peer-reviewed publication in the above mentioned journals:
- 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-2021 Conference.
- The responsible editor committee is responsible for arranging the first communication and relationship between the author and the journal.

12th ICEEE Responsible Editors:

[1] Prof. Dr. Hosam Bayoumi Hamuda (bayoumi.hosam@uni-obuda.hu)
[2] Prof. Dr. Faissal AZIZ (f.aziz@uca.ma)

12th ICEEE-2021
Awards of the Conference

12th ICEEE-2021 Excellence Awards for best papers: 12th ICEEE-2021 Excellence Awards for best papers and presentation was instituted sine 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 12th ICEEE-2021 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 and every 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.

1. Value of the Content (30%)
2. Clarity of Presentation (20%)
3. Appropriate Audio Visual Aids (20%)
4. Ability to Connect with the Audience (10%)
5. 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.

1. Depth of Content (40%)
2. Introduction and Abstract (15%)
3. Content knowledge and organization (20%)
4. Poster Design and Overall Visual Appeal (10%)
5. Verbal Interaction (15%)

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.

1. Total Marks gained in the presentation (100%)
2. Significance of the paper to the field (30%)
3. Theoretical contribution (15%)
4. The ability of practical implementation (20%)
5. Use of appropriate methodological rigor (20%)
6. Originality (15%)

12th ICEEE-2021

AWARDS CEREMONY

List of the Best Presentation in 12th ICEEE-2021 Conference

Global Environmental Development & Sustainability: Research, Engineering & Management

Congratulations to all our presentations in 12th ICEEE-2021 International Annual Conference Awards winners

The most outstanding presentations during the two-day conference in oral or poster presentations

1. PROFESSIONAL RESEARCHERS

1. ***Sadhan Kumar GHOSH, Sannidhya Kumar GHOSH in the presentation:***

   INTERNATIONAL STANDARDS FOR ENVIRONMENTAL MANAGEMENT SYSTEM, AND RESOURCE EFFICIENCY

2. ***Borbála BIRÓ, Hosam E.A.F. BAYOUMI HAMUDA, Klára CZAKÓ VÉR in the presentation:***

   SYMBIOSIS and "BIOSPHERES" in SOIL-PLANT-MICROBE-INTERRELATIONS and SOIL-ENVIRONMENT-HUMAN HEALTH (Doctor's Program founded by Prof. M. KECSKÉS, in Hungary)

3. ***Nedjima BOUZIDI, Athmane BOUZIDI, Omar DJEZAIRI in the presentation:***

   STUDY OF THE RECYCLING OF SOLID BARITE WASTES AS MAIN CONSTITUENT IN CERAMIC COMPOSITION

4. ***Abdelwahab TAHSIN in the presentation:***

   GEOSYNTHETICS IN SUSTAINABLE INFRASTRUCTURES

5. ***Lydia SOBOTOVA, Miroslav BADIDA, Veronika GUMANOVA in the presentation:***

   NEW TRENDS AND UTILISATION OF MATERIALS IN PROTECTION AGAINST FLOOD

6. ***Csaba CENTERI, Zsolt BIRÓ, Claudia Mária KING, Márton VONA, Viktória VONA, Barbara SIMON in the presentation***

   CONNECTION BETWEEN EARTHWORMS AND SOIL PARAMETERS

2. YOUNG SCIENTISTS

7. ***Faissal AZIZ in the presentation:***

   NEW STRATEGY TO ENHANCE THE REUSE OF TREATED WASTEWATER BY PROMOTING SMART IRRIGATION SYSTEMS IN THE MENA REGION USING BIOPOLYMER

8. ***Csilla PATKÓ in the presentation:***

   THE EFFECTS OF WOODEN BUILDING MATERIALS ON THE INDOOR AIR QUALITY OF HOUSES

3. PhD STUDENTS

The most outstanding presentations presented by a participant who has registered under the Ph.D. student. The winner Ph.D. students were:

9. ***Asmaa RHAZOUANI, Halima GAMRANI, Khalid AZIZ, Mustapha My BOUYATAS, Lhoucine GEBRATI, Faissal AZIZ in the presentation:***

   TOXICITY OF GRAPHENE OXIDE IN BIOLOGICAL SYSTEMS

10. ***Imane HAYDARI, Laila MANDI, Amina LISSANEDDINE, Khalid AZIZ, Naaila OUAZZANI, Faissal AZIZ in the presentation:***

    REMOVAL OF PHENOLIC COMPOUNDS FROM OLIVE MILL WASTEWATER BY NOVEL LOW-COST BIOSORBENT: OPTIMIZATION OF PREPARATION CONDITIONS AND ADSORPTION PROCESSES

11. *Evan DAYOUB in the presentation:*

THE EFFECT OF SOIL COMPACTION UNDER DIFFERENT RATES OF BIOCHAR ON SOME PHYSICAL AND HYDRODYNAMICAL SOIL CHARACTERISTICS AND IN SOYBEAN (GLYCINE MAX L) PRODUCTIVITY

12. *H. BOUSBA, C. BENABBAS, Z. ZOUAK, R. MARMI, N. CHABOUR, S. CHELLAT in the presentation:*

INSTABILITY OF THE SLOPES LINKED TO A NEO-TECTONIC ACTIVITY, MAHOUNA, NORTH-EAST, ALGERIA

13. *Mohammad MOHAMMAD, Orsolya SZIGETI in the presentation:*

THE IMPORTANCE OF SUSTAINABLE DAIRY FUNCTIONAL FOOD PROCESSING

14. *Rima KIFOUCHE, K. BOUFAA, F. BOUAICHA, O. BOUTERAA, H. SHOUT in the presentation:*

URBAN AND INDUSTRIAL SURFACE WATER POLLUTION AND THEIR IMPACTS ON THE ENVIRONMENT. CONSTANTINE CITY CASE STUDY, NORTH-EAST OF ALGERIA

15. *Sundoss KABALAN, Katalin JUHOS, Javid AAQIB, Borbála BIRO in the presentation:*

THE ROLE OF SYMBIOTIC INTERRELATIONS IN THE AVAILABILITY OF NUTRIENTS FOR FIVE COVER CROPS

16. *Sahir M. AL-ZURAIJI, József S. PAP in the presentation:*

IMMOBILIZATION AND CHARACTERIZATION OF WATER-INSOLUBLE FE COMPLEXES AS MOLECULAR CATALYSTS FOR WATER OXIDATION

17. *Malak SHATNAWI, Haya ALTALEB, Rajnai ZOLTÁN in the presentation:*

ASSESSMENT OF THE RISK MANAGEMENT FOR VARIOUS TYPES OF DISASTERS: IMPACT AND SUSTAINABILITY

4. YOIUNG RESEARCHERS

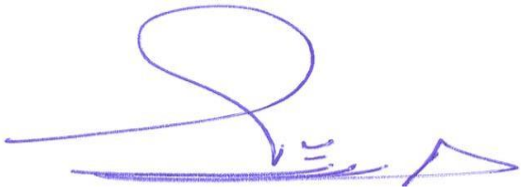
18. ***Yanina L. ROMERO, J. BESSEMBINDER, N.C. van de GIESEN, F.H.M. van de VEN in the presentation:***

    A RELATION BETWEEN EXTREME DAILY PRECIPITATION AND EXTREME SHORT TERM PRECIPITATION

19. ***Tsend-Ayush ERDENEJARGAL, Hosam E.A.F. BAYOUMI HAMUDA in the presentation:***

    BIOMONITORING OF LICHEN AS A BIOINDICATOR OF ATMOSPHERE QUALITY IN ULAANBAATAR, MONGOLIA

Budapest, 29th of November 2021.



Prof. Dr. Hosam Bayoumi Hamuda
President of ICEEE, Conference Chairman

The certificates will be sent to all the awardees in email by 27th of December 2021. In case of non-receipt of the certificate, please write to us with your contact details to: Bayoumi.hosam@uni-obuda.hu

"Global Environmental Development & Sustainability: Research, Engineering & Management"

Modes of Conference Attendance & Presentation: Online

12th ICEEE–2021

International Annual Conference

November 18 – 19, 2021

RKK – Óbuda University

Budapest, Hungary

Proceedings Book ISBN: 978-963-449-256-6

Proceedings Book websites:

– www.iceee.hu

– kti.rkk.uni-obuda.hu

CONFERENCE'S SCIENTIFIC PROGRAM

The First Day
Thursday, November 18, 2021

09:00 – 09:15	**Opening Ceremony and Introduction**

Opening & Welcome Speech

- **Prof. Dr. habil. Hosam Bayoumi Hamuda – President, International Council of Environmental Engineering and Education (ICEEE)**

- **Dr. habil. László Koltai – Dean, Rejtő Sándor Faculty of Light Industry & Environmental Engineering (RKK)**

- **Dr. Rita BODÁNÉ-KENDROVICS – Director, Institute of Environmental Engineering & Natural Sciences ((KTI)**

09:15 – 10:10	**Plenary Session**

Chair: Rita BODÁNÉ-KENDROVICS

Time	Title and Author
09:15 – 09:40	**INTERNATIONAL STANDARDS FOR ENVIRONMENTAL MANAGEMENT SYSTEM, AND RESOURCE EFFICIENCY** **Sadhan Kumar GHOSH[1], Sannidhya Kumar GHOSH[2]** *[1]Department of mechanical Engineering, Jadavpur University, Kolkata, India,* *[2]Department of Civil, Environmental and Architectural Engineering, University of Colorado Boulder, USA*
09:40– 10:10	**SYMBIOSIS and "BIOSPHERES" in SOIL-PLANT-MICROBE-INTERRELATIONS and SOIL-ENVIRONMENT-HUMAN HEALTH (Doctor's Program founded by Prof. M. KECSKÉS, in Hungary)** **Borbála BIRÓ[1], Hosam E.A.F. BAYOUMI HAMUDA[2], Klára CZAKÓ VÉR[3]** *[1]Department of Agri-Environmental Studies, Szent Istvan University, Budapest, Hungary,* *[2]Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary,* *[3]University of Pécs, Faculty of Technology and Informatics, Pécs, Hungary*

10:10 – 13:20	Keynote Session
	Chair: **Borbála BIRÓ**
Time	**Title and Author**
10:10 – 10:30	**ENVIRONMENTAL DEVELOPMENT & SUSTAINABILITY: TECHNOLOGY & MANAGEMENT** **Hosam E.A.F. BAYOUMI HAMUDA** *Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary*
10:30 – 10:50	**INDIAN HUNGARIAN RESEARCH COOPERATION POSSIBILITIES IN THE FIELD OF ENVIRONMENTAL DEVELOPMENT & SUSTAINABILITY** **Hilda FARKAS** *Embassy of Hungary 2/50-M Niti Marg, Chanakyapuri, New Delhi 110-021, India*
10:50 – 11:10	**MAPPING THE ENVIRONMENTAL DAMAGES CAUSED BY CONSTRUCTION OF THE ROAD “RRUGA E ARBËRIT”** **Edmond HOXHA[1], Klea MECI[2]** *[1]Department of Mineral Resources, Faculty of Geology and Mine, Polytechnic University of Tirana, Rr. Elbasanit, Tirana, Albania, [2]Department of Mineral Resources, Faculty of Geology and Mine, Polytechnic University of Tirana, Rr. Elbasanit, Tirana, Albania*
11:10 – 11:30	**EFFECT OF CLIMATE CHANGE ON SOIL MICROBIOME AND RESISTOME** **Lyudmyla SYMOCHKO[1,2]** *[1]Uzhhorod National University, Uzhhorod, Ukraine,* *[2]Institute of Agroecology and Environmental Management of NAAS, Kyiv, Ukraine*
11:30 – 11:50	**NEW STRATEGY TO ENHANCE THE REUSE OF TREATED WASTEWATER BY PROMOTING SMART IRRIGATION SYSTEMS IN THE MENA REGION USING BIOPOLYMER** **Faissal AZIZ[1,2]** *[1]Laboratory of Water, Biodiversity & Climate Change, Semlalia Faculty of Sciences, University Cadi Ayyad, Marrakech, Morocco,* *[2]National Centre for Research and Studies on Water and Energy (CNEREE), University Cadi Ayyad, Marrakech, Morocco*
11:50 – 12:10	**THE BEHAVIOR OF ECO-FRIENDLY CERAMIC MATERIALS BASED GOLD MINING TAILINGS** **Nedjima BOUZIDI[1], Athmane BOUZIDI[2], Amina BAZIZ[1]** *[1]Laboratory of Materials Technology and Process Engineering (LTMGP), University of Bejaia, Algeria,* *[2]Electrical Engineering Laboratory (LGE), TarguaOuzemmour Road, Bejaia, Algeria*
12:10 – 12:30	**CONTAMINATION MONITORING AND RISK ASSESSMENT IN THE CRITICAL ZONE WITH A VIEW ON HEATH, FOOD AND WATER PROTECTION UNDER CLIMATE CHANGE CONDITIONS: CHALLENGES, TECHNIQUES AND CASE STUDIES: A GLOBAL PERSPECTIVE** **Gyozo JORDAN[1], Zsofia KOVACS[2], Silvana BELTRAN[3], Péter SZABO[4]**

	[1]Research Centre for Astronomy and Earth Sciences, ELKH, Budapest, Hungary, *[2]Faculty of Engineering, University of Pannonia, Veszprem, Hungary, Faculty of Engineering, University of Pannonia, Veszprem, Hungary,* *[3]Theoretical and Experimental Ecology Station SETE, Moulis, France,* *[4]Faculty of Natural Sciences, ELTE University, Budapest, Hungary*
12:30 – 12:50	**WATER MANAGEMENT ISSUES IN SPAIN AND PORTUGAL AT BEGINNING OF 2020S** **Sándor J. ZSARNÓCZAI** *Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering and Natural Sciences, Budapest Hungary*
12:50 – 13:10	**CHANLLENGES AND ASSETS IN THE SANITATION OF CITIES IN REPUBLIC OF BENIN (WEST AFRICA)** **Léocadie ODOULAMI** *Pierre PAGNEY Laboratory, Climate, Water, Ecosystem and Development LACEEDE / DGAT / FASHS / 1 University of Abomey-Calavi, Cotonou, Republic of Benin (West Africa)*
13:10 – 13:30	**GEOSYNTHETICS IN SUSTAINABLE INFRASTRUCTURES** **Abdelwahab TAHSIN** *Arab Consulting Engineers Office, Dokki, Giza, Egypt*
13:30 – 14:00	**Lunch Break**

14:00 – 15:00	Oral Technical Session (1)
	Chair: Hosam Bayoumi Hamuda
Time	**Title and Author**
14:00 – 14:10	**THE EFFECTS OF WOODEN BUILDING MATERIALS ON THE INDOOR AIR QUALITY OF HOUSES** **Csilla PATKÓ** *University of Technology and Economics Department of Building Constructions, Budapest, Hungary*
14:10 – 14:20	**IMPACT OF LANDFILL GASES ON THE SURROUNDING POPULATION – A MODELLING APPROACH** **Bogdana VUJIĆ[1*], Mira RADENOVIĆ[2], Una MARČETA[1] Maja PETROVIĆ[3]** *[1]University of Novi Sad, Technical faculty "Mihailo Pupin", Đure Đakovića bb, Zrenjanin, Serbia,* *[2]City of Novi Sad, City Council,* *[3]University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia*
14:20 – 14:30	**REJUVENATION OF SOIL ORGANIC CARBON THROUGH SOIL AMENDMENTS: A NOVEL APPROACH TO MANAGING HEAVY METALS IN SOIL AND PLANTS** **P. SENTHILVALAVAN[1], V. VINOTHKUMAR[1], M.V. SRIRAMACHANDRASEKHARAN[1], R. MANIVANNAN[1], C. RAVIKUMAR[2], T. VASANTHAKUMAR[3]** *[1]Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamilnadu, India,* *[2]Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamilnadu, India,* *[3]Department of Chemical Engineering, Faculty of Engineering and Technology, Annamalai University, Annamalainagar, Tamilnadu, India*
14:30 – 14:40	**USE OF VEGATABLE OILS AS INSULATING DIELECTRIC LIQUID IN ELECTRICITY INDUSTRY** **Ildikó BOCSI[1], Mária SZEBENI[1], Zoltán JUVANCZ[2]*, Rita BODÁNÉ-KENDROVICS[2], Krisztina DEMÉNY[2], Árpád KÁRPÁTI[3]** *[1]TPV Diagnosztikai és Kutató Kft, Budapest, Hungary,* *[2]Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary,* *[3]Environmental Engineering, Institute, University of Pannonia, Hungary*
14:40 – 1450	**NEW TRENDS AND UTILISATION OF MATERIALS IN PROTECTION AGAINST FLOOD** **Lydia SOBOTOVA, Miroslav BADIDA, Veronika GUMANOVA** *Department of Engineering of Environment, Faculty of Mechanical Engineering, Technical University of Košice, Kosice, Slovakia*
14:50 – 15:00	**TOXICITY OF GRAPHENE OXIDE IN BIOLOGICAL SYSTEMS** **Asmaa RHAZOUANI[1,2,3], Halima GAMRANI[2], Khalid AZIZ[4], Mustapha My BOUYATAS[2], Lhoucine GEBRATI[5], Faissal AZIZ[1,3]** *[1]Laboratory of Water, Biodiversity & Climate Change, Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco,* *[2]Team of Neurosciences, Pharmacology & Environment, Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco,*

	[3]National Centre for Studies & Research on Water and Energy, Faculty of Technical Sciences, Cadi Ayyad University, Marrakech, Morocco, *[4]Laboratory of Materials, Biotechnology, and Valorization of Natural Resources, Department of Chemistry, Faculty of Sciences, University Ibn Zohr, Agadir, Morocco*, *[5]Laboratory of Materials, Processes, Environment and Quality, Cadi Ayyad University, Safi, Morocco*

15:00 – 16:00	**Oral Technical Session (2)**

Chair: **Zoltán JUVANCZ**

Time	Title and Author
15:00 – 15:10	**EFFECTS OF LAND USE LAND COVER CHANGES ON HYDROLOGICAL SYSTEM IN THE CASE OF ETHIOPIA** **Anmut Enawgaw KASSIE** *Department of Natural Resources Management; Debre Markos University Burie Campus, Ethiopia*
15:10 – 15:20	**ENGINEERING OF HIGHLY BRACHYCHITON POPULNEUS SHELLS@POLYANILINE BIO-SORBENT FOR EFFICIENT REMOVAL OF PESTICIDES FROM WASTEWATER: OPTIMIZATION USING BBD-RSM APPROACH** **Khalid AZIZ[1], Rachid MAMOUNI[1], Nabil SAFFAJ[1], Faissal AZIZ[2,3]** *[1]Laboratory of Materials, Biotechnology, & Valorization of Natural Resources, Department of Chemistry, Faculty of Sciences, University Ibn Zohr, Agadir, Morocco,* *[2]Laboratory of Water, Biodiversity & Climate Change, Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco,* *[3]National Centre for Studies & Research on Water & Energy, Faculty of Technical Sciences, Cadi Ayyad University, Marrakech, Morocco.*
15:20 – 15:30	**WATER CIRCULARITY TO ACHIEVE SDG 6 THROUGH TREATMENT OF WASTEWATER** **Sadhan Kumar GHOSH[1,2], Dineshkumar M.[1]** *[1]Department of Mechanical Engineering, Jadavpur University, Kolkata, India* *[2]President, International Society of Waste Management, Air and Water, Kolkata, India*
15:30 – 15:40	**REMOVAL OF PHENOLIC COMPOUNDS FROM OLIVE MILL WASTEWATER BY NOVEL LOW-COST BIOSORBENT: OPTIMIZATION OF PREPARATION CONDITIONS AND ADSORPTION PROCESSES** **Imane HAYDARI[1,2], Laila MANDI[1,2], Amina LISSANEDDINE[1,2], Khalid AZIZ[3], Naaila OUAZZANI[1,2], Faissal AZIZ[1,2]** *[1]Laboratory of Water, Biodiversity, & Climate Change, Faculty of Sciences Semlalia, Cadi Ayyad University, Marrakech, Morocco.* *[2]National Center for Research & Studies on Water and Energy (CNEREE), Cadi Ayyad University, Marrakech, Morocco,* *[3]Laboratory of Materials, Biotechnology, & Valorization of Natural Resources, Department of Chemistry, Faculty of Sciences, University Ibn Zohr, Agadir, Morocco.*
15:40 – 15:50	**THE EFFECT OF SOIL COMPACTION UNDER DIFFERENT RATES OF BIOCHAR ON SOME PHYSICAL AND HYDRODYNAMICAL SOIL CHARACTERISTICS AND IN**

	SOYBEAN (GLYCINE MAX L) PRODUCTIVITY **Evan DAYOUB** *Department of soil and water sciences, Faculty of Agriculture / Tishreen University, Latakia, Syria*
15:50 – 16:00	**SPATIAL EVOLUTION OF SURFACE WATER QUALTE, WADI KEBIR WATERSHED (North-East ALGERIA)** **H. BOUDRA[1], A. DROUICHE[2], F. ZAHI[2], F. BOUAICHA[1], W. MELOUAH[3], W. BOUKHATEM[1]** *[1]Geology and Environment Laboratory, University of Constantine 1, Road Ain El Bey Zouaghi Slimane Constantine, Algeria,* *[2]Geological Engineering Laboratory (LGG), Mohammed Seddik Benyahia University, Jijel, Algeria,* *[3]Laboratory of Underground Oil, Gas and Aquifer Reservoirs, Faculty of Hydrocarbons, Renewable Energies and Earth and Universe Sciences Kasdi Merbah University, Ouargla, Algeria*
16:00 – 17:00	**Oral Technical Session (3)**
	Chair: **Lóránt SZABÓ**
Time	**Title and Author**
16:00 – 16:10	**REMOTE SENSING: DETERMINATION OF SOIL SALINITY IN MEDITERRANEAN REGION USING UNMANNED AERIAL VEHICLE** **Kaoutar LKIMA[1,2,3], Francisco Pedrero SALCEDO[3], Faissal AZIZ[1,2]** *[1]Laboratory of Water, Biodiversity & Climate Change, Semlalia Faculty of Sciences, University Cadi Ayyad, Marrakech, Morocco,* *[2]National Centre for Research & Studies on Water & Energy, University Cadi Ayyad, Marrakech, Morocco,* *[3]Department of Irrigation, CEBAS-CSIC, Campus Universitario de Espinardo, Murcia, Spain*
16:10 – 16:20	**HYDROGEOLOGICAL STUDY OF THE SAF-SAF WATERSHED SKIKDA NORTH-EAST ALGERIA** **Meriem BOUKHATEM, R. GUERIREM, N. CHABOUR, F. BOUAICHA, H. BOUDRA, S. CHELLAT** *Geology and Environement Laboratory, University of Constantine 1, Road Ain El Bey Zouaghi Slimane Constantine, Algeria*
16:20 – 16:30	**FORAMINIFERS AS POLLUTION BIO-INDICATOR AT AL HARIQA OIL HARBOUR OF TOBRUK, LIBYA** **Eihab A.S. MOHAMED[1], Ahmed M. MUFTAH[2*], Osama R. SHALTAMI[2]** *[1]Jaowfe Company for Oil Technology, Ganfouda, Libya* *[2]University of Benghazi, Faculty of Science, Department of Earth Sciences, Benghazi, Libya*
16:30 – 16:40	**PLASTICS CIRCULAR ECONOMY USING PYROLYSIS TECHNOLOGY** **Sadhan Kumar GHOSH[1,2], Sampad Kumar DAS[1]** *[1]Department of mechanical Engineering, Jadavpur University, Kolkata, India,* *[2]President, International Society of Waste Management, Air & Water, Kolkata, India*

16:40 – 16:50	**OIL POLLUTION IN THE PORT OF BENGHAZI CITY AT NORTHEAST OF LIBYA** **Osama R. SHALTAMI[1], Fares F. FARES[1], Osama A. El-FALLAH[1], Farag M. EL OSHEBI[1], Hwedi ERRISHI[2], Salah S. El-EHFIFI[3]** *[1]Department of Earth Sciences, Faculty of Science, Benghazi University, Libya,* *[2]Department of Geography, Faculty of Arts, Benghazi University, Libya,* *[3]National Oil Corporation (NOC), Exploration Department, Libya*
16:00 - 17:00	**THE INFLUENCE OF PROPANE-FUELED FLAME WEEDING ON MICROBIOLOGICAL PROCESSES IN THE SOIL** **Iryna GUMENIUK, Alla LEVISHKO, Olena DEMYANYUK, Oleksandr BOTSULA, Yevheniia TKACH** *Institute of Agroecology and Environmental management of National Academy of Agrarian Sciences of Ukraine, Kyiv, Ukraine*
17:00 – 18:00	**Poster Technical Session (1)**
	Chair: Hosam Bayoumi Hamuda
Time	**Title and Author**
17:00 -17:05	**MODERN AGROTECHNOLOGIES OF CORN CULTIVATION IN CONDITIONS OF CLIMATE CHANGE** **Olena DEMYANYUK[1], Lyudmyla SYMOCHKO[1,2], Dmitry SHATSMAN[1]** *[1]Institute of Agroecology and Environmental Management of NAAS, Kyiv, Ukraine, [2]Uzhhorod National University, Faculty of Biology, Uzhhorod, Ukraine*
17:05 – 17:10	**CONNECTION BETWEEN EARTHWORMS AND SOIL PARAMETERS** **Csaba CENTERI[1], Zsolt BIRÓ[1], Claudia Mária KING[1], Márton VONA[2], Viktória VONA[2], Barbara SIMON[3]** *[1]Institute of Wildlife Management and Nature Conservation, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary,* *[2]Csernozjom Ltd., Hungary,* *[3]Institute of Environmental Sciences, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary*
17:10 – 17:15	**GREEN CHEMISTRY: IONIC LIQUIDS IN INDUSTRIAL APPLICATIONS** **Cemile Ceren TOSUN[1], Arife Candas Adiguzel ZENGIN[2*]** *[1]Uşak University, Leather, Textile and Ceramic Design Application and Research Center, 64000, Uşak, Turkey,* *[2]Ege University, Engineering Faculty, Leather Engineering Department, 35100, Bornova, Izmir, Turkey.*
17:15 – 17:20	**STUDY OF THE RECYCLING OF SOLID BARITE WASTES AS MAIN CONSTITUENT IN CERAMIC COMPOSITION** **Nedjima BOUZIDI[1], Athmane BOUZIDI[2], Omar DJEZAIRI[1]** *[1]Laboratory of Materials Technology and Process Engineering (LTMGP), University of Bejaia, Algeria,* *[2]Electrical Engineering Laboratory (LGE), TarguaOuzemmour Road, Bejaia, Algeria*
17:20 – 17:25	**BIOINDICATION OF SOIL AS ADDITIONAL TOOL FOR ECOLOGICAL MONITORING** **Olga HAFIIYAK[1], Lyudmyla SYMOCHKO[1,2]** *[1]Uzhhorod National University, Uzhhorod, Ukraine,*

	[2]Institute of Agroecology and Environmental Management of NAAS, Kyiv, Ukraine
17:25 – 17:30	**SYNTHESIS OF SILVER AND GOLD NANOPARTICLES USING MELISSA OFFICINALIS L. LEAF EXTRACT** **R. MARIYCHUK[1], R. SMOLKOVÁ[1], A. ELIAŠOVÁ[1], L. GRISHCHENKO[2], V.V. LISNYAK[2]** *[1]Department of Ecology, Faculty of Humanities and Natural Sciences, University of Prešov, Prešov, Slovakia,* *[2]Faculty of Chemistry, Taras Shevchenko National University of Kyiv, Kyiv, Ukraine*
17:30 – 17:35	**AIR POLLUTION MODELLING SOFTWARE PERFORMANCE COMPARISON - A CASE STUDY OF KOMÁROM ROAD** **Marko JOVANOV [1], Bushra AFTEH[2], Bogdana VUJIĆ [1], Una MARČETA [1], Jelena VUKOVIĆt** *[1]University of Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia,* *[2]Department of Meteorology, Eötvös Loránd University, Budapest, Hungary,* *[3]Faculty of Technology Zvornik, Republic of Srpska, Bosnia & Herzegovina*
17:35 – 17:40	**MANAGEMENT AND SUSTAINABLE DEVELOPMENT OF ECOTOURISM DESTINATIONS** **Vuk MIRČETIĆ, Adriana RADOSAVAC*** *Faculty of Applied Management, Economics and Finance, Belgrade, Serbia*
17:40 – 17:45	**REPRODUCTION OF POTENTIAL SOIL FERTILITY AND THE STATE OF THE ENVIRONMENT AT THE WASTE APPLICATION FROM PIG COMPLEXES** ***Stanislav DEHODIUK[1], Olena LITVINOVA[2], Dmytro LITVINOV[2], Yuliia BORKO[1]*** *[1]National Science Center «Institute of Agriculture NAAS Ukraine, Chabany, Ukraine;* *[2]National University of life and environmental sciences of Ukraine, Kyiv, Ukraine*
17:45 – 17:50	**INFLUENCE OF OXIDANTS ON SORPTION OF IRON IONS ON CLINOPTILOLITE** **Stepan MILYOVICH, Snanislav KREMSA** *Uzhhorod National University, Uzhgorod, Ukraine*
17:50 – 17:55	**HYDRAULIC INFRASTRUCTURES MANAGEMENT IN KETOU MUNICIPALITY IN REPUBLIC OF BENIN (WEST AFRICA)** **Léocadie ODOULAMI, Moranikédji Odile ADEBITE** *Pierre PAGNEY Laboratory, Climate, Water, Ecosystem and Development LACEEDE / DGAT / FASHS / 1 University of Abomey-Calavi, Cotonou, Republic of Benin (West Africa)*
17:55 – 18:00	**FEASIBILITY OF USING GREEN TEA POWDER AS A NATURAL ANTIOXIDANT AND STEVIA AS A SWEETENER IN NON-FERMENTED LAYER CAKE** **Leyla NNATEGHI[1], Fatemeh ZAREI[2], Hosam E.A.F. BAYOUMI HAMUDA[3]** *[1]Department of Food Sciences and Industries, Faculty of Agriculture, Varamin-Pishva Branch, Varamin, Iran,* *[2]Food Sciences and Industries, Food and Drug Administration, Tehran, Iran,* *[3]Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary.*

12th ICEEE-2021

The Second Day
Friday, November 19, 2021

09:00 – 10:00	**Oral Technical Session (4)**
	Chair: **Krisztina DEMÉNY**
Time	**Title and Author**
09:00 – 09:10	**EXAMINATION OF SATURATED HYDRAULIC CONDUCTIVITY USING GRADING CURVE FUNCTIONS** **Emőke IMRE[1], László NAGY[2], Zsombor ILLÉS[2], Ágnes BÁLINT[3], Daniel BARRETO[4]** *[1]Hydro-Bio-Mechanical Systems Research Center, Óbuda University, Budapest, Hungary,* *[2]Department of Engineering Geology and Geotechnics, Budapest University of Technology and Economics, Budapest, Hungary, [3]Institute of Environmental Engineering and Natural Sciences, Óbuda University, Budapest, Hungary, [4]Edinburgh Napier University, UK*
09:10 – 09:20	**ENVIRONMENTAL ODOR PROBLEM IN HUNGARY, LEGISLATION, MEASUREMENT POSSIBILITIES** **Csaba ÁGOSTON** *Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary*
09:20 – 09:30	**ASSESSING SURFACE WATERS QUALITY OF EL MALLEH RESERVOIR** **Nouhaila MAZIGH, Abdeslam TALEB, Nihal BAJI, Badr FATHI, Mohammed MOUKHLISS, Ali EL BILALI** *Laboratory of Environmental Process Engineering, Faculty of Science & Technology, University Hassan 2, Casablanca, Morocco*
09:30 – 09:40	**RECOVERY OF SCANDIUM FROM THE BAUXITE RESIDUE BY SOLVENT EXTRACTION** **Ali Dawood SALMAN[1,2], Tatjána JUZSAKOVA[1], Moayyed G. JALHOOM[3], Thamer Adnan ABDULLAH[1], Phuoc-Cuong LE[4,5], Endre DOMOKOS[1]** *[1]Sustainability Solutions Research Lab, University of Pannonia, Veszprém, Hungary, [2]Department of Chemical & Petroleum Refining Engineering, College of Oil & Gas Engineering, Basra University, [3]Department of Production Engineering & Minerals, University of Technology Baghdad-Iraq, [4]Institute of Research & Development, Duy Tan University, Danang, Vietnam, [5]Faculty of Environmental & Chemical Engineering, Duy Tan University, Danang, Vietnam*

09:40 – 09:50	**EVALUATION OF TOXICITY AND BIOSORPTION FOR THE REMOVAL OF HEXAVALENT CHROMIUM USING FRESHWATER MICROALGAE** **Karim SBIHI[1,2], Khalid AZIZ[3], Faissal AZIZ[2,]** *[1]Laboratory of Biotechnology, Materials & Environment, Natural Substances & Environment Team, Polydisciplinaire Faculty, University Ibn Zohr, Taroudant, Morocco,* *[2]National Centre for Research & Study on Water & Energy, University Cadi Ayyad, Marrakech, Morocco.* *[3]Laboratory of Materials, Biotechnology, &Valorization of Natural Resources, Department of Chemistry, Faculty of Sciences, University Ibn Zohr, Agadir, Morocco,* *[4]Laboratory of Water, Biodiversity & Climate Changes, Semlalia Faculty of Sciences, Marrakech, Morocco*
09:50 – 10:00	**INSTABILITY OF THE SLOPES LINKED TO A NEO-TECTONIC ACTIVITY, MAHOUNA, NORTH-EAST, ALGERIA** **H. BOUSBA[1], C. BENABBAS[2], Z. ZOUAK[1], R. MARMI[1], N. CHABOUR[1], S. CHELLAT[1]** *[1]Laboratoire de géologie et environnement, Université Constantine 1, Constantine, Algérie,* *[2]Université Salah Bou Bnider, Constantine 3, Constantine, Algérie*
10:00 – 11:00	**Oral Technical Session (5)**
	Chair: **Csaba ÁGOSTON**
Time	**Title and Author**
10:00 -10:10	**IMPACTS OF CONTAMINATED WATER ON REAL ESTATE VALUES** **Slimani CHAHID[1], Farhaoui MOHAMED[2]** *[1]Law School, Sidi Mohamed Ben Abdellah University, ESSOR Lab, Fes, Morocco,* *[2]Law School, Sidi Mohamed Ben Abdellah University, ESSOR Lab, Fes, Morocco*
10:10 – 10:20	**PHYSICO-CHEMICAL PROPERTIES OF THERMAL WATERS IN THE GUELMA REGION, NORTH-EAST ALGERIA** **M. HACID[1], K. BENMARCE[2], O. MELOUAH[3], N. CHABOUR[1]** *[1] Geology and Environment Laboratory, University of Constantine 1, Road Ain El Bey Zouaghi Slimane Constantine, Algeria, [2]Geosciences laboratory, university of Setif 1., Algeria, [3]Laboratory of Underground Oil, Gas and Aquifer Reservoirs, Faculty of Hydrocarbons, Renewable Energies and Earth and Universe Sciences Kasdi Merbah University, Ouargla, Algeria*
10:20 -10:30	**THE IMPORTANCE OF SUSTAINABLE DAIRY FUNCTIONAL FOOD PROCESSING** **Mohammad MOHAMMAD, Orsolya SZIGETI** *Department of business and management, Hungarian University of Agriculture and Life Sciences MATE, Kaposvár Campus, Gödöllő, Hungary*
10: 30 – 10:40	**NEXUS BETWEEN THE MINERAL RESOURCES ABUNDANCE, RENEWABLE ENERGY POLICIES AND ECONOMIC GROWTH, AND THEIR CONNECTION WITH CO2 EMISSIONS IN TRANSITION COUNTIRES** **Dina MALGAZHDAROVA[1], Imre NAGY[2]**

	[1]Faculty of Economic Sciences, Hungarian University of Agriculture and Life Sciences, Hungary, *[2]Faculty of Sciences, University of Novi Sad, Serbia*
10:40 – 10:50	**URBAN AND INDUSTRIAL SURFACE WATER POLLUTION AND THEIR IMPACTS ON THE ENVIRONMENT. CONSTANTINE CITY CASE STUDY, NORTH-EAST OF ALGERIA** **Rima KIFOUCHE[1], K. BOUFAA[2], .F. BOUAICHA[1], O. BOUTERAA[1], H. SHOUT[1]** *[1]Laboratoire de géologie et environnement, Université Constantine 1, Route Ain El Bey Zouaghi Slimane Constantine, Algeria,* *[2]Université Frères Mentouri Constantine 1, Algeria*
10:50 – 11:00	**THE QUALITY ASSESSMENT OF DRINKING WATER FROM DISTRICT ABBOTTABAD, KPK, PAKISTAN** **Zahid MEHBOOB[1], Nadia SHUJAHAT[1], Mukhtiar HUSAIN[1], Samiyah TASLEEM[2]** *[1]Department of Biochemistry, Faculty of Health Science, Hazara University Mansehrar, Pakistan,* *[2]Department of Microbiology, FUUAST-Karachi and University of Karachi.Pakistan*

11:00 – 12:20	**Oral Technical Session (6)**

Chair: **Hosam Bayoumi Hamuda**	
Time	**Title and Author**
11:00 – 11:10	**THE ROLE OF SYMBIOTIC INTERRELATIONS IN THE AVAILABILITY OF NUTRIENTS FOR FIVE COVER CROPS** **Sundoss KABALAN, Katalin JUHOS, Javid AAQIB, Borbála BIRO** *Doctoral School of Horticulture, Hungarian University of Agriculture and Life Science (MATE), Budapest, Hungary*
11:10 – 11:20	**A RELATION BETWEEN EXTREME DAILY PRECIPITATION AND EXTREME SHORT TERM PRECIPITATION** **Yanina L. ROMERO[1], J. BESSEMBINDER[2], N.C. van de GIESEN[3], F.H.M. van de VEN[3]** *[1]The Netherlands,* *[2]Royal Netherlands Meteorological Institute, De Bilt, The Netherlands,* *[3]Water Management, Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, The Netherlands*
11:20 – 11:30	**IMPACT OF BRASSWARE UTENSILS INDUSTRY ON THE ENVIRONMENT, CONSTANTINE, NORTH-EAST OF ALGERIA** **Amina BOUSSELIOU[1], N. CHABOUR[1], H. BELAIDI[1], I. BOUDRA[2,3,4], S. CHELLAT[1]** *[1]Geology and Environment Laboratory, University of Constantine 1, Constantine, Algeria* *[2]Constantine 1 University, Department of Chemistry, Pollution and WaterTreatment Laboratory, Constantine, Algeria,* *[3]August 1955 University of Skikda, Department of Chemistry, Skikda, Algeria,* *[4]nvironmental Molecular and Structural Chemistry Research UnitConstantine, Algeria*

11:30 – 11:40	**A NOVEL-TYPE ANALYTICAL SOLUTION OF THE PROBLEM OF SIMULTANEOUS CONVECTION AND MULTI COMPONENT DIFFUSION PROCESS THROUGH POROUS MEDIA** **Ágnes BÁLINT[1,2], István NIKOLÉNYI[3], Csaba MÉSZÁROS[3]** *[1]Institute of Environmental Engineering and Natural Sciences,* *[2]Hydro-Bio-Mechanical Systems Research Centre, Óbuda University, Budapest, Hungary,* *[3]Department of Mathematics and Basic Sciences, MATE, Gödöllő, Hungary*
11:40 – 11:50	**SEPARATION STUDIES ON BINARY MIXTURE OF BIOMASS-DERIVED GAMMA-VALEROLACTONE AND TOLUENE** **Munaf AL-LAMI, László T. MIKA** *Department of Chemical and Environmental Process Engineering/Budapest University of Technology and Economics, Budapest, Hungary*
11:50 – 12.00	**IMMOBILIZATION AND CHARACTERIZATION OF WATER-INSOLUBLE FE COMPLEXES AS MOLECULAR CATALYSTS FOR WATER OXIDATION** **Sahir M. AL-ZURAIJI[1], József S. PAP[2]** *[1]Surface Chemistry and Catalysis Department, Centre for Energy Research, Budapest, Hungary,* *[2]Doctoral School on Materials Sciences and Technologies, Óbuda University, Budapest, Hungary*
12:00 – 12:10	**DIFFERENT POLYMERS MODIFIED MAGNETIC MWCNTS FOR HYDROCARBONS REWMOVAL FROM WATER** **Thamer Adnan ABDULLAH[1,2], Tatjana JUZSAKOVA[1], Ali D. SALMAN[1], Rashed T. RASHEED[2], Balázs ZSIRKA[3], Sebestyen VIKTOR[1]** *[1]Sustainability Solutions Research Lab, University of Pannonia, Veszprém, Hungary* *[2]Chemistry Branch, Applied Sciences Department, University of Technology, Baghdad, Serbia,* *[3]Laboratory for Surface and Nanostructures (LASUNA), University of Pannonia, Veszprém, Hungary*
12:10 – 12:20	**DISSOLVED ORGANIC MATTER DIFFERENCES IN THE SOIL AS AFFECTED BY THE EXTRACTION METHOD** **Thulfiqar AL-GRAITI, Gergely JAKAB, Zoltán SZALAI** *Department of Environmental and Landscape Geography, Institute of Geography and Earth Sciences, Faculty of Science, Budapest, Hungary.*
12:20 – 12:30	**ASSESSMENT OF THE RISK MANAGEMENT FOR VARIOUS TYPES OF DISASTERS: IMPACT AND SUSTAINABILITY** **Malak SHATNAWI, Haya ALTALEB, Rajnai ZOLTÁN** *Doctoral School on Safety and Security Sciences, Óbuda University, Budapest, Hungry*

12:30 – 13:30	Poster Technical Session (2)

Chair: Hosam Bayoumi Hamuda

Time	Title and Author
12:30 – 12:35	**INFLUENCE OF VITERI VITERI 8-4-5 FERTILIZER ON SOWING QUALITIES OF CEREALS AND LEGUMIN CROPS SEEDS** **Olga KICHIGINA, Mychailo ZOLOTOV, Olena DEMYANYUK, Yuliya TSYBRO** *Institute of Agroecology and Environmental Management of NAAS, Kyiv, Ukraine*
12:35 – 12:40	**RICHNESS IN POLYMETALLIC MINERALISATION Fe, Pb, Zn, Ba AND HYDROTHERMAL SPRING OF MOUNT M'CID AICHA, TELLIAN ATLAS, NORTH-EAST OF ALGERIA** **H. BELAIDI[1], S. MANSOURI[2], A. BOUZENOUNE[2], A. BOUSSELIOU[1], S. KITOUNI[3], S. CHELLAT[1]** *[1]Laboratoire de géologie et environnement, Université Constantine 1, Constantine, Algeria,* *[2]Laboratoire de géni géologie (LGG), Université Mohamed El Sedik Ben Yahia, Jijel, Algeria,* *[3]Département Génie des Procédés, Faculté Génie des Procédés. Université Salah Boubnider Constantine 3, Algeria.*
12:40 – 12:45	**MORPHOTAXONOMICAL INVESTIGATION AND HORTICULTURAL APPLICABILITY OF FESTUCA WAGNERI TAXA** **Dániel BALOGH*[1], Attila FŰRÉSZ[1], Éva Horváthné BARACSI[2], Gergely PÁPAY[1], Virág KALCSÓ[1], Károly PENKSZA[1]** *[1]Department Of Botany, Hungarian University Of Agronomy And Life Sciences, Gödöllő, Hungary,* *[2]Institute for Horticulture, Hungarian University Of Agronomy And Life Sciences, Gödöllő, Hungary*
12:45 – 12:50	**EVALUATION OF MICROAEROBIC AND AEROBIC XYLENE DEGRADATION POTENTIAL OF PSEUDOMONAS SP. STRAIN MAP12 AND SPHINGOBIUM SP. STRAIN AS12 ISOLATED FROM PETROLEUM-CONTAMINATED GROUNDWATER OF SIKLÓS, HUNGARY** **Sinchan BANERJEE[1], András TÁNCSICS[1]** *Hungarian University of Agriculture and Life Sciences, Institute of Aquaculture and Environmental Safety, Department Molecular Ecology, Gödöllő, Hungary*
12:50 – 12:55	**IMPACT OF WASTE ON THE ENVIRONMENT STUDY OF POLLUTANTS STATISTIC AND SOLUTIONS, CITY OF CONTANTINE, NORTH-EAST OF ALGERIA** **H. BELAIDI[1], K. Belouad[1], A. BOUSSELIOU[1], S. KITOUNI[2], S. CHELLAT[1]** *[1]Laboratoire de géologie et environnement, Université Constantine 1, Constantine, Algeria,* *[2]Département Génie des Procédés, Faculté Génie des Procédés, Université Salah Boubnider Constantine 3, Algeria.*
12:55 – 13:00	**DESIGN GUIDELINES FOR MECHANICALLY STABILIZED EARTH WALL** **Abdelwahab TAHSIN** *Arab Consulting Engineers Office, Dokki, Giza, Egypt*

13:00 – 13:05	**EFFECT OF ADDING POTASSIUM HUMATE AT DIFFERENT LEVELS OF MOISTURE TENSION IN SOME PHYSICAL PROPERTIES OF SOIL AND IN GROWTH OF ZEA MAIZE** **Jihad IBRAHIM, Evan DAYOUB[2]** *Department of Soil and Water Sciences, Faculty of Agriculture, Tishreen University, Lattakia, Syria*
13:05 – 13:10	**EDUCATION TO SUPPORT THE DEVELOPMENT OF A CIRCULAR ECONOMY APPROACH** **Rita BODÁNÉ-KENDROVICS** *Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary*
13:10 – 13:15	**THE HYDROGEN IS HOPE AND REALITY** **Lóránt SZABÓ** *Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary*
13:15 – 13:20	**INFLUENCES OF MICROBIAL ACTIVITIES IN THE INSECTICIDES TREATED SOIL** **Bence AKLI, Hosam E.A.F. BAYOUMI HAMUDA** *Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary*

13:20 – 14:40	**Oral Technical Session (7)**

Chair: Sándor J. ZSARNÓCZAI

Time	Title and Author
13:20 – 13:30	**LITHIUM AND HEAVY METAL CONCENTRATION ANALYSIS IN SAJÓ VALLEY** **Ágnes BÁLINT[1,2], Péter, LENGYEL[3], Péter ENDRŐDY[3], Csaba MÉSZÁROS[4]** *[1]Institute of environmental Engineering and Natural Sciences,* *[2]Hydro-Bio-Mechanical Systems Research Centre, Óbuda University, Budapest, Hungary,* *[3]Szent István University, Gödöllő, Hungary,* *[4]Department of Mathematics and Basic Sciences, MATE, Gödöllő, Hungary.*
13:30 – 13:40	**ENVIROMENTAL AND ECOLOGICAL IMPACTS OF ILLEGAL DUMPING** **Bianka Júlia HORVÁTH, Hosam E.A.F. BAYOUMI HAMUDA** *Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary*
13:40 – 13:50	**BIOMONITORING OF LICHEN AS A BIOINDICATOR OF ATMOSPHERE QUALITY IN ULAANBAATAR, MONGOLIA** **Tsend-Ayush ERDENEJARGAL, Hosam E.A.F. BAYOUMI HAMUDA** *Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary*

13:50 – 14:00	**ANALYSING OF ANTHROPOGENIC IMPACTS IN SEMI-NATURAL AREA** **Krisztina DEMÉNY** *Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary*
14:00 – 14:10	**SMART-BUILT ENVIRONMENT: REVIEW** **Zeinab ESMAIL** *Aechitecure, Ybl Miklós Faculty of Building Science, Óbuda University, Budapest, Hungary*
14:10 – 14:20	**CLIMATIC CHANGES AND NATURAL DISASTERS AFFECTING THE GLOBAL ENVIRONMENT** **Hosam E.A.F. BAYOUMI HAMUDA** *Institute of Environmental Engineering and Natural Sciences, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Óbuda University, Budapest, Hungary*
14:20 – 14:30	**WATER MANAGEMENT IN SELECTED EU MEMBER STATES IN 2010S** **Sándor J. ZSARNÓCZAI[1]*, Balázs MEDVECZKY[2]** *[1]Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering and Natural Sciences, Budapest Hungary,* *[2]Hungarian University of Agriculture and Life Sciences, Doctoral School of Economic and Regional Sciences*
14:30 – 14:40	**SOME CASES OF BACKWARD EROSION/LIQUEFACTION PIPING FROM HUNGARY** **Emőke IMRE[1], Edina KOCH[2], Ágnes BÁLINT[3,1], László NAGY[4], Zsombor ILLÉS[4], Daniel BARRETO[5]** *[1]Hydro-Bio-Mechanical Systems Research Center, Óbuda University, Budapest, Hungary,* *[2]Széchenyi István University, Győr, Hungary,* *[3]Institute of Environmental Engineering and Natural Sciences, Óbuda University, Budapest, Hungary,* *[4]Department of Engineering Geology and Geotechnics, Budapest University of Technology and Economics, Budapest, Hungary, [5]Edinburgh Napier University, UK*
14:40 – 14:50	**NUMERICAL MODELLING AND CALIBRATION OF GEOSYNTHETIC- REINFORCED EARTH WALL PERFORMANCE USING PLAXIS 3D CODE** **Abdelwahab TAHSIN, Rami EL-SHERBINY** *Civil Engineering Department/ Cairo University and ACE Consulting Engineers, Cairo, Egypt.*
14:50 – 15:00	**AIR QUALITY AND DISTRIBUTION OF LICHENS AS BIOMONITORS IN SOME SERBIAN TERRITORIES** **Doris STOJILKOVIC, Hosam E.A.F. BAYOUMI HAMUDA** *Institute of Environmental Engineering and Natural Sciences, Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Budapest, Hungary*
15:00 – 15:15	**Closing Ceremony and Thanking Speech**
	Prof. Dr. habil. Hosam Bayoumi Hamuda
	Chairman of the Conference

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The First Day
Thursday, November 18, 2021

Plenary Session

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INTERNATIONAL STANDARDS FOR ENVIRONMENTAL MANAGEMENT SYSTEM, AND RESOURCE EFFICIENCY

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Abstract: *The growth in population, the urbanisation as well as the environmental pollution is increasing day by day. There are a number of initiatives taken in the globe in concerted ways, starting from the the Stockholm Conference in 1972 to the COP 26 in recent past. Still the environmental pollution is at the centre of significant concerns. With the urbanisation and per capita growth in income the consumption patter changes which in turn results in increased extraction of natural resources. Effective actions to be planned and implemented to reduce the extraction of natural resources that will enhance the materials cycles and resource efficiency. Globally, sincethe United Nations (UN) conference in Rio de Janeiro in 1992, a progressively increasing number of firms have shown interest in voluntary environmental commitments to eliminate or control negative environmental impacts associated with their activities. As such, firms shifted from a relatively reactive approach to more proactive environmental management strategies to protect the environment and public health as well as to satisfy international trade requirements. The ISO 14000 series of international standards have been developed to integrate environmental aspects into processes and product standards including environmental management systems (ISO 14001), auditing guidelines (ISO 14010), labeling (ISO 14020), performance evaluations (ISO 14031), life cycle assessment (ISO 14040), and product standards (ISO 14060). An integrated standard for quality, Environment, Energy and safety management system will help the organisation to achive resource efficiency, higher profitability, enehance commitment levels to prootect environment and the society. This article brings forward some cases from small scale industries in implemeting ISO 14001 to achieve the above.*

Keywords:. *Environment management, EMS implementation, iso standards, ISO 9001, ISO 50001,*

Biography: *Prof. Sadhan K Ghosh, PhD. He is the Professor in mechanical engineering and Ex-Dean of faculty of engg. & Tech., at Jadavpur University & served as the Director, CBWE, Ministry of L&E, Govt. of India. He is internationally well-known researcher on waste management, Green Manufacturing, SDG, ISO Standards and sustainable SME. He has published more than 250 papers in reputed journals, books and proceedings. Research interest briefly. He is the PI of more than 20 International and 25 national Research Projects funded by different agencies, like, EU, GCRF, DST, DBT, UKIERI, Royal Acad. ofEngg, SINTEF Norway, Hungarian Govt., Georgia Govt., and many others. He is international expert of UNCRD/UN DESA, SACEP, IJES and APO having research collaboration with 40 countries. His web:www.sadhankghosh.com and available at :* *sadhankghosh9@gmail.com & www.sadhankghosh.com.*

Sannidhya Kumar Ghosh, just completed his Ph.D. in Civil Engineering (Structural Engineering) graduating in December 2021 at University of Colorado Boulder, USA. He has extensive knowledge in Structural Analysis, Earthquake Engineering, Concrete design, Steel design. Familiar with structural design and finite element tools such as AutoCAD, SAP 2000, RISA, ABAQUS etc. Proficient in MS Excel, MS Word, and MS Office Suite. Conversant with MATLAB and Java. He acted as the Adjunct Course Instructor in :
Structural Analysis and worked as Consultant Engineer With SPA Risk LLC, Denver, CO, (Nov 2016 - Aug 2017)

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SYMBIOSIS and "BIOSPHERES" in SOIL-PLANT-MICROBE-INTERRELATIONS and SOIL-ENVIRONMENT-HUMAN HEALTH (Doctor's Program founded by Prof. M. KECSKÉS, in Hungary)

Borbála BIRÓ[1*], Hosam E.A.F. BAYOUMI HAMUDA[2], Klára CZAKÓ VÉR[3]

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Abstract: *Prof. Dr. Mihály KECSKÉS (1931-2013) was founder of Doctors' PRPGRAM (DS) in "Microbiology and Biotechnology for Environmental and Agricultural Sciences", University of Agricultural Sci. in Gödöllő, Hungary. Main topics of this DS were study on the various biospheres around and in connection with "higher plants: The "sphere" research focused on the seeds, called "**spermosphere**", study on those microorganisms, which are associated to the seeds or inside the seeds. After seed emergence, the "**rhizosphere**" is very important. Roots are chemically attracted to the microorganisms (fungi, bacteria), providing the nutritiveelements for plants either directly or indirectly. During plant growth, surface of leaves, called "**phyllosphere**" can provide additionally nutrients for plants and providing them from harmful environmental pathogens.* ***Methods****: Conventional microbiological studies were done, such as the Colony Forming units (CFU) of differentmain species of microbes and selection of the most appropriate one for the further studies. Enzymatic analysis was used to learn the current activity in those microbes, beside soil-plant chemical analysis.* ***Results****: Studies were showing that among temperate environmental conditions the fluorescent-putida type of Pseudomonas bacteria are resulting plant-protection ability through their siderophore production. Those PGPR bacteria and other beneficial ones can be suggested for biotechnological application both in agriculture and also perhaps in metallurgy research. The N_2-fixing Rhizobium sp. bacteria, as symbionts were suggested by M. KECSKÉS for reducing the artificial fertilizers in the agriculture, involving the leguminous plants.* ***Conclusion****: By studying thevarious "spheres" in connection with plant growth and development, we can learn how the biotic and abiotic environmental factors are efficient: This knowledge can be very helpful for the successful application of our knowledge for the sustainable environmental quality and soil-plant-human health.*

Keywords:. *Soil-environmental microbiology, spermosphere, rhizosphere, phyllosphere, biotechnology*

Biography: *Borbala BIRÓ, PhD, CSc, DSc, soil biologist, terrestrial ecologist, doctor of Hung. Acad. Sci, prof. emerita of Szent István University, Dept. of Agro-environmentalStudies. She has published about 300 papers in Hungarian and in International Journals. Supervisor of 6 PhD students, so far and currently for 4 other students. She can show a 35- year-experience in Research Institute for Soil Science and Agrochemistry of Hung Acad. Sci. She is teaching RhizoBiology, RhizoEcology and RhizoTechnology at PhD Schools. Currentlyshe is a top-expert (soil-ambassador) of EU Horizon 2020 Mission Board of Soil Health and Food).*
All authors in this conference contribution were PhD. students of Prof. M. KECSKÉS.

Keynote Session

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ENVIRONMENTAL DEVELOPMENT & SUSTAINABILITY: TECHNOLOGY & MANAGEMENT

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Abstract: *Most of the people all over the world today have an immediate and intuitive sense of the urgent need to build a sustainable future. Environmental engineering is the branch of bioengineering and sustainable engineering that is concerned with protecting people from the effects of adverse environmental effects, such as pollution, and improving and safe environmental quality. Environmental bioengineers work to improve recycling, waste disposal, public health, and water and air pollution control. Environmental health bioengineering can be considered as sanitary bioengineering brought to meet the needs of the future of the World. Sanitary bioengineering is essentially disease-oriented: it may be defined as the use of bioengineering principles and bioengineering devices for public health purposes. Environmental health bioengineering is the application of bioengineering fundaments to the control, modification or adaptation of the physical, chemical or biological characteristics of the environment in the interest of the health, comfort and social activities of people. It requires the control (quantity and quality) of the basic necessities and waste by-products, whether solid, liquidor gaseous. These by-products, if uncontrolled and allowed to accumulate, lead to widespread disease and physical damage, and could literally make human existence impossible. The fundamental concept of sustainable development is depending on the social, the economic and the environmental dimensions. For development to be sustainable, all the 3 dimensions need to be addressed in a balanced and integrated way, to reach present and future needs. Education for sustainable development is an emerging but dynamic concepts that encompass a newvision of education that seeks to empower people of all ages to assume responsibility for creating a sustainable future. Today, the prospects for future health depend to an increasing extent on the processes of globalisation and on the emergence of global environmental changes occurring in response to the great weight of humankind'seconomic activity. The globalization of trade, travel and culture is likely to have both positive and negative impacts on health. Increased trade in services and products harmful to health and the environment, travel and mass migration of people constitute additional global threats to health. A healthy population is essential for economic development. The modern engineering education should be reformed to include the spheres of economy, science and education. Finally, we have to accelerate progress towards universal health coverage and the sustainable development goals by ensuring equitable access to a skilled and motivated health worker withina performing health system.*

Keywords: *. bioengineering, education, environment, health, management, sustainable development, technology*

Biography: *Prof. Dr. Hosam Bayoumi Hamuda is working at Óbuda University. He is Environmental Microbiologist and Soil Biotechnologist dealing with the interactions between the microbiomes and the environment for increasing soil quality and saving the soil from pollutants in the agriculture. His investigations are on the role of waste management, soil quality, fertility, the crop production and environmental impacts related to the application of organic wastes; measurements soil microbial biomass and enzymatic activities in wastewater sludge amended soils; and roles of engineered metal oxide nanoparticles in biosphere.*
Research Interest*: Waste management; Biotechnology; Protection; Sustainable; PGPR; Microbial inoculants; gut microbiomes and human health and modern biology.*

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INDIAN HUNGARIAN RESEARCH COOPERATION POSSIBILITIES IN THE FIELD OF ENVIRONMENTAL DEVELOPMENT & SUSTAINABILITY

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Abstract:

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Keywords:.

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MAPPING THE ENVIRONMENTAL DAMAGES CAUSED BY CONSTRUCTION OF THE ROAD "RRUGA E ARBËRIT"

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Abstract: *The purpose of this paper is to identify and map the areas damaged by the construction of the "Rruga e Arbërit" Road construction, creating a GIS map of the damaged areas, and making recommendations for improving the situation. Mapping the environmental damages is important for the future of the area development, especially in the tourism field. The methodology used is the comparison of the existing situation with that before the road was built. At its core is the analysis of existing graphics and satellite images, comparing changes in years, and field measurements to determine the coordinates of some control points. To realise these objectives, the following steps have been taken: Identification of damaged areas on the ground; Taking control points of the damaged areas; Satellite imagery of the area analysed; Comparisons of imageswere made in different historical periods. The result of this study is the GIS maps of damaged areas preparing. The paper closed with conclusions and recommendations for the future. Most important conclusions have to do with: rehabilitation of the damaged area mostly from the waste stocks; reforesting the excavation area; protecting the area from landslide risk; and protecting river water from pollution.*

Keywords: *Road, GIS, Mapping, Environment, Rruga e Arbërit, Albania*

Prof.Asoc.Dr. Edmond HOXHA *received the PhD degree on Geosciences and Environment on Polytechnic University of Tirana, Faculty of Geology and Mine. He studied also leadership on Harvard University. He has huge experience working with Government of Albania and International institutions like World Bank, European Union, GIZ etc. He was Deputy Minister of European Integration of Albania. He is Founder of "Albanian Centre of Excellence" and publisher of Scientific Journal "Albanian Excellence". He is member of Eurosciences; International Association of Sciences, Technology and Development. He speaks English and German language. Actually he is a professor in Faculty of Geology and Mine, Tirana, Albania, teaching GIS technology, Mine Modelling and Project Management. He is author of one book, one monograph and many scientific papers*

Klea MECI *is a Master student in Faculty of Geology and Mine in Polytechnic University of Tirana. She received the Bachelor degree on Geoinformatic and recently is following the Master Degree in Geomatic in Faculty of geology and Mine, Department of Mineral resource engineering in Albania.*

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EFFECT OF CLIMATE CHANGE ON SOIL MICROBIOME AND RESISTOME

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Abstract: *Climate change is a threat to the Carpathian Mountains. Climate has one of the greatest effects on soil microbial activities. Forests are expected to face significant pressures in the future from climate change. Data from long-term monitoring can be used to answer questions on the impacts of climate change on forestecosystems as well as the feedback of forests to the climate. Microbiological properties in seven forest sites were monitored over a period of 10 years. Soil samples were collected in the late spring and autumn and were characterized by measuring biomass of soil microorganisms, respiration, enzyme activities, diversity of soil microbiome and succesional processes. The general regularities of changes in the functional and taxonomic structure of soil microbial communities at different stages of the succession process have been established. It is noted that soil biomass and phylogenetic diversity are markers of succession processes in the soil microbiome. Endogenous heterotrophic succession cause increasing biomass of oligotrophic bacteria and decreasing phylogenetic diversity. Diversity is indicate, how changed microbial communities during succession. After 10 years, fluctuation of microbial diversity at different altitudes was the same. But it should be noted that in 2008the Shannon index fluctuated within (4.54-2.10), after 10 years the values of this index decreased by an average of 15% and ranged from 3.45 (at altitude 500 m.a.s.l) to 1.72 (at altitude 1100 m.a.s.l). The study of soil samplesfrom the primeval beech forests have showed that the microbial community characterized by a low content of antibiotic-resistant microorganisms in 2008. In 2018 the number of antibiotic-resistant bacteria has increased in3 times. Analysis of functional successions of soil microbiome showed the presence of hot spots in edaphotopes at an altitude of 700-800 meters. In these edaphotopes significantly decreased the level of catalase from 6.68±0.13 to 4.92±0.22 ($cm^3 O_2$/gr. soil per 1 min), and the level of invertase from 26.10± 0.69 to 20.46± 0.41* (mg. glucose/gr. soil). *Long term monitoring of soil microbiome allowed determines climate change effect on structural and functional successions of soil microbiome in virgin forests.*

Keywords: *microorganism, activity, succession, soil, climate change, ecosystem.*

Biography: *Lyudmyla Symochko got her Master's degree in Ecology and Environment Protection in 2000. Doctor's degree (Ph.D.) by Specialty - 03.00.16 Ecology in 2005. She is Associate Professor since 2008. Symochko Lyudmyla – a specialist in environmental microbiology and ecology. Since 2008 she has focused on autecology and synecology researches of soil and water microbiota. Explores the soil resistome and the role of natural and transformed ecosystems as a reservoir of antibiotic-resistant microorganisms. Helds microbiological monitoring in different types of ecosystems. Detects antibiotic-resistant opportunistic pathogens in the environment and provide they risk assessment to human health. Author of over 170 scientific publications, including 5 books.*

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NEW STRATEGY TO ENHANCE THE REUSE OF TREATED WASTEWATER BY PROMOTING SMART IRRIGATION SYSTEMS IN THE MENA REGION USING BIOPOLYMER

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Abstract: *In general, wastewater treatment plants in Morocco, Tunisia and Palestine are designed to serve residential communities without considering the generated wastewater from industrial facilities. The fact is that most of the cities in the Arab countries are characterized by a lack of infrastructure planning and a lack of the separation of industrial areas from residential communities. This drives local municipalities to connect and mix the industrial facilities with the municipal wastewater network and transfer them to the central wastewater treatment plants. This leads to impacts on the competencies of these wastewater treatment plants and their removal efficiencies. Furthermore, the final treated wastewater (TW) will be unsuitable for agricultural purposes because it contains huge quantities of heavy metals and some industrial micropollutants. Therefore, as a partial solution to this dilemma, the idea of research depends on using Superabsorbent Polymer technology (SPT), which could be manufactured at the laboratory level? SPT can absorb high quantities of industrial pollutants, both organics and inorganics. Therefore, we argue that SPT has a promising application potential to help local municipalities find environmentally sound solutions to reduce the fate of organic and inorganic residues from reclaimed water. This smart irrigation system using eco-gum and recycling reclaimed water aimedat water-food security and water resources protection. This project will validate the wastewater treatment technology suitable for our geographical context for the reuse in agriculture and economic study of farmerability to pay for irrigation by TW. On the other hand, an economic study of superabsorbent commercializationto farmers and agriculture companies will be considered.*

Keywords: *Wastewater treatment, Reuse, Irrigation, Superabsorbent Polymer, Water-food security.*

Professor AZIZ Faissal is currently an Associate Professor at the Department of Biology, Faculty Poly-disciplinary of Safi, Cadi Ayyad University, Morocco. Prof. AZIZ is a Young researcher at MENA NWC (Middle East and North Africa Network of Water Centers of Excellence) in Nanotechnology for the water treatment field. He supervises six thesis subjects onwastewater treatment and reuse; he has published over 60 papers and co-edited one book. He coordinates many research projects on wastewater treatment and biomaterial engineering in collaboration with national and international partners. He has more than 60 conference and seminar presentations, of which more than ten have been plenary, keynote and invited lectures.
He is a member steering committee of the new Water-Energy-Food Nexus Network for the Mena region and the Vice-coordinator of Mediterranean Youth for Water Network (MedYWat).

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THE BEHAVIOR OF ECO-FRIENDLY CERAMIC MATERIALS BASED GOLD MINING TAILINGS

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Abstract: *The treatment of gold ore generates considerable quantities of Gold mining Tailings (GMT). These last are considered as major environmental problem in the mining industry. In Amesmessa mine (Hoggar, Algeria); where mining have carried out for over 15 years, about 2 million tons of mill tailings have been accumulated each year. The aim of this work is to study the reuse of GMT as raw material, substituting feldspar, in ceramic field. The effect of the addition amount of GMT on microstructure, mechanical and chemicalproperties were studied. During investigation, the results show that GMT is mainly composed by quartz,hematite, pyrite, and dolomite. However, during sintering, mullite, quartz and rutile were the mineralogical phases which composed the ceramic samples. Moreover, as the temperature rises at 1200°C, peaks of mullite increased, beside rutile and quartz phases. When 30 wt% of the reject were added, the crystalline phases as quartz and mullite diminished, giving rise to the glassy phase formation. Mechanical properties as Young's modulus of the samples increased from 09.35 to 15.93 GPa and from 19.66 to 60.94 GPa at 1100°C and 1200°C respectively. These results suggested the use of Gold Mining Tailings in the ceramic field, as a substituent of feldspar, and might be an alternative and reliable method for the disposal of these tailings.*

Keywords: *Ceramics, Gold Mining Tailings, mechanical properties, microstructure, mineralogy, porosity.*

Biography: *Nedjima BOUZIDI is a full professor at the university of Bejaia, Algeria. She is a teacher –researcher in the department of mine and geology, Faculty of technology. She obtained her Ph.D. in process engineering (chemical engineering). She has published more than 20 papers in reputed journals and has been serving as reviewer of repute journals. She has a background on raw materials used in ceramics, glasses, glass-ceramics, enamels, geopolymers, etc… as well as engineering process. Currently she leads a research team within the research laboratory Materials Technology and Process Engineering (LTMGP)*

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CONTAMINATION MONITORING AND RISK ASSESSMENT IN THE CRITICAL ZONE WITH A VIEW ON HEATH, FOOD AND WATER PROTECTION UNDER CLIMATE CHANGE CONDITIONS: CHALLENGES, TECHNIQUES AND CASE STUDIES: A GLOBAL PERSPECTIVE

Gyozo JORDAN[1*], Zsofia KOVACS[2], Silvana BELTRAN[3], Péter SZABO[4]

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Abstract: *Climate change induces new pathways of Potentially Toxic Element (PTE) contamination release and transport at the local, regional and global scales in the Critical Zone which is the thin earth surface providing the habitat for ecosystems and the healthy living space, safe food and water resources for mankind. It is mandatory therefore to monitor the governing processes and estimate the associated contamination risks in order to develop a sustainable and climate resilient society, in accordance with UN resolutions and EU policies. This study reviews the spatial and temporal monitoring and modelling methods for the assessment of contamination distribution, mobility and availability, and provides abundant case studies in the field of environmental geochemistry for the development of innovative methods and techniques including river sediment quality monitoring under the EU Water Framework Directive.*

Keywords:. *assessment, geochemistry, global bio-geochemical cycles, medical geology, pollution*

Biography: *Gyozo Jordan is a geologist and environmental geochemist, receiving his MSc degree at the ELTE University of Sciences, Hungary and his second MSc and PhD degrees at the Uppsala University in Sweden. He studied at the Queen’s University of Belfast, UK and carried out post-doctoral research at the BOKU University in Austria. Dr. Jordan acted as visiting scientist at Int’l Institute for Geo-Information Science and Earth Observation, the Netherlands, at the U.S. Geological Survey, at the Chinese Academy of Sciences, acted as project leader of Europe Aid Technical Assistance Project in Turkey, and worked for the Joint Research Centre (JRC), European Commission. He was a guest lecturer at the China University of Geosciences in Beijing (CUGB) under a Chinese Belt and Road Project in 2018-2019. For 15 years he worked for the Hungarian Geological Survey (department head) and for 7 years for the Szent István University (department head). He has been the member of several international expert groups and lead numerous EU and other international projects. Dr Jordan acts as the associate editor of international scientific journals and has received over 20 national and international awards. His research work is documented by 2 books, 60 ISC research papers and 56 other papers, marked with a Hirsch Index: 25 (Scopus) and Citation Number: 1920 (Scopus). His research interest is environmental geochemistry, with focus on PTE contamination and spatial and temporal data analysis and modelling.*

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WATER MANAGEMENT ISSUES IN SPAIN AND PORTUGAL AT BEGINNING OF 2020S

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Abstract *In the EU-28 productivity could have decreased somehow, because price indices of means of agricultural production, as input increased by 9,7% more than increase of price indices of agricultural products,as output in field of cereals including seeds, which increased only by 6,8% for period of 2010-2017. But agricultural income factor income per annual working unit has considerably increased by 27,2% for period of 2010-2020, mostly approximately closed to same period. This means that factor income increased more than thiscould be explained by low level of increase according to increasing rate of price indices of output in the EU-28. The agricultural income, factor income per AWU is valid for all of agricultural production also beyond cereal and seed production.* ***Motivation/Background****: Productivity of agricultural industry is basic issue to ensure sustainability of agriculture, which is accompanying with irrigation innovation. Analyse the irrigation prosperityfor the increasing output.* ***Method****: Compare price input and price out is based on statistical analysis.* ***Conclusions****: This increase of the profitability has only partly been resulted by 10% decrease of number of the agricultural total labour force, as input for this time. Because decreasing trend of the agricultural total labour force input was considerable, but subsidies for agricultural production including the consumption of fixedcapital was also significant.*

Keywords: *Annual working unit, Factor income, Input, Irrigation, Output, Productivity*

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CHANLLENGES AND ASSETS IN THE SANITATION OF CITIES IN REPUBLIC OF BENIN (WEST AFRICA)

Léocadie ODOULAMI

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Abstract: *Sanitation is one of the key sectors for achieving the Sustainable Development Goals. It contributes to the good performance of the socioeconomic tissue and ensures the environmental sustainability of the living environment. In Benin, many efforts are made by the government, however, challenges remain. These communications first set out the activities carried out at assets by the government in the field of sanitation and secondly what remains to be done as challenges for the achievement of the Sustainable Development Goals. The documentation made on the components of sanitation in the services of institutions, libraries competent in sanitation, hygiene, and water, and field observations have shown after statistical processing and analyses that there is a synergy of institutional actions in the field of sanitation in Benin. Indeed, the Ministries of Living Environment and sustainable development (MCVDD), Health (MS), Family and Social Affairs (MFAS), Water (ME), Planning and Development (MPD) just as several NGOs are joining forces for adequate and acceptable sanitation. Thus, several flagship projects. In this context, the government has built new faecal ludge treatment stations in the communes of Abomey-Calavi, Sèmè-Kpodji and plans to build them also in the commune of Parakou. However, the place of sanitation on the development agenda in Benin is mixed and faces several challenges. Indeed, it comes down to raising the institutional profile of the sub- sector based on experience feedback, bringing sanitation out of its marginality and making it a real "national cause", taking up the challenge of financing water projects sanitation. Sanitation is essential for improving the health of populations, preserving water resources and the living environment. It is the engine of economic development and reduces the cost of public health spending. It is also an essential commercial argument in the current context of international competition and the health risks of Covid-19; it promotes education and improves social well-being. Sanitation is also a matter of human dignity. Including, Grand Nokoué, the Pluvial Sanitation Project dor Secondary Cities (PAPVS) of Bénin, the Cotonou Pluvial Sanitation Project (PGoG) are the most important implemented in the country. Benin has signed several international agreements to increase funding for the sanitation sub-sector by 100 % each year and rise the institutional positioning within the framework of the Water and Sanitation for All (SWA) organization in Washington in 2012. Then, in 2015, Benin signed the N'Gor Declaration in Senegal on the occasion of the4th Africa Conference on Sanitation (Africasan4 summit).*

Key words: *Benin (West Africa), Sanitation, SDGs, Population health, environmental sustainability*

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CHARACTERIZATION OF GEOSYNTHETICS REINFORCED SOIL STRUCTURES USING LABORATORY TESTS UNDER SERVICE LOADING

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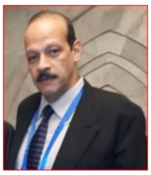
Abstract: *Deployment of Geosynthetics Reinforced Soil GRS technology has grown dramatically worldwide in the past three decades in various fields of Geoenvironmental engineering. GRS as a sustainable construction solution, has thus gained extensive approval, as an alternative to conventional systems with right-of-way acquisition restrictions. Provides efficient strengthen for poor subsoil conditions to sustain excessive loads and promotes reduction in life cycle cost and* CO^2 *emission. This manuscript announces material characterization and laboratory tests performed under service loading to identify key design aspects that better simulate the stress-transfer mechanism and numerical modelling. Shear strength parameters, interface elements properties, consolidation characteristics, elastic modulus, and unloading- reloading stiffness were assessed in accordance with ASTM. The measured stress-strain response curves for loading and unloading increments at confining stress of 0.5, 1.0, and 2.0 kg/cm*^{2} *were used to anticipate secant moduli* E_{50} *(at 50% of maximum deviator stress). Tri-axial CD test brought ratios* E_{ur}/E_{50} *of 2.0 and 3.25 for confining stress of 1.0 and 2.0 Kg/cm*^{2}*, respectively. The constrained modulus of elasticity due to Odometer primary compression* E_{oed} *equals to* E_{50} *for the examined vertical stress of 1.0, 2.0, and 4.0 kg/cm*^{2}*. The performed direct shear test in presence of Polyester PET Geogrid layer proven an indicative interface element roughness factor* $R_{int} = 0.71$*. Findings are in close agreement with default values proposed by Brinkgreve, et al., 2002.* E_{50} *inferred from tri-axial testing was approximately 2.25 times lower than the pre-estimated nominal value introduced by design codes, that acknowledged to fitting Plane Strain laboratory tests.*

Key words: *constrained modulus, deviator stress, Geosynthetics, interface element roughness, unloading-reloading stiffness*



Abdelwahab Tahsin *has completed his PhD in Civil engineering at the age of 51 years on July 2020 from Faculty of Engineering, Cairo University, Egypt. He is a professional Consultant engineer, certified PMP and design director at ACE consulting office, Egypt. Participating and managing large complicated civil engineering projects across multiple asset classes in Egypt, Gulf, Middle East, and Africa. Strong experience of international standards through interactive collaboration with International Managed Joint Ventures. He is an Instructor (Part- time) and Supervising graduation projects at the Egyptian Russian and 6th of October Universities, Egypt. He has published 8 papers in reputed scientific journals and conferences, has been serving as a reviewer of reputable research journal "Innovative Infra Structure Solutions" (IISS). He is sharing at many conferences, workshops and invited talks. He is an organizing member of GEOAFRIAC 2023 international conference, hosted by the International Geosynthetics Society IGS, Egypt chapter.*

Oral Technical Session (1)

THE EFFECTS OF WOODEN BUILDING MATERIALS ON THE INDOOR AIR QUALITY OF HOUSES

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Abstract: *Exposure to indoor chemical air pollutants has a great impact on our health because we spend most of our time inside buildings. Pollutant exposure levels inside buildings are likely due to pollutants from both indoor and outdoor sources. As a natural, biological material, wood emits various organic chemical substances, mostly volatile organic compounds (VOCs), very volatile organic compounds (VVOCs) and formaldehyde. When such emissions occur in indoor spaces, concentrations of these substances are higher than concentrations outdoors. Consequently, the level of emissions from building materials is of relevance in relation to their possible health effects. The current work shows the measurements of the indoor air concentration in a passive, low-energy, wooden, light frame house. Concentrations of volatile organic compounds (VOC) and formaldehyde were measured and compared and with the current international regulations of air pollutants. Six measurements were taken throughout one year. An active sampling device was used on the site. The results of the measurements showed the changing concentrations of air pollutants. Concentrations of 180 components were determined according to standards ISO 16000-6:2004. During the field measurements we detected the presence of formaldehyde (34µg/m3), BTX (35.51µg/m3), and some materials in the terpene family, limonene (64.7$\mu g/m^3$), and alpha-pinene (297$\mu g/m^3$), in the indoor air. The concentration of the detected TVOC (Total Volatile OrganicCompounds) was 2150µg/m3, which does not significantly differ from European average values. We determined the health risk of all measured substances according to the German standard using the Lowest Concentration of Interest (LCI) analysis. The conclusion of the present case study is that the total volatile organic compounds (TVOC) of the indoor air during the one-year measurements had been changed only slightly and they did not pose a health risk. The concentration of the TVOC was influenced by indoor temperature, indoor relative humidity and air exchange rate. Human activities and the furniture had the greatest impacts on the concentrations. The rate of the wooden clothing in each room had a great influence on the concentrations of alpha-pinene and 3-carene.*

Keywords: *IAQ; wooden building materials; VOCs.*

Biography: *Csilla Patkó Phd has completed her Phd at the age of 31 from University of West Hungary - Faculty of Wood Science (2010-2014).She graduated from the Faculty of Architecture of University of Technology and Economics as an architect. After her PhD dissertation, she continued her research in the field of building biology and building ecology. She is currently involved in research on natural building engineering in sustainable buildings at the Department of Building Constructions.*

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IMPACT OF LANDFILL GASES ON THE SURROUNDING POPULATION – A MODELLING APPROACH

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[3]*University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia*

Abstract: *One of the largest controlled landfills located in Novi Sad in Serbia was selected to estimate the population exposure to hydrogen-sulphide. Sensitive receptors (individual housings, shopping malls and commercial facilities) were located at 300-1000 m distance from the landfill. To determine the effect on the receptors, the emission of hydrogen-sulphide using LandGEM software was first calculated. Afterwards, the dispersion simulation was performed using the Atmospheric Dispersion Modelling System. To determine the distribution of pollutants, the concentrations were modelled at different heights and distances under the representative weather. The results showed that hydrogen-sulphide concentrations were maximal on the landfill body (0.001 ppm). Within the sensitive receptors at heights of 1.5 m, the maximum concentration of 4.3·10-5 ppm was noted which is below the level of typical background concentration (1.1·10-4 ppm).*

Keywords: *air dispersion modelling, hydrogen sulphide, landfill gas*

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REJUVENATION OF SOIL ORGANIC CARBON THROUGH SOIL AMENDMENTS: A NOVEL APPROACH TO MANAGING HEAVY METALS IN SOIL AND PLANTS

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Abstract: *Soil organic carbon (SOC) imparts better soil structural stability which in turn enhances the soil physical environment. Further, SOC plays a key role in maintaining soil health especially soils under stress.With aim of improving soil resilience under heavy metal stress, this study was formulated to find out the effect of soil amendments on rejuvenating soil organic carbon content under heavy metal stress. The field experiment was conducted in a farmer's field near SIPCOT industrial area, Cuddalore District, Tamil Nadu, India during June - September 2017. A randomized block design with seven amendments [Farmyard manure (FYM), Press mud (PM), Ethylene diamine tetraacetic acid (EDTA), Lime, Gypsum, Potassium humate (PH), Natural Zeolite (NZ)] and control were replicated thrice for assessing the effects on SOC enrichment in soil and its interventions with heavy metals in soil and plant using sunflower as a test crop. The outcome of the study confirmed that the application of FYM and PM distinctively enriched the soil organic carbon (0.65 and 0.57 g kg-1, respectively) content than the other amendments used from the initial SOC status (0.41 g kg-1). Consequently, the organic amendments halt the heavy metals (lead and cadmium) progress in the soil thus bioavailability is reduced. In contrast, among inorganic amendments application of EDTA induces the mobility of heavy metals in soil (52.3 - 65.7 % over control) so increased the bioavailability and resulted in more uptake by sunflower plants.*

Keywords: *EDTA, FYM, Heavy metals mobility, Soil organic carbon, Sunflower..*

Biography: *Dr. P. Senthilvalavan has completed his graduation and post-graduation inTamil Nadu Agricultural University and Ph.D. from Annamalai University, Tamilnadu, India.For over 14 years have been working as a soil scientist in the Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Tamilnadu, India. He has published more than 70 papers in reputed journals and also being editorial board member/reviewer of reputed Journals. He had worked with radio-isotopes like ^{137}Cs, ^{131}I, ^{90}Sr, ^{60}Co and ^{32}P related to phytoextraction and transfer co-efficiency in different crops and completed projects in AERB, IPNI, and TENMA. Presently, working with Soil fertility & Biology, Soil-Water Pollution &Conservation, and Problem Soils (P & Zn nutrition).*

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USE OF VEGATABLE OILS AS INSULATING DIELECTRIC LIQUID IN ELECTRICITY INDUSTRY

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Abstract: *The aim of this study is the work out of the substitution of insulation mineral oils with ecofriendly vegetable oils in transformers. The PCBs are the ideal insulation transformer oils from technological point of view. The extremely high toxicity and environmental pollution properties of PCBs, result in the prohibition of their use. Recently, the mineral oil based insulation transformer oils are applied most frequently. Our aim is to show the vegetable oils are more suitable insulation materials for transformer than mineral oil products. The vegetable oils more easily decompose than mineral oils due to biological way in the environment. Moreover, the vegetable oils have not highly toxic PAH components. The applications of the vegetable oils are safer than mineral oils because they have flash points than mineral oil products. On the other hand, the application of vegetable oils requires different safety standards than mineral oils. The safety standards of vegetable oils have not developed yet. This project shows the developments of new safety standards and limits values for the vegetable oils as transformer oils. Our results were demonstrated with changing of insulation mineral oil of a transformer for vegetable oil.*

Keywords:. *insulation oil, vegetable oil, eco-friendly transformer oil, development of a test method*

Biography: *I have got my M.Sc. diploma at ELTE as chemistry researcher in 1975. Idefended my D.Sc. title in 2003 at Hungarian Academy of Sciences. I have published more than 190 papers and lectures with more than 100 IF, and gaining almost 1400 citations. My research fields are chromatography on open tubular columns (GC, SFC, CE), and various topics of environmental protections. I visited various laboratories in USA, Germany, Sweden, and Switzerland. My best results dealt with chiral separations. I took part in the introductions more than 15 chiral selective agents. The endocrine disruptive chemicals and pharmaceutical pollutions are my research topics in environmental science. I am also interested in the educational part of environmental protections.*

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NEW TRENDS AND UTILISATION OF MATERIALS IN PROTECTION AGAINST FLOOD

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Abstract: *The* climate *change is causing changes in the environment. Drought periods are beginning to alternate with the period of major floods in recent times. The paper deals with principles of active flood control protection. Authors tried to give information about new trends in flood protection by showing on new methods and new possibilities against flood and damage of men properties. The growing production and utilization of various materials, mainly plastics are enormous in the last period. Plastics have excellent mechanical properties, are light and in many cases replace metals. The volume of plastic waste is growing up; therefore it is necessary to determine how to solve the processing of plastic waste. In early studies were noted the methods of plastics recycling, whereas, the problem of utilisation of these plastics is much more complicated. From the plastic waste as the semi-products can be prepared the plastic plates, boards, foils. The contribution also deals with the testing of materials properties of recycled plastics produced by extruding and also it shows the utilisation of produced plastics plates in engineering practice and environment. River floods are the most common natural disaster in Europe and world, too, and flood damage is expected to increase in the next decades. The biggest damage is caused by the so-called torrential rains and subsequent flash floods. The purpose of current work was an experimental study of utilisation of plastic recycled materials, testing of their mechanical properties and their utilisation in specific conditions as flood barriers. The methods of experimental investigation and data processing have developed on a practical basis.*

Keywords: *Flood, protection, methods, materials, plastics.*

Biography: Sobotová Lýdia *- Associate Professor, Department of Process and Environmental Engineering, Technical University of Košice, Faculty of Mechanical Engineering, Park Komenského 5, 042 00, Košice, Slovakia,* ***e-mail:*** *lydia.sobotova@tuke.sk.* ***Where and when he(she) graduated:*** *Technical University of Košice, Faculty of Mechanical Engineering, 1983.* ***Professional orientation or specialization:*** *optimization of technological processes, environmental engineering - impact of engineering production on the environment.The relevant publication output: Badida, M., Sobotová, The Utilization of Recycled Materials from Automobiles in Noise Barrier Structures, In: Waste forum : recenzovaný časopis pro výsledky výzkumu a vývoje pro odpadové hospodářství. - Praha (Česko) : České ekologické manažerské centrum č. 1 (2019), s. 12-27*

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TOXICITY OF GRAPHENE OXIDE IN BIOLOGICAL SYSTEMS

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Abstract *Nanomaterials have been widely used in many fields in the last decades, including electronics, biomedicine, cosmetics, food processing, buildings, aeronautics, etc. The application of these nanomaterials in the medical field could improve diagnosis, treatment and prevention techniques. Carbon-based nanomaterials exist in many forms and are used in science and technology for drug delivery, cell imaging and cancer therapy. Graphene oxide (GO), an oxidized derivative of graphene, has interesting properties, such as nanometric size, specific surface area and electrical charge. Through those physicochemical properties, GO is used in biotechnology and medicine for cancer treatment and drug delivery. However, the toxic effect of GO on living cells and organs is a limiting factor that limits its use in the medical field. Recently, numerous studies have evaluated the biocompatibility and toxicity of GO in vivo and in vitro. Generally, GO can exert different degrees of toxicity in animals or cell models depending on the different routes of administration, the dose administered, and the duration of treatment. The toxic effects of this nanomaterial on biological systems are manifested by inflammation of the lungs, morphological alteration of the liver, destruction of the gastrointestinal surface, necrosis of neuronal cells and changes in neurotransmitter levels. In addition, several typical mechanisms underlying GO toxicity were revealed, e.g. cell membrane destruction, oxidative stress, DNA damage, inflammatory response, apoptosis, autophagy and necrosis. To understand the toxicological mechanism of this nanoparticle, it is necessary to identify the molecular targets involved in toxicity and assess the health benefits and risks of GO to minimize the risks to human health.*

Keywords: *Biocompatibility, DNA damage, Graphene oxide, inflammatory response, oxidative stress, toxicity effect.*

Biography: Asmaa RHAZOUANI is a second-year Ph.D student at the Faculty of Sciences Semlalia of Cadi Ayyad University in Marrakech. She has published two papers in reputable journals. Both publications are reviews of the literature, the first entitled Synthesis and Toxicity of Graphene Oxide Nanoparticles: A Literature Review of In Vitro and In Vivo Studies. The second publication is: Can the application of graphene oxide contribute to the fight against COVID-19? Antiviral activity, diagnosis and prevention.

Oral Technical Session (2)

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EFFECTS OF LAND USE LAND COVER CHANGES ON HYDROLOGICAL SYSTEM IN THE CASE OF ETHIOPIA: REVIEW

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***Abstract**: Background: Understanding the land use land cover changes and their implication on the hydrology of the catchment is vital for the management and utilization of water resources. Many researchers identified the impact of land use land cover change on the hydrology of the catchment in Ethiopia. Objective: The objective of this review is to consolidate the studies conducted in Ethiopian catchment on the effects of land use land cover changes on the hydrological process of the catchment. Results: The main drivers of land use land cover change were the combination of biophysical processes, demographic dynamics, unplanned urbanization and lack of strong institutional and technological support. According to many researchers cultivated land and built-up areas significantly increasing while areas occupied by natural vegetation such as forest land, shrub land and grasslands are significantly degrading at a rapid rate. The lands converted from forest to farm and urban land increased wet seasonal peak flow. Conversely, the observed changes had reduced in annual and dry season flow.The change of land cover from forested and shrub land to agricultural land discourage the infiltration capacityof the catchment. It helps to increase quick runoff generation and significant flooding and soil erosion observed. Conclusions: Land use land cover change analysis will aid catchment managers and stream ecologists in the protection of adequate water supply and habitat availability for stream biota. To overcome such problems researchers, policy makers and land managers should work together on the catchment management system to use land resource appropriately.*

***Keywords:** Land use; land cover; land use/cover change; stream flow*

His name is Anmut Enawgaw Kassie. He has completed his MSc at the age of 25 years from Arbaminch University. He is the Lecturer of Irrigation and Drainage Engineering in Debre Markos University. He has published more than 4 papers in reputed journals and his research interest focused on water resources, Irrigation water management and Integrated water management.

ENGINEERING OF HIGHLY BRACHYCHITON POPULNEUS SHELLS@POLYANILINE BIO-SORBENT FOR EFFICIENT REMOVAL OF PESTICIDES FROM WASTEWATER: OPTIMIZATION USING BBD-RSM APPROACH

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Abstract *New biocomposite based on polyaniline and Brachychiton populneus shells (BP@PANI) was successfully synthesized through in situ chemical polymerization. The prepared composite was characterized using different analytical techniques such as scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), Fourier transform infrared spectroscopy (FTIR) and Brunauer-Emmett-Teller (BET) analysis. The BP@PANI material was effectively used as an adsorbent to remove thiabendazole (TBZ) and methyl parathion (MP) pesticides from wastewater. The kinetic and equilibrium results indicated that theadsorption process followed the pseudo-second-order model and the Langmuir isotherm. The optimum adsorption amounts were 255.39 and 78.59 $mg.g^{-1}$ for TBZ and MP, respectively. The biosorption mechanismof both pesticides was evaluated and assigned to electrostatic interactions, pi-pi interactions and hydrogen bonding. The desorption study proved the excellent recycling of BP@PANI biosorbent. Moreover, the biosorption process was optimized by the response surface methodology combined with the Box Behnken design (RSM-BBD). The optimal parameters were found to be: $Dose = 0.88\ g.L^{-1}$, $Ci = 5\ mg.L^{-1}$ and $Time = 100\ min$ for TBZ and $Dose = 1\ g.L^{-1}$, $Ci = 5\ mg.L^{-1}$ and $Time = 120\ min$ for MP. The predicted elimination efficiency was determined to be 85% for TBZ and 84% for MP. The experimental data obtained were in good agreement with that predicted by the model, indicating the RSM approach's importance in modeling and optimization.*

Keywords: *Adsorption, Brachychiton populneus, Isotherm, Optimization, Pesticide.*

Biography: *Ph.D. student in analytical chemistry in Faculty of Science Agadir,Ibn Zohr University. Published several papers in high-impact journals, working on wastewater treatment by adsorption and membrane filtration, and currently developing a research axis entitled microextraction of metals from seawater at University of Cadix, Spain*

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WATER CIRCULARITY TO ACHIEVE SDG 6 THROUGH TREATMENT OF WASTEWATER

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Abstract: *In 2015, 195 nations agreed to join their hands together with the United Nations (UN) to improve the quality of lives existing in their country sustainably by adopting seventeen sustainable development goals (SDG). SDG-6 aimed to ensure the availability of clean drinking water and sanitation, facing a colossal decline. Despite its presence, there were about 2.3 billion people worldwide living in a water-scarce region, associated with a death toll of 1.6 million children (under age five) per year due to contamination and lack of sanitation facility according to the UN Economic and social affairs department 2018 data. Moreover, a signifinace portion of medical expenses in most of the developing and under developed countries are only due to due to contamination and poor sanitation. These in turn cause huge problems in economic, environmental, and health-related issues, especially for a developing country like India. Though this nation had an adequate amount of water, due to rapid industrialization followed by poor infrastructure, and knowledge in handling wastewater made the India among the extremely water stressed countries. This paper aims to investigate the viability of achieving water sustainability through water circularity (WC) and its problems associated during water reclamation and reuseby implementing a decentralized wastewater treatment plant (DWTP), with the help of a paradigm advocating social, economic, and environmental acceptability to achieve water quality, wastewater treatment and reuse (SDG-6.3 target). This study assesses the achievability of the SDG 6 with the help of DWTP as a low cost water reclamation solution, peculiarly for India, whose majority of the wastewater is left untreated and contaminating the water bodies*

Keywords: *Clean water and sanitation, decentralized wastewater treatment, reclamation, reuse, sustainable development goals 6, water circularity.*

Biography: *Prof. Dr. Sadhan Kumar Ghosh, President, ISWMAW & IPLA Global Secretariat, chairman and editor in chief, IconSWM-CE, project leader, Global status of implementation of circular economy, Associate Editor, Waste Management, Journal, and International Journal of Materials Cycles and Waste Management. Professor & Former Head, Mechanical Engineering Dept, Chief-Coordinator, Centre for Sustainable Development & Resource Efficiency Management (CSD&REM) in Mechanical Engineering, Ex-Dean, Faculty council of Engineering and Technology at Jadavpur University, Kolkata.*

Dineshkumar M, a student pursuing a Ph.D. in wastewater and circular economy, mechanical engineering department. Junior research fellow in the EU and DBT sponsored India H2O Research Scheme, under the supervision of Prof. Sadhan K. Ghosh Principal investigator of the project, Department of Mechanical Engineering, Jadavpur University, Kolkata. He has M.Tech in renewable energy. Research areas cover management of wastewater, recovery, was & enegy.

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REMOVAL OF PHENOLIC COMPOUNDS FROM OLIVE MILL WASTEWATER BY NOVEL LOW-COST BIOSORBENT: OPTIMIZATION OF PREPARATION CONDITIONS AND ADSORPTION PROCESSES

Imane HAYDARI[1,2*], Laila MANDI[1,2], Amina LISSANEDDINE[1,2], Khalid AZIZ[3], Naaila OUAZZANI[1,2], Faissal AZIZ[1,2]

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Abstract: *The olive mill wastewaters (OMWW) are viscous, acidic and rich in organic matter such as total sugars, organic acids, phenolic compounds, pectin-mucilage and fats. They have harmful effects on the soil, rivers and groundwater. This work consists of treating the OMWW, in a continuous fixed bed, with a low-cost biosorbent prepared from the olive pomace waste, targeting a green circular economy. In this study, we used the MINITAB software to determine the optimal conditions (activation temperature X_1, activation time X_2 and impregnation rate X_3) to prepare the biosorbent. The novel biosorbent was characterized by Scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), Fourier transform infrared spectroscopy (FTIR) and Brunauer-Emmett-Teller (BET) analysis. In addition, the adsorption performance of this material was evaluated in fixed-bed reactors operated in a concurrent flow system. A removal percentage higher than 60% was obtained for an initial 4000 mg L^{-1} phenolic compound concentration. Furthermore, the adsorptions followed by desorption to recover phenolic compounds showed high percentage desorption (70%) and was efficient after several OMWW treatment and phenolic compounds recovery cycles.*

Keywords: *Biosorbent, Olive mill wastewater, Olive pomace, Optimization, Phenolic compounds*

Imane HAYDARI is a second-year PhD student at the Faculty of Sciences Semlalia, Cady Ayyad University Marrakech, Morocco. The theme of her work is industrial wastewater treatment and the recovery of valuate by-products. Currently, she is in an internship at the National Centre of Study and Research on Water and Energy.

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THE EFFECT OF SOIL COMPACTION UNDER DIFFERENT RATES OF BIOCHAR ON SOME PHYSICAL AND HYDRODYNAMICAL SOIL CHARACTERISTICS AND IN SOYBEAN (GLYCINE MAX. L) PRODUCTIVITY

Evan DAYOUB

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Abstract: *Biochar is proven to enhance soil fertility and increase crop productivity. Given that the influence of biochar on soil compaction remains unclear, selected physico-hydrodynamical properties of soil amended with wood-derived biochar will be assessed. Thus, agricultural land application of organic wastes, such as biochar, could alter soil properties to offset the degradation effects. This research would shed some light on the effect of the use of heavy agricultural machinery on compaction of the soil-biochar matrix which has yet to be studied in detail. A field experiment will be carried out over two consecutive seasons on a Sandy-loam soil in a completely randomized block design, which includes three rates of biochar (0,5,10%) and three levels of compaction (0, 199.04, 330 Kpa) and each treatment has three replicates. Biochar will be produced by pyrolysis from woody residues at 450°C and added to soil with mineral fertilizers before 40 days of cultivation. The compaction procedure will be performed at the plastic limit with a tractor and a water trailer hanging on it. The weight can be controlled on the axle of the rear wheels of the trailer, where three different loads of the trailer will be used, and the weight of the trailer will be calculated. Trial plots will be prepared with an area of 5 m^2 per plot (2.5 m length* 2 m width) after that soybean seeds will manually be implanted on lines so that the distance between the lines is 50 cm, and 18cm between plants..*

Keywords: *Biochar; bulk density; soil compaction; soybean; soil shear stress; Unsaturated hydraulic conductivity*

EVAN DAYOUB is a Ph.D. student in the department of soil and water sciences/faculty of agriculture/ Tishreen university his research title is (The effect of amendment with biochar and olive mill wastewater in some physical and hydrodynamical characteristics of soil and in soybean (Glycine max. L) productivity). He has completed his MSc at the age of 28 years from Tishreen University while he was teaching practical lessons in soil physics laboratory. He is an agricultural engineer in Whata aikhan guidance unit, a former fertilizers supervisor in Latakia agricultural directorate and a participant in GIS projects. He has published one article in Tishreen University Journal -Biological Sciences Series.

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SPATIAL EVOLUTION OF SURFACE WATER QUALTE, WADI KEBIR WATERSHED (North-East ALGERIA)

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Abstract: *Oued Kebir which represents the downstream part of the Kébir-Rhumel watershed, is characterized by a dense hydrographic network, a rainfall varies from more than 600mm/year in upstream (Beni Haroun dam) to more than 1000mm/year at the mouth of wadi Kebir (Ledjnah region). Its waters present a resource for drinking water supply (upstream part), as well as for agricultural development in the downstream plains. The objective of our research work is to determine the quality of the raw water of wadi Kebir and its tributaries. A total of nine samples were taken during the period of high water (April 2017): three samples on the tributaries of the Oued and six samples in the waters of wadi Kebir from upstream to downstream. The physico-chemical parameters of the water (T, pH, EC) were measured in-situ, the major elements (TH, Ca^{2+}, Mg^{2+}, Na^+, K^+, HCO_3^-, SO_4^{2-}, Cl^-) and the indicators of pollution (NH_4^+, NO_3^-, NO_2^-, PO_4^{3-}) were analyzed at the Geological Engineering Laboratory (LGG). The results obtained show an organic pollution of the waters of Wadi Kebir and itstributaries with levels in the range of 0, 16 to 4, 72 mg/l in ammonium and 0.005 to 3, 67 mg/l in nitrite. The electrical conductivity varies from 1306 to 3460 s/cm indicating charged water. However, it remains below 1080s/cm for the tributaries. The surface waters of the Wadi Kebir watershed are more or less alkaline (8, 19 - 8, 67). The most dominant hydrochemical facies is chloride calcic-magnesian with minor hydrochemical facies such as sulfate-sodic-magnesian. Its chemistry is controlled by the weathering of the geological formations that characterize the watershed. The Organic Pollution Index (OPI) revealed a degradation of the water quality fromupstream to downstream, especially after the passage of the wadis through the different agglomerations such as those of Elmilia and Djamaa.*

Keywords: *Surface water, Wadi Kebir Watershed, Facies, Pollution, Electrical conductivity, Elmilia*

Biography: *2018 I have completed my license in hydrogeology at the age 23 years from Jijel University, 2020 have got a master's degree of 25 years in hydrogeology from Jijel University, 2021 have started my PhD in hydrogeology at the University of Constantine I.*

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REMOTE SENSING: DETERMINATION OF SOIL SALINITY IN MEDITERRANEAN REGION USING UNMANNED AERIAL VEHICLE

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Abstract *The Mediterranean zone is experienced environmental challenges that would have several effects on water resources. To serve agricultural requirements, a mix of irrigated sources of water was combined.* ***Motivation/Background****: Unmanned Aerial Vehicles develop stronger sensors based on advanced detectors that can be reinforced using Internet of Things techniques. Producers judged soil salinization monitoring employing UAVs and satellite imaging being a viable tool.* ***Method****: This study, conducted to define saltwater stress that affects lettuce development, which was irrigated using non-conventional sources of water, discovered that applying the Salinity Indicator (SI) to bare soil.* ***Results****: (SI) is a significant indicator for monitoring soil salinity, with an R2 range from 0.4 to 0.83. Meanwhile, the Normalized Difference Salinity Index (NDSI) 's second bare-soil indicator exhibited poor correlations, with R2 values as low as 0.49. Furthermore, the thermal imaging camera did not work well within the greenhouse but is performed in the commercial plot, where canopy temperature and R2 equaled 0.5. The second vegetative index investigated, the Normalized Difference Vegetation Index (NDVI), which is exclusively used to measure vegetation, had no strong correlations with soil salinity. However, the canopy temperature variations were extremely comparable to the electrical conductivityof the soil in the visual evaluation of the maps, which was not found in other investigated indicators.* ***Conclusions****: Therefore, it is deduced that SI is a promising index for assessing soil salinity with high precision. Canopy temperature must be investigated further, demonstrating impressive results when the camera operates inan ideal situation. Using non-traditional slightly saline irrigated water adversely impacts lettuce growth byreducing fresh head mass and rising sodium and chloride leaf components.*

Keywords: *Soil index, Unmanned aerial vehicle, Precision agriculture, Crop water stress index*

Biography: *kaoutar Lkima is a second-year PhD student in smart GIS tool irrigation studies from Cadi Ayyad University in Morocco.and the Department of Irrigation, CEBAS-CSIC, Campus Universitario de Espinardo, Spain. Her research interests center around water, irrigation, soil and digital technologies.*

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HYDROGEOLOGICAL STUDY OF THE SAF-SAF WATERSHED SKIKDA NORTH-EAST ALGERIA

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Abstract: *The control of water resources is a necessity whether superficial or underground, in order to understand the circulation and origin of groundwater in the downstream part of the Saf-Saf watershed located inthe city of Skikda, North-East Algeria. A detailed qualitative and quantitative study was carried out and 15 analyses were carried out. The results shown from ground water. The generally do not present a risk of alkalinisation, but a moderately high risk of salinization due, on the one hand, to marine invasion and, on the other hand, to discharge of wastewater of industrial origin. Sodium chloride facies is the most predominant. The study of the suitability of groundwater for irrigation of agricultural land shows that the majority of water wells have an acceptable quality for irrigation. The analysis of hydro-climatological data allowed an estimate of the water resources of the watershed, thus attributing a Mediterranean climate, characterised by two distinct seasons: one wet and cold and the other dry and hot. The hydrogeological data reveal the existence of two superimposed layers of unequal importance, the first superficial sandy of the Quaternary and the other of deep gravel. These two reservoirs present an important resource for exploitation.*

Keywords: *Algeria, Saf-Saf watershed, groundwater, circulation, salinisation, irrigation*

Biography: *Meriem Boukhatem, is a first year educational hydrogeology PhD student at the University of Constantine 1 at Algeria, she has completed her license degree at the age of 22 years from Constantine 1 University. In 2020, she has also obtained her master's degree in hydrogeology from Constantine 1 at the age of 24 years.*

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FORAMINIFERS AS POLLUTION BIO-INDICATOR AT AL HARIQA OIL HARBOUR OF TOBRUK, LIBYA

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Abstract: *The main objective of this work is to use foraminifera as a pollution bio indicator at Al Hariqa Oil Harbour in Tobruk, northeast Libya. Ten beach sediments samples have been collected and analyzed to define and examine their foraminiferal contents. About ninety-six abnormal foraminiferal tests out of total 1220 picked foraminiferal tests have been encountered in this study. Selected specimens were analyzed and micro-photographed by Scanning Electron Microscope to highlight their morphological variations. The abnormalities in the encountered foraminiferal tests are largely in form of: i) corrosion, smoothing and polishing of test surfaces due to post-morten action which may attribute to water chemistry. ii) coil twisting, deformed chamber size, disturbed suture, dislocated aperture and twinned individuals, which are attributed to high concentration ofheavy metals such as Cadmium and Lead in the studied samples. However, the dirty black or brown colors are also seen on some tests, which may attributed to the reducing conditions as a result of human and industry- related drained wastes.*

Keywords: *bioindicators; heavy metals; pollution; foraminifera; Libya.*

Biography: *Ahmed M. Muftah, enghazi, Libya**.** He has completed his PhD at the age of 55 years from National and Kapodistrian University of Athens, Greece, 2013 and Postdoctoral Studies from University College London, UK. He is the Libyan director of the East Libya Neogene Research Project (ELNRP), shared coordination with Dr. Moftah El-Shawaihdi and Prof. Noel Boaz. A team Member of the Cyrenaica Karst Project (CKP) in collaboration with Bliblo Center, Sicily, Italy. He is a staff member at the Department of Earth Sciences, faculty of Science, University of Benghazi (previously Garyounis). He has published more than 14 papers in reputed journals and has been serving as a member of the editorial board of Scientific Journal of the University of Benghazi (SJUOB). Research interest briefly. Other Publications are available on the link: https://www.researchgate.net/profile/Ahmed_Muftah2*

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PLASTICS CIRCULAR ECONOMY USING PYROLYSIS TECHNOLOGY

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Abstract: *Plastics are now a day is an integrated part of our daily life. On an average, production of plastic globally crosses 150 million tonnes per year. It has been observed that approximately 70% of plastic products are going as plastic waste in a very short span of time. In India approximately 9.4 million tons of plastic waste is generated per year. Out of this almost 9,400 tonnes of plastic waste ended up polluting streams or groundwater resources. The main concern here is the decomposition rate of this plastic. But plastics are not inherently harmful, they can be utilised for sustainable development. It is the technology, legislation, governance, awareness and finance which helps the plastics pollution to convert resource depletion into resource efficiency. There are a number of technologies that helps in establishing a strong plastics economy. Pyrolysis is one of suchprocesses that can be used for fuel production from different feedstocks such as plastics, biomass, swedge sludgeetc. Plastics have more carbon and hydrogen and almost no oxygen relative to biomass. The thermochemical conversion of plastics to high quality liquid oil through pyrolysis process is preferred because the produced liquid oil has very high calorific value than that of conventional commercial fuel while the world is trying to reduce the use of fossil fuels and enhancing the utilisation of green energy using different feedstocks. This paper describes pyrolysis of plastics and its potential to produce alternative fuel and resource efficiency. Therefore, theaddition of plastic for pyrolysis can make a positive contribution to the quality of syngas and bio-oil in terms of high heating value, efficiency and energy output. It has also been observed in this paper that pyrolysis of plasticsminimizes waste generation and toxic environmental impact but maximizes the utilization of plastics as a new alternative fuel to have circular economy by the creation of new economical corridor*

Keywords: *Alternative fuel, circular economy, clean energy, environmental impact, pyrolysis of plastics, waste management.*

Biography: *Sadhan Kumar Ghosh, PhD (Engg.), is the professor in Mechanical Engineering in Jadavpur University, India. He is the well-known international expert of UNCRD, APO, IGES, SACEP and ISO in the field on waste management and circular economy. His other areas of interests are Energy recovery from Wastes, Co-processing, E-waste, Plastics Waste, HCW, C&DW and Haz. waste management, Recycling & Recovery, Sustainable SupplyChain of Waste Management, Environment management systems, Sustainable Development, 3R strategies and Implementation, Green manufacturing & Productivity, TQM, ISO Standards, SME improvement and MSME cluster development. He has more than 250 publications, three patents and is expert in various committees.*

Sampad Kumar Das, B.E. in Mechanical Engineering from IIST & M.E. in Nuclear Engineering Jadavpur University, India. He worked as junior research Fellow in SERB, DST funded project of GoI, & presently as JRF in the Indo-Hungarian Joint Research Project, Dept of Mech Engg, Jadavpur University. He published 4 papers in reputed journals. His research interest includes thermodynamic analysis, pyrolysis, gasification, fuel characterisation, alternative fuels, renewable energies, etc.

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OIL POLLUTION IN THE PORT OF BENGHAZI CITY AT NORTHEAST OF LIBYA

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Abstract: *This work represents the first comprehensive survey of polycyclic aromatic hydrocarbons (PAHs) in beach sands of the Port of Benghazi city northeast Libya. The analysed PAHs are originated mainly from pyrolytic sources. The carcinogenic PAHs such as benzo [a] anthracene (BaA), chrysene (Chr), benzo [b] fluoranthene (BbF), benzo [k] fluoranthene (BkF), benzo [a] pyrene (BaP), Dibenzo [a,h] anthracene (DahA) and indeno [1,2,3-cd] perlyene (IP) are observed in all samples. The risk evaluation revealed the exceedingly high environmental risk of PAHs in the beach sands.*

Keywords: *Aromatic Hydrocarbons, environment, Libya, Oil Pollution, Polycyclic, Port of Benghazi..*

Biography: *Osama A. El-Fallah, (Born in Benghazi-1972), Libyan nationality. I have completed M.Sc. Degree in Hydrogeology and Water Management, at Faculty of Agricultural and Environmental Sciences, Szent István University in Gödöllő Hungary, 2007. My first employment was as Mud-logger geologist in Jowfe Oil Technology Company (1996-2004), and then joined the department of Geology at Omar Al-Mokhtar University, Al Bayda Libya (2008-2019). Recently I am a staff member at earth science department, faculty of science, University of Benghazi Libya. My field of interest in Hydrogeology and Water Quality published some papers in the field of Hydrogeology and Stratigraphy on Al Jabal al Akhdar region eastern Libya and Tazerbo water wellfield south-eastern Sirt Basin in Libya as joint papers with other colleagues. Currently, I have enrolled as PhD candidate at Department of Geology, Cairo University.*

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THE INFLUENCE OF PROPANE-FUELED FLAME WEEDING ON MICROBIOLOGICAL PROCESSES IN THE SOIL

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Abstract: *Weeds are the main problem in conventional and organic farming systems. Propane-fueled flame weeding provides significant advantages over chemical and mechanical methods of weed control. It is effective under both conventional and organic crop production systems. During the fire treatment, the burners expose the weed plant tissues to a high level of heat, which quickly changes the internal temperature of the plant cells and leads to their rupture. As a result, water loss and protein denaturation dramatically reduce weeds' ability to survive.* ***Motivation/Background****: In our work it was important to investigate how such propane-fueled flame weeding affects the quantity and diversity of major ecological and trophic groups of microorganisms in the soil.* ***Method****: Microbiological analyzes of soil were performed using generally accepted methods. The direction of microbiological processes in the soil was determined by Andreyuk et al. using methods described by Volkogon et al.* ***Results****: Our analysis of the total microbial biomass of selected soil samples allows us to assert the safety of the applied fire method of weed control. Ecological indicators of microbiological processes indicate a decrease in the intensity of decomposition of soil organic matter, in particular humic compounds, as well as a decrease in soil oligotrophicity indicates an increase in soil nutrient content. This type of treatment allows not only to control weeds, but also stimulates and set microbiological processes in a positive direction.* ***Conclusions****: Thus, fire treatment does not have a negative impact on the main ecological and trophic groups of microorganisms and directs the processes in the soil to increase the amount of nutrients and slow decomposition of organic matter.*

Keywords: *propane-fueled flame weeding, soil, ecological indicators, groups of microorganisms.*

Biography: *Iryna Gumeniuk has completed her PhD at the age of 26 years (Institute of Agroecology and Environmental Management of NAAS) in Biological Sciences (Ecology). She is Senior Researcher in Laboratory of ecology of microorganisms (Institute of Agroecology and Environmental Management of NAAS). She has published more than 18 papers in scientific journals*

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MODERN AGROTECHNOLOGIES OF CORN CULTIVATION IN CONDITIONS OF CLIMATE CHANGE

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ABSTRACT: *Ukraine is among the world top five exporters of grain maize and the area under this crop has increased by 3.7 times over the last decades. Such an increase in crop areas caused gross violations of crop rotation. The pests number increase in agrophytocenosises and the buildup of the biological and chemical agroecosystems contamination due to the expansion of crop protection chemicals use. The aim of our work was to research the technologies conditions effect (monoculture, and plant protection system) soil organic matter and carbon transformation in soil, productivity maize. Growing maize in monoculture has a negative impact on the soil, its agrochemical and biological parameters. Found that growing maize in monoculture leads to a decrease in the content of humus in 1.3 times, organic matter stocks - in 1.7 times. Part of C_{org} in total soil carbon pool is 78%. The losses of C_{org} from soils are 24% and this is due to a significant reduction in the content of C_{mic} (65%). It is set that application only of the ground herbicides did not guarantee complete defense of sowing against weeds. The efficiency of complex application of the ground herbicides is certain with the additional sprinkling of sowing of corn by insurance herbicides. Found out the important value of increase of efficiency of chemical preparations by the repeated bringing of herbicides, at what the number of weeds diminished and them an air- dry mass. Application in the ground of herbicide Harnes (active substance: Acetochlor) and additionallyherbicide Milagro (active substance: Nicosulfuron) provide the best height and development of corn.*

Keywords: *soil, maize, monoculture, herbicides, soil organic matter*

Mrs. Olena Demyanyuk, has the degree of Doctor of Agriculture (2017), Professor of Ecology (2019). Research areas: ecological safety of agricultural production; the quality and safety of agricultural products; food security in the context of climate changes; soil microbiology and in biological diagnostic of soil of the different agroecosystems. She is working with microbiological monitoring in different types of ecosystems. She is author of over 175 scientific publications. Participant and co-organizer of numerous international congresses and conferences.

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CONNECTION BETWEEN EARTHWORMS AND SOIL PARAMETERS

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Abstract: *Soil organic matter plays a crucial role in combating climate change. Earthworms play a determining role in forming soil organic matter from organic materials, their presence is a good indicator of soils' biological activity and soil health. The main question of the research was if there was any effect of earthworms on soil characteristics, especially the organic matter content or vice versa. The investigated area was the Gödöllő Hillside. Ten sites were chosen, mainly in semi-natural areas. The earthworms were counted and soil samples were collected from 25×25×25 cm pits, 5 pits per site. Soil samples were analysed by a NIR soil scanner device (1300–2600 nm). Four earthworm species were found during the research: Aporrectodea rosea, Lumbricus terrestris, Lumbricus caliginosa and Eisena fetida. There were 4 sites characterized by sandy texture where no earthworms were present. The NIR device measured pH, humus, total N, exchangeable K, clay content and cation exchange capacity (CEC). There were significant connections between the number and the weight of adults and the soil parameters, and there was no significant connection in the case of the number of juvenile earthworms, however, their weight correlated significantly with clay and CEC. Based on the medium strength of the correlation between the soil parameters and earthworm characteristics, we can conclude that more soil parameters have effects on earthworm numbers and weight than what was measured, so more measurements areneeded to reveal all the connections.*

Keywords: *soil-earthworm relation, soi organic matter, soil texture, soil moisture, species richness.*

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 more than 18 papers in Q1 and Q2journals and has been serving as a chief editor in the Hungarian Journal of Landscape Ecology, guest editor of special issues in the journal of Water, Sustainability and Remote Sensing. His main research interest is soil water erosion, soil erosion modelling, land-use change, ecosystem services, soil-plant, soil-wildlife and soil-animal interactions, with special emphasis on nature conservation related issues.*

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GREEN CHEMISTRY: IONIC LIQUIDS IN INDUSTRIAL APPLICATIONS

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Abstract: *Chemical reactions are generally performed in the presence of volatile, flammable, and toxic organic solvents, whether on a small scale in the laboratory or on a large scale in industry. Every year, approximately 20 million tons of volatile organic chemicals are discharged into the atmosphere. Consequently, the change in global climate, air pollution, and health issues are come into the forefront. Thus, alternative, and green solvents are becoming more popular within years. Fluorinated solvents, water, and supercritical liquids are utilized as alternatives to volatile organic solvents. The interest of ionic liquids as green solvents is due to their several advantages such as low vapour pressure, low flammability, a wide liquid range, excellent thermal stability, adjustable polarity, and miscibility with other organic and inorganic chemicals. Ionic liquids are an ideal “environmentally friendly solvents” alternative to organic solvents used today for synthesis, homogeneous catalysis, and most chemical processes. It has developed as a reinforcing family of chemicals in ionic liquids, electrochemistry, organic synthesis, catalysis, gas separation, protein preservation, and other applications due to its outstanding characteristics and vast combinations of cations and anions. This review is focused on the use of ionic liquids especially in the field of biotechnology and leather production.*

Keywords: *biotechnology, green solvent, green chemistry, ionic liquid, leather, organic solvents*

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STUDY OF THE RECYCLING OF SOLID BARITE WASTES AS MAIN CONSTITUENT IN CERAMIC COMPOSITION

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Abstract: *Large amounts of Solid Barite Wastes (SBWs) materials are discarded in the Boucaïd's mine located in the North of Algeria ((Tissemsilt) producing an average of 50 wt% of barite rejects after the physico-chemical treatment. This work investigates the incorporation of solid barite waste (SBWs) as a raw material into a clay body, replacing feldspar material by up to 20 wt%. Ceramic pieces were produced at temperatures varying from 1200 to 1300°C. The technological properties of the ceramic pieces (e.g., linear shrinkage, apparent density, water absorption, and compressive strength) have been determined. The leaching toxicity of the fired pieces has also been determined. The results showed that SBWs could be used in ceramic materials (porcelain type), in the range up to 20 wt%, as a partial replacement for feldspar. Mineralogical analysis of the <125 µm of SBWs, shows that it is mainly composed of calcite (22%), barite (25%), cerusite (13%) and hemimorphite (27%). After sintering, mullite, anorthite and quartz are the main mineralogical phases appeared at 1200 °C; when the temperature roses at 1300 °C, celcian phase appears, beside anorthite and quartz phases. The obtained ceramic samples exhibit better mechanical properties compared to the reference ceramic samples (0% SBWs). However, up to 10 wt% additions of SBWs in the ceramic bodies, micro-hardness and the Young's modulus have higher values, reaching 480 kg/mm2 and 35.27 GPa respectively at 1300 °C. Besides, the evaluation of the release of various chemical species (Pb^{2+}, Zn^{2+}, $Ba^{2+}$and Cu^{2+}) contained in the ceramic samples indicates successful inertization of the pollutants. The results show that solid barite wastes can be used as substituent of feldspar to produce eco-friendly ceramic materials.*

Keywords: *Barite wastes, Boucaid's mine, ceramic, mechanical properties, microstructure, environment.*

Biography: *Nedjima BOUZIDI is a full professor at the university of Bejaia, Algeria. She is a teacher –researcher in the department of mine and geology, Faculty of technology. She obtained her Ph.D. in process engineering (chemical engineering). She has published more than 20 papers in reputed journals and has been serving as reviewer of repute journals. She has a background on raw materials used in ceramics, glasses, glass-ceramics, enamels, geopolymers, etc… as well as engineering process. Currently she leads a research team within the research laboratory Materials Technology and Process Engineering (LTMGP).*

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BIOINDICATION OF SOIL AS ADDITIONAL TOOL FOR ECOLOGICAL MONITORING

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Abstract: *Sustainable management of soils requires soil monitoring, including biological indication, to be able to relate land use and management to soil functioning and ecosystem services. Ecological monitoring of soil on the* area *adjacent to the Carpathian Biosphere Reserve with using bioindication methods have shown changes in the soil microbial cenoses under the direct influence of unauthorized landfills of solid waste, namely increased the number of organotrophic bacteria and micromycetes and decreased number of nitrogen-fixing microorganisms. The highest number of bacteria using nitrogen of organic compounds (25.36-28.61 $*10^6$ CFU/g.soil) and micromycetes (51.8-76.8 $*10^3$ CFU/g.soil) was fixed in the soils in the tract Pidhirna and Feresok with advantage of 1.5-1.7 times and 2.5-3.8 times compared to the soil of the protected area. Increasing the number of pedotrophic and oligotrophic microorganisms and microorganisms that assimilate organic forms of nitrogen, on averag The coefficient of oligotrophicity varied in the range of 0.21–0.30, mineralization, immobilization - 1.22–1.38, pedotrophic - 0.55–0.96 with a maximum in the soil of the landfill in the tracts of Feresok and Pidhirna, which indicates about intensification of microbiological processes of mineralization and decomposition of soil organic matter, including humus compounds*

Keywords: *bioindication, soil, monitoring, microorganisms.*

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SYNTHESIS OF SILVER AND GOLD NANOPARTICLES USING MELISSA OFFICINALIS L. LEAF EXTRACT

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***Abstract**: Utilization of plant extracts for the synthesis of various nanoparticles is a new trend in modern nanotechnology. They deliver a renewable, mild, non-toxic, and environmentally friendly reducing agents and efficient stabilizers for nanocolloid systems. Complex composition of plant extracts opens the wide possibilities to design the morphology of resulting nanoparticles. Melissa Officinalis L. leaf extracts prepared using different extraction conditions (composition of solvent and temperature) were used for synthesis of silver and gold nanoparticles. The bioactive compounds present in each extract were studied using high performance liquid chromatography and attenuated total reflection Fourier transform infrared spectroscopy. Synthesis process was followed by UV-Vis spectroscopy and resulting nanoparticles were characterized with surface and transmission electron microscopy, atomic force microscopy. The study was focused on the optimization of synthesis protocol of the nanocolloid solutions with maximal yield of non-spherical nanoparticles. It was observed that the products of fytosynthesis depend on various factors, like the reaction conditions (such as temperature, concentration, pH), as well as reaction time and extract constituents, which define the formation and stability of the nanoparticles*

***Keywords:** nanoparticles, electron microscopy, green synthesis, phytosynthesis, plasmonic materials.*

***Biography:** Dr. Ruslan Mariychuk has obtained his PhD degree in Inorganic chemistry in 2000 at the Taras Shevchenko National University of Kyiv, Ukraine and Postdoctoral Studies on 2003-2007 at Departments of Inorganic chemistry, Regensburg University and Bayreuth University, Germany. In 2009, he obtained his Associate Professor diploma in Ecology and Environment Protection at Uzhhorod National University, Ukraine. From 2019 is the Head of Department of Ecology at the Faculty of Humanities and Natural Sciences, University of Prešov, Slovakia. He has published over 50 papers in reputed journals and co-author of 3 patents. Research interest are green technologies, green chemistry, and nanomaterials*

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AIR POLLUTION MODELLING SOFTWARE PERFORMANCE COMPARISON - A CASE STUDY OF KOMÁROM ROAD

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Abstract: *Recent economic development in many countries has shown an increase in the number of vehicles in urban areas, which further results in an increase in pollutant emissions. This paper presents the results of modelling the simulation of carbon monoxide (CO) distribution in ambient air on roads in Komárom inHungary. The modelling was performed in two softwares ADMS and IMMI. This paper presents a case study of air pollution of bypass road No. 131 in Komárom, Hungary. Modelling in IMMI software was done before and after the construction of the bypass road, based on the simulation in IMMI software, the new bypass helpsreduce pollutant emissions the city. In order to compare the modelled concentrations from the IMMI software, a comparative analysis was performed with ADMS software. The analysis showed that there is a difference between the concentrations from both softwares.*

Keywords*: ADMS, IMMI, air pollution, carbon monoxide*

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MANAGEMENT AND SUSTAINABLE DEVELOPMENT OF ECOTOURISM DESTINATIONS

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Abstract: *The accelerated development of ecotourism reflects through an almost equally rapid increase in the number of researchers who draw attention to potentially harmful and destructive consequences of tourism development. Sustainable tourism and ecotourism destinations are essential for sustainable development, which arose as a logical necessity to stop the expansive economic growth based on the uncontrolled use of available resources. A positive approach, designed to reduce tensions and conflicts that create complicated interactions between the tourism industry, visitors, the environment and the communities that host tourists, advocates the concept of sustainable tourism. Tourism and the environment are interconnected and dependent, while environmental protection is of fundamental importance for the future development of tourist destinations. The motivation of modern tourists is increasingly tied to destinations guided by the principles of sustainable development, so the decision-makers and the local community should pay more attention to the regulations related to environmental protection and the effectiveness of its implementation. Environment protection aims to properly constitute new or implement existing protection measures to achieve positive environmental and social results of a long-term nature. Despite numerous studies regarding ecotourism, there is a particular gap regarding the management of ecotourism destinations. This article provides better insight into ecotourism destinations' management and sustainable development through a comprehensive literature review of groundbreaking researches and articles from state-of-art journals. The concept of ecotourism destination management requires finding new and revising various management strategies to preserve biodiversity in tourism destinations and educate about the importance of sustainable development.*

Keywords: *Eco-management, ecotourism destinations, management strategies, sustainable development, tourism.*

Biography: *Vuk Mirčetić (Belgrade, Serbia) is a Teaching Assistant at the Faculty of Applied Management, Economics and Finance and a Member of Parliament at the National Assembly of the Republic of Serbia. He holds a master's degree in Economics, and he is currently a PhD student at two faculties - Faculty of Organizational Sciences and Faculty of Applied Management, Economics and Finance, pursuing PhD in two different scientific fields. As a first author, alone or with co-authors, he published 39 scientific papers, mainly about the management of human resource management.*

Adriana Radosavac (Belgrade, Serbia) Associate Professor at the Faculty of Management, Economics and Finance, University Business Academy in Novi Sad. She has participated in scientific and professional conferences of international and national importance and published several scientific and professional papers in the field of economics, entrepreneurship and agribusiness.

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REPRODUCTION OF POTENTIAL SOIL FERTILITY AND THE STATE OF THE ENVIRONMENT AT THE WASTE APPLICATION FROM PIG COMPLEXES

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Abstract: *The increase of the livestock and waste concentration per unit area of agricultural land determines a qualitatively different nature of the impact on the indicators of potential soil fertility and the state of the environment. Livestock breeding complexes for fattening up to 70 thousand pigs per year are located in the Polissya zone on typical sod-podzolic soils. However, large pig complexes cause an increase in the chemical load on ecosystems in waste disposal sites due to technical and organizational reasons related to the capacity of effluents per unit area. The research aimed to establish the parameters of changes in soil fertility and the ecological state of the environment in the conditions of the intensive waste load of pig complexes. It has established that the use for 25 years of low doses of the solid fraction of effluents from the Agricultural Open Joint-Stock Company «Agrocombinat Kalyta» as well as their combination with straw and green manure in the long-term stationary experiment of the National Science Center «Institute of Agriculture NAAS» caused widespread reproduction of sod-podzolic soil fertility. The highest fertility parameters were achieved by applying the solid fraction of effluents at a dose of N_{75}, where the humus content was 0,28 % higher than control (without fertilizers) and was – 1,17 %. At the norm of the effluents solid fraction of N_{75}, the content of mobile phosphorus in the soil increased to control 1,4 times, and at doses N_{300} – 3,2 times, which caused high soil phosphating. The content of mobile potassium in the soil at the application of the solid fraction of effluents at thedose of $N_{100-200}$ remained low (70-75 mg/kg), which is required the additional application of potassium fertilizers at the dose K_{60-120}. At the fertilizing of the soil with the pig effluents, the dose of their application should not exceed 200-225 kg/ha in terms of nitrogen has been established. At doses of N_{400} and above, there were a sharp increase in soil acidity, a decrease in the amount of absorbed bases by 1.9 times, an increase in the content of mobile phosphates by 25 times to the natural background, and contamination of groundwater with nitrates. At high effluents loads (N_{400}), nitrogen leaching from nitrates in the soil thickness to 500 cm is increased 14,6 times compared to the control: at the control - 102 kg/ha, at the dose of excess activated sludge N_{225} - 657, dose N_{675} - 1488 kg/ha. At the intensive effluents loads, there was defined the inhibition of the development of mostphysiological groups of soil microorganisms, in particular, actinomycetes and ammonifiers. However, the number of denitrifying and phosphate-mobilizing microorganisms increased 13 and 4 times, respectively, at the increasing intensity of organic matter mineralization. It was significantly affected the processes of nitrate pollution and phosphating of the soil. The use of a solid fraction of livestock effluents in the dose of N_{75} provided crop rotation productivity at the level of 4.10 t/ha of grain units at the dose of N_{75} + K_{90} – 4,57. The highest productivity of crop rotation (5.65 t/ha) was achieved at the application of excess activated sludge at a dose of N_{225}, while a similar indicator at the control was 2,56 t/ha. Further increase of the products doses of biological processing of livestock effluents reduced the payback per unit of fertilizer by 4-5 times and created an environmental hazard in the environment.*

Keywords: *sod-podzolic soil, fertility, waste of pig complexes, environmental protection, soil microorganisms, surface soil water.*

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INFLUENCE OF OXIDANTS ON SORPTION OF IRON IONS ON CLINOPTILOLITE

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Abstract: *There are many methods of water deironing have been proposed to solve the problem of excess iron content in water. They are divided into reagent and non-reagent by type of action. One such method is ion exchange, which uses expensive ion exchange resins. It is necessary to replace expensive ion exchange resins with natural zeolites to remove the disadvantages of this method and preserve its advantages. Among the known zeolite minerals (more than 40), only six of them have large reserves and properties required for industrial use: clinoptilolite, mordenite, erionite, shabazite, farrierite, and phillipsite. Clinoptilolite and mordenite are widespread in the Transcarpathian zeolite-bearing region, which belonged to the largest zeolite deposits in Europe. The aim of this investigation was to study as the sorption of iron ions on clinoptilolite of the Sokyrnytsya deposit and the possibility of extracting iron ions from natural waters, as well the influence of oxidants on the sorption process. Iron in water is mainly in two oxidation states +2 and +3. Previous our theoretical studies performed by the semi-empirical method GFN2-xTB, indicate that the sorption of iron on natural clinoptilolite (calcium form) is energetically beneficial only in the case of the reaction of ion exchange with* Fe^{3+}*. The ion exchange sorption is possible for both* Fe^{2+} *and* Fe^{3+} *when uses the modified clinoptilolite (sodium form). It reasoned the investigation of iron ions sorption at the presence of the oxidants. The* H_2O_2 *was used as an oxidant because it has the best environmental performance. The results of the study show that the sorption grade of iron ions on natural clinoptilolite Z-0 increases by 82% with the addition of oxidant* H_2O_2*, compared with the process without its usage.*

Keywords: *clinoptilolite, sorption, iron ions*

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HYDRAULIC INFRASTRUCTURES MANAGEMENT IN KETOU MUNICIPALITY IN REPUBLIC OF BENIN (WEST AFRICA)

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ABSTRACT: *The insufficient management of the hydraulic infrastructures of Kétou commune limits access to drinking water for households in this commune. This research aims to analyze the management methods of hydraulic structures in Kétou commune. For this propose, documentation, observations, and field surveys in 150 households selected according to the low or medium level of access to water infrastructures were carried out. Likewise, resources such as local elected officials and those in charge of water management of those infrastructures. The data collected was compiled in Word and Excel 2010 on Windows, descriptive statistics were used for the processing of these data and QGIS 2.14.6 was used for the creation of buffer zones which spatially prioritize the density, the average and weakness of the service points in water points as well as human concentrations. As results, the drinking water supply rate for the Kétou commune is 42.75 %. This commune has 182 hydraulic structures (FPM, PM, PEA, AEV) unevenly distributed, of which 106 structures are functional, i.e a rate of 58 % and 76 are broken down, ie 42 %. This situation leads households in unnerved localities travel lo.,ng distances to obtain drinking water. It urges that communal, local and government actors in collaboration with the population of Kétou define strategies for easy access to drinking water for households in the commune.*

Keywords*: Benin, Kétou, unequal distribution of hydraulic structures, difficult access to drinking water*

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FEASIBILITY OF USING GREEN TEA POWDER AS A NATURAL ANTIOXIDANT AND STEVIA AS A SWEETENER IN NON-FERMENTED LAYER CAKE

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Abstract: *Today there is an increasing demand for low-calorie and functional food products worldwide. Green tea powder has antioxidant property due to its phenolic structure which makes it a good natural replacement for synthetic antioxidants. Stevia is a calorie-free product which can be substituted for sucrose in foods. The aim of this study was to investigate the feasibility of using green tea powder and stevia instead of flour and sugar respectively in the formulation of non-fermented layer cake. To do so, different concentrations of green tea powder (10, 20, 30% w/w) and stevia (40, 60, 80% w/w) were incorporated into the formulation of cake. Ten treatments were designed and the rheological properties of dough including pharinograph and extensiograph characteristics were measured. Three dough samples with superior rheological properties along with control sample were baked. The physicochemical and sensory properties of the selected samples were compared with those of control sample. The layer cakes containing 10% green tea powder and 40, 60 and 80% stevia were selected as the superior treatments and their quality properties were compared with those of control sample. Increased concentration of stevia significantly reduced the specific volume and increased the firmness of the layer cake samples. Since there was no significant difference in total acceptance between the layer cakes containing green tea powder and stevia and control sample, the treatment containing 10% green tee powder and80% stevia was selected as the superior treatment regarding the nutritional and quality properties..*

Keywords: *Non-fermented layer cake; Green tea powder; Stevia*

Biography: *I am Fatemeh Zarei from Iran; I got my PhD in food science in 2019 at the age of 39 years from Azad University and now working in Food and Drug Administration (FDA). I have published more than 14 papers in reputed journals.*

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EXAMINATION OF SATURATED HYDRAULIC CONDUCTIVITY USING GRADING CURVE FUNCTIONS

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Abstract: *In a previous research program 74 artificial soil mixtures of natural fluvial soils were prepared in 4 series of measurements for permeability testing, differing in d10. The conclusions drawn from the original investigations were as follows: the k showed a decreasing tendency with the increase of the uniformity index U and increasing with d10. In this research these data are used (i) to test the value of the grading entropy parameters in case of non-precise grading curve measurement with missing fines, (ii) to correlate the usual grading curve parameters and the grading entropy moreover specific surface parameters, (iii) to validate some existing permeability – grading curve equations and to elaborate some new permeability – grading curve relationships. For these aims, data have been started to be reevaluated using grading entropy parameters and specific surface parameters. The original conclusions are reformulated for the new parameters.*

Keywords: *Grading Entropy; Hydraulic Conductivity; Grading Curve Functions; Void Ratio*

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ENVIRONMENTAL ODOR PROBLEM IN HUNGARY, LEGISLATION, MEASUREMENT POSSIBILITIES

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Abstract: *Legislation and regulations concerning the state of ambient air in the European Union have been harmonized by the member states. Exceptions to this are environmental odors, the legal regulation of which has been transferred to national competence by the European Union. Each Member State regulates odor-related activities differently. Some Member States allow a certain percentage of annual hours to be emitted into the ambient air with an odor that disturbs the population. In Hungary, design guidelines have been set for which higher odor concentrations are not permitted in ambient air. Limit values are expressed in odor units to which odor concentrations determined by standard olfactometric measurements can be compared. In recent years, significant measurement experience has been gained in connection with certain odor-emitting technologies, which have been published in Hungarian-language publications.*

Keywords: *environmental odour, air pollution, olfactometric measurements, legislation*

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ASSESSING SURFACE WATERS QUALITY OF EL MALLEH RESERVOIR

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Abstract: *The El Malleh dam is located in the Benslimane region, 30 km from its outlet in Mohammedia and 25 km north of Casablanca. It was built in 1927 to fight against flooding in order to protect Mohammedia city, and prevent develop agriculture.* ***Motivation/Background****: However, these uses were not ensured before, due to its silting (2.5M tons per year) intensified by water erosion. For this reason, the General Directorate for Water took charge of raising the El Malleh dam height in 2012, which increased its storage capacity and its lifespan. Nevertheless, the evolution of siltation over time is growing much faster than the initial state. This has impacted the quality of the reservoir.* ***Method****: In this context, we carried out a Spatio-temporal evaluation of the contamination of the water of the El Malleh dam by conservative and non-conservative elements. To carry out this study, we selected 20 sampling sites. The physicochemical analyses were carried out according to the AFNOR standards, and the major elements were analysed using the ICP-MS method.* ***Results****: The obtained results allowed us to quantify the degree of pollution by the above-mentioned elements. We noted the predominance of the major elements (N, Ca, Mg, and K) and the low quantity of nutrients.* ***Conclusions****: This explains the absence of organic pollution, and shows that the origin of this pollution is water erosion andgeology of El Malleh.*

Keywords: *Silting, Water Erosion, Spatio-temporal evaluation, Contamination, Pollution*

Biography: *Nouhaila MAZIGH; PhD student in Laboratory of Environmental Process Engineering; Faculty of Science and Technology of Mohammedia; University Hassan 2 of Casablanca; Morocco. Researcher on hydrology, soil, Climate Changes and geographic information systems*

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RECOVERY OF SCANDIUM FROM THE BAUXITE RESIDUE BY SOLVENT EXTRACTION

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Abstract: *Bauxite residue, or red mud, is a solid waste produced from the alumina refining of bauxite ore. Hungarian red mud includes acceptable quantities of scandium, making it an interesting source for rare metal processing and manufacture. A new approach for selective separation of scandium from red mud leachate was proposed in this work. Different organophosphorus compounds, such as bis(2-ethylhexyl) phosphoric acid (D2EHPA), tributyl phosphate (TBP), and trioctylphosphine oxide (TOPO), were employed as extractants where the HCl leachate was treated. Because the physicochemical properties of Fe(III) and Sc(III) are similar, the presence of a considerable amount of iron in red mud makes it difficult to recover scandium (III). The findings show that of the three organophosphorus extractants studied, D2EHPA extractant performed the best. The results showed that, Sc and Ti was extracted at a concentration of 0.05 mol/L of D2EHPA in the organic phase,a ratio of 3:1 in the A/O phase, pH 0 for 10 minutes, and a temperature of 25 °C. Sc and Ti as a precipitate can be efficiently obtained by stripping from the D2EHPA extractant by 2.5 mol/L NaOH with stripping efficiency 95%.*

Keywords: *Scandium, D2EHPA, Trioctylphosphine oxide, Tributyl phosphate, Red mud*

Ali Dawood Salman completed his Master of Chemical Engineering studies at University of Technology Baghdad,Iraq. Since 2016 he has been working as assistant lecturer at the College of Oil and Gas Engineering Basra University, Iraq. Currently he is involved in PhD studies and he is researcher in Laboratory for Surfaces and Nanostructures (LASUNA), Faculty of Engineering, University of Pannonia, Veszprem, Hungary.

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EVALUATION OF TOXICITY AND BIOSORPTION FOR THE REMOVAL OF HEXAVALENT CHROMIUM USING FRESHWATER MICROALGAE

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Abstract: *Due to different human activities, hexavalent chromium (Cr(VI)) is enriched in the environment's water system above the regulatory level. Therefore, it is carcinogenic and shows toxicity even at trace amounts, threatening environmental ecology and human health. Recently, one of the effective methods for removing heavy metals and water purification is microalgae. This study cultured three microalgae such Nitzschia palea, Navicula subminuscula manguin, and chlorella vulgaris, in an artificial growth medium Wright's Cryptophyta (WC). After purification, they were exposed to various concentrations (1-2-4-10-20 ppm) of Cr (VI) for 12 days, and then chromium biosorption was measured by atomic absorption spectrophotometer. The results show a significant growth of three microalgae for Cr concentrations up to 10 ppm, and the growth rate decreases as a function of increasing concentrations of Cr(VI). Furthermore, the IC50 values calculated for three microalgae showed a remarkable resistance for Cr (VI). The maximum absorbed chromium percentages were 99.25, 98.20 and 98 % for N. palea, N. subminuscula and C. vulgaris, respectively. The biosorption of the metal ion for all three species followed the Langmuir isotherm. This work provides valuable insights to help the future development of efficient and commercially viable technology for microalgae-based heavy metal bioremediation*

Keywords: *Microalgae, heavy metals, chromium, toxicity, biosorption, wastewater*

Biography: *Karim SBIHI, Ph.D., is an Assistant Professor and member of Laboratory of Biotechnology, Materials and Environment, Research, Polydisciplinaire Faculty, University Ibn Zohr, Taroudant, Morocco. His Principal researcher is the use of algae for wastewater treatment and the algae bio-remediation technology to manage a variety of industrial effluents, including chemical, textile and leather industries.*

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INSTABILITY OF THE SLOPES LINKED TO A NEO-TECTONIC ACTIVITY, MAHOUNA, NORTH-EAST, ALGERIA

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Abstract: *The Mahouna region located in northeastern Algeria, in a margin considered active; it constitutes a fragmented landscape, extremely varied, with a very complex substratum characterised by a tectonic heritage of several geological units. The sedimentary soil dates from the Permo-Triassic to the Plio-Quaternary. It is distinguished by a structural relief, young, active, due to its geodynamic evolution during the Upper Tertiary (convergence of the Africa-Eurasia plates). The instability of the slopes by the size and extent of the affected masses constitutes a serious threat and pose problems of development of this region. It is recommended on the one hand to discern the different revealers of recent tectonics; and on the other hand, the highlighting of the relationship between neo-tectonic activity and disorder whose main purpose is to improve the geologicalbalance of a region that remains very little explored from the morpho-structural point of view. The multi-source mapping and analysis through the GIS, the deciphering of a mosaic of aerial photos, coupled with the field study, give us new results and show that the construction and the genesis of this relief is closely linked to the neo- tectonic activity, whose activation is confirmed by the disorder, dismemberment and quite significant deformation that affect both ancient and recent geological formations and the morphology of the region.*

Keywords: *Deformation, Instability of the slopes, Mahouna, Neo-tectonic, Structural relief, SIG.*

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2015 – 2019: Part-time lecturer, Skikda University
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Areas of interest
Scientific research, education and training (Geology, Environment and GIS...)..

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IMPACTS OF CONTAMINATED WATER ON REAL ESTATE VALUES

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Abstract: *Water plays a key role in the development. Sustainable development needs to manage and preserve water resources to meet the inhabitants needs with the quantity and the quality required. However, the water quality is decreasing due to industrial, agricultural and anthropic activities. The water contamination causes bigloses in the economy. Moreover, its impacts decrease the real estate value considered as pillar of development programs. Studies examining the impacts of contaminated water on real estate values are few. This paper seeks to fill that void by examining the effects of contaminated water on property values: ground water and surface water.*
Motivation/Background*: In property appraisal, water quality plays a great role in determining the real estate value. Many difficulties are observed to assess the property value according to water quality in appraiser's reports. This paper tries to provide tools in order to help appraisers in assessing market price taking into account water quality as one of the most important factors of value and to determine the influence of water quality may have on property final market value.* ***Method****: To discuss this issue, the analytical method is used. Many appraisers' reports and law decisions related to real estate value influenced by water quality areanalysed, discussed and compared to many studies findings.* ***Results****: The water quality is a factor, which decreases the real estate value.*
Conclusions*: Real estate valuation depends on many factors such as economic, social and physical factors. The water quality is one of the most important factors that the appraiser should take into account to assess the real estate value. It decreases significantly the property value and causes very important loses.*

Keywords: *Appraiser, contaminated water, environment, property value, real estate appraisal.*

Biography: *Farhaoui Mohamed has completed his PhD in Sciences at the age of 40 years from My Ismail University, Meknes, Morocco. He is a head of water production department at the National Office of Electricity and Drinking Water. He has published more than 12 papers in reputed journals and has been serving as an editorial board member of reputed journals all over the world. He continues his studies in law and tries to use scientificbackground to explain law decisions and help appraisers to assess the real estate value using scientific information.*

PHYSICO-CHEMICAL PROPERTIES OF THERMAL WATERS IN THE GUELMA REGION, NORTH-EAST ALGERIA

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Abstract: *The thermal springs of Hammam Debagh (Meskhoutine), Belhachani, Guerfa, N'bail and Ouled Ali located in the wilaya of Guelma in the extreme north-east of Algeria, it is characterised by a temperate climate. They have very large quantities of emerging groundwater thanks to major tectonic accidents, in carbonate platform formations. The study consists of establishing a comparison between the physico-chemical and socio- economic characteristics of the different thermal springs. The descriptive analysis of the physico-chemical parameters and the application of different diagrams showed that the thermal waters are calcium sulphated for the springs (Debagh, Belhachani), calcium bicarbonate for the springs (Guerfa, Ouled Ali) and sodium chlorinated for the N'bail spring, with a varied emergence temperature between 44 and 93°C. These waters not only present a variety of chemical facies, but also temperature, surrounding landscape that makes these hot springs tourist places par excellence, given their curative specificities (hydrotherapy) against several diseases such as rheumatic, dermatological, and neurological diseases.*

Keywords: *Guelma, thermal spring, hydrochemistry, chemical facies, hydrotherapy, tourism.*

Biography: *Hacid Mebarak currently I am a PhD student at the University of the Mentouri Brothers Constantine 1. I obtained my bachelor's degree at the University of Setif in 2017, at the age of 25. In 2020 and my master's degree in hydrogeology at the age of 27. I am currently preparing a doctoral thesis entitled: Determination of the geothermal potentialities of the Triassic Province, Algerian Sahara. Most of my studies on the problem of origin and transfer mechanism From water flow from the lower crust to the surface, and how to transfer this energy for human benefit.*

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THE IMPORTANCE OF SUSTAINABLE DAIRY FUNCTIONAL FOOD PROCESSING

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Abstract: *The Functional food is one of the main directions of healthy lifestyle and sustainable food production, due to its positive influence on health because of the usage of raw materials of natural origin. Therefore, it attracted the interest of consumers and manufacturers concerning human healthy lifestyle and sustainable economic growth. In addition to this, the importance of supplying local food markets with healthy alternatives for consumers by Small and medium enterprises SMEs. For this purpose, Our study will discuss the importance of functional food for better sustainability, especially in Dairy functional food in the Hungarian market. by reviewing previous studies and logical analysing for better comprehension and recommendations for SMEs in the Hungarian market.*

Keywords: *Sustainability, Functional Food, Dairy, SMEs, Healthy Food.*

Biography: *Mohammad MOHAMMAD PhD Student since 2018 completed his Master study in 2018 in Engineering of Animal Nutrition and feed Safety from Kaposvár University. Completed Engineering of Agronomy specialized in animal production in 2014 from Faculty of Agriculture in Damascus University.*

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NEXUS BETWEEN THE MINERAL RESOURCES ABUNDANCE, RENEWABLE ENERGY POLICIES AND ECONOMIC GROWTH, AND THEIR CONNECTION WITH CO_2 EMISSIONS IN TRANSITION COUNTIRES

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Abstract: *the mineral resources abundance play an important role for the economic growth in transition countries. The excessive mining, mineral resources production affect the environment. Governments from their part take decisions on implementing the renewable energy policies efficient ones or not. In spite of being known as part of the world rich by mineral resources, the studies on connection between their mining and resource export policies, renewable policies and environmental quality are quite limited in number. The current paper examines if there is a connection between the mineral resource abundance, economic growth and renewable energy policies in transition countries and their connection with CO_2 emissions in the group of these countries. The study uses the annual panel data spanning from the year 1995 to 2020 applying the Augmented Mean Group(AMG) panel algorithm, which is robust to heterogeneity, and which is employed considering the economic growth, mineral resources export, implementation of renewable energy policies and the CO_2 emissions volumes. The findings show that natural resource abundance has a significant effect in economic growth, while the effect of renewable energy promotion policies in some sub-group of transition countries does not have a great effect on CO_2 emissions. This sub-group mostly includes countries of Commonwealth of Independent States. Results of the current study may be considered by the local Government bodies in order to find when the wrong turn in their renewable energy policies implementation was taken and raise some thought on changes needed in order to improve the environmental conditions.*

Keywords: *carbon emissions, economic growth, natural resources, mineral resource abundance, renewable energy policies.*

Biography: *Dina Malgazhdarova, has completed her Master's degree in Economic studies at the age of 30 in 2013 from the University of Quebec in Montreal (Canada) and currently is a PhD student of Hungarian University of Agricultures and Life Sciences. She is also a Lead Consultant of the Agency for Defense and Development of Competition of the Republic of Kazakhstan under President of the Republic of Kazakhstan, also has a work experience in local Investment policy division being responsible for communication with international bodies and enforcement of Investment climate in Kazakhstan. She has published 15 papers in reputed local journals as well as participated in publication of the textbook (namely the part that touched the questions of environmental and economic sustainability) for students of Military Institute of Radioelectronics and Communication in Almaty city of Kazakhstan. Has astrong interest in studying and promoting the environmental sustainability as well as finding the ways to raise the efficiency of State bodies in her motherland.*

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URBAN AND INDUSTRIAL SURFACE WATER POLLUTION AND THEIR IMPACTS ON THE ENVIRONMENT. CONSTANTINE CITY CASE STUDY. NORTH-EAST OF ALGERIA

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Abstract: *The study area is located in Constantine, at the North-East of Algeria; it regards the segments of wadi Rhumel and its branch wadi Boumerzoug. It is characterized by a semi-arid climate. This work focused on the assessment of the physical-chemical quality and the level of contamination by hydrocarbons (oils and greases) and metallic trace elements (TMEs) (As, Cd, Cu, Fe, Ni and Zn). 14 samples were collected spread the wadi, and were analyzed. Results show the order of abundance of the cations in the majority of the samples is: Na> Ca> Mg> K. The concentrations ranking is: Na (66.812-396.493 mg/l), Ca (90.11-96.66 mg/l), Mg (18.96-30.52 mg/l), K (9.494-13.988 mg/l).For TMEs, the analyses showed relatively high concentrations. The abundance ranking in most elements is: As > Fe > Cd > Ni > Zn > Cu. The concentrations ranking is: As (1.316-0.436 mg/l), Fe (0.119-0.170 mg/l), Cd (0.054-0.099 mg/l), Ni (0.007-0.043mg/l), Zn (0-0.08 mg/l), Cu (0.008-0.016 mg/l). All analysis shows oils and greases concentrations are extremely high (88.2-390.6 mg/l). The correlation matrix and the PCA between all metal elements reflect the signature of anthropogenic and domestic inputs at the same time. The SEQ-Water: qualifies very poor quality according As and Cd contents, good to fair for Ni and good quality for Cu and Zn. This situation reveals a direct influence of anthropogenic inputs conveyed by the wadis. Oils and greases, their contents are found to be very high and reflect an intense uncontrolled activity linked to the use of hydrocarbons and derivatives.*

Keywords: *Anthropogenic, contamination, oils and greases, SEQ-Water, TME, wadi Rhumel, wadi Boumerzoug.*

Biography: *Rima Kifouche, she is PhD student; Université frères Mentouri Constantine 1. Department of geology. Laboratoire de géologie et Environnement (LGE); Hydrogeologist, she had Master in Environmental Geology; she participated in the 7th seminar of the geology of the Arab world in Cairo through our supervisor Mrs. Djebbar Mounir. Currently, my research focuses are on geothermal energy and resources, factors of pollution of waterresources and their impact on the environment. She is also working on pollution of surface water and their impact on the environment and water resources. The methods used relate to the collection of samples and their chemical analysis as well as the use of appropriate software for interpretation. Skills and experience: Hydrogeology, water quality, water chemistry, ground water chemistry, water resources, environmental pollution, geothermal energy, geothermal resources, Geostatistical Analysis and SIG.*

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THE QUALITY ASSESSMENT OF DRINKING WATER FROM DISTRICT ABBOTTABAD, KPK, PAKISTAN

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Abstract: Motivation/Background*: The quality of water is a vital concern for mankind since it is directly linked with human welfare. It is matter of history that fiscal pollution of drinking water caused water borne diseases which wiped out entire population of cities. The aim of this study to Qualitative and Quantitative analysis of drinking water from Tehsil Abbottabad and analyze physicochemical & biological parameters of drinking water samples collected from the selective localities of district Abbottabad, KPK, Pakistan.* ***Method****: Chemical and biological parameters were determined by using standard method.* ***Results****: The complete analysis of 15 drinking water samples was carried out so as to develop a data base on the quality of water being consumed in the different areas of district Abbottabad. The pH value of water samples taken from the different places ranges from 7.26 to 8.84 slightly alkaline. Maximum TDS of well water found having value of the 664 mg/L while the minimum TDS value was found to be 198mg/L. The maximum value of the conductivity of well water is 132.7µs/cm. The minimum conductivity value is 395µm/s. The minimum value of calcium hardness is 0.160mg/L found is well wall of Abbottabad and maximum value of calcium hardness is 0.350mg/L. that the chloride found in well water sample is and (10.44GIL).chloride found in water sample was 0.8 g/L high chloride value in watercause problem s in after sewerage. The result on Alkalinity of water samples show that the alkalinity found in well water sample is 300.4 mg/L. Minimum turbidity found in District Abbottabad water sample was 1.74 NTU. The maximum range of turbidity is 20.02NTU. Minimum total coli form count found in District Abbottabadwater sample was 15/100ml.****Conclusions****: The results of the present research work show that drinking water collected from different areas of district Abbottabad was not found to be suitable for human health.*

Keywords: *Chemical and biological parameters analysis, Drinking water, District Abbottabad.*

Biography: *Dr. SAMIYAH TASLEEM has completed her PhD at the year of 2013 from university of Karachi and Postdoctoral studies from University of Karachi, Sindh, Pakistan. She is the CEO – Founder of Pakistan Education, Health and Technology Innovation Consultant Group. She has Published more 50 papers in reputed journals has been serving editorial board member of reputed journals. Her research interest in Antimicrobial agent, Phytochemicals, Formulation and Clinical Research.*

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THE ROLE OF SYMBIOTIC INTERRELATIONS IN THE AVAILABILITY OF NUTRIENTS FOR FIVE COVER CROPS

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***Abstract**: Cover crops (CC) serve as essential source of nutrients in soil and improving of soil properties. The production of cover crops is considered as a benefit of soil quality; by protecting of soil from erosion, reduce weeds and so-called soil-borne plant pathogens and enhance soil biological activity. There are different varieties of cover crops that can be grown: such as legumes, non -legumes, brassica and grass-type of plants. Each of these cover crops have their own benefits to soils, helps in maintaining the nitrogen cycle as well as improve growth of nitrogen- and phosphorus producing and/or solubilizing bacteria. Our examinations were carried out in pot experiments at MATE Buda Campus, in a heated greenhouse. The pot experiment wasdesigned with five types of cover crops species (Phacelia tanacetifolia, P.t.; Brassica carinata, B.c.; Vicia faba, V.f.; Avena strigosa, A.s.; Vicia benghalensis, V.b.) and a mixture of the five species, placed in sandy soil (arenosol) in plastic pots in 4 repetitions. We measured soil biological activity, which can be the first step to achieve healthy soils. We assessed saline content of soils, i.e., quantity of salts in the soil-plant environment.This parameter is considered as an indicator of soil health and fertility. The mixture of all the cover crops tended to show the maximum electrical conductivity quite significantly compared to the other cover crops. Formation of cover crops might support also growth of the symbionts, such as arbuscular mycorrhiza fungi. Different plants can have variable interactions with the AM fungi. We have measured the frequency of mycorrhizal infection (F%). Percentage of mycorrhiza colonization was good in all CC except mustard, B.c.(0%) as a non-symbiotic plant. Wetch (V.b.) was responding positively to AM fungal inoculation. It is well known that the AMF has the ability to improve the uptake of the phosphorus (P) of the hosting plants as well as the performance of its growth. Hyphae of AM fungi can produce a protein called glomalin. The glomalin concentration along with cover crops can be very important in maintaining soil quality and aggregation- stability. It was found, that vetch (V.b.) has the highest capacity to retain glomalin concentration, followed by mustard (B.c.) and the mixture of cover crops. Further aim is to test benefits of mycorrhiza symbiosis and interrelation with their "helper" bacterial community in connection with the secondary structure of soil.*

***Keywords:** cover crops, mycorrhiza symbiosis, soil nutrients, sustainable agriculture.*

***Biography:** Sundoss Kabalan PhD student at MATE university, completed master's degree in plant Biotechnology from Szent István University of Gödöllő in 2017 and bachelor's degree in agricultural engineering in the section of soil and water management from Tishreen University (TU) in Latakia, Syria. Worked as assistant young teacher at TU,besides working as sales engineer at Bedar Ltd company, Prepare and deliver technical presentations that explain products or services to customers, help in researching and developing new products. Participated in many courses like Sustainable Agricultural Land Management by university of Florida and DNA Decoded, and have published 3 papers. Worked at Computacenter company for 9 months in accounting payable position and presently at INNIO company as part time job in billing team in Budapest. Her PhD is part of the "Symbioses research", supervised by Prof. B. BIRO at Doctors' School of Horticulture (MATE University).*

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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'06 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 h or less. The aim ofthis 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 bases 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.*

Biography: *Yanina L. Romero has completed her BSc at the age of 24 years from Civil and Environmental Engineering, University of California at Davis, USA. She has completed her MSc at the age of 34 years from Water Management from the Faculty of Civil Engineering and Geosciences, Delft University of Technology, The Netherlands. She published a paper based on her MSc thesis in Climatic Change which has had numerous worldwide citations. She has worked as a software consultant, AutoCad drafter, and advisor for diverse engineering firms and as a wastewater policy worker for a water board. She reviews papers for diverse journals including Theoretical and Applied Climatology. She recently presented her paper at The Atmospheric and Earth Sciences Conference. Ms. Romero's research interest is applying climate change effects to urban water management. She currently resides with her husband in The Netherlands..*

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IMPACT OF BRASSWARE UTENSILS INDUSTRY ON THE ENVIRONMENT, CONSTANTINE, NORTH-EAST OF ALGERIA

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Abstract: *The traditional industry of brassware utensils localised in Constantine, north-eastern of Algeria. This industry occupies the left bank of the Rummel Valley, a work based on the transformation of copper in sheets into utilitarian or simply decorative items, using chemicals harmful to the environment discharged directly either into the sewerage network or run off on the surface to Oued Rummel, a solid and liquid sample was carried out in order to dose the degree of pollution of possible heavy metals. The results of analyses show a high percentage of heavy metal pollutants in solid and liquid samples show a Cu level that varies from 2mg/l to 3 mg/l, chromiumCr reaches 1.07 mg/l, Nickel Ni 0.81 mg/l, Lead Pb 0.13 mg/l, Cadmium Cd 1.1 and Silver Ag 0.21 mg/l. Rates that exceed all standards, Algerian, WHO, AFNOR. The lack of long-term treatment of these discharges will cause pollution of metal elements harmful to groundwater tables and cause a degradation of water resources exploited for irrigation north of the city of Constantine and which partially flow into the Beni Haroun dam that supplies the major cities of north eastern Algeria.*

Keywords:. *Traditional industry, copper, impact, heavy metals, pollution, Constantine*

Biography: *2013 A. BOUSSELIOU had got my baccalaureate in experimental sciences at the age 19 years, in 2016 she had completed her license in Geology specialising in hydroscience at the age 22 years from Constantine university,2018 she had got a master's degree of 24 years in environmental geology from Constantine university, from 2021 she stated her PhD at the UniversityConstantine1 in Mineral and Geomaterial resources and the Environment*

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A NOVEL-TYPE ANALYTICAL SOLUTION OF THE PROBLEM OF SIMULTANEOUS CONVECTION AND MULTI COMPONENT DIFFUSION PROCESS THROUGH POROUS MEDIA

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Abstract: *A novel-type analytical solution is proposed for simultaneous convection-diffusion processes taking place through porous media. It is shown, that the Riccati-type ordinary differential equation, frequently applied at modelling of such processes, may be interpreted in a more general manner, as it has been done. For simultaneous convection and diffusion of multi-component, chemically interacting materials, a completely new modelling type approach is proposed and described in the present work. Then, the integration factor function method is applied, and completely novel-type formulae are derived for solving of the adequate types of the Riccati's ordinary differential equation. Finally, the new analytical results are compared to the earlier analytical solutions and their relevance for accurate future modelling of such types of drying processes is also discussed concisely*

Keywords:*. Simultaneous convection and diffusion, percolative-fractal processes, fractional-order derivatives, Riccati-type ordinary differential equations*

Biography: *Dr. Ágnes Dr. habil. Mészáros-Bálint (Ágnes Bálint is the author name), she MSc, Chemistry and Physics; Bsc, Software Information Technologist, Eötvös University, Budapest, Hungary, PhD; habilitation from Szent István University, Gödöllő, Hungary. She is Associate Professor at Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering and Natural Sciences, and Hydro-Bio-Mechanical Systems Research Center, +36303721342;* ***Specialty:*** *Inorganic chemistry, environmental analytics, colloid chemistry, Development and application of chromatographic methods for soil/plant, polymer, amino acids and food analysis, Nitrogen transformation in soil/plant/atmosphere system, application of stable isotope tracers, as fertilizer, and Experimental and theoretical modelling of transport processes.*

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SEPARATION STUDIES ON BINARY MIXTURE OF BIOMASS-DERIVED GAMMA-VALEROLACTONE AND TOLUENE

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Abstract: *Biomass solvents play a vital rule in minimizing health and environmental hazards, which may be caused by using traditional solvents. Providing a platform data for the green solvent is a key for promoting and strengthening the utilization of these solvents, especially vapor-liquid equilibrium (VLE), that are crucial for the designing of the separation systems. From the series of the eco-friendly solvents, γ-valerolactone (GVL) was recommended as a successful substitute for fossil resources [1,2]. The vapor pressures for the Toluene were experimentally determined and correlated by Clark-Glew and Antoine equations. VLE data for the Tol with GVL were measured at two isobaric conditions: atmospheric and half-atmospheric pressures. The correlation of the data was launched by using Wilson, NRTL, and UNIQUAC models. All three models offered a decent agreement with the measured data, where the absolute deviation in temperature was varied between (0.3-0.7) K, and the deviation in the vapor mole fraction was varied between (0.0017-0.0029) for both atmospheric and reduced pressure. Oonk's arch representation [3] was used to evaluate the experimental data and it revealed that data can be deemed as consistent. VLE data were made by binary interaction parameters that generated via ChemCad for the three models mentioned above and associated with the measured data.*

Keywords: *VLE, GVL, vapor pressure, Antoine parameters, regression, biomass..*

Biography: *Al-lami has completed his M.Sc at the age of 24 years from Baghdad University, Baghdad, Iraq, and he is currently a PhD student at Budapest University for technology and economics, Budapest, Hungary. He is working as a lecturer at Basra university for oil and gas, Basra, Iraq.*

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IMMOBILIZATION AND CHARACTERIZATION OF WATER-INSOLUBLE FE COMPLEXES AS MOLECULAR CATALYSTS FOR WATER OXIDATION

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Abstract: *The apparent difference between the expanding consumption of fossil fuels and chemicals and the limited amount of resources has motivated many researchers to seek solutions for maintaining the sustainability of our community. Artificial photosynthesis (AP), which utilizes sunlight to produce high-value chemicals, including H_2 from abundant resources, is regarded as the most encouraging and viable method. Modern AP systems necessitate in the first place to develop inexpensive, highly active, and stable catalysts for the hydrogen production (Hydrogen Evolving Reaction, HER) and water oxidation (Oxygen Evolving Reaction, OER), both of these are crucial challenge. However, prior to implementing any artificial systems on water splitting catalysts that generates oxygen from water without the need for extreme driving potentials are demanded. Many recent studies concentrate on molecular systems based on the highly abundant first row transition metals (TMs) proper as water oxidation catalysts (WOCs) due to their structural versatility, transparent catalytic mechanisms, and ultimate atomic efficiency with respect to catalytic centers. Herein, we report Fe-based compounds among these TMs as efficient electrocatalysts for OER. In this context, we studied the electrochemical behaviour of water- insoluble Fe complexes in homogeneous water/organic mixtures to reveal their intrinsic molecular properties. The water-insolubility of the selected Fe complexes allowed for simple immobilization methods (dip-coating and drop-casting) on model semiconductors. Ultimately, electrodeposition has been explored to reduce to a minimumamount of the complex required for long-term operando stability. The consequence of these studies is that water-insolubility presents a viable strategy for designing new molecular catalyst/(photo)anode hybrids.*

Keywords: *Artificial photosynthesis; water oxidation; molecular precursor; iron complex; immobilization.*

Biography: *Sahir M. Al-Zuraiji completed his Master's degrees at the age of 26 from Al-Nahrain University, Iraq, Baghdad. He is currently a PhD candidate with almost 4-years of experience in and catalyst design for water oxidation, electrochemistry and electrocatalysis. He is doing his research at Centre for Energy Research, Budapest. His research interests are artificial photosynthesis and development of molecular catalysts. First author of three papers in reputed journals.*

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DIFFERENT POLYMERS MODIFIED MAGNETIC MWCNTS FOR HYDROCARBONS REWMOVAL FROM WATER

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Abstract: *The increasing of population around the world increases the demand of fossil fuel which led to increasing the probability of oil shipping accidents. The cleaning of oil spilled and their derivatives in ocean and sea, still one of the biggest challenges of researchers to produce costly effective processes and environmental friendly. In this work, different polymers were added to magnetite/MWCNTs (Fe/MWCNTs) and applied for kerosene and toluene removal from water. Firstly MWCNTs were oxidized using strong acids. Then magnetite was prepared over MWCNTs using precipitation method and magnetite/MWCNTs (Fe/MWCNTs) were prepared. Then physo-sonication method was used to for the preparation of final nanocomposites. Different polymers: polyethylene (PE) and poly-N-isopropylacrylamide-co-butylacrylate (P-NIPAM) were added to Fe/MWCNTs and PE:Fe/MWCNTs, P-NIPAM:Fe/MWCNTs final nanocomposites were synthesized for keroseneremoval from water and PS:Fe/MWCNTs were prepared for toluene removal from water. The fresh MWCNTs and modified with magnetite and polymers were characterized using XRD, SEM, TEM, EDX, FTIR, Raman and BET. PE:Fe/MWCNTs and P-NIPAM:Fe/MWCNTs achieved 3500 mg/g and 8000 mg/g removal capacity of kerosene from water , while PS:Fe/MWCNTs achieved 1160 mg/g removal capacity of toluene from water. The results shows that the adding of polymers to MWCNTs have greatly increased their efficiency for kerosene/toluene removal from water.*

Keywords: *Nanocomposites; Toluene removal; water treatment; Nanomaterials; Polystyrene; Magnetite.*

Acknowledgments: *The authors would like to express their appreciation to the Sustainabil-ity Solutions Research Lab, Bio-Environmental and Chemical Engineering Research and Devel-opment Center, Faculty of Engineering, University of Pannonia, Veszprém, Hungary, and GINOP (2.3.2-15-2016-00016) and Applied Science Department, University of Technology, Minis-try of Higher Education and Scientific Research, Baghdad, Iraq for the generous support of the research*

Biography: *Thamer Adnan Abdullah completed his Master of Chemical Engineering from Guru Gobined Singh Indraprastha University New Delhi., since 2008 he is working as assistantlecturer in the University of Technology, Baghdad, in Applied Science Department, Chemistry Branch Group. Currently he is doing his PhD and he is researcher in Sustainability Solutions Research Lab, Faculty of Engineering, University of Pannonia, Veszprem, Hungary. He has several articles published in sciencediret reputed journals and has participated in many international conferences in the field of environmental chemistry and nano-research.*

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DISSOLVED ORGANIC MATTER DIFFERENCES IN THE SOIL AS AFFECTED BY THE EXTRACTION METHOD

Thulfiqar AL-GRAITI*, Gergely JAKAB*, Zoltán SZALAI

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Abstract: *Dissolved organic matter (DOM) leaching from topsoils negatively impacts ecosystem stability by losing carbon (C) and nutrients. Therefore, understanding DOM dynamics in soils is a necessity. Previous studies have been used methods to measure DOM properties, such as an extraction method. It is based on thew/v ratio (soil/solution) using a dilute salt solution or distilled water with shaking for a specified time. This method is referred to as water-extractable organic matter (WEOM) and found to represent soil solution DOM. However, in practice, DOM properties may vary widely and cannot always be described by such a standardized method. This project aimed to study the compatibility between the WEOM and the leaching approach. The leaching method is based on undisturbed soil samples with distilled water application on the soil surface, keeping a continuous coverage of 1 cm. DOM is investigated from the collected leached soil solution. In the present study, WEOM and DOM under grassland and cropland from a Chernozem were studied. The study siteis part of a long-term trial next to Martonvásár, Hungary. Dissolved organic carbon (DOC) and total dissolved nitrogen (TDN) were measured. Our results indicated that the WEOM method provides high DOC and DN concentrations compared with the leaching method. In the WEOM method, soil shaking within a solution may reveal a high DOC and TDN concentration, resulting from destroying soil structure. DOM gained by the leaching method, related more to the microbial organic matter (OM). In contrast, WEOM was more humified therefore, the OM composition extracted by the two methods are not directly comparable. Further studies to compare DOM by various methods under different soil types can contribute to standardized DOM measurements.*
The study was supported by the Development and Innovation Fund of Hungary [No. NKFIH 123953] and GINOP-2.3.2-15-2016-00056

Keywords:. *Pore water, Undisturbed soil sampling, Dissolved Organic Matter (DOM), Leaching, Water-Extractable Organic Matter (WEOM), Soil Organic Matter Extraction*

Biography: *Thulfiqar Al-Graiti is a second year Ph.D. student at ELTE Eötvös Loránd University, Doctoral School of Environmental Sciences*

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ASSESSMENT OF THE RISK MANAGEMENT FOR VARIOUS TYPES OF DISASTERS: IMPACT AND SUSTAINABILITY

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***Abstract*:** *Disaster management and crisis action planning play a primary role in disaster avoidance, mitigation response, and recovery. According to the research, effective disaster management is largely dependent on the efforts of emergency response organizations. There are disaster risk management problems concerning the communication process, the development of coordination, and the exercise of authority. This paper overviews and assets the risk management for various types of disasters which are classified into five main parts: Geophysical, Hydrological, Climatological, Meteorological, and Biological. Biological disasters are two types in origin namely, Calamities which are produced in crops by certain animals, and pandemics which are caused by the spread of infectious diseases among large numbers of people, and this kind of crisis creates new risks that needed to be identified. The investigation in this research will identify the risk concept that comes from natural disasters and prepare the plans and set priorities to respond effectively where and when needed, by implementing the risk assessment. However, the similarities are significant concerning the health, social, economic, and environmental aspects of all types of disasters, COVID-19 pandemic was the complete opposite from an environmental and social point of view i.e., but highly affected the death rate and urban health.*

Keywords: *Crisis management, Disaster impacts, Pandemics, Risk management, Sustainability.*

Biography: Eng. Malak Shatnawi *is a Ph.D., candidate at Óbuda University in the Doctoral School of Safety and Security Sciences. She held the head of the technical department at Cities and Villages Development Bank (CVDB)- Jordan which support and finance Local Municipal Councils, through the technical department, CVDB was received accreditation from the Green Climate Fund GCF with the help of Global Green Growth Institute GGGI to implement Renewable Energy and Energy Efficiency projects in 100 municipalities. Eng. Malak was the deputy director for Municipal Services and Social Resilience Project MSSRP which was funded by World Bank and other Donors, to support and finance Jordanian municipalities affected by the influx of Syrian refugees, the number of beneficiaries reached one million and targeting three million at the end of the project. Additional positions and tasks; Procurement officer for Regional and Local Development Projects RLDP, a member in many committees such as procurement, local and special tender committees for projects which were funded by CVDB, JTZ, JRLDP JESSRP, and JMSSRP. Eng. Malak holds a BSc and Master's degree in Civil Engineering from Jordan University of Science and technology.*

Eng. Haya Altaleb *is a Doctoral Researcher. She is pursuing her doctoral degree in safety and security sciences in the Doctoral School of Safety and Security Sciences at (Óbuda University) she is working as a lecturer in Bánki Donát Faculty of Mechanical and Safety Engineering at Óbuda University (Budapest), where she completed her masters in Mechatronics engineering with the first ranked honors (summa cum laude). She has worked in the field of renewable energy as a photovoltaic design engineer to promote clean energy in Jordan. Ms. Altaleb research interests includes risk managements, safety and security science, industrial control systems, disaster geomatics, autonomous vehicle systems and exploring the cultural and innovative boundaries between data and society. Ms. Altaleb is a member of the Association of Energy Engineers and Member of CEDS Advisory Board, she models excellence as an early career woman in science by expanding her professional skill set and area of expertise above and beyond her graduate school program*

Prof. Dr. Rajnai Zoltan *is a Dean of Bánki Donát Faculty of Mechanical and Safety Engineering. He is holding a PhD degree in Military science from Miklós Zrínyi University of National Defense. Adding to his distinguished education records, The Senate of Politehnica University Timişoara has decided to confer the title of Honorary Professor in 12 Feb 2020. Prof. Dr. Zoltan Rajnai is a lecturer in the Doctoral School of Safety and Security Sciences at Óbuda University (Budapest). He has research interest in the field of protection of critical infrastructure, information security, and security of communication networks of qualified periods. He has been a member of Association (HEA) and the AFCE (Armed Forces Communications and Electronics Assoc) International Military Communications and Electronics Association. He is also a member Tivadar Puskás Fraternal Association News; The HTEZ rinski Group member, 2004-2006 Head; Since 2001 the Hungarian he is a member of the public body of the Academy of Sciences; Memberof the Board of Trustees of the János Bolyai Honvéd Foundation; Founder of the Tivadar Puskás Technical College; Since 1999 he has been continuously participating in international research projects related to his field.*

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INFLUENCE OF VITERI VITERI 8-4-5 FERTILIZER ON SOWING QUALITIES OF CEREALS AND LEGUMIN CROPS SEEDS

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Abstract: *The use of environmentally friendly fertilizers and plant growth regulators in the cultivation of crops, in particular for pre-sowing seed treatment, improves plant productivity, quality of crop products and is a promising direction in the development of agricultural production. The aim of our work was to research the effect of different concentrations and methods of using a new organo-mineral fertilizer based on aqueous extracts of animal origin Viteri 8-4-5 on crop quality, namely laboratory germination of legume seeds and cereals. Laboratory tests were performed to select the optimal parameters, namely, concentrations of organo- mineral fertilizer Viteri 8-4-5, duration and methods of pre-sowing seed treatment. Distilled water was used as a control. The optimal concentrations of VITERI 8-4-5 were determined: 1%, 2% and 3% solutions. It was found that pre-soaking the seeds in 1% solution for 24 hours has a positive effect on germination processes, which was confirmed by the similarity and germination energy indicators. At the same time, the germination of legume seeds increased by 12-15%, corn and wheat seeds - by 10-13% compared to the control. The obtained results show the prospects of further study of the use of complex organo-mineral fertilizer VITERI 8-4-5 for pre-sowing treatment of agricultural crops seeds.*

Keywords: *organo-mineral fertilizer Viteri 8-4-5, seeds of agricultural crops, sowing qualities, product concentration*

Biography: *Zolotov Mykhailo Viktorovych obtained the Master's degree at the Kharkiv National Automobile and Highway University in 2002. Since 2014 he has been working in the agricultural business in the field of organic production and organic fertilizers. Since 2021 he has been studying at the graduate school of the Institute of Agroecology and Environment Management of NAAS, majoring in agronomy. He is interested in studying of the influence of organic fertilizer Viteri in the biocenosis of organic crops and using the gained knowledge to promote and develop organic farming*

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RICHNESS IN POLYMETALLIC MINERALISATION Fe, Pb, Zn, Ba AND HYDROTHERMAL SPRING OF MOUNT M'CID AICHA, TELLIAN ATLAS, NORTH-EAST OF ALGERIA

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Abstract: *The massif of M'cid Aïcha is located in Tellian Atlas in the north-eastern of Algeria. This mountain chain is made up extrusions of Triassic gypsiferous formations and Jurassic carbonate, which contain polymetallic mineralization (Zn, Fe, Pb, Cu and Ba) and hydrothermal spring. The region is affected at the north by magmatic events. The structure is a set of anticlines and synclines of E-W direction delimited at the north and south by longitudinal faults; it is also affected by transverse meridian faults rich by a mineralisation. The hydrothermal spring localized in the intersection of the main tectonic accidents. The formation characterises a shallow sea environment. The M'cid Aïcha deposit was once mined for their zinc ore in the form of calamine. However, the rare gitological work carried out on these two gites has described polymetallic mineralisation with Fe, Pb, Zn, Cu, Ba expressed as sulphides (galena, sphalerite, pyrite, covellite and gray copper), oxides and hydroxides (haematite, goethite and limonite), sulphate (baryte) and carbonates (cerusite, malachite and azurite). This concentration shows a form of clusters, pockets, veins and lenses of very modest dimensions.*

Keywords:. *M'cid Aïcha, Lias, mineralization, polymetallic, carbonate, Hydrothermal*

Biography: *In 2018* **H. BELAIDI** *had completed her license in Geology of mineral resources at the age of 21 years from Jijel University, in 2020 she had got a master's degree of 23 years in mineral resources, geomaterials and environment from Jijel University, in 2021 she started her PhD at the University of Constantine 1. Shee interested to research in all geological fields, especially those attached to minerals and natural resources.*

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MORPHOTAXONOMICAL INVESTIGATION AND HORTICULTURAL APPLICABILITY OF *FESTUCA WAGNERI* TAXA

Dániel BALOGH*[1], Attila FŰRÉSZ[1], Éva Horváthné BARACSI[2], Gergely PÁPAY[1], Virág KALCSÓ[1], Károly PENKSZA[1,]

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Abstract: Background: *Among the Festuca taxa in the sandy grasslands of the Great Hungarian Plain two were chosen for the survey: F. wagneri and F. tomanii. 30 specimens of each taxa were planted into similarenvironment for the sake of taxonomic and morphologic analyses. F. tomanii specimens were uniform, but F. wagneri formed clearly distingushable taxonomic groups. These groups were separated by the structure of leaf tissues in the first place, and this was the basis of the analyses of the morphological parameters of the inflorescences.* ***Method:*** *In 2018, 30 F. wagneri specimens were transported to MATE (then Szent István University) Department Of Horticulture in Keszthely, and were planted both in open field and into pots. Earlier, several types were selected from them, which could be useful in horticultural practice. These were named and described as such: 1. leaves and inflorescences both stand up densely; 2. generative shoots bend apart; 3. dense but short „dwarves"; 4. Very tall with spreading inflorescence with a particular lilac, antocianic colour on the nodes. These groups were expanded with the colour of the specimes, so green, grayish and silvery variants can also be separated.* ***Results:*** *The groups separated by the tissuic differences were in line with their horticultural decorative values and the differences in the inflorescence parameters. Specimens separating by horticultural means also differed based on morphologic and tissue analyses. Tamás Pócs remarked earlier that F. wagneri isa species of sandy steppe grasslands. This proved to be correct, but it is a taxon which adapts to highly varied environments in the Kiskunság. In the extremely varied circumstances, the overall appearance of Festuca taxa was similar, which exacerbated their identification. The survey was supported by OTKA K-125423 and 2030- 3/2018/FEKUSTRAT.*

Keywords: *Grasslands, horticulture, morphology, taxonomy*

Biography: *Dániel Balogh has studied Nature Conservation Engineering and has a BSc and MSc in this topic. He is currently a PhD student of environmental sciences at Hungarian University of Agronomy and Life Sciences. Currently he is examinng the taxonomy and genetics of the genus Festuca under the direction of Dr. Károly Penksza PhD.*

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EVALUATION OF MICROAEROBIC AND AEROBIC XYLENE DEGRADATION POTENTIAL OF *PSEUDOMONAS SP.* STRAIN MAP12 AND *SPHINGOBIUM SP.* STRAIN AS12 ISOLATED FROM PETROLEUM-CONTAMINATED GROUNDWATER OF SIKLÓS, HUNGARY

Sinchan BANERJEE*, András TÁNCSICS

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Abstract: *Because of relatively high-water solubility and toxic nature of xylene, they are often considered as a threat to the primary drinking water reserves. Hence, it is always important to study the diversity of the indigenous xylene degrading community to develop effective strategies for xylene degradation. To gain in-depth knowledge and to find potential strains that harbour C23O genes, an enrichment was setup using hydrocarbon contaminated ground water sample with xylene as a source of carbon and energy under aerobic and microaerobic conditions. Study of microbial community of both aerobic and microaerobic enrichments showed that in aerobic enrichments Shingobium was the main difference creating group which was completely replaced by Azovibrio and Rhodoferax in microaerobic enrichments. From these enrichments, a presumably novel Sphingobium sp. strain AS12 was found that capable of degrading all three isomeric forms (meta-, para-, ortho- xylene) of xylene and a likely new species of Pseudomonas sp. strain MAP12 was also isolated that can degrade meta -, para-xylene , benzene and toluene both aerobically and micro aerobically. This study, is, by far, the first direct evidence of biodegradation of all xylene isomers by a Sphingobium strain and microaerobic degradationof benzene and xylene by a Pseudomonas strain.*

***Keywords: C23O** genes**:** catechol 2,3-dioxygenase.*

Biography: *Sinchan Banerjee: PhD student at Hungarian University of Agriculture and Life Sciences. Gödöllő campus, Hungary*

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IMPACT OF WASTE ON THE ENVIRONMENT STUDY OF POLLUTANTS STATISTIC AND SOLUTIONS. CITY OF CONTANTINE, NORTH-EAST OF ALGERIA

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Abstract: *Daily human activity poses many problems for the environment because of the waste it leaves, the study conducted on solid and liquid household waste located in the city of Constantine, Northeastern Algeria. Regardless of a manufacturer or consumer, especially in the absence of dissuasive laws for such abuses. A solid and liquid sampling was carried out on the waters and sediments of the main Oued Rhummel which crosses the city of Constantine from the South to the North, the hydrochemical results show an increase in the rate of heavy polluting metals from upstreamto downstream, Pb 0.15 mg/l, Cr 1 mg/l, Ni 0.80 mg/l. These metals are also revealed by X-ray diffractometric analyses. The spread of heavy metals in water poses a major threat to people's lives, requiring a quick and effective solution. The statistical analysis showed in El-Khroub and Ali Mendjli the two main municipalities are the most waste-producing district, while Ben Badis comes in last place. In 2019, total waste received at the Technical burying center of Bougharb 32623.37m^3 and 1533.62 T/month for inert waste where it receives about 700 tons of waste. The daily discharge and treatment of this waste in the Technical burying center of Bougharb lead to many nuisances for the environment. This wide dispersion of waste represents a major threat to citizens and requires strict decisions and a rapid solution to stop and eliminate these pollutants.*

Keywords: *Waste, CET, pollution, Environment, Oued Rhumel*

Biography: *In 2018 I have completed my license in geology of mineral resources at the age of 21 years from Jijel University, in 2020 I have got a master's degree of 23 years in mineral resources, geomaterials and environment from Jijel University, in 2021 I started my PhD at the University of Constantine 1. I'm interested to research in all geological fields, especially those attached to minerals and natural resources.*

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DESIGN GUIDELINES FOR MECHANICALLY STABILIZED EARTH WALL

Abdelwahab TAHSIN

Arab Consulting Engineers Office, Dokki, Giza, Egypt

Abstract:

Not received, presentation was done

Keywords:.

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EFFECT OF ADDING POTASSIUM HUMATE AT DIFFERENT LEVELS OF MOISTURE TENSION IN SOME PHYSICAL PROPERTIES OF SOIL AND IN GROWTH OF ZEA MAIZE

Jihad IBRAHIM, Evan DAYOUB

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Abstract: *The need to determine the ideal moisture tension for maize growth is significant, because the plant's response to water is more related to moisture tension compared to any other single factor and studying the effect of the interaction with the optimal level of potassium humate, considering it a rapid organic intervention that improves the physical and hydrodynamic properties of the soil and increases the nutrients use efficiency Accordingly, A pot experiment was conducted on a clay silty soil to study the effect of different levels of potassium humate (POWHUMUS WSG 85) (0.6-1.8-3.6 kg/d) at different levels of moisture tension (400-600- 800 millibar) on the physical properties of clay silty soil growing maize. The results show that soil bulk density was significantly decreased at 400 millibar in all levels of potassium humate added by 0.05-0.1-0.17 g/cm^3 respectively. Increasing moisture tension to 600 and 800 millibar and not receiving humate, bulk density decreased by 0.08 -0.13 g/cm^3 compared to the moisture tension 400 millibar treatment. The experimental constants (a) and (b) in $\psi=a\theta^b$ increased as the level of humate addition was increased at all levels of moisture tension. Moreover, leaf area of maize plant at the same moisture tension increases with the increase of humate addition reaching the highest value of 2476 cm^2 at 600 millibar and 1.8 kg/d. This study suggests that potassium humate has the potential to increase, nutrient uptake by improving soil physical properties. However, it recommends the application of this material for corn at the rate of 1.8 kg/d on a clay silty soil.*

Keywords: *Available water*; bulk *density; clay soil; Potassium humate; moisture tension; moisture content; Zea mays.*

EVAN DAYOUB is a Ph.D. student in the department of soil and water sciences/faculty of agriculture/ Tishreen university his research title is (The effect of amendment with biochar and olive mill wastewater in some physical and hydrodynamical characteristics of soil and in soybean (Glycine max. L) productivity). He has completed his MSc at the age of 28 years from Tishreen University while he was teaching practical lessons in soil physics laboratory. He is an agricultural engineer in Whata aikhan guidance unit, a former fertilizers supervisor in Latakia agricultural directorate and a participant in GIS projects. He has published one article in Tishreen University Journal -Biological Sciences Series.

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EDUCATION TO SUPPORT THE DEVELOPMENT OF A CIRCULAR ECONOMY APPROACH

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Abstract: *Global environmental problems, wasteful over-consumption and increasing waste related to that, growing and increasingly dangerous effects of pollutants released to the environment, depletion of raw material resources, all call attention that it's no longer enough to just talk about sustainability, but we need to act. It requires first of all a change in the approach to the economy and a turnaround to replace the linear managementsystems still widely used today with a waste-free system, since product of today is the raw material of the future. The implementation of circular economy needs long-term thinking covering the entire life cycle of products from the initial moment of design. It requires well-informed decision-makers who have all the competencies that help to validate the mechanism of natural ecosystems' operations in today's economic systems. Development of skills and abilities expects a change of attitude in education. Through education, such knowledge and values must be conveyed, skills and abilities must be developed that are essential for the realization of a sustainable society and economy, primarily the responsibility and ethical behaviour towards the environment. This is supported by Environmental Pedagogy as an integrated, independent science and educational strategy for project teaching. The aim of the study is to present the educational strategy that develops the competencies needed to implement a circular economic approach.*

Keywords: *circular economy, competences, project education, sustainable development*

Biography: *Her degrees: M.Sc. thesis in Technical University of Budapest in mechanical engineering (1991), Ph.D. in environmental sciences (2012), Municipal water and wastewater management (2017) and Environmental protection (1998) special engineering course. She works at Óbuda University in Rejtő Sándor Light Industry and Environmental Engineering Faculty as associate professor. She is acting as vice dean of the faculty and director of the Institute of Environmental Engineering and Nature Sciences. Subjects she taught: Water qualityprotection, Wastewater treatment technologies, Technical drawing. Her education skills cover the theoretical lectures, laboratory practices and field work. She is an expert in water quality protection, water and wastewater treatment technologies, and project education. She is member of Hungarian Water and Wastewater Association and Hungarian Hydrological Society, Water Supply and Sewerage Committee of the Hungarian Academy of Sciences. Research experience in environmental education, water quality protection, university lectures, more than 60 scientific publications.*

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THE HYDROGEN IS HOPE AND REALITY

Lóránt SZABÓ

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Abstract: *This paper deals with green hydrogen production, conversion and end uses. Nowadays global energy consumption was increased increasingly due to the growing the population and standards of living style.Moreover, with increasing the global warming and environmental pollution, the development of renewable energy sources was becoming more essential. Hydrogen is one of the most promising clean and sustainable energy carriers and emits only water as a by-product without any carbon emissions. Hydrogen (H_2) is the simplest first chemical element of the periodic table. Hydrogen is the most abundant element in the universe, accounting for approx. 75% is hydrogen, but it occurs only in bound form in its compounds, from which hydrogen can only be produced by investing a large amount of energy (in the case of water decomposition it is 286 kJ/mol). On Earth, hydrogen only occurs naturally in compounds formed with other elements including in oxygen to form water (H_2O) and carbon to form hydrocarbons which are found in fossil fuels such as natural gas(predominately methane (CH_4)), coal and petroleum. Electrolysis is the process of using electricity to split water into hydrogen and oxygen. This reaction takes place in a unit called an electrolyser. A fuel cell utilizes the chemical energy of hydrogen and oxygen to generate electricity without combustion or pollution. Fuel cell is not a new technology. Major industrial nations must look to a range of options to reduce their carbon emissions and meet their various environmental targets. Of the many emerging solutions, hydrogen will have a significant part to play in our sustainable future as an efficient and clean energy carrier that can be utilised in new applications but also integrated into existing industrial processes in place of fossil fuels. The green hydrogen revolution has started, and we hope it will not be stopped.*

Keywords: *green energy, hydrogen, electrolysis, fuel cell, sustainable future.*

Biography: *Ín 2014, he completed his PhD at the age of 52 years from Nyugat- magyarországi University. He has published more than 20 papers in different journals. His research fields are air-jet looms, acoustics, renewable energies.*

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INFLUENCES OF MICROBIAL ACTIVITIES IN THE INSECTICIDES TREATED SOIL

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Abstract: *Globally, the consumption of nitrogen (N) fertilizer- is significantly increased day after day. The biological N_2-fixation is the main source of N input in agricultural soil. However, international emphasis on environmentally sustainable development with the use of renewable resources is likely to focus attention on the potential role of biological N_2-fixation in supplying N for agriculture. Several environmental conditions are limiting factors to the growth and activity of the N_2-fixing root nodule rhizobia. One of the most important and potentially limiting factors to biological N_2 fixation is the use of pesticides including the insecticides. The objective of the study is to investigate the adverse effect of insecticides on N_2-fixing rhizobia. Experiments were conducted to study the impact of seven insecticides [Anthio 33 EC (Formotion (33%), Sevin 85 WP (Carbaryl (85%), Rogor L-40 (Dimethoate (40%), Thiodan 50 WP (Endosulfan (50%), Phosphotion (Malathion (50%), Lannate 20 L (Methomyl (200 g/l), Pirimor 50 DP (Pirimicarb (50%)] on the growth of seven strains of N_2- fixing root-nodule rhizobia (four strains belonging to Rhizobium leguminosarum, one strain belonging to R. phaseoli, one strain belonging to R. trifolii and one strain belonging to R. loti) in vitro by measuring optical density. The rhizobial strains were grown in yeast extract mannitol broth medium treated each with different concentrations (0, 0.1, 1, 10, and 100 mg/litre of active ingredient) of each insecticide and incubated for 48 hours in microfermentor at 28°C The results illustrated that Phosphotion and Sevin had an adverse effect on the growth of the investigated rhizobial strains, whereas Thiodan was safe to these rhizobial strains. Whereas the strain Lóbab Z of R. leguminosarum was the most tolerant and R. trifolii Lo133/64 was the most sensitive one among the tested strains. The adverse effects of insecticides on rhizobia were observed at concentrations not normally expected to occur under field conditions. For further task, it is required to investigate the adverse effects of these insecticides on nodulation and N2-fixation capacity of specific host plants with their rhizobia in pot and field experiments as well as other vital microbial processes in a wide range of soils.*

Keywords:. *insecticides, N_2-fixing root-nodule rhizobia, in vitro, adverse effect*

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LITHIUM AND HEAVY METAL CONCENTRATION ANALYSIS IN SAJÓ VALLEY

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Abstract: *The Sajó valley was a blooming industrial area 20-25 years ago, but in the early 1990s most of the factories closed down, but relatively little attention was paid to the pollution left behind. The Green Action Association carried out a comprehensive monitoring of the Sajó Valley in the early 1990s. This gave us the idea to carry out our work, as significant heavy metal and lithium pollution was found in the areas surveyed. It is very likely that this was mainly caused by heavy industry from the 19th century until the 1980s. Our aim was to investigate how the lithium and heavy metal contamination might be found in some of the areas studied by the association more than 20 years later. Six areas were selected as study sites for the soil samples, between Onód and Muhi (3 areas) and near Tiszaszederkény and Tiszagyulaháza (3 additional areas). Our soil samples were collected from the floodplains of the Sajó, Hernád and Tisza rivers at a depth of 0-40 cm. After proper storage, we started the analysis by preparing and digesting the samples. The pH-value and dry matter content of the sieved (2 mm) samples were determined. Digestion of the finely sieved samples (0.45 mm) with nitric acid using a Milestone 1200mega microwave digestion system allowed the samples to be analysed with an "ATI UNICAM 939 AAS" atomic absorption spectrometer for seven elements: cadmium, copper, zinc, lead, manganese, iron andlithium.*
The results of the measurements were converted to mg/kg dry matter. The results obtained showed that there are still areas where some elements, such as Cd, are contaminated above the limit values (Joint Decree 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management). The measured pH values are slightly alkaline and slightly acidic, which means that the contaminants are immobile in the soil. Statistical evaluation was performed by use of the three-factor random block analysis variance method using SPSS 14.0 for Windows software package. After performing analysis of variance, it was shown that the heavy metal content of soil samples was significantly related to the sampling location. Based on the data obtained in our work, we propose to carry out a study of similar magnitude to the monitoring carried out in the 1990s and to clean up the contaminated soils.

Keywords:. *Lithium, Heavy metals, Heavy Industry, Soil contaminatio*

Biography: *Dr. Ágnes Dr. habil. Mészáros-Bálint (Ágnes Bálint is the author name), she MSc, Chemistry and Physics; Bsc, Software Information Technologist, Eötvös University, Budapest, Hungary, PhD; habilitation from Szent István University, Gödöllő, Hungary. She isAssociate Professor at Óbuda University, Rejtő Sándor Faculty of Light Industry and Environmental Engineering, Institute of Environmental Engineering and Natural Sciences, and Hydro-Bio-Mechanical Systems Research Center, +36303721342;* **Specialty:** *Inorganic chemistry, environmental analytics, colloid chemistry, Development and application of chromatographic methods for soil/plant, polymer, amino acids and food analysis, Nitrogen transformation in soil/plant/atmosphere system, application of stable isotope tracers, as fertilizer, and Experimental and theoretical modelling of transport processes.*

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ENVIROMENTAL AND ECOLOGICAL IMPACTS OF ILLEGAL DUMPING

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Abstract: *The topic of the environmental and ecological impacts of illegal dumping was chosen because today it is a very big problem in Hungary and around the world. During research work, we studied the impacts done to the soil using Hungarian standards to determine soil quality. Within this, we used organic and inorganic chemical test methods such as e.g. analysis of heavy metals, detection of inorganic compounds or organic compounds by spectrophotometric methods. Soil pollution is a global problem that affects both humans and the wildlife around them. Contamination entering the soil can spread to other environmental elements, so its investigation is also important for human health. The results show that illegal dumping not only causes social problems, but also the impact of soil as an environmental element based on the performed studies. We established these results with the help of Hungarian and European Union regulations and pollution limit values. In conclusion, we can talk about the fact that in each case the degree of pollution depends on the wastedeposited and its amount, which is reflected in the ecological effects as well as in the measured results.*

Keywords:. *illegal, waste, pollution, soil, health, environment*

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BIOMONITORING OF LICHEN AS A BIOINDICATOR OF ATMOSPHERE QUALITY IN ULAANBAATAR, MONGOLIA

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Abstract: *The lichen species are an essential part of plant diversity and they are well-established indicators of air pollution. Lichen is used to indicate different levels of nitrogen pollution and as indicators of forestcontinuity City of Ulaanbaatar, the capital of Mongolia was initially designed for a half million residents. Due to intense rural-to-urban migration after transition to market driven economy, the population of the capital is nearly tripled, which resulted in huge area of informal settlements and elevated number of vehicles. Tents and small buildings in above settlements heated by conventional stoves by burning coal and wood, while the most vehicles on the road are imported second-hand cars. During last two decades, air quality of capital city Ulaanbaatar is considered as an emerging issue and above two are primary sources of outdoor air pollution. The most abundant air pollutants are nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and carbon monoxide (CO) which have disastrous effects on health when inhaled over prolonged periods of time. Due to the quantities of thesepollutants would be far more abundant and thus cause the catastrophic effects to the air quality that is seen in Ulaanbaatar. Various techniques have been developed to monitor air quality, including biomonitoring using lichens. In this study, we monitored types of epiphytic lichens covering sensitive to air pollution fruticose type and relatively tolerant foliose type of lichens. Unlike air quality index, lichens clearly show negative impact of poor air quality on surrounding ecosystems. We examined lichens on Larix sibirica, the most abundant coniferous tree of the area. Both foliose and fruticose types of lichens are abundant in Larix sibirica dominated forests located to the northern areas of Ulaanbaatar. It indicates the area is free of pollution. In contrary, fruticose type lichens, especially representatives from the genera Usnea, Cladonia and Vulpicidia are absent in coniferous forest to the southern areas of Ulaanbaatar.*

Keywords:*. lichen species, Ulaanbaatar, Mongolia, air pollution, bi indicators*

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ANALYSING OF ANTHROPOGENIC IMPACTS IN SEMI-NATURAL AREA

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Abstract: *The decline of natural and semi-natural areas has intensified in recent decades, including in Hungary. One indicator of the changes is the decline in the proportion of forested areas, while another spectacular change is the increase in urbanization. This study analyses how the proportion of semi-natural areas has changed with the growth in urbanization. Particular focus is on wetlands and forest areas, which are the most sensitive from nature conservation perspective.*

Keywords: *. Land use change, land-stability, semi-natural areas*

Biography: *Krisztina Demény has completed her PhD in Environmental Sciences at the age of 2019 from Szent István University, Gödöllő.*
She is the assistant professor and Deputy Director of Institute of Environmental Engineering and Natural Science in Óbuda University.
Her publication list can be found here:
https://m2.mtmt.hu/gui2/?type=authors&mode=browse&sel=10019676
Her research fields: landscape protection, landscape ecology and land use change from analysing nature conserve perspective.

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SMART-BUILT ENVIRONMENT (CITY): REVIEW

Zeinab ESMAIL

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Abstract: *The purpose of this review is to explain the intelligent built environment. And what are the motives for turning cities into smart cities? In addition, analysis of the aspects that must be made available to achieve this equation at an urban level, from people to infrastructure. In addition, the chapter provides a reference to the role of linking technological modernity in service management on urban scales and buildings (smart cities, smart buildings.*

Keywords:. *Smart city –Built environment- Smart City Features*

Biography: *Zeinab Esmail -24 years -Syrian.*
Architecture engineer from Syria completed my BSc at the age of 22 years from Tishreen University' Syria-Latakia.
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CLIMATIC CHANGES AND NATURAL DISASTERS AFFECTING THE GLOBAL ENVIRONMENT

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Abstract: *Today, there is near universal consensus among the world’s professions that human activity is causing climate change. The Intergovernmental Panel on Climate Change (IPCC) cautions that global greenhouse gas emissions should be cut in half by 2030 and reach net zero emissions by mid-century in order to avert the most catastrophic consequences climate change. Climate change in combination with other factors is putting at least one million plant and animal species at risk of extinction around the world. Changes in the global climate exacerbate climate hazards and amplify the risk of extreme weather disasters. Increases of air and water temperatures lead to rising sea levels, supercharged storms and higher wind speeds, more intense and prolonged droughts and wildfire seasons, heavier precipitation and flooding. The evidence is overwhelming and the results devastating: The number of climate-related disasters has tripled in the last 30 years. Between 2006 and 2016, the rate of global sea-level rise was 2.5 times faster than it was for almost all of the 20th century. More than 20 million people a year are forced from their homes by climate change. The United Nations Environment Program estimates that adapting to climate change and coping with damages will cost developing countries $140-300 billion per year by 2030. Extreme weather disasters affect all countries, rich and poor. But as we face a future with enhanced risks, it is critical to face the reality of those who bear the burden of our changing climate. For Oxfam, this is an issue of justice: those living in poverty are the hardest hit by climate change despite being the least responsible for the crisis. Climate change is forcing people from their homes, bringing poverty on top of poverty and increasing hunger. People in poorer countries are at least four times more likely to be displaced by extreme weather than people in rich countries. The world faces a race against time to reduce emissions and help the most vulnerable cope with climate impacts that are already being faced today and will escalate in the years ahead. It’s time to act now.*

Keywords:*. climate change, extreme weather disasters, United Nations Environment Program*

Biography: *Prof. Dr. Hosam Bayoumi Hamuda is working at Óbuda University. He is Environmental Microbiologist and Soil Biotechnologist dealing with the interactions between the microbiomes and the environment for increasing soil quality and saving the soil from pollutants in the agriculture. His investigations are on the role of waste management, soil quality, fertility, the crop production and environmental impacts related to the application of organic wastes; measurements soil microbial biomass and enzymatic activities in wastewater sludge amended soils; and roles of engineered metal oxide nanoparticles in biosphere..* ***Research Interest****: Waste management; Biotechnology; Protection; Sustainable; PGPR; Microbial inoculants; gut microbiomes and human health and modern biology.*

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WATER MANAGEMENT IN SELECTED EU MEMBER STATES IN 2010S

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Abstract*: Study overviews main issues for agricultural water-use and wastewater conditions in Czech, Hungary, Romania, Slovakia, Bulgaria, Slovenia, Portugal, and Spain in 1998 -2017. Analysis can provide possibility to compare water management and water cleaning avoiding wastewater in countries. Water management connects with irrigation mostly on permanent cultivated agricultural areas. Analysis focuses on agricultural value added contributing to GDP growth, share of agricultural GVA produced by irrigated agriculture, total renewable water resources per capita, produced municipal wastewater, the agricultural water withdrawal as % of total renewable water resources mainly on total agricultural water managed area concerning qualified level of cultivated lands.*
Motivation/Background*: Aim of analyses is to clear some correlations of several economic variables mentioned as features of selected countries. Global warming and longer drought period in EU-28 need for more successful water management to balance scarcity of water.* ***Method****: Study compares water management feature of Spain and Portugal with some EU member states in Central – East European based on SPSS statistical analyse.*
Conclusions*: Innovation prosperity should be developed by more educated and skilled human power resources in agricultural production. Share of production based on irrigated land by cleaning water should increase in total agricultural value added.*

Keywords*: Arable lands, Correlations, Gross value added, Irrigation, Permanent cultivated areas, Scarcity of water*

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SOME CASES OF BACKWARD EROSION/LIQUEFACTION PIPING FROM HUNGARY

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Abstract: *Some cases of backward erosion/liquefaction piping are described. These distinguish between usual sand boils and the 'fast' piping, the - possibly dynamic liquefaction induced – breach. The latter happens in a matter of minutes, whereas in the former emergency response measures can be effective. According to the presented case studies, the 'fast' piping failure has a typical pattern. This pattern can be explained by optimisation theory in fluid flow since the liquefied soil layer behaves as a fluid.*

Keywords: *liquefaction; grading curve, sand boil, fine sand, piping, failure path*

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Phone: *+36202892656;* ***E-mail:*** *imre.emoke@uni-obuda.hu*
Position: *Head of Hydro-Bio-Mechanical Systems Research Center, Associate Professor*
Specialty and publications: *dikes, coupled consolidation models, applied math, inverse problem solution and reliability testing, unsaturated soils, municipal landfill waste and energy utilisation of the landfill gas, grading entropy of granular matters, entropy-based grading rules, filtration, internal erosion, segregation, in situ -situ testing (e.g. CPT dissipation tests, evaluation methods and software preparation), laboratory experiments (oedometric relaxation and compression test, water retention curve measurements, evaluation method and software).*

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NUMERICAL MODELLING AND CALIBRATION OF GEOSYNTHETIC- REINFORCED EARTH WALL PERFORMANCE USING PLAXIS 3D CODE

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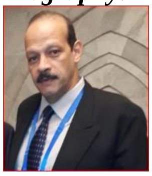
Abstract: *Geosynthetics assist in reducing carbon footprint of infrastructure development that contributes significantly in achieving several UN Sustainable Development Goals to create a more sustainable future. Geosynthetic- Reinforced Soil GRS walls is an appropriate solution for retaining structures promoting anticipated acceptable performance features, reduced cost, and safety measures compared to conventional techniques. Numerical modelling approaches would contribute to more innovative, economical-based design; however, trustworthiness of its outcomes depends on techniques, constitutive model, and adopted set of parameters to simulate various components. A finite element modelling was employed using Plaxis 3D code, calibrated versus the monitoring records and predictions of physical wall reported by Hatami & Bathurst (2005)during staged construction procedures and surcharge loading. Facing displacements, foundation stresses, and reinforcement strains were assessed. Numerical 3D modelling predictions revealed closely match to experimental measurements, that acknowledge convenient on 3D schemes alternating 2D to fit GRS wall actual intrinsic behavior. Hardening Soil constitutive model is capable to synchronize the stress-strain response;* E_{50} *inferred from tri-axial testing was approximately 2.25 times lower than the pre-estimated nominal value introduced by design codes that acknowledged to fitting plane- strain laboratory tests. Linear Elasto- Plastic anisotropic geotextile with secant modules at strain 1.5% is proper for Polypropylene Geogrid. Plate element with nominal stiffness reduction 0.10 is fitting to represent the discrete concrete facing blocks. Custom joint option is necessary to simulate the connection between facing blocks and Geogrid to match the anticipated bulging facing deformation. A representative roughness factor of 0.75 was found applicable for interfaceelements.*

Keywords: *3D numerical modelling, Geosynthetic- reinforced walls, facing deformation, Hardening soil model, Plaxis.*

Biography:



Abdelwahab Tahsin *has completed his PhD in Civil engineering at the age of 51 years on July 2020 from Faculty of Engineering, Cairo University, Egypt. He is a professional Consultant engineer, certified PMP and design director at ACE consulting office, Egypt. Participating and managing large complicated civil engineering projects across multiple asset classes in Egypt, Gulf, Middle East, and Africa. Strong experience of international standards through interactive collaboration with International Managed Joint Ventures. He is an Instructor (Part- time) and Supervising graduation projects at the Egyptian Russian and 6th of October Universities, Egypt. He has published 8 papers in reputed scientific journals and conferences, has been serving as a reviewer of reputable research journal "Innovative Infra Structure Solutions" (IISS). He is sharing at many conferences, workshops and invited talks. He is an organizing member of GEOAFRIAC 2023 international conference, hosted by the International Geosynthetics Society IGS, Egypt chapter.*

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AIR QUALITY AND DISTRIBUTION OF LICHENS AS BIOMONITORS IN SOME SERBIAN TERRITORIES

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***Abstract**: This paper deals with using lichens as a bioindicators of the air quality. A bioindication and physical-chemical detection of air pollution in Zrenjanin has not been carried out. Over recent decades, air quality has become environmental problem worldwide due to industrial activities and road traffic. Atmospheric monitoring has been necessary to control air quality and reduce pollution sources. Air quality is a topic that attracts more and more attention especially with the problem of human health. Biomonitoring is based on the detection and monitoring of changes that occur on different levels of the biological organization for living organisms under the influence of air pollutants. It was noted that not all lichen species are equally likely to indicate different levels of air pollution. The assessment of lichen biodiversity was based on the calculation of lichenic abundance indices. This research work deals with using lichens as a bioindicators of the air quality and it was conducted from various Serbia locations. Also, it is shown the relationship between the Serbian air qualities, and how lichens actas a bioindicator for the air quality, in some parts of Serbia such as in Sremska Mitrovica city, Fruska Gora mountine, Palic Lake and Silver Lake. The bioanalysis of the samples from investigated sites indicates the presence of different lichen taxa, which shows that these sites are rich in lichen species. Information about theair quality index of Zrenjanin city as an example of the Serbian cities which demonstrates the chemicalpollutants, climate changes for example weather, wind and temperature This work also shows the distribution of the lichens which can be found in the investigated sites. The presence of lichen indicates that the air quality in these sites: Sremska Mitrovica city, Fruska Gora mountine, Palic Lake and Silver Lake is quite good. It was concluded that the presence of epiphytic lichens plays an important role in determining the air pollution in those sites. By the presence of these lichens, we have found that the most dominant lichen taxa were Rhizocarpon geographicum, Lecanora muralis, Lecanora muralis, Rhizocarpon geographicum, Xanthoria parietina andXanthoria candelaria.*

***Keywords**: air quality; bioindication; lichen biodiversity*

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ENVIRONMENTAL DEVELOPMENT & SUSTAINABILITY: TECHNOLOGY & MANAGEMENT

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Abstract: *Most of the people all over the world today have an immediate and intuitive sense of the urgent need to build a sustainable future. Environmental engineering is the branch of bioengineering and sustainable engineering that is concerned with protecting people from the effects of adverse environmental effects, such as pollution, and improving and safe environmental quality. Environmental bioengineers work to improve recycling, waste disposal, public health, and water and air pollution control. Environmental health bioengineering can be considered as sanitary bioengineering brought to meet the needs of the future of the World. Sanitary bioengineering is essentially disease-oriented: it may be defined as the use of bioengineering principles and bioengineering devices for public health purposes. Environmental health bioengineering is the application of bioengineering fundaments to the control, modification or adaptation of the physical, chemical or biological characteristics of the environment in the interest of the health, comfort and social activities of people. It requires the control (quantity and quality) of the basic necessities and waste by-products, whether solid, liquidor gaseous. These by-products, if uncontrolled and allowed to accumulate, lead to widespread disease and physical damage, and could literally make human existence impossible. The fundamental concept of sustainable development is depending on the social, the economic and the environmental dimensions. For development to be sustainable, all the 3 dimensions need to be addressed in a balanced and integrated way, to reach present and future needs. Education for sustainable development is an emerging but dynamic concepts that encompass a newvision of education that seeks to empower people of all ages to assume responsibility for creating a sustainable future. Today, the prospects for future health depend to an increasing extent on the processes of globalisation and on the emergence of global environmental changes occurring in response to the great weight of humankind'seconomic activity. The globalization of trade, travel and culture is likely to have both positive and negative impacts on health. Increased trade in services and products harmful to health and the environment, travel and mass migration of people constitute additional global threats to health. A healthy population is essential for economic development. The modern engineering education should be reformed to include the spheres of economy, science and education. Finally, we have to accelerate progress towards universal health coverage and the sustainable development goals by ensuring equitable access to a skilled and motivated health worker within a performing health system.*

Keywords:*. bioengineering, education, environment, health, management, sustainable development, technology*

INTRODUCTION

We have only one planet, and we are using its resources 50% faster than it can take. So, what about the future of the new and next generations! Future of humanity and the planet depends on successful resolution of the interconnected challenges of economic, social, cultural, and environmental sustainability."

Sustainability is the capacity to endure. In ecology the word describes how biological systems remain diverse and productive over time. For humans it is the potential for long-term maintenance of well-being, which in turn depends on the maintenance of the natural world and natural resources.

Sustainability has become a wide-ranging term that can be applied to almost every facet of life on Earth, from local to a global scale and over various time periods. Long-lived and healthy wetlands and forests are examples of sustainable biological systems. Invisible chemical cycles redistribute water, oxygen, nitrogen and carbon through the world's living and non-living systems, and have sustained lifesince the beginning of time. As the earth's human population has increased, natural ecosystems have declined and changes in the balance of natural cycles has had a negative impact on both humans and other living systems

Sustainable development has gained momentum as a more significant movement over the years. The sustainable development notion is supposed to assemble humankind's development while contemporarily sustaining the natural environment's competence to preserve ecosystems and resources upon which the human economies be contingent. The Sustainable Development Goals (SDGs), as presented in the 2030 Agenda for Sustainable Development, represent a global plan required for all of us to live and grow in a sustainable and prosperous world. The goals are comprehensive, covering development opportunities and challenges relating from water, energy to climate, ecosystems, food, jobs, innovation, health, and poverty (Figure 1).

Figure 1. The main goals of sustainable development

National, regional, and local efforts across all social sectors are required to achieve these 17 goals and 169 targets (United Nations, 2017). Khan and Khan (2012) writes that the "Sustainable Development" modeldescribed in Agenda 21 rests on Social Sustainability, Economic Sustainability, and EnvironmentalSustainability, the three conceptual pillars (Khan and Khan, 2012). The idea of environmental sustainability is all about how the environment tends to be fruitful and resilient for human life. Environmental sustainability is tied to the ecosystem's stability and the natural environment's carrying potential (Brodhag and Talière, 2006). This suggests that it is essential to extract natural resources no faster than it is possible to recover them. Simultaneously, waste should not be generated faster than its absorption in the atmosphere (Haller, 2018). Thatis because, the processes of the earth have borders and constraints. However, the race of uncontrolled growthputs higher demands on the physical system and increasingly burdens these constraints as technological advances may not support exponential growth. There is mounting evidence of concerns about environmental sustainability and poverty (Zhao et al., 2021; Imaz and Sheinbaum, 2017).

Environmental Sustainability and Development

- Environmental sustainability is defined as responsible interaction with the environment to avoid depletion or Environment degradation of natural resources and allow for long-term environmental quality.

- The practice of environmental sustainability helps to ensure that the needs of today's population are met without jeopardizing the ability of future generations to meet their needs.
- The three pillars of sustainability are (Figure 2.):

1. Economic development,
2. Social development and
3. Environmental protection.

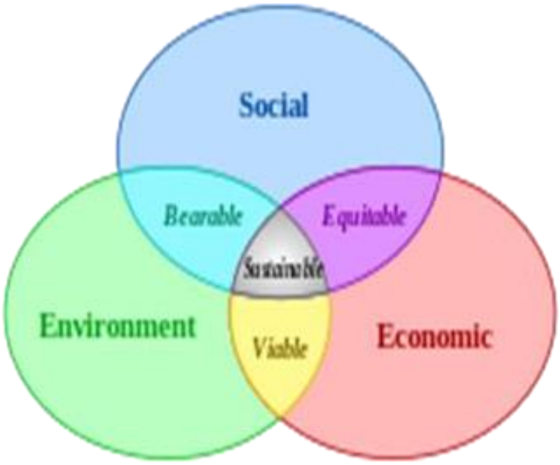

Figure 2. Definitions of sustainability often refer to the "three pillars" of social, environmental and economic sustainability

- The world is facing a serious environmental, social and economic challenge:
    - climate change,
    - environmental pollution,
    - public health as well as the world population increases,
    - pressure on soi,l and
    - increases and the natural capital of soil faces continuing reduces.

- **Environmental Sustainability decided to restructure itself around 7 foci:**
    1. Environmental change issues;
    2. Environmental change assessments;
    3. Environmental Change & Global Sustainability
    4. System dynamics & sustainability;
    5. Sustainability governance & transformation;
    6. Sustainability challenges; and
    7. Sustainability science.

CONSUMPTION — POPULATION, TECHNOLOGY, RESOURCES

The overall driver of human impact on Earth systems is the destruction of biophysical resources, and especially, the Earth's ecosystems. The total environmental impact of a community or of humankind as a whole depends both on population and impact per person, which in turn depends in complex ways on what resources are being used, whether or not those resources are renewable, and the scale of the human activity relative to the carrying capacity of the ecosystems involved.
Careful resource management can be applied at many scales, from economic sectors like agriculture, manufacturing and industry, to work organizations, the consumption patterns of households and individuals and to the resource demands of individual goods and services.

One of the initial attempts to express human impact mathematically was developed in the '70s and is called the I PAT formula. This formulation attempts to explain human consumption in terms of three components: population numbers, levels of consumption (which it terms "affluence", although the usage is different), and impact per unit of resource use (which is termed "technology", because this impact depends on the technology used).
The equation is expressed:

$$I = P \times A \times T$$

Where:
I = Environmental impact,
P = Population,
A = Affluence,
T = Technology

- Soil is the basis of the landscape and ecosystem that provides biophysical, economic, cultural and spiritual services to the humanity and to all global biotic factors.

- Food and water securities, climate change limit, ecosystem development, biodiversity protection, energy sustainability, etc. are the main basic elements of global societal challenges and the concept of soil security can be used to provide a useful links between soil and important basic elements in sustainable development.

- A fully functioning soil lies at the centre of solving the issues of food and water securities, biodiversity, climate change and fresh-water regulation and other global environmental problems.
- . So, functioning soil is need for improvement of the ecological and human sustainable developmental ecosystems.
- The most significant threats to soil function at the global scale are soil erosion, loss of soil organic carbon and nutrient imbalance.
- Increasing human demands on soil-derived ecosystem services requires reliable data on global soil resources for sustainable development.
- Finally, it is true that the world that secures its soil will sustain itself.
- Increasing human demands on soil-derived ecosystem services requires reliable data on global soil resources for sustainable development.
- Finally, it is true that the world that secures its soil will sustain itself.

Integrating sustainable development is fully into higher education and research strategies.

- Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Environmental protection and green development is of great importance

Therefore, this outline lecture attempts to propose an environmentally friendly and sustainable development model that depends on Environmental Socio-economics and Technology.

KEEPING AN EYE ON HIGHER EDUCATION DEVELOPMENTS WORLDWIDE

In this regard, we strongly think that a political message that is supposed to enlighten the future should be: Education and, above all, University Education for All (UE4A). And by this we mean Higher Education that is: broadly and proactively **inclusive**; of **good quality; geographically distributed; respectful of difference** (gender, age, culture, religion and civil beliefs). In order to achieve such an ambitious goal, it is of utmost importance that the academic world tackles it soon and as effectively as it can.

How do higher education institutions contribute to the Sustainable Development Goals (SDGs)?

- Higher education (HE) plays a key role in achieving the 2030 Development Agenda and related Sustainable Development Goals (SDGs).
- Leaders of universities and other higher education institutions, academic and administrative staff, students and other HE stakeholders are driving the processes towards a more sustainable present and future.
- Environmental sustainability practices in universities can play an important role in helping society form a sustainable future.
- In this study, the roles that universities play in terms of sustainability practices on their campuses.
- The existing research on sustainability practices is to put the environmental sustainability practices in the higher education institutions of the world.
- The term '*sustainability science*' has been employed to refer to a scientific trend, movement or program aimed at studying problems related to human–nature interactions.
- However, since it does not have its own set of principles for knowledge building and lack of a definition of a study object, sustainability science is not a science, at least in the usual sense of the word.
- A study object is the conceptual delimitation of the problems tackled by a science, and therefore, its search in the context of a science of sustainability requires exploring different notions of sustainability.

The concept of sustainable community is emerging faster than ever.

Developments of sustainable cities require new action and policies, very often compared with essential benchmarks as sustainability, resilience and smartness.
The formation of a sustainable community in order to preserve the environment promotesthe aspiration to create as much value as possible with as few resources as possible while providing measures and systems for waste management and disposal and recycling, which reduces the consumption of natural resources as a basic postulate of the circular economy.
The availability of energy is directly related to the economic and political stability of each country, while resources such as water and food directly affect human health and quality of life, as well as the realization of basic human rights.
Having in mind the importance that these two areas have, the basic task is to harmonize the human interest to live today (energy) and survive tomorrow (ecology).

- There are some concepts that deal with health and relation between the environment and human life-style:
    1. environmental determinants of health (medical and health geography),
    2. Political ecology of health, and
    3. Social studies of biomedicine.
- For medical and health geography, environmental epigenetics shows the need to treat place and space as more than a setting, and bodies as more than receptors.
- Populations are impacted by environmental physical or chemical factors e.g., toxins, stress, temperature, radiation, etc. with varying degrees, and potential to cause changes in gene expression.
- Many ecological external mechanisms and their effects on human bodies are known through epigenetics.
- It was demonstrated that in addition to classical gene mutations, there is a mechanism, called "epigenetics," refers to a change in the gene expression.
- There is constant interaction between the external and internal environments that is required for normal development and health maintenance as well as for influencing disease load and resistance.

- For example, exposure to pharmaceutical and toxic chemicals, diet, stress, exercise, and other environmental factors are capable of eliciting positive or negative epigenetic modifications with lasting effects on development, metabolism and health.
- These can impact the human body so profoundly as to permanently alter the epigenetic profile of an individual.
- Most of the people all over the world today have an immediate and intuitive sense of the urgent need to build a sustainable future.
- Environmental engineering is the branch of bioengineering that is concerned with protecting people from the effects of adverse environmental effects, such as pollution, and improving environmental quality.
- Environmental bioengineers work to improve recycling, waste disposal, public health, and water and air pollution control.
- Environmental health bioengineering can be considered as sanitary bioengineering brought to meet the needs of the future of the World.
- Sanitary bioengineering is essentially disease-oriented: it may be defined as the use of bioengineering principles and bioengineering devices for public health purposes.
- Environmental health bioengineering is the application of bioengineering fundaments to the control, modification or adaptation of the physical, chemical or biological characteristics of the environment in the interest of the health, comfort and social activities of people.
- It requires the control (quantity and quality) of the basic necessities and waste by-products, whether solid, liquid or gaseous.
- These by-products, if uncontrolled and allowed to accumulate, lead to widespread disease and physical damage, and could literally make human existence impossible.
- The fundamental concept of sustainable development is depending on the social, the economic and the environmental dimensions.
- For development to be sustainable, all the 3 dimensions need to be addressed in a balanced and integrated way, to reach present and future needs.
- Many health problems will continue to be exacerbated by pollution, noise, crowding, inadequate water and sanitation, improper waste disposal, chemical contamination, poisonings and physical hazards associated with the growth of densely populated cities.
- Education for sustainable development is an emerging but dynamic concepts that encompass a new vision of education that seeks to empower people of all ages to assume responsibility for creating a sustainable future.
- Today, the prospects for future health depend to an increasing extent on the processes of globalisation and on the emergence of global environmental changes occurring in response to the great weight of humankind's economic activity.
- The globalization of trade, travel and culture is likely to have both positive and negative impacts on health.
- Increased trade in services and products harmful to health and the environment, travel and mass migration of people constitute additional global threats to health.
- A healthy population is essential for economic development.
- The modern engineering education should be reformed to include the spheres of economy, science and education.
- Sustainable development holds the key not to resolve the problems every nation is facing these days but also for long-lasting effects (Chen, 2021).

SDG7: Affordable and Clean Energy

- The recent sixth assessment report of the IPCC warned again of the dangers of climate change.
- We may be able to limit global warming to a maximum of 1.5°C but only if we take big steps now to cut down on greenhouse gas emissions.
- At the same time a third of humanity uses dangerous and unsafe cooking systems and 759 million people have no access to electrical power.
- The UN Sustainable Development Goal 7 (SDG7) 'Affordable and Clean Energy' exists to engage with grand global challenges and facilitate the rapid expansion of modern renewable

energy systems, particularly in heating and transport, and an acceleration of energy efficient technology.
- If we can do both we can help prevent an environmental catastrophe while improving the health and standards of living of hundreds of millions.

HIGHER EDUCATION AND SOCIAL ECONOMIC DEVELOPMENT

Despite the fact that more equal access to higher education has been an objective public policy for several decades, little is known about the effectiveness of alternative means for achieving such goal. Indeed, nowadays high level of graduate population can be observed both in countries with high and low level of fees, or high and low level of public expenditure in higher education.

Sustainable Development Research
This is multidisciplinary topic objectives:
- to creating a unified foundation for the Sustainable Development: research, practice and education
- to provide the exchange of ideas around best practice sustainability research in the all global Region.
- to draw links between research, practice, education for sustainability and the needs of industry, and address the sustainable development goals (SDGs).
- Future Universities and Graduate: Quality Education Beyond the Horizon
- Close linkages between the Rectors and the Students is assured through a synergic exchange
- Contribute to the policy dialogue on higher education
- Strengthen the linkages between universities, governments, business and industry, and local communities

Eight keys are important:
- Environmental Sustainability
- Sustainability Education
- Education for Sustainability
- Sustainability in Economic, Social, and Cultural Context
- Sustainable Cities
- Sustainable Buildings
- Sustainable Infrastructure
- Sustainability Policy and Practice

Highlight how institutions explore the local and the global, designing experiences where students apply new learning in diverse contexts—including through nuanced deliberation about the complexity of the real-world issues of our time.
The dialogue will provide models, practices, and resources for
- developing courses, programs, and curricula that put student engagement with real-world issues at the center of the educational experience;
- project-based and signature assignments that advance ethical integrative thinking, teamwork, and community-based research and service;
- assessing global learning, engagement, and social responsibility to ensure that all students leave college prepared to address the issues of our time with knowledge, sensitivity, and commitment to the well-being of others;
- using requirements of the accreditation review process (such as the Quality Enhancement Plan) as opportunities to develop institutional commitment to and strategic planning for global learning;
- preparing faculty for their multiple roles—including teacher, facilitator of difficult dialogues, and mentor—with special attention to issues affecting student well-being, and investing in institutional resources to ensure that students, faculty, and staff receive the support they need.

Environmental dimension

Healthy ecosystems provide vital goods and services to humans and other organisms. There are two major ways of reducing negative human impact and enhancing ecosystem services:
1) ***Environmental management***.
This direct approach is based largely on information gained from earth science, environmental science and conservation biology. However, this is management at the end of a long series of indirect causal factors that are initiated by human consumption, so a second approach is through demand management of human resource use.
2 ***Management of human consumption of resources***, an indirect approach based largely on information gained from economics. Herman Daly has suggested three broad criteria for ecological sustainability: renewable resources should provide a sustainable yield (the rate of harvest should not exceed the rate of regeneration); for non-renewable resources there should be equivalent development of renewable substitutes; waste generation should not exceed the assimilative capacity of the environment

SUSTAINABLE ENERGY, RENEWABLE ENERGY, AND EFFICIENT ENERGY USE

The Sun's energy, stored by plants (primary producers) during photosynthesis, passes through the food chain to other organisms to ultimately power all living processes. Since the industrial revolution the concentrated energy of the Sun stored in fossilized plants as fossil fuels has been a major driver of technology which, in turn, has been the source of both economic and political power.

In 2007 climate scientists of the IPCC concluded that there was at least a 90% probability that atmospheric increase in CO_2 was human-induced, mostly as a result of fossil fuel emissions but, to a lesser extent from changes in land use. Stabilizing the world's climate will require high income countries to reduce their emissions by 60-90% over 2006 levels by 2050 which should hold CO levels at 450-650 ppm from current levels of about 380 ppm. Above this level and temperatures could rise by more than 2°C to produce "catastrophic" climate change. Reduction of current CO_2 levels must be achieved against a background of global population increase and developing countries aspiring to energy-intensive high consumption Western lifestyles.

Reducing greenhouse emissions, referred to as decarbonization, is being tackled at all scales, ranging from tracking the passage of carbon through the carbon cycle to the commercialization of renewable energy, developing less carbon-hungry technology and transport systems and attempts by individuals to lead carbon neutral lifestyles by monitoring the fossil fuel use embodied in all the goods and services they use.

In the current era of digital age, each nation wants to achieve sustainable development for their future generations. In addition, environmental sustainability is an imperative module to achieve sustainable development.

CONCLUSION

- Finally, we have to accelerate progress towards universal health coverage and the sustainable development goals by ensuring equitable access to a skilled and motivated health worker within a performing health system.
- There's no way around it. Sustainability is an extremely urgent and universal concern

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WATER MANAGEMENT ISSUES IN SPAIN AND PORTUGAL AT BEGINNING OF 2020S

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***Abstract**: In the EU-28 productivity could have decreased somehow, because price indices of means of agricultural production, as input increased by 9,7% more than increase of price indices of agricultural products,as output in field of cereals including seeds, which increased only by 6,8% for period of 2010-2017. But agricultural income factor income per annual working unit has considerably increased by 27,2% for period of 2010-2020, mostly approximately closed to same period. This means that factor income increased more than thiscould be explained by low level of increase according to increasing rate of price indices of output in the EU-28. The agricultural income, factor income per AWU is valid for all of agricultural production also beyond cereal and seed production. **Motivation/Background**: Productivity of agricultural industry is basic issue to ensure sustainability of agriculture, which is accompanying with irrigation innovation. Analyse the irrigation prosperityfor the increasing output. **Method**: Compare price input and price out is based on statistical analysis. **Conclusions**: This increase of the profitability has only partly been resulted by 10% decrease of number of the agricultural total labour force, as input for this time. Because decreasing trend of the agricultural total labour force input was considerable, but subsidies for agricultural production including the consumption of fixedcapital was also significant.*

***Keywords:** Annual working unit, Factor income, Input, Irrigation, Output, Productivity*

INTRODUCTION

In the EU-28 productivity could have decreased somehow, because price indices of means of agricultural production, as input increased by 9,7% more than increase of price indices of agricultural products, as output in field of cereals including seeds, which increased only by 6,8% for period of 2010-2017. But agricultural factor income per annual working unit has considerably increased by 27,2% for period of 2010-2020, mostly approximately closed to same period. This means that factor income increased more than this could be explained by low level of increase according to increasing rate of price indices of output in the EU-28. The agricultural income, factor income per AWU (annual working unit) is valid for all of agricultural production also beyond cereal and seed production. According to the motivation and background the productivity of agricultural industry is basic issue to ensure sustainability of agriculture, which is accompanying with irrigation innovation. Analyse the irrigation prosperity for the increasing output.
The study focuses on the analysing the above-mentioned economic conditions, namely price indices of means of agricultural production, price indices of agricultural products, agricultural factor income per annual working unit in cases of Spain and Portugal with comparing some selected EU member states, namely Hungary, Czechia, Slovakia, Romania, Bulgaria and Slovenia based on inputs and efficiently using renewable water resources. At present the scarcity of water emphasizes the importance of

efficient allocation of water resources based on the productive water management. The sustainability for the agricultural production is based on two main balances, namely

- the first is the profitable agricultural production to keep balance between the production cost and benefit or input and output ratio by satisfactory price income and agricultural factor income.
- The second is to keep balance between the used natural resources and sustainability of the natural environmental background for the agricultural production. Farmers and producers can use natural resources, which can regenerate.

The global warming has the negative effects on the agricultural production even by long and frequent drought periods, which challenges make agriculture save scarcity water. The efficient water use is sensitivity issue, which is accompanying with the efficient irrigation.

The greatest benefit of using *irrigation* is in increasing the *productivity* of all the factors involved in production, particularly the land and labour force. *Water management* and usage, regardless of farm size, are the responsibility of farmers. These responsibilities include managing infrastructure for irrigation, building infrastructure for collecting and storing rainwater, the proper use of different technologies, managing water surplus, and complying with standards on the use of aquifers. Giving more attention to obtaining a higher return on investment is a priority, in order to boost the capacity of *human resources* at all levels, since the change that is needed depends on them to a great extent. This chapter addresses the following *aspects of innovation*: i) innovation for more efficient use of water on farms via pressurized irrigation systems; ii) innovation for reducing energy consumption for water usage on farms; iii) progress made in water harvesting at the farm and community levels (p. 34)(IICA,2015).

Agricultural practices, such as soil management, irrigation and fertilizer application and disease and pest control are related with the *sustainable water management* in agriculture and protection of the environment. Socio-economic pressures and climate change impose restrictions to *water allocated* to agriculture. The adoption of sustainable water management in Mediterranean is not only a technological problem but involves many other considerations relative to social behaviour of rural communities, the economic constrains, or the legal and institutional framework that may favour the adoption of some measures and not others (Chartzoulakisa – Bertaki, 2015).

Increase *water use efficiency*: Can be achieved with the obligatory use of localized irrigation systems by the farmers (with or without subsidies), the proper irrigation scheduling according to actual needsof the crops, the establishment of a system for advising farmers on their irrigation schedules, the introduction of appropriate agronomical practices and the application of salinity management techniques. Water pricing policy, for proper water pricing volumetric water metering and accounting procedures are recommended. Progressive, seasonal and over-consumption water tariffs as well as temporary drought surcharges rates contribute to water savings and should be promoted. Furthermore, it could affect cropping patterns, income distribution, efficiency of water management, and generation of additional revenue, which could be used to operate and maintain water projects. (Chartzoulakisa – Bertaki, 2015; Liao et al, 2007; Tsur-Dinar, 1997).

Agricultural water productivity ("crop per drop") is a partial productivity measure of economic performance that focuses on a single input, water use, and water productivity is affected by the farmers' managerial abilities, environmental conditions among other factors (Vrachioli et al, 2016; more Scheierling 2016; Chakravorty - Roumasset, 1991; Baietti et al, 2012).

Naturally the study focuses on the economic analyses for the price indices of agricultural input and output concerning the agricultural factor incomes mostly in Spain and Portugal comparably with other EU member states of this study, but the water management and irrigation system should be innovative first to develop production. Therefore, some main issues were mentioned above about importance of water management and advanced irrigation system, even the negative effects of global warming on the agricultural sector. The agricultural producers can implement their agricultural production in order to realise their adequate factor income and in order to stay and remain in their original places or establishments.

MATERIALS AND METHODS

The study focuses on the comparing price indices of the means of agricultural production inputs and

price indices of agricultural products output concerning the agricultural factor income per AWU and agricultural total labour force input in period of 2010-2020, where the 2010 = 100. The compering among the economic factors is based on statistical analysis. The Eurostat provided main data for comparing the declining trend of the agricultural total labour force, as annual working unit in selected countries, while factor incomes per AWU could increase. By one hand because of intensive agricultural mechanization decreased the employed labour forces in agricultural sector and by the other hand in the same time the agricultural subsidies increased for further agricultural modernization. Therefore, the innovation in agricultural and irrigation modernization by increasing factor incomes for agricultural producers and farmers can lead to strengthen the sustainability.
The share of the agricultural sector was 2,65% of the Spanish GDP, while Andalusia ranked as the region with the largest cropland area with 3,6 million hectares in 2019. Castille-La Mancha andCastille and Leon followed second and third, respectively. Andalusia also leads the Spanish agricultural production value, far ahead of the other autonomous communities (Blázquez 2021; Eurostat 2021).

STATISTICAL ANALYSIS AND GRAPHICAL PRESENTATION

The statistical analyses accompanying with the geographical conditions of selected countries show main elements of economic-income conditions of agricultural producers as title of annual working units. The AWU means the fulltime workers including some part-time workers added to full time workers. Therefore, the statistical data under AWU calculate only full timeworkers to make the analyse be simply unified method, which make also the analyse and compare among countries in this field be easier (Vidal-Macuaa et al 2018).

Table 1. Price indices of the means of agricultural production Input and Price indices of agricultural products Output and Agricultural income Factor income per AWU, 2010 = 100, and Agricultural total labour force input (1000) in period of 2010-2020

	Price indices of the *means of agricultural production* Input	Price indices of *agricultural products* Output	*Agricultural income* Factor income per AWU	*Agricultural total labour force* input (1000)		
	2010 = 100					
	2010-2017		2010-2020	2011	2019	2019/2011
Czechia	8,4	20,0	50,26	106,20	102,02	-4
Hungary	16,1	15,0	104,24	436,95	358,89	-18
Romania	12,0	12,5	20,65	1532,00	1402,00	-8,5
Slovakia	-1,2	0,4	9,05	57,40	44,50	-22
Bulgaria	3,5	10,5	146,2	375,80	190,40	-49
Slovenia	7,8	5,0	27,5	77,99	77,31	-1
Portugal	12,1	0,4	34,12	299,14	234,42	-22
Spain	9,4	4,9	44,6	903,31	854,70	-5
EU-28	**9,7**	**6,8**	**27,2**	10099,80	9033,59	**-10**

Source: Eurostat, 2021, (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06), (aact_ali01) EU-28 including UK

Based on the data the productivity can be calculated by out/input the profitability can be calculated by price income / output. The income able can be calculated by agricultural incomes / agricultural total labour force input and also the factor income / AWU.
The statistical data focuses on factor income, because each kind of economic activities concerning different kinds of sectors or branches within agricultural companies or farms can provide some incomes for farmers or generally for AWU. The data added incomes from all of branches of producers,

as animal husbandry, crop production and services.

Note:
Price indices of the *means of agricultural production, input* (2010 = 100) - annual data [apri_pi10_ina] Last update: 08.02.21 Source of data: Eurostat, P_ADJ: Nominal index UNIT: Index, 2010=100 PRODUCT: Goods and services currently consumed in agriculture (Input 1)
Price indices of *agricultural products, output* (2010 = 100) - annual data [apri_pi10_outa] Last update: 08.02.21 Source of data: Eurostat. P_ADJ: Nominal index UNIT: Index, 2010=100 PRODUCT:
Economic accounts for agriculture - *agricultural income* (indicators A, B, C) [aact_eaa06] Last update: 09.04.21 Source of data: Eurostat. ITM_NEWA: Indicator A: Index of the real income of factors in agriculture per annual work unit (AWU) UNIT: Index, 2010=100
Agricultural labour input statistics: absolute figures (1 000 annual work units) [aact_ali01] Last update: 04.03.21 Source of data: Eurostat, ITM_NEWA: Total labour force input

RESULTS AND DISCUSSION

In Price indices of the *means of agricultural production, input* the growth was **9,7%** between 2010-2017, in EU-28 in field of cereals including seeds. Price indices of *agricultural products, output* increased by **6,8%** between 2010-2017, in EU-28. Economic accounts for agriculture, the *agricultural income* increased by **27,2%** in EU-28 between 2010-2020 (Table 1), (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06), (aact_ali01).
In the EU-28 the productivity could have decreased somehow, because the price indices of the *means of agricultural production, as* input increased more than the increase of price indices of a*gricultural products,* as output in field of cereals including seeds, which increased in the same time. But the *agricultural income* factor income per AWU (annual working unit) has considerably increased mostly approximately closed same period. This means that the factor income increased more than this could be explained by the low level of increase according to the increasing rate of the price indices of output in the EU-28. The *agricultural income* factor income per AWU is valid for all of the agricultural production also beyond the cereal and seed production.
This increase of the profitability has only partly been resulted by 10% decrease of number of the agricultural total labour force, as input for this time length. Because the decreasing trend of the agricultural total labour force input was considerable, but subsidies for the agricultural production including the consumption of fixed capital was also significant.
The price indices of the *means of agricultural production, as* input increased by 16,1% in Hungary at the highest level within selected countries in the period of 2010-2017, and the second one by 12,1% in Portugal, which mostly was same as by 12,0% in Romania. This means that the input considerably increased more in these three countries comparably with one of the other selected countries and the average level of EU-28. The higher price level of inputs can more cover the cost of developing the mechanization and the irrigation developed in the basic agricultural production. But this price increase can show that the agricultural production can be more costly than in cases of the other selected countries. Therefore, from this point of view the price indices of a*gricultural products*, as output has important role for calculating cost -benefit ratio in the basic agricultural production. In Hungary the price level of the output has increased by 15% in the same period, mostly by the same rate or closed same rate of input price level. In Romania also the same price increasing rate of the input and output by 12,5%. Themost favourable cost-benefit or input-output ratio was in Czechia, where the price increase of inputwas 8,4%, but the price of output was by 20,0% more than two times more than the price increase of input in basic agricultural production. (Table 1), (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06),(aact_ali01).
Also, in *Bulgaria* agricultural producers have favourable position, because the price increase of output was by 10,5%, while the price increase of the input was only by 3,5%, mostly one third of the price increase of the output. In spite that in Bulgaria the price indices of input increased at the lowest level of the selected EU member states and average level of the EU-28, this could probably occur by less developed mechanization, less equipped irrigation system and less used chemicals, as fertilizes and

pesticides. In Bulgaria all of these missing or less used inputs can realise less favourable agricultural basic production, which last one can stimulate more imported products in fields of outputs and also even inputs by increasing the more economic dependence from the highly developed economies. The more increase of the price of outputs can be explained by the less supply of agricultural basic products than the demand of the users and consumers on the domestic market of Bulgaria.

Hungary, Romania and *Slovenia* have considerable increasing price indices of input concerning the emerging investment in their agricultural production, in spite that in *Portugal* the price indices of input were little more than in Slovenia and Czechia, and the Portugal price indices was at the same level as the level of Romania. Price indices of input in Bulgaria was considerably below the level of Portugal. The price indices of input decreased only by 1,2% in Slovakia, while the price indices of agricultural products as outputs increased only by 0,4%. This means that in Slovakia the balance of price increase of input and output was somehow favourable, because the production cost as input decreased more than the price of out increased, namely more income and less cost for agricultural production.

In those countries, where the price indices of the *means of agricultural production, as* input increased, also the price indices of *agricultural products, output* could increase based on the innovative industrial agricultural development, the cost benefit ratio can be unfavourable. Therefore, the increase rate of price in field of the input should be decrease by decreasing production cost level of input for agricultural basic production. The economic measure of input production at firm level should increase mostly in fields of innovative advanced mechanization and chemical production in industry accompanying with increasing level of skilled and educated employees in the agricultural production. The increase of the financial supports for agriculture is obligatory in any case.

In case of *Portugal* the price indices of a*gricultural products* output increased by only 0,4%, mostly this stagnated, while the price of input sharply increased by 12,1%. This condition can lead to more negative financial balance for the agricultural producers. The more increasing problem can avoid by more developing innovation process which can be realised by more subsidies and investment in fieldof fixed capital. In spite that the negative balance of input-output price changes Portugal couldincrease factor income per AWU by 34% more than the average level of the EU-28 as 27,2%. Naturally, the agricultural total labour force as input decreased by 22%, as one of the highest decreasing rates in this field within the selected countries after Bulgaria by 49% and Slovakia also by 22%. The considerable decrease of number of AWU also could contribute to the increase of factor income per AWU in Portugal.

Bulgaria can increase factor income per AWU by 146,2% as top level of selected countries and then in Hungary by 104,24%, which last one could be implemented by moderate difference between price increases of input and output. Bulgaria and Hungary could realise such favourable increase in field of factor income per AWU by ambition development of basic agricultural production, production concentration, mechanization, increasing competitiveness of the sector and former backwardness of income level of AWU. (Table 1), (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06), (aact_ali01).

According to development of *water management* by innovative prosperity of irrigation system in *Spain* and *Portugal* the EU member states can initiate their innovative development of water management based on the objective of the WFD (Water Framework Directive) is to achieve the good ecological status of all water bodies in the EU, maintain and promote sustainable water use in a long- term perspective. Structured in a basin-based management unit, the WFD requires also the elaboration of program measures to achieve the objective of good water status by 2010. River basin management plans (RBMP) have to be implemented in all basins and assure transparency and public participationof all stakeholders involved in the production, review and updating of the plans. The RBMP under preparation in all Spanish basins and the public participation process has been launched recently (CEC2000; CEC 2007; Varela-Ortega 2008).

The global warming and the extending period of drought led to increase the price of the water use also in Spain, which increased by 30% in the first decade of 21st century. These unfavourable economic conditions pressed farmers to decrease their water demands or increase selling price of their agricultural products. Finally, their income decreased by 20% by the end of 2000s (Varela-Ortega 2008). By the end of 2017 the factor income per AWU in Spain could increase by 44,6%, which could be realised by more subsidies to innovative agricultural production and increase of consumption of fixed capital (Table 1; Eurostat 2021), (apri_pi10_ina), (apri_pi10_outa), (aact_eaa06), (aact_ali01).

In Spain the water scarcity was very intensive difficulty in south regions of the country than in central north regions. Therefore, the law system concerning the water supply has permitted more flexible transfer of water from more water supplied regions to the less water supplied regions (see more Mejías et al, 2004).
The water management including water use in Spain can be characterised by some main elements from point of view of the environmental effects, which are as follows (see more Varela-Ortega 2008 and CEC 2007):

- Lower water consumption
- Use of modern irrigation techniques
- Increase in low water demanding crops
- Recovery of the aquifer
- Wetlands are partially restored

Also, there are some main social effects water management at water policy level, which are as follows:
Large adoption rate by farmers
Compensation payments are sufficient

  - Farm income gains
  - Employment increase
  - Social stability
  - Low enforcement cost
  - Low costs
  - High public cost
  - Low cost-effectiveness

In Spain and Portugal, the cost-benefit ratio should be increasing more for the production of agricultural producers concerning the innovative water management with better water supply in order to decrease the price level or tariff for the water use. Additionally, to subsidies for farmers the water management should follow to decrease the press the natural environment, because the over irrigating land will increase the difficulty of saliferous process and the water erosion for soil degradation. The geographical and natural conditions of Spain are similarly to Portugal.
According to Portugal the governmental strategy focuses on the increasing the quality of water management and decreasing the level of vulnerability from the scarcity of water and polluted water resources. From points of view governmental offices created a main project namely the *Integrated De-pollution System of Vale do Ave (SIDVA)*, located in the north-west of Portugal. SIDVA integrates a network of collectors / interceptors, consisting of three drainage fronts, five treatment stations and more than 120 km of collectors, along the main water courses of the River Ave, in a densely occupied area by urban and industry uses, with the predominance of the textile sector. The regional solution wasdeveloped based on the following assumptions **(Francisco da Silva** Costa, 2018):

- Solution defined at the river basin scale (1450 km^2) and not according to administrative limits;
- Joint treatment of domestic and industrial effluents;
- Implementation of the solution in several phases;
- Demanding purification in each treatment infrastructure in order to recover the water quality of the basin;
- Tertiary treatment with removal of the color produced by textile industry;
- Creation of Wastewater Discharge Regulation and tariffs that considered the *polluter – payer principle.*

Spain and Portugal share five river basins: Minho, Lima, Douro, Tagus, and Guadiana. The total area of these basins is 268.500 km^2, which represents about 45% of the Iberian Peninsula, and corresponds to 64% and 42% of mainland Portugal and Spain, respectively (Nesheim et al, 2010; **Francisco da Silva** Costa, 2018). Portuguese-Spanish relations regarding *common river use* have been established through several bilateral legal instruments. These treaties were later complemented, in their territorial scope (broadening to the entire basin and its river banks) and material range (the protection of water bodies and not just their use) by the *Convention on Cooperation for the Protection and Sustainable Use of Portuguese-Spanish River Basins*, signed in 1998 (Albufeira Convention) (APA, 2015; EAA, 2012):

- Systematic exchange of information on plans and projects for new water uses and programs of measures to improve and protect the quality of the water bodies;
- Coordination of water management;
- Transboundary impact evaluation of new projects in the shard river basins;
- Conducting joint studies on the transboundary water bodies;
- Coordination of participation in Community and international programs of common interest.

Within the program the companies should also participate with their own wastewater treatment plants to keep the water resource be clean. Also, the project declared that the need to distribute with equity all users, including industrialists, investments in fixed capital and associated with the implementation and operation of the Integrated De-pollution System of Vale do Ave **(Francisco da Silva** Costa, 2018; Zucco- Costa 013; Kaika 2003)

CONCLUSIONS AND RECOMMENDATIONS

In selected countries of this study the increase of the profitability has only partly been resulted by decrease of number of the agricultural total labour force, as input for this time. Because decreasing trend of the agricultural total labour force input was considerable, but subsidies for agricultural production including the consumption of fixed capital was also significant. The scarcity of the water isa large challenge for agricultural producers even in more extending drought periods, which appeared recently accompanying with more dangerous water flood.

The *cost-benefit ration of farmers* can be improved by the contractual arrangement in order to compensate and balance the negative effects of the water scarcity even in Spain and Portugal. The intensity of the contractual arrangement varies according to the depth and complexity of the provisions in each of the following three areas (see more in FAO 2000):

- *Market provision:* The grower and buyer agree to terms and conditions for the future sale and purchase of a crop or livestock product;
- *Resource provision:* In conjunction with the marketing arrangements the buyer agrees to supply selected inputs, including on occasions land preparation and technical advice;
- *Management specifications:* The grower agrees to follow recommended production methods, inputs regimes, and cultivation and harvesting specifications.

This *contractual arrangement* can strengthen the *agro business connection* among the participants by increasing role of agricultural producers for basic production. The agro business network helps farmers to obtain easier the inputs including the highly developed mechanization and irrigation system based on the environmental technologies, and also, farmers can sell their products by fixed prices determined in the contracts among participants of the agro business network.

The price changes of inputs and outputs for agricultural production should be closed to each other but balance of both of them should ensure more income for farmers by increasing price income for them than the price level increase of inputs. The agricultural production should make less press on the natural background by decreasing negative effects of saliferous and the soil erosion.

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CHALLENGES AND ASSETS IN THE SANITATION OF CITIES IN THE REPUBLIC OF BENIN (WEST AFRICA)

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Abstract: *Sanitation is one of the key sectors for achieving the Sustainable Development Goals. In Benin, many efforts are made by the government, however, challenges remain. This communication sets out the activities carried out as assets by the government in the field of sanitation and secondly what remains to be done as challenges for the achievement of the Sustainable Development Goals. Documentation made in institutions and direct observations in the field made it possible to collect data on sanitation, hygiene and water. The data collected was analyzed with the sphnix 4.5 software. The results show a synergy of institutional and non- governmental actions around sanitation. Thus, several flagship projects including, Grand-Nokoué, the Pluvial Sanitation Project of Secondary Cities (PAPVS) of Benin, the Cotonou Pluvial Sanitation Project (PAPC) have been implemented and several international agreements to increase by 100% funding each year for the sanitation sub-sector and raising the institutional positioning were signed within the framework of the Water andSanitation for All (SWA) organization in Washington in 2012. Then, in 2015, the Declaration of N'Gor in Senegal on the occasion of the 4th African Conference on Sanitation (Africasan4 summit). The government has built new Faecal Sludge Treatment Stations in Abomey-Calavi, Sèmè-Podji and plans to build them in Parakou commune as well. The institutional profile of the sub-sector is based on feedback, bringing sanitation out of its marginality and making it a real "national cause", and the financing of sanitation projects is the real one. Sanitation is essential to improve the health of populations, is the engine of economic development and to reduce the cost of public health expenditure.*

Keywords: *Benin (West Africa), Sanitation, SDGs, Population health, environmental sustainability*

INTRODUCTION

Like other countries, Benin is committed to the implementation of the SDGs. In this perspective, the country has decided to proceed with the prioritization of targets taking into account its aspirations, its vision, while maintaining the level of ambition carried by the SDGs and capitalizing on the experiences of the implementation of the Millennium Development Goals (MDGs). A prioritization process was conducted in 2017 by the Directorate in charge of monitoring the SDGs with all the actorsinvolved. The prioritization aims to identify the targets and indicators of the Sustainable Development Goals (SDGs) that are in line with national development priorities given the constraints and specificities of Benin. This process allowed us to select 49 targets (with 80 indicators) out of 169, including access to drinking water and sanitation. With regard to Goal 6 (Ensure access to water supply and sanitation services for all and ensure sustainable management of water services), the national indicators selected for the specific targets taken from the RIA22 matrix on the prioritization ofSDG targets are as follows:
- the rate of water supply in rural and urban areas, with the Ministry of Water and Mines as the institution responsible for implementing the target (line ministry)

- the proportion of the population using sanitation services, the coverage rate of households with excreta disposal facilities, and the coverage rate of excreta disposal facilities in schools, with the Ministry of Health as the institution responsible for implementing the target (the lead ministry).
Benin has not been able to meet the water and sanitation needs of the entire population of Benin. Disparities from one locality to another persist and half of Benin's population still does not have access to a source of drinking water. More than half of the population does not have access to improved sanitation services (SNAEP-MR 2017-2030; SNPHAB-MR 2018-2030). The challenges are significant:
With regard to the water sub-sector:
- Accelerating investments in the sector to achieve universal and sustainable access by 2021;
- Reducing disparities in access to drinking water for low-income populations, particularly in rural areas;
- access to drinking water in densely populated areas that have so far lacked access;
- Access to drinking water in quantity and quality and at affordable prices for all (with a view to eliminating inequalities);
- Efficiency in the use of mobilized resources;
- The involvement of the private sector.
With regard to the sanitation sub-sector:
- scaling up of the Hygiene and Sanitation Promotion strategies (for rural, urban and peri-urban areas) to achieve the elimination of open defecation by 2025 and universal access to improved facilities by 2030;
- Mobilization of the resources needed to achieve the above objectives;
- the involvement of the private sector.

MATERIALS AND METHODS

In this research, the methodology used is based on documentary research, institutional interviews and direct observations in the field. The institutional interviews made it possible to visit 6 institutions. The interview guide developed was sent to the resource persons met. The observation grid was used to observe and assess the government's efforts in the field of urban sanitation in Benin. The sphinx software was used to analyze the results obtained. This methodological approach led to the following results:

Institutional and regulatory framework of the sanitation sub-sector in Benin

Institutional Framework

The institutional analysis examines all the actors that play a role in the wastewater sanitation sector and those that are likely to play a role

Ministerial level: At the governmental level, several ministries are involved in the sanitation sector, the main ones being the following
The Ministry of Water (MoW) is responsible for developing and implementing government policy in the water sector.
The Ministry of Decentralization and Local Governance (MDGL):
The Ministry of Health is responsible for implementing the policies defined by the Government in the health sector. The Direction de l'Hygiène et de l'Assainissement de Base (DHAB) plays a central role in the field of sanitation.
The Ministry of the Living Environment and Sustainable Development (MCVDD) is responsible for proposing national policies in the environment and nature protection sectors and for ensuring their implementation. The General Directorate of Environment has among its missions, the control and the follow-up of all the activities of development having an impact on the environment including the fight against all the forms of pollution, the nuisances and environmental risks, in collaboration with the concerned structures.
The Ministry of Public Works and Transport (MTPT) can also intervene in sanitation, notably through its Directorate in charge of new works and its Directorate in charge of the maintenance of works.

Local authorities: The law on decentralization gives the Communes responsibility for the supply of drinking water and sanitation and important responsibilities in the area of hygiene (Articles 93, 94 and 95). However, these prerogatives are not currently fully exercised by local authorities, due to a lack of implementing legislation, financial resources and qualified human resources. SONEB is designated as the delegated project manager acting on behalf of the communes for water and wastewater services in urban and peri-urban areas.

SONEB: In January 2004, the government split the Société Béninoise d'Electricité et d'Eau (SBEE) into two separate entities. These are: Société Nationale des Eaux du Bénin (SONEB) and Société Béninoise d'Energie Electrique (SBEE). The SONEB has a capital of one (01) billion CFA francs.
The attributions of the SONEB are:
- Delegated project management, pending the assumption of this role by the Communes when the framework conditions are met;
- The collection, transfer, treatment and distribution of drinking water in urban and peri-urban areas throughout the country;
- Treatment and disposal of wastewater in urban areas.

SONEB is responsible for the treatment and disposal of urban wastewater (see the decree of creation and the articles of association), but this activity has not yet been developed by the company pending clarification of the institutional framework. SONEB is represented in the regions by six regional offices that are generally involved in water production and distribution.

The DHAB: According to decree n°2006/396 of 31/07/06 on the attribution, organization and functioning of the Minister of Health, the mission of the Directorate of Hygiene and Basic Sanitation (DHAB) is to ensure the application of the National Health Policy in terms of Hygiene and Basic Sanitation.
sanitation.
In terms of basic sanitation and hygiene, the DHAB has an important role in defining and implementing policy (Benin National Sanitation Policy PNAB) and legislation. It is also responsible for:
- the development and proper application of standards and standard plans for sanitation
the development and proper application of standards and standard plans for basic sanitation facilities
- monitoring the development and implementation of basic sanitation programs

The DHAB is also involved in the design and implementation of basic sanitation programs and in the application of standards and regulations for the treatment and discharge of industrial wastewater.
The DHAB also participates in the design and dissemination of information
in the field of hygiene.
Other missions are entrusted to the DHAB and concern (i) the control of the quality of drinking water and foodstuffs, (ii) the application of national and international sanitary regulations, (iii) the elaboration of standards and regulations on food hygiene.

The General Directorate for Water (DG-Water): The DG-Water develops and implements the national water policy. It draws up legislation and regulations relating to water management and ensures that they are properly applied. In the field of sanitation, it is responsible for:
- developing and ensuring the implementation of programs;
- defining and monitoring the implementation of the tariff policy.

Associations and NGOs in the water, sanitation and environment sectors: Several associations or non-governmental organizations are already active in the water, sanitation and environment sectors. It should be noted, however, that in the sanitation sub-sector, the associations or NGOs active in the country work mainly on solid waste pre-collection activities. This is the case, for example, of the NGO Béthesda. These structures are potential actors that can be trained to provide local services in wastewater sanitation (surveys, awareness raising, intermediation, etc.), awareness, intermediation...)
Some actors have a regional and international vocation such as: CREPA, PDM and Cities Alliance.

Special case of Water Users Associations (WUA)
Decree No. 96-317 of 2 August 1996 on the constitution, organization and operation of Water Users' Associations (WUAs) clearly states in Article 1 that WUAs are non-profit associations governed bythe Law of 1901 and, in general, by the legislation in force.
According to this decree (Article 2), the purpose of the Water Users' Associations (WUA) is as follows
- to promote and improve the community drinking water supply system(s)
- To provide a public water supply service for the community;
- To operate, maintain, renew and, if necessary, expand the system(s).

Delegated Project Management Agencies: Some executing agencies are involved in delegated project management and are increasingly acting on behalf of municipalities that have project management authority as a result of the decentralization laws. Among these agencies, we can mention in a non-limitative way:
- SGDS-GN (Société de Gestion des Déchets Solides et de la Salubrité du Grand Nokoué);
- ANAEPMR (Agence Nationale d'Approvisionnement en Eau Potable en Milieu Rural);
- AGETUR (Agency for the execution of urban works);
- AGETIP-BENIN (Agency for the execution of public interest works);
- SERHAU SA (Société d'Etudes Régionales d'Habitat et d'Aménagement Urbain).

Regulatory framework
The wastewater sanitation sub-sector in Benin is currently governed directly or indirectly in its various aspects by various texts, the most important of which are
- the Public Hygiene Code promulgated in 1987 and its application decrees (1999 - 2000);
- the framework law on the environment (Law 98-030);
This agreement is to be signed jointly by three parties: the Chairman of the WUA Steering Committee, the Directorate of Hydraulics (now the General Directorate of Water), and the Sub-Prefect (now the Mayor).
- the draft law on water management;
- the decree setting the quality standards for wastewater;
- a ministerial decree (1995) on septage.
The legislative and regulatory framework is poorly enforced and often does not meet the realities and requirements of IWRM. (Integrated Water Resources Management). However, the 1987 Water Code will be replaced by the new water management law, which will take into account the context of decentralization, deconcentration, IWRM and the strengthening of stakeholders' intervention capacities.

Past and present state of urban sanitation in Benin and government efforts to provide adequate sanitation
This paper presents the past and current state of urban sanitation in Benin and the government's efforts to achieve adequate sanitation.

Past and present state of urban sanitation in Benin
Benin's cities, like other cities in the subregion, have been and are being cleaned up. In fact, urban sanitation follows a diachronic analysis and varies according to the policies in place. To this end, Plate 1 shows the level of the Womey market in a depression that constitutes a natural receptacle for the neighborhood's rainwater.

Figure 1. Status of the sanitation of the Womey market in 2015
Shot: Liner Environnement, IVATIS, BETACI, SILICON SARL, June 2015

Figure 1 presents the level of sanitation of the Womey market in 2015. The Womey market is a real factor of social mobility and development of economic activities. This market is a real center of attraction for the inhabitants of the surrounding neighborhoods who, day and night, come to buy the products necessary for their food. Unfortunately, during the rainy season, due to flooding, this market is no longer accessible to the population. Thanks to the Government Action Program (PAG), the Womey market has been cleaned up. It has benefited from the PAURAD project. Plate 2 shows a frontview of the market.

Figure 2. Womey market cleaned up in 2021
Shot: Odoulami, November 2021

The photos in Figure 2 show a view of the front of the same Womey market. It can be seen that,

10 years later, this market has benefited from the Government Action Program (PAG) and is already proving its worth in terms of improving the living environment, combating climatic hazards and protecting the environment in the nine towns that have benefited from the project to develop and rehabilitate primary, secondary and tertiary roads (asphalting). The image above presents a diachronic analysis of the environment between yesterday and today. The image above presents a diachronic analysis of the environment between yesterday and today. The comparative analysis of the present image shows that efforts are being made to clean up the cities in the Republic of Benin. These efforts
find their rightful place in the various projects implemented by the government. Long before these projects, the living environment was unhealthy. Figure 3 presents a case in point.

Figure 3. Household waste in the city of Cotonou in 2017

The photos on Figure 3 show the state of street sanitation in the city of Cotonou in 2017. It appears that they were used as dumping grounds. Indeed, the edges of the streets and paved roads were used as garbage dumps. The living environment was unhealthy. In view of this situation, the government is carrying out several actions for an appropriate environment for its citizens.

GOVERNMENT EFFORTS IN THE FIELD OF URBAN SANITATION IN BENIN

Creation of the SGDS-GN

The Société de Gestion des Déchets et de la Salubrité Urbaine du Grand Nokoué (SGDS-GN SA) was created in November 2018 by the Beninese State, for the implementation of the Modernization Project for the Management of Solid Household Waste. This ambitious project, which is part of the operationalization of strategic axis 7 of Pillar 3 of the Government's Action Program, aims to sustainably resolve the problem of urban sanitation in order to improve public health conditions, the well-being of the population, and to reduce the harmful impact of the proliferation of waste on the environment.

Presentation of the SGDS-GN

The Government of Benin initiated the Solid Household Waste Management Modernization Project to address the problem of household solid waste management and sanitation in Grand Nokoué. The latter is reflected in

- A permanent increase in the amount of waste produced: more than 400,000 tons of waste to be collected and managed in a sustainable manner on a territory of approximately 1,200 km2, i.e. 10% of the national territory in 2019;
- A paved and asphalted road network of more than 500 km in the Greater Nokoué area that is being extended with more than 130 km of roads being paved. The cleanliness of this road network and the maintenance of rainwater drainage structures are imperative to preserve the quality of life of the populations and to reinforce the attractiveness of the Grand Nokoué territory. This project is one of the flagship projects of the Government Action Program (PAG 2016-2021) and is part of the operationalization of strategic axis 7 of Pillar 3 of the PAG. Through this project, the Government has decided to perpetuate the colossal investments underway since 2016 and those to come, to improve the living environment of the population and to strengthen the attractiveness of the territory. This project also aims to perpetuate the achievements of the Emergency Urban Environmental Management Project (PUGEMU) and to reduce the prevalence of diseases related to unhealthy living conditions. To operationalize this project, the Government created in November 2018 the Société de Gestion des Déchets de la Salubrité du Grand Nokoué (SGDS-GN). The waste management modernization project is part of an integral and inter-communal approach to sustainable improvement of public health. The option made by the Government in creating the SGDS-GN aims at making efficient the waste management and public health services rendered to the populations by optimizing the resources. The aim is to make the cities of Greater Nokoué clean and attractive in the long term by developing innovative waste management and sanitation solutions that have a small ecological footprint and create jobs. Figure 4 presents some of the government's efforts in the sanitation sub-sector.

Figure 4. Modern means of waste collection

The photos in Figure 4 and Plate 1 show the means of waste collection in the Grand Nokoué region of Benin. The Société de gestion des déchets et de la salubrité du Grand Nokoué (SGDS-GN) has just equipped 69 small and medium-sized enterprises (SMEs) operating in the waste sector with 550 tricycles to speed up collection work in the field.

Photo 1. Modern waste collection garbage cans

To modernize waste management, households in the Greater Nokoué area (Cotonou, Abomey-Calavi, Sèmè Kpodji, Ouidah, Porto-Novo) can now package their waste in garbage cans (EN 840 standards). The required garbage cans are two-wheeled garbage bins with a capacity of 120 liters (Plate 1).

Waste sorting and recovery units for Grand Nokoué

In Benin, the Société de gestion des déchets solides et de la salubrité du grand Nokoué (SGDS-GN) plans to equip about 20 collection points with units for sorting and recycling household waste. The first unit was recently inaugurated in the city of Porto-Novo.

The Société de gestion des déchets solides et de la salubrité du grand Nokoué (SGDS-GN) is innovating for the management of household waste in the Grand Nokoué area in Benin. The public service company plans to equip its collection points with units for the sorting and recovery ofrecyclable household waste. About 20 garbage dumps will be equipped out of the fifty or so points in the greater Nokoué area. "Our objective is to have 70 household waste collection points. The stored garbage is collected by 69 small and medium-sized enterprises (SMEs), then transported by garbage trucks out of the cities. The photos in Figure 5 show some of the cases.

Figure 5. Foun-Foun collection point in Porto-Novo (a) and Agori in Abomey-Calavi

The photos on Figure 5 show the sorting and recovery units for recyclable household waste that are in operation at the Foun-Foun collection point in Porto-Novo (the Beninese capital) and at Agori in Abomey-Calavi. The Porto-Novo plant alone produces 60,000 tons of waste per year, of which only 30% is sent to landfills. It has a storage facility for recovered materials. About 20 garbage dumps will be equipped out of the fifty or so points in the greater Nokoué area. "Our objective is to have 70 household waste collection points. The operation of free collection of waste in the communes of Grand Nokoué is led by the Company of management of waste and salubrity of Grand Nokoué (Sgds-GN). The photos on the board illustrate this operation.

Figure 6. Free waste collection in the communes of Cotonou and Abomey-Calavi

ADVANTAGES OF URBAN SANITATION IN THE REPUBLIC OF BENIN

Sanitation is essential to improve the health of populations
In developing countries, and particularly in urban areas, both megacities and their peripheries and in small towns, the lack of sanitation infrastructure at home and the inadequacy of wastewater treatment represent a huge threat to human health and the environment, especially for the poorest.

Conserving water resources and the living environment
On a global scale, 85% of anthropogenic pollution returns to the environment without being purified. However, the world population has multiplied by 7 over the last two centuries, and, in the last 55 years, the number of mega-cities with more than 10 million inhabitants has increased from 1 to 30, particularly in developing countries. In 2005, nearly 50% of the world's population was urban. This galloping urbanization exerts unprecedented pressures on aquatic and coastal environments that collect all the waste, while 50% of the world's population lives in coastal areas. Africa, which is expected to have 1.8 billion inhabitants in 2050, compared to 850 million today, treats only 2% of its urban, industrial and domestic pollution and is experiencing catastrophic deterioration of its aquatic and coastal resources.
In Benin, the population with access to improved sanitation facilities is 12.8% (DHS 2017-2018) and could reach 45% in 2021 and 75% in 2025. The country's ambition is to finish with air defecation by 2025 for a rate that was 42.5% (DHS 2017-2018). Indeed, at the national level, more than one household out of two (54%) does not use a toilet and still defecates in the open air (bush/fields): 77% in rural areas against 36% in urban areas. 7 out of 10 children have unhygienically disposed of feces;
- Only 13% of households use improved toilets (22% in urban areas versus 6% in rural areas). In more than half of the cases, there is no specific place for toilets and only 9% of households have toilets in the dwelling (16% in urban areas versus 3% in rural areas).
- In more than half of the cases (55%), the place used by households to wash their hands is mobile, and in only 18% of the cases does the place have soap.

It drives economic development and reduces the cost of public health spending
The costs of investing in and operating adequate sanitation systems are far less than the costs of not having sanitation. Sanitation-related illnesses are indeed a drag on economic growth. In Madagascar, it is estimated that lost work due to poor sanitation-related illnesses amounts to more than 5 million productive days per year, with a total annual value of lost production of just under 80 million Euros (representing more than 2% of the country's GNP). During the first twelve weeks of the cholera epidemic that hit Peru in 1991, the loss of revenue from tourism and agricultural exports was three times greater than the amount of investment in water and sanitation made by Peru in the 1980s ($1 billion).

Investing in sanitation reduces the cost of public health spending
At the global level, a WHO study states that health expenditures due to the four major waterborne

diseases are estimated at more than $7 billion per year, compared to the more than $11 billion per year theoretically needed to halve the number of people without access to safe water and adequate sanitation.3 More than 60 percent of the investment in sanitation would be paid for by lower public health costs.

It is also an unavoidable commercial argument in the current context of international competition and the health risks of Covid-19

It is the threat of international economic sanctions and its desire to increase free trade agreements with rich countries that has pushed Chile to invest in wastewater treatment: in 2005, more than 70% of the wastewater in the city of Santiago was treated, compared to nearly 3% in 2014.

Providing sanitation promotes schooling

In Orangi, Pakistan, the construction of latrines with two spaces, one for each gender, resulted in an 11% increase in girls' enrollment.

Sanitation facilities improve social welfare

The acquisition of an excreta disposal system can often ease neighborhood relations that are often degraded by the odor nuisance caused by those who do not have a disposal system.

Sanitation is also a question of human dignity

Open defecation and unhygienic practices are often considered dishonorable and degrading. Access to adequate sanitation allows people to regain their self-esteem and that of their neighbors. Among other things, women no longer have to hide to defecate and regain their right to privacy and physical safety.

CHALLENGES OF SANITATION IN BENIN

The place of sanitation in the development agenda in Benin is mixed and faces several challenges. Indeed, the institutional profile of the sub-sector needs to be raised based on feedback, sanitation needs to be brought out of its marginality and made a real "national cause" and the challenge of financing sanitation projects needs to be addressed. The mobilization of different parties with synergy actions between sectoral ministries at the state level, but also in close collaboration with local authorities, civil society organizations, technical and financial partners. To this end, all 77 communes in Benin must integrate sanitation into their communal planning, in particular through the Communal Development Plans, and mobilize both domestic and external financial resources to finance sanitation- related actions.

CONCLUSION

In view of the assets at its disposal, sanitation is a priority of any development policy. Benin has already embarked on this by initiating several projects relating to sanitation. The largest and major is the “Grand-Nokoué” project. A project whose results can already be observed in all the municipalities concerned. However, the authorities would take up a big challenge by extending this project to all the municipalities of the country. Also, the institutional framework deserved to be reviewed in order to facilitate the financing of projects relating to sanitation.

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THE EFFECTS OF WOODEN BUILDING MATERIALS ON THE INDOOR AIR QUALITY OF HOUSES

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Abstract: *Exposure to indoor chemical air pollutants has a great impact on our health because we spend most of our time inside buildings. Pollutant exposure levels inside buildings are likely due to pollutants from both indoor and outdoor sources. As a natural, biological material, wood emits various organic chemical substances, mostly volatile organic compounds (VOCs), very volatile organic compounds (VVOCs) and formaldehyde. When such emissions occur in indoor spaces, concentrations of these substances are higher than concentrations outdoors. Consequently, the level of emissions from building materials is of relevance in relation to their possible health effects. The current work shows the measurements of the indoor air concentration in a passive, low-energy, wooden, light frame house. Concentrations of volatile organic compounds (VOC) and formaldehyde were measured and compared and with the current international regulations of air pollutants. Six measurements were taken throughout one year. An active sampling device was used on the site. The results of the measurements showed the changing concentrations of air pollutants. Concentrations of 180 components were determined according to standards ISO 16000-6:2004. During the field measurements we detected the presence of formaldehyde (34µg/m3), BTX (35.51µg/m^3), and some materials in the terpene family, limonene (64.7µg/m^3), and alpha-pinene (297µg/m^3), in the indoor air. The concentration of the detected TVOC (Total Volatile OrganicCompounds) was 2150µg/m^3, which does not significantly differ from European average values. We determined the health risk of all measured substances according to the German standard using the Lowest Concentration of Interest (LCI) analysis. The conclusion of the present case study is that the total volatile organic compounds (TVOC) of the indoor air during the one-year measurements had been changed only slightly and they did not pose a health risk. The concentration of the TVOC was influenced by indoor temperature, indoor relative humidity and air exchange rate. Human activities and the furniture had the greatest impacts on the concentrations. The rate of the wooden clothing in each room had a great influence on the concentrations of alpha-pinene and 3-carene.*

Keywords: *IAQ; wooden building materials; VOCs*

INTRODUCTION

The global climate change and increasing energy requirements have led to the development of airtight, energy-saving buildings with very low air exchange rates. Because of the cheap mass-production the most common building materials are synthetic materials. The houses may become more and more comfortable and automatized, still the question arises: Do these technical improvements provide a healthy living-space for people? We spend 80-90% of our lives inside buildings [1]. Environmental health researchers have been investigating intensively the indoor air quality of newly built homes, existing homes and renovated homes [2] [3] [4]. The guidelines of WHO (World Health Organisation) categorize the harmful substances emitted by the sources [5]. In Germany the Committee for the Health Assessment of Building Materials (AgBB - Ausschuss zur gesundheitlichen Bewertung von Bauprodukten) first defined VOCs from the emission of building products in 2000. Now more than

180 different VOCs can be defined [6]. Because of the differences in factors such as climatic conditions, lifestyles, and construction habits the indoor environments can vary from region to region, and country to country.

However, despite this variation, many industrialized societies are facing a growing number of very similar indoor air quality problems. It is necessary to re-evaluate the way in which buildings are designed and constructed. By choosing the right building materials (low-emitting materials) andtechnologies (slow-tech, low-tech) can these adverse impacts on the indoor air quality be avoided. More in-situ measurements are needed, to get a wider view of the "health condition" of buildings and how they affect our health. People have the right to a healthy living environment. The Agenda 21 sais: "Support research and develop programmes for applying prevention and control methods to reducing indoor air pollution."[7].

There are some countries where the regulations of the indoor air quality define the building materials and the concentrations of air pollutants emitted from them. In the European Directive it is emphasized, that provisions should not only relate to building safety, "but also to health, durability, energy economy and other aspects important in the public interest" [8].

In Hungary there are no regulations regarding the maximal values of air pollutants emitted in the indoor air of residential buildings. There are regulated values for the working environment (MSZ 21461 1-2) [9].

Wood is one of the most environment-friendly raw materials. Wood cells contain high amount of carbon absorbed from the CO^2 component of the air. Wood as a raw material has a very low demandof energy during manufacturing compared to other materials such as metals or silicate based materials. [10]. Engineered wood products, such as oriented strand board (OSB) contain chemical materials in form of added adhesives or as surface treatment etc. These chemicals have significant emissions of volatile organic compounds (VOCs) that could pose a health risk especially in indoor spaces [11] [12].There are researches examining the beneficial effects of wood indoors [44] [45]. In a Norwegian studyresearchers made a comparison of wooden building materials and other synthetic building materials onthe basis of their ecological effect. The conclusion was that wood absorbs much less greenhouse gases and leaves much less waste behind. This conclusion stands only for natural wood, not for engineered wood products (e.g.: OSB) [13].

There are several studies about the emission of VOCs and formaldehyde from wood based composites, such as MDF, plywood, particleboards, etc [19-22]. Ze-Li showed in their study that the most emitted VOCs were terpenes, aldehydes, and aromatics. Pine wood plank had the highest VOCs(approximately 900 $\mu g/m^3$). Fresh particleboard showed the second highest value with 450 $\mu g/m^3$ [22].Manninena's study compared the emissions of VOCs from air-dried pine wood and heat-treated pine wood. Terpenes were clearly the main compound group in the air-dried wood samples, whereas aldehydes and carboxylic acids and their esters dominated in the heat-treated wood samples. The results suggest that if heat-treated wood is used indoors, emissions of monoterpenes are reduced compared to air-dried wood, but some irritating compounds might be released into indoor air. Significant chemical changes have occurred; volatile monoterpenes and other low molecular weight compounds have evaporated from the wood during the heat-treatment process when compared to air dried wood [23].

The emission of wood-based materials depends on the type of wood. Hard wood emits high concentrations of acetic acid and formic acid, while soft wood emits more terpenes (alpha-pinene, 3-carene, etc.) [24]. The age and the time of logging are another important influence factors. The reuse and recycling of waste wood is a growing field in many countries. The most critical point is still the presence of used adverse chemicals e.g. urea formaldehyde, phenol formaldehyde. To reduce the concentrations of these chemicals in engineered wood, there are studies made in the last fifteen years [25-28].

Song-Yung measured the emissions of particleboard from recycled wood-waste chips using polymeric 4,40-methylenediphenyl isocyanate (PMDI) and phenol-formaldehyde (PF) resins. The research showed that by increasing ratio of PMDI the concentration of emitted formaldehyde was lowering[25].

Sumin Kim used natural tannin as adhesive in wood-based flooring. They had to add PVAc to increase the bonding strength of tannin. The formaldehyde emission was lowered even by adding PVAc (Polyvinyl acetate), and more greatly reduced when UV curable urethane acrylate was coated [26]. The volcanic pozzoloan is another material added as scavenger to engineered wood, which reduced the emissions of formaldehyde [27].

In a newly-built wooden house the concentrations of the emitted air pollutants can be reduced with the "bake out" process. The inside temperature is raised to 32-40°C and kept it for a week. The extent of the reduction of air pollutants in the indoor air is about 60-90% [28].
Standardized emission testing using test-chambers are part of the national and international approval for construction materials, thus a lot of data exits for the emission from wood and wood-based composite boards. Weschler emphasises in his review, that still there are few studies analyzing the harmful substances in indoor air of existing houses [29].
The present study shows the measurements of the indoor air concentration in a passive, low-energy, wooden, light frame house. Concentrations of volatile organic compounds (VOC) and formaldehyde were measured and compared with the current Hungarian [9] and international regulations (WHO) of air pollutants [1]. We determined the health risk of all measured substances according to the German standard using the Lowest Concentration of Interest (LCI) analysis.

MATERIALS AND METHODS

The sampling was performed in a newly built, low-energy, frame-house [30]. The turnkey construction of the building was completed during summer. It has an area of 120m2, a ground floor and an attic room. Downstairs there are a hall, a living room + a kitchen, a room and a bathroom. From the living room there is a staircase leading up to the gallery, which opens into a room in the attic.
The structure of the building consists of wooden frames and wooden panels with Isocell insulation, which is rendered from the outside and covered with gypsum fibre panels inside (Table 1). The interior walls are covered with solid wood panels. The house is heated with circulating hot air combined with an airing system. The heat is derived from solar panels and stored in seasonal thermal storage system. In addition, the ground floor heating is supported by electric under-floor heating in winter.

Table 1. Outside wall layers (from outside to inside)

No.	Thickness		Description	Thermal conductivity W/mK
1	5	mm	Breathable render	0.6
2	60	mm	Fiber Insulation Panel THD NF 230	0.05
			KVH 60x160 mm spruce, truss frame	0.1
3	160	mm	with 160 mm ISOCELL in between	0.039
4	12	mm	MFP	0.13
			KVH 60x160 mm spruce, truss frame	0.1
5	160	mm	with 160 mm ISOCELL in between	0.039
6	15	mm	H15 gypsum fibre board	0.22
7	0.25	mm	ÖKO-NATUR vapour-stop paper	
8	30	mm	Planed and dried spruce, batten framework	-
9	05.dec	mm	impregnated plasterboard	0.24

Sampling was performed in the building and the samples were analysed by the laboratory of Wessling Hungary Ltd. An active sampling device was used on the site. During the sampling, in order to facilitate the accuracy of the laboratory tests the physical characteristics of indoor air had been set 24

hours before the sampling. Thus the sampling was performed in a stationary state. The air exchange rate was 2.51/h, which means that during the measurement the doors and windows were closed.
Two sampling tubes were connected to the active measuring device used in the sampling. The sampling tube was a 200 mg Tenax TA stainless steel tube, 90 mm long, for sampling the VOCs.
Suction duration: 60 min
Suction rate: 100 ml/min
Suctioned air volume: 6000 ml
Six measurements were taken throughout one year. The results of the measurements showed the changing concentrations of air pollutants. When we determined the VOC content of the samples taken from the indoor air we measured the concentrations of 180 components according to standards ISO 16000-6:2004 and ISO 16000-3:2001.

RESULTS AND DISCUSSION

In Table 2 we included the measured concentrations of those VOC components out of the 180 measurement results whose values were significantly greater than the detection limit and are present in each room. Presumably, these are the materials which determine the quality of indoor air in the building.

Table 2. Measured concentrations of VOCs above detection limit measured in all rooms

	1. Measurement	2. Measurement			3. Measurement			4. Measurement			5. Measurement			6. Measurement		
Time	december	january			february			march			june			july		
Temperature (C)	18	18			15			21			24			26		
Relative Humidity (%)	41	37			37			40			43			43		
Compound name	Indoor	1. Living room	2. Room	3. Attic	1. Living room	2. Room	3. Attic	1. Living room	2. Room	3.Attic	1. Living room	2. Room	3. Attic	1. Living room	2. Room	3.Attic
Formaldehid	34	11	4	10	130	10	23	32	21	49	41	35	51	32	24	40
Benzene	3,11	2,79	2	2,16	0,08	0,08	0,08	0,08	1,66	0,01	1,71	1,8	2,35	0,08	1,65	0,08
Toluene	11,6	4,92	4,78	5,09	5,16	4,74	6,13	4,97	6,85	19,7	34,4	37,1	38,4	4,86	3,36	6,21
Ethyl benzene	4,8	1,96	1,81	1,86	1,66	1,27	1,46	4,14	4,38	33	102	61,6	66,5	6,64	5,09	3,22
1,3-Xilol, 1,4-Xilol	20,8	8,59	7,57	8,23	6,72	5,36	5,31	11,6	12,5	104	76,8	90,5	96,8	7,09	5,14	4,19
Styrene	3,06	0,96	1,2	1,32	0,08	0,08	0,08	3,52	4,98	0,08	134	147	127	7,93	6,27	4,29
3-Carene	300	133	97,3	109	85,8	64,4	233	300	244	274	2120	468	1500	232	157	171
alpha-pinene	297	170	122	157	162	119	300	300	300	300	1130	1520	2710	284	211	217
beta-Pinene (b)	30	15,2	11,8	15,3	16,9	9,33	33,1	55,9	52,9	47,8	157	145	187	34,9	23,7	28,4
Naphtalene	0,08	0,08	0,08	0,08	0,08	0,08	0,08	1,13	1,06	1,81	0,08	1,15	1,04	0,08	0,08	0,08
Limonene	64,7	21	16,1	17,5	15,8	10,7	23	59,7	51,9	46,3	178	118	289	30,2	21,9	25,1
Hexanal	48,9	23,8	19	21,3	16,4	9,88	20,7	79	57,8	65,9	199	218	244	57,1	42	66,9
Benzaldehyde	7,27	0,01	3,87	0,01	3,37	1,67	5,35	9,87	10,4	16,8	39,6	39,8	51,8	11,7	10,1	9,18
Acetic acid	10,4	17,6	26,9	26,9	138	8,29	22,6	0,01	0,08	0,08	65,5	41,3	141	34,9	23,2	83,4

After the construction of the building was completed, the first measurement was taken before the heating was started. At this stage the inside doors had not been installed yet. The measurement was taken in the living room. Most of the measured values stayed well below 50 μg/m^3, except for the values of limonene (64.7 μg/m^3), hexanal (48.9 μg/m^3), alpha-pinene (297 μg/m^3) and 3-carene (300 μg/m3), which differ substantially from the other values.
After the first measurementt the air-heating was turned on, this might be the reason of the decreasing values. In the living room, there were human activities just before the 3. measurement, which may have caused the increased concentrations despite of the drop in temperature. Before the 4^{th} measurement the floor-heating was turned on, the indoor temperature lifted to 21°C. This must have caused the increased concentrations. This assumption of ours seems to be confirmed by study ofYoung [32].
During June, the indoor temperature was raised above 24°C which indicated the significant change in the concentrations. In this period were the rooms furnished, which could have affected the increasing values as well. Probably the frequent natural ventilation indicated the lowering of high VOCs concentrations. By summing the measured concentrations of VOCs, we get the total VOC values (TVOC). The TVOC value of the first measurements was 2150 μg/m^3, the last was 1190 μg/m^3. The maximum value (9480 μg/m^3) was measured at sampling 5. The graph (Fig.1**)** clearly shows that

TVOC concentrations were influenced by indoor temperature, indoor relative humidity, and air exchange rate. Human activities and the furniture had the greatest impacts on the concentrations (Figure.1).

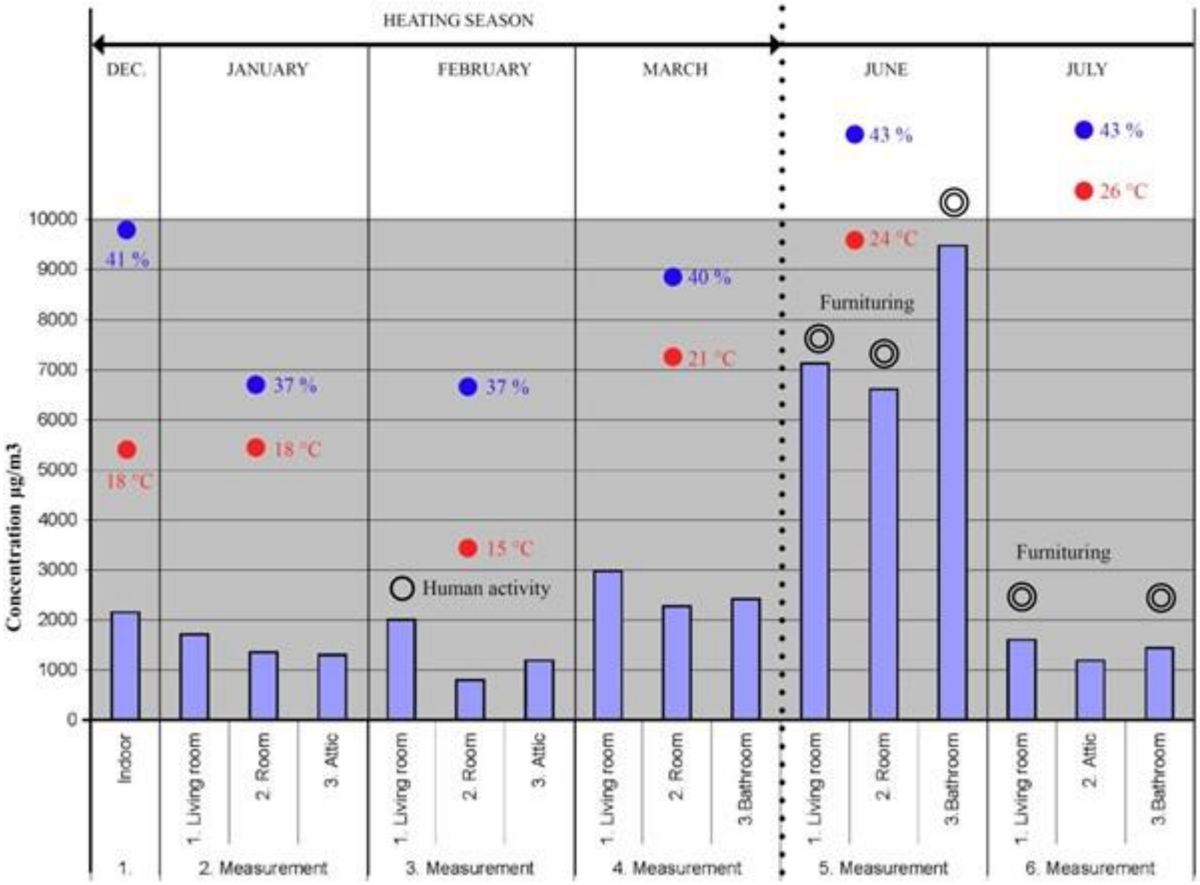

Figure 1. TVOC values of the measurements
The red dots show the indoor temperature, the blue dots show the indoor relative humidity, the circle shows human activity and the double circles show additional furniture

Some of the measured maximal concentrations were compared with the current Hungarian and international regulations (WHO) of air pollutants (Table 3)

Table 3. Comparison of the measured maximal values with the current Hungarian and international regulations (WHO) of air

Measurements (µg/m3)	1.	2.	3.	4.	5.	6.	Hungarian Regulations (MSZ) (µg/m3)	WHO (µg/m^3)
Benzene	3,11	2,79	0	1,66	2,35	1,65	3000	0,17 - 17
Toluene	11,6	5,09	6,13	19,07	38,4	4,86	190000	26
Styrene	3,06	1,32	0	4,98	147	7,93	50000	26
Formaldehyde	34	11	130	49	51	40	600	100
Naphtalene	0	0	0	1,81	1,15	0	5000	10

The maximum concentration of benzene was 3.11 µg/m^3, in the other measurements this value was decreased. The maximum value was not deviant from the values of the current Hungarian and

international regulations of air pollutants. The WHO did not recommend any safe level for benzene, it determines only the concentrations of airborne benzene associated with an excess lifetime risk of 1/10 000, 1/100 000 and 1/1000 000 are 17, 1.7 and 0.17 µg/m3.
The concentration of toluene was between 5.09 – 38.4 µg/m3. The increase was affected probably by indoor temperature, indoor relative humidity, human activity and the presence of furniture in the room. The highest concentration (38,4 µg/m3) exceeded the maximal value given by WHO (26 µg/m3). From the measured concentrations of styrene, it can be stated that the difference was significant only in the 5th measurement. The drastic increase is not related to the change in indoor air temperature and relative humidity (since these parameters also changed between measurements 3 and 4), but to the furnishing of the rooms. The concentration of formaldehyde with the value of 130 µg/m3 did overpass the values of the current international regulations by the WHO (100 µg/m3) during the third measurement, but it was just temporary. The main sources were the wooden materials cut into pieces in the living room. By the following measurements the concentration of formaldehyde was slightly increased because of the rise of the indoor temperature. The rate of the wooden clothing in each room presumably had an influence on the concentrations of alpha-pinene and 3-carene. Alpha-pinene and 3-carene are two natural substances that are not considered toxic. Their source is dried wood from which they are emitted in demonstrably high concentrations. Also, in soft trees (e.g. spruce), the concentration of natural evaporation of alpha-pinene and 3-caren is also observed to be high, which also depends on the age of the tree and the time of felling [46]. Based on these, it can be concludedthat there is a correlation between the proportion of spruce wood coverings in the rooms and the concentration of materials. Table 4 shows the wood cladding ratio of each room.

Table 4. The load of wooden building materials in the rooms

Ratio of wood in the rooms (%)	
Room	28
Living room	51
Bath	70
Attic	100

Figure (2) shows the influence of indoor temperature, indoor relative humidity, and the presence of furniture in the rooms on the concentrations of alpha-pinene and 3-carene.

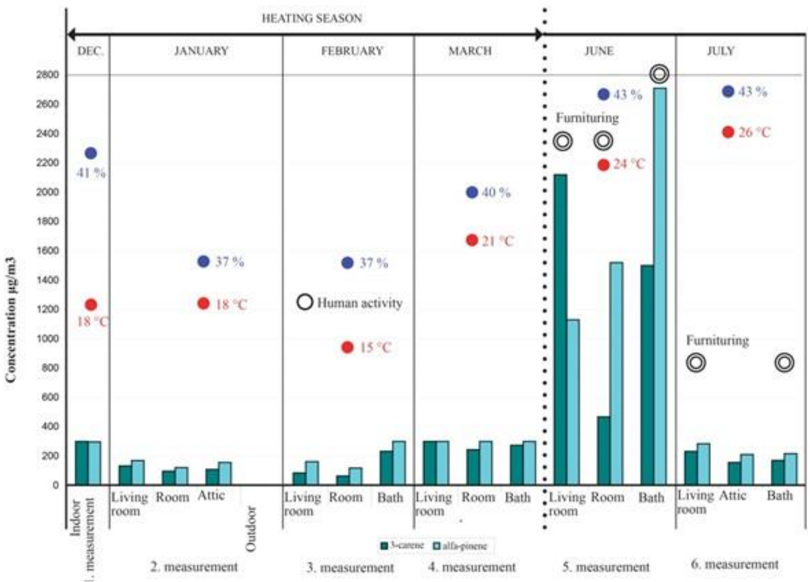

Figure 2. 3-carene and alpha-pinene values of the measurements. The red dots show the indoor temperatures, the blue dots show the indoor relative humidity, the circle shows human activity and the double circles show additional furniture.

Finally, we determined the health risk of all measured substances according to the German standard using the Lowest Concentration of Interest (LCI) analysis. German law stipulates that VOC emissions from building materials must be reduced in the long term so that they do not endanger the health of those in the building.
The working group of the German Building Materials Health Assessment Committee (Ausschuss zur gesundheitlichen Bewertung von Bauprodukten - AgBB) has established a list of VOC substances that determine indoor air quality and has also set a concentration limit for VOC substances that affect air quality[6]. The degree of health risk is expressed as a ratio, the value of the measured concentration divided by the limit value according to AgBB. If this ratio is less than one, the test substance does not pose a health risk. If the ratio is greater than one, the value of the health risk posed by the substance is proportional to the value of the ratio (AgBB, 2012).
We performed this test on all measurement results. The LCI table of the measurements contains the VOC substances we measured, their list number (CAS), the given LCI limit of the concentration, the measured concentration and their quotient. Table 5 contains the LCI values for those substances which measured values were the highest. We found that the quotient of the most component (measured value/LCI value) is not greater than 1, so they do not pose a health risk.
The quotient of 3-carene, alpha-pinene (measured value/LCI value) was greater than 1 in only the 5th measurement, so they represent a health risk in this measurement. However, as these high values were significantly reduced at the next measurement, it can be concluded that they do not pose a health risk in the long run.

Table 5. The LCI table of the measurements

Name of component	CAS	LCI [μg/m^3]	Measured highest concentration [μg/m3]	Measured highest concentration / LCI
Benzene (VOC)	71-43-2	5	3,11	0,62
Toluene (VOC) 1	108-88-3	1900	38,40	0,02
Etilbenzene	100-41-4	4400	66,50	0,02
1.3-Xylene and 1.4-Xylene (VOC) 1	106-42-3; 108-38-3	2200	96,80	0,04
Styrene	100-42-5	860	147,00	0,17
3-Carene	498-15-7	1500	2120,00	1,41
alpha-pinene	80-56-8	1500	2710,00	1,81
beta-Pinene (b)	127-91-3	1500	187,00	0,12
Naphtalene	91-20-3	10	1,15	0,12
Limonene	5898-27-5	1500	289,00	0,19
Hexanal	66-25-1	890	244,00	0,27
Benzaldehyde	100-52-7	90	51,8	0,58
Acetic acid	64-19-7	500	141,00	0,28

CONCLUSIONS AND RECOMMENDATIONS

The conclusion is that the wooden materials applied in the house are low-emitting materials and do not pose a health risk for people. The observations showed that the main influencing factors of indoor air quality were the changes in indoor temperature, relative humidity, air exchange rate, and human activities. This conclusion is correlating with other case studies [39-43]. The measurements of indoor air quality are providing the designers and the building occupants with essential information about the state of the building and the health impacts. They can be used in many type of the architectural procedures, e.g. in building diagnostics for renovations, in measuring the health impacts of a newly built house, and in finding the main sources of adverse chemicals of buildings with "sick building syndrome". For a detailed analysis of other building materials a further research work is needed.

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REJUVENATION OF SOIL ORGANIC CARBON THROUGH SOIL AMENDMENTS: A NOVEL APPROACH TO MANAGING HEAVY METALS IN SOIL AND PLANTS

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Abstract: *Soil organic carbon (SOC) imparts better soil structural stability which in turn enhances the soil physical environment. Further, SOC plays a key role in maintaining soil health especially soils under stress. With aim of improving soil resilience under heavy metal stress, this study was formulated to find out the effect of soil amendments on rejuvenating soil organic carbon content under heavy metal stress. The field experiment was conducted in a farmer's field near SIPCOT industrial area, Cuddalore District, Tamil Nadu, India during June - September 2017. A randomized block design with seven amendments [Farmyard manure (FYM), Press mud (PM), Ethylene diamine tetraacetic acid (EDTA), Lime, Gypsum, Potassium humate (PH), Natural Zeolite (NZ)] and control were replicated thrice for assessing the effects on SOC enrichment in soil and its interventions with heavy metals in soil and plant using sunflower as a test crop. The outcome of the STUDY confirmed that the application of FYM and PM distinctively enriched the soil organic carbon (0.65 and 0.57 g kg^{-1}, respectively) content than the other amendments used from the initial SOC status (0.41 g kg^{-1}). Consequently, the organic amendments halt the heavy metals (lead and cadmium) progress in the soil thus bioavailability is reduced. In contrast, among inorganic amendments application of EDTA induces the mobility of heavy metals in soil (52.3 - 65.7 % over control) so increased the bioavailability and resulting in more uptake by sunflower plants.*

Keywords: *EDTA, FYM, Heavy metals mobility, Soil organic carbon, Sunflower*

INTRODUCTION

Heavy metals are importunate, non-biodegradable, and toxic when their accumulation is above the permissible limit in soil. Contamination of soils with toxic heavy metals has become one of the major causes of concern for living things. The existence is mainly anthropogenic sources from different industries and agricultural practices [1]. At present, inputs of heavy metals from anthropogenic sources exceed natural inputs due to amplified urbanization and industrialization. Industrial wastes deposition, industries, production sites from crowded cities, and other domestic wastes are among the major sources of heavy metals to get accumulated in more soils [2]. The bioavailability of heavymetals depends on certain physicochemical of properties soil like pH, EC, CEC, organic matter, soil texture, etc. Soil amendments play a key role in managing heavy metals. Organic amendments stabilize the heavy metals and reduce the bioavailability whereas inorganic amendments destabilize the same and increase its bioavailability [3].

Organic amendments like farmyard manure (FYM), press mud, poultry manure, and other compost helps not only improve soil properties and fertility but also involve altering the heavy metal availability in soil. On the other side inorganic amendments like ethylene diamine tetraacetic acid (EDTA), lime, gypsum, Zeolite, etc, are employed certain role in the mobility of heavy metals in soil. Metals like lead (Pb), and cadmium (Cd) reacted with soil organic matter by various mechanisms such as ion exchange, complexation, and precipitation reactions [4, 5]. The availability of heavy metals decreases with increasing retention of heavy metals either by silicate clays, calcite, and/or soil organic matter. Such retention of heavy metals is ascribed to reactions between metal ions and soils like adsorption, precipitation, and/or complexation. Further, the retention of metals (Pb & Cd) was greater with organic amendments than with inorganic. Stabilization or Immobilization of metals by interactionwith humic substances can trigger the formation of insoluble complexes or solid-phase complexationto humates present as coatings on soil solid surfaces [6]. To understand the effect of soil amendments for rejuvenating the soil organic carbon and other soil properties to manage the progress of heavy metals in soils and plants, detailed information is needed to halt the lethal effects of heavy metals in soils and make the contaminated soil productive. There are many studies are available in different aspects of managing heavy metals in a controlled soil environment but very few field studies are available in polluted sandy loam textured urban coastal soils. Therefore, the present field experiment was carried out to find out suitable soil amendments for rejuvenating soil organic carbon and its effect on the availability of certain heavy metals (Pb & Cd) in soil and plants using sunflower as a test cropin an industrially polluted coastal sandy loam soil.

MATERIALS AND METHODS

The experimental site, soil & design:

The field experiment was conducted in a farmer's field in sub-urban. Cuddalore; SIPCOT industrial estate area, it is geographically located at $11^{0}39'$ N latitude and $79^{0}45'$ E longitude with an altitude of 16.54 ft, to find out suitable soil amendments for rejuvenating soil organic carbon and its effect on the availability of certain heavy metals (Pb & Cd) in soil and plants using sunflower (*Helianthus annuus* L.) as a test crop during June – September,2017. Contaminated soil containing 69.1 mg kg^{-1} and 9.12 mg kg^{-1} of total lead and cadmium concentration and DTPA extractable concentration of Pb and Cd were 13.1 mg kg^{-1} and 0.82 mg kg^{-1}, respectively. The experimental soil was sandy loam in naturewith the pH, EC, CEC, and organic carbon status of 7.8, 0.73 d Sm^{-1}, 13.2 C mol (P+) kg $^{-1}$, and 0.41g kg^{-1}, respectively. The experiment was laid out in randomized block design (RBD), with seven soil amendments and one control as treatments and replicated thrice.

Crop management & amendments application:

Experimental plots were prepared with the dimension of 5 m × 4 m and soil was treated with different amendments [T_1 - Control),T_2 - Farmyard manure @ 12.5 t ha^{-1}, T_3 – Press mud @ 5 t ha^{-1}, T_4 – EDTA @ 1000 kg ha^{-1}, T_5 - Lime @ 2.5 t ha^{-1}, T_6 - Gypsum @ 2.5 t ha^{-1}, T_7 - Potassium Humate @ 100 kg ha^{-1}, T_8 - Zeolite @ 20 t ha^{-1}] selected for the study were applied as per the treatment schedule and seeds of sunflower variety KBSH1 were sown with a spacing of 60 × 30 cm and plants were thinned toa proper density at 4 - 5 leaf stage. Scheduled irrigation was given uniformly and regularly. The root and shoot weight were recorded at harvest.

***Soil analysis*:**

Surface soil samples (15 cm depth) were collected (initial & post-harvest) and used for analyzing soil pH (1:2.5 soil: water using a glass electrode standardized with pH 4, 7, and 9.2 buffer tablets attached to an Ion analyzer), conductivity (conductivity meter), and cation exchange capacity was determined by neutral normal ammonium acetate method [6]. Organic carbon content was determined by the modified Chromic acid wet digestion titration method [7]

Analysis of heavy metals in soil and plant:
Soil and plant samples (1g) were digested after adding a tri-acid mixture (HNO_3, H_2SO_4, and $HClO_4$ in 5:1:1 ratio) at 80˚C until a transparent solution was obtained [8]. The digested sample was filtered using Whatman no. 42 filter paper and the filtrate was finally made up to to 50 ml with distilled water. Concentrations of heavy metals in the filtrate of digested soil and plant samples were estimated by using an Inductively Coupled Plasma Optical Emission Spectrometer (Model-ICP-OES-5110, Agilent).

Statistical analysis:
The experiment was arranged in a Randomized Blocks Design (RBD) with three replicates. The data on soil properties and heavy metal contents in soil and plants were subjected to a one-way analysis of variance (ANOVA). Statistical tests were performed using SPSS software and the significant differences between the means were tested against the critical difference at a 5% probability level.

RESULTS AND DISCUSSION

Effect of soil amendments on the characteristics of polluted soil and availability of heavy metals

Soil amendments were added to the industrially polluted soil to investigate their effects on the soil properties and the availability of Pb and Cd. The results for the studied characteristics of sunflower-grown soil are depicted in Table 1. The soil pH was affected significantly ($p < 0.05$) by the different amendments. The pH and EC values ranged between 7.2 and 8.3; 0.34 and 0.87; the lowest significant value was found for EDTA, while the highest one was found for lime, respectively. The highest values of cation exchange capacity (CEC) and soil organic carbon (SOC) were found for the soil amended by FYM and it was on par with press mud. Soil amendments significantly ($p < 0.05$) affected the soil properties which in turn affected the bioavailability of Pb and Cd. Organic amendments decreased the availability of Pb and Cd by 42-50 %, and 28 - 37 % compared to the control, respectively. While inorganic amendments increased these values by 1.7 to 3 times compared to control treatment. FYM and press mud addition caused a decrease in the bioavailability of Pb and Cd approximately by 6 and 2.3 times compared to EDTA amended plots, respectively. The decrease in soil pH and EC with EDTA application was due to its nature and characteristics i.e. as a polyaminocarboxylic acid its ability of hydrogen bond donor count(2) and hydrogen bond acceptor count of (10) perpetuate the reduction in soil pH and EC by chelating the salty ions. As soil pH decreases, metals like Pb and Cd might have to compete with the extra positive charged ions for positions on the exchange sites and increase the solubility of these metals and a greater proportion was present as highly available free metal ions in the soil solution. Besides, Pb and Cd are, respectively, considered highly mobile and relatively mobile due to their small hydrated radius and large mass and therefore more absorption by EDTA [9]. Concerning soil organic carbon and its complexation mechanism had an immobilization effect on Pb and Cd in soil. The DTPA extractable Pb and Cd decreased significantly in FYM andpress mud applied plots Table 1. This might be attributed to the products such as humic and fulvic acids resulting from the decomposition of FYM and press mud with increased SOC compared to other amendments. Increased SOC formed stable organo-metallic complexes with Pb and Cd alone and in association with soil solids thus reducing the DTPA extractable Pb and Cd in soil solution. As fulvic and humic acids forms soluble as well as insoluble complexes depending upon the degree of saturationthus metal availability [10]. The importance of the organic matter in limiting Pb and Cd availabilityhas also been reported by [11, 12, 13]. Further, increased SOC content enhanced the CEC of soil in FYM and press mud amended plots which might have strengthened the organo-metal complex (O-M- C) formed with SOC and still reduced the DTPA extractable Pb and Cd.

Effect of soil amendments on the uptake of heavy metals (Pb &Cd) by sunflower

The addition of organic amendments decreased the bioavailability of Pb and Cd; on the other hand, inorganic amendments increased their availability in soil Fig 1 and 2. Soil application of inorganic amendments increased the bioavailability of Pb and Cd by 52.3 and 65.7 % compared to control, respectively. The availability of Pb and Cd in the FYM and press mud amended plots was decreased the plant uptake by 10-12 and 2 -3 times of Pb and Cd, respectively compared to control. Whereas, the availability of these two metals in the EDTA amended plots were increased by three times over control. Organic amendments (FYM and press mud) were more effective than inorganic amendments in enhancing the immobilization of Pb and Cd in reducing metal bioavailability in soil. In contrast, inorganic amendments increase the bioavailability of Pb and Cd in the following order EDTA > K-humate > Zeolite >Lime >Gypsum to sunflower plants.

Table 1. Initial and post-harvest soil properties of the experimental site (Representative samples)

Soil samples	pH	EC (dSm^{-1})	CEC ($c\,mol(P^{+})kg^{-1}$)	SOC ($g\,kg^{-1}$)	DTPA Pb ($mg\,kg^{-1}$)	DTPA Cd ($mg\,kg^{-1}$)
Initial Soil →	7.8	0.73	13.2	0.41	1.31	0.82
T_1 - Control	7.7^{c}	0.71^{b}	12.8c	0.51^{c}	1.42^{f}	0.79^{f}
T_2 - FYM	7.4^{e}	0.52^{d}	14.7a	0.65^{a}	0.71^{g}	0.52^{h}
T_3 - Press mud	7.6^{d}	0.63^{c}	14.3a	0.57^{b}	0.82^{g}	0.61^{g}
T_4 - EDTA	7.2^{f}	0.34^{f}	13.4b	0.43^{d}	4.21^{a}	1.23^{a}
T_5 - Lime	8.3^{a}	0.87^{a}	9.40f	0.17^{f}	2.94^{d}	1.14^{b}
T_6 - Gypsum	7.4^{e}	0.41^{e}	11.7d	0.24^{e}	2.51^{e}	0.93^{d}
T_7 - K - Humate	7.7^{c}	0.62^{c}	11.3d	0.28^{e}	3.96^{b}	1.04^{c}
T_8 - Zeolite	8.2^{b}	0.65^{c}	10.2e	0.19^{f}	3.13^{c}	0.98^{cd}
SEm±	0.03	0.02	0.37	0.02	0.08	0.03
(p=0.05)	0.05	0.06	0.82	0.05	0.17	0.07

pH-soil reaction, EC-electrical conductivity, CEC = cation exchange capacity, SOC = soil organic carbon. The available form of heavy metals was extracted by 0.005 M DTPA (diethylene triamine penta acetic acid). Mean (±standard deviation, n =3) with the same letters are not significantly different at $p < 0.05$; p values were determined by ANOVA.

Obviously, higher SOC content was recorded in the FYM and pres mud applied plots thus stabilized or immobilized the Pb and Cd in soil by forming O-M-C thus reduced uptake have realized by sunflower plants. Similar reports opined that organic amendments like composts, biochar have significantly reduced the availability of the metals compared to inorganic amendments [14, 15]. In contrast to that, inorganic amendments especially EDTA, destabilized or mobilized the Pb and Cd in soil solution by chelation effectively thus more availability of Pb and Cd. Consequently, the sunflower plants in contact with more metal cations of Pb and Cd and along with nutrients were well conducted and increased the uptake of said metals significantly (Figures 1 & 2). On the extraction capacity, EDTA depends on soil pH, EDTA concentration, major cationic content all coherently decides the metal mobility in soil and possible to increase the extraction efficiency of more than 60 % of total content [16].

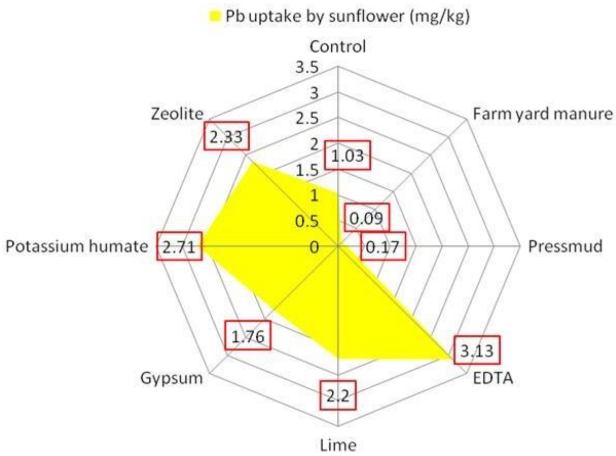

Figure 1. Effect of various soil amendments on lead (Pb) uptake by sunflower

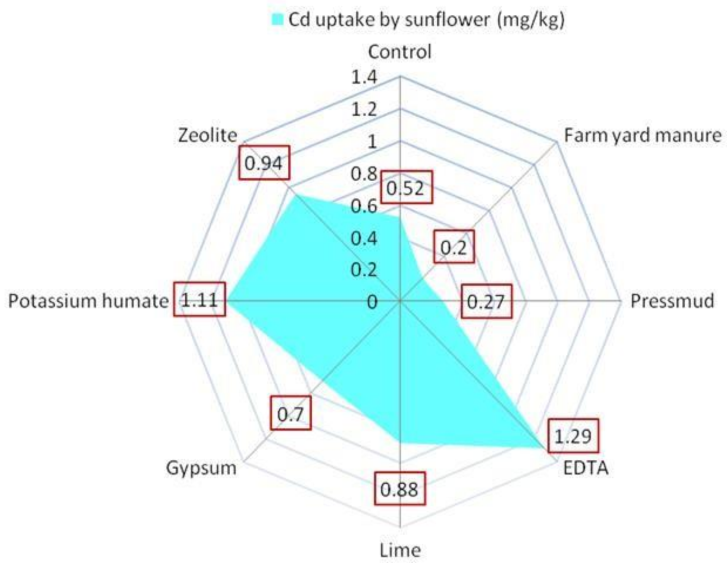

Figure 2. Effect of various soil amendments on cadmium (Cd) uptake by sunflower

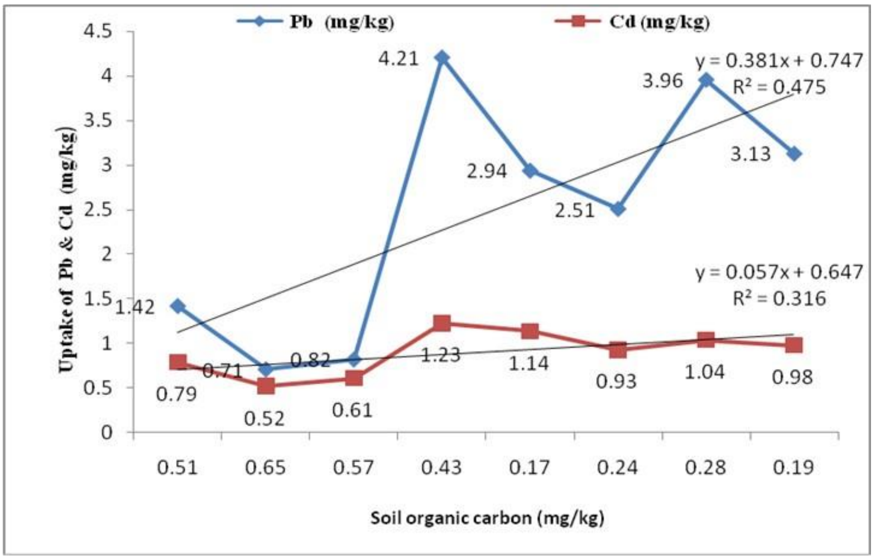

Figure 3. The Linear relationship between soil organic carbon and heavy metals uptake by sunflower

In addition, the above discussion was well supported by linear relationship between the SOC and heavy metals (Pb & Cd) uptake (Y= 0.381+ 0.747, R^2=0.475*; Y=0.057+0.647, R^2= 0.316*) respectively (Figure 3).

Such positive correlation of SOC plays a determining role in immobilizing heavy metals in soil organic matter complexes in sandy loam soils proved in this study i.e. increasing organic carbon content reduces the bioavailability of Pb and Cd in soil by FYM (T_2) and press mud (T_3).

It was the just opposite in the case of inorganic amendments that showed bioavailability of Pb and Cd in the diffused order due to their nature and characteristics which altered other soil properties especially pH.

Thus, uptake of these two metals majorly relied on SOC content and the nature of amendments too. Amongst the inorganic amendments EDTA registered higher uptake of Pb and Cd. This might be attributed due to its pH-dependent high cheating capacity with cations of equimolar concentration.

CONCLUSIONS AND RECOMMENDATIONS

From the outcome of the results, it can be concluded that the application of FYM or press mud to the industrially polluted soil could be a viable option for enriching the soil organic carbon content which in turn can halt the progress of Pb and Cd and improve the soil productivity. Whereas the application of EDTA significantly enhanced the Pb and Cd mobility in soil and improved their uptake bysunflower plants. Finally, we recommend that FYM / press mud can be applied to low-level contaminated soils as an in-situ immobilization to cut the mobility of Pb and Cd to plant nutrient cycle and thus food web. Whereas, EDTA can be recommended to highly polluted soils to effectively remove these metals from the soil through phytoextraction using hyper-accumulator plants like sunflower, and selection of the candidate for phytoextraction depends on the pedo-edapho- meteorological status of the regions.

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NEW TRENDS AND UTILISATION OF MATERIALS IN PROTECTION AGAINST FLOOD

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Abstract: *The* climate *change is causing changes in the environment. Drought periods are beginning to alternate with the period of major floods in recent times. The paper deals with principles of active flood control protection. Authors tried to give an information about new trends in flood protection by showing on new methods and new possibilities against flood and damage of men properties. The growing production andutilization of various materials, mainly plastics are enormous in the last period. Plastics have excellent mechanical properties, are light and in many cases replace metals. The volume of plastic waste is growing up, therefore it is necessary to determine how to solve the processing of plastic waste. In early studies were noted the methods of plastics recycling, whereas, the problem of utilisation of these plastics is much more complicated.From the plastic waste as the semi-products can be prepared the plastic plates, boards, foils. The contribution also deals with the testing of materials properties of recycled plastics produced by extruding and it shows the utilisation of produced plastics plates in engineering practice and environment. River floods are the most common natural disaster in Europe and world, too, and flood damage is expected to increase in the next decades. The purpose of current work was an experimental study of utilisation of plastic recycled materials, testing of their mechanical properties and their utilisation in specific conditions as flood barriers. The methodsof experimental investigation and data processing have developed on a practical basis.*

Keywords: *Flood, protection, methods, materials, plastics*

INTRODUCTION

Materials, however, with increased production bring also no small ecological problems. Plastic is one of the most adapted and water proof material. Higher plastic waste recycling rates, increased volumes and improved quality of re-granulates will boost the demand for secondary raw materials. In the context with this problem, there is a question of secondary use - recycling of waste material also in theflood protection area. Production, consumption and subsequent disposal of the waste are natural parts of the "life cycle" of all things. A circular plastics value chain is explained in the Figure 1.

POSSIBILITIES OF PLASTICS WASTE IN FLOOD AS BARRIERS PROTECTION

The environmental questions, change of world climate, elevation of water surface forces the people to think about protection against water in the form as bags, flood barriers, gates and other accessories. The main goal of flood barriers is to accumulate water in high water levels outside inhabited areas (e.g. in water reservoirs, ditches or undeveloped areas, etc.) and to drain water from the area as quickly as possible in built-up areas. The construction of mobile flood barriers is an effective and at the same time very aesthetic protection against floods.

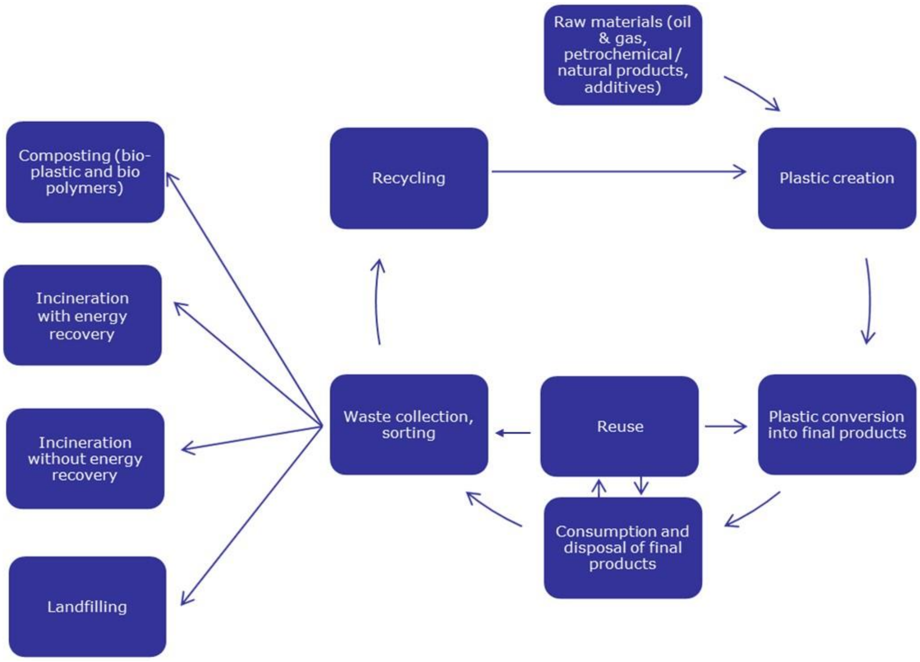


Figure 1. Circular plastics value chain [2]

The system of mobile flood barriers most often consists metals as of aluminium palisades, which are stacked on top of each other. The testing and utilisation of plastics as flood barriers are also famous and useful. Flood barriers can be assessed from various perspectives:

- according to material composition, e.g. metallic and non-metallic ones,
- according to construction, movable and firmly anchored, with structure embedded in the ground,
- according to shape, thickness and hardness of the material, e.g. foils or plates,
- according to suitability of use,
- according to methods of fastening and handling.
- according to magnitude of the system.

The height of the barriers usually ranges from 20 cm to 1.8 m. In practice, it is possible up to a height of 3 - 4 m, or even in atypical dimensions. Main advantages of the flood mobile system are:

1. high stability,
2. water resistance
3. low weight of individual parts,
4. simple and fast assembly – disassembly,
5. affordability.

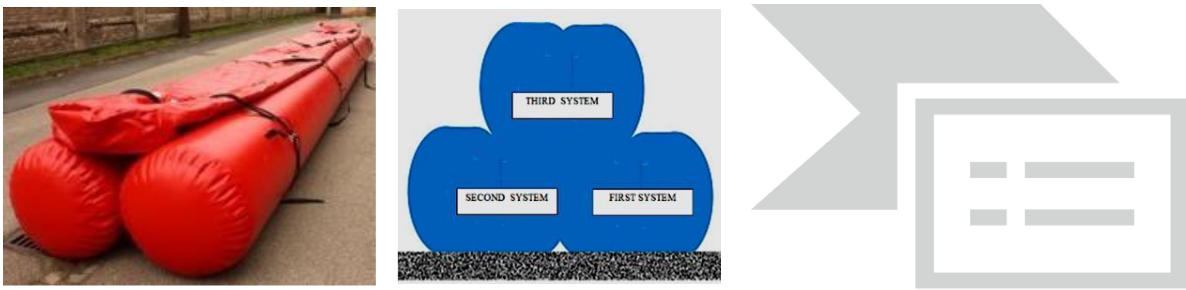
The great advantages have mobile flood barriers, which can be placed as:

- directly into the desired hole,
- for retaining wall / fence wall,
- between the walls,
- on the steel structure of the entrance gate,
- anchor the brackets to the wall,
- on support columns with support,
- for foundation steel piles / earth bolts, and others.

The principles and examples of plastics flood foil are shown in the Figure 2, Figure 3 and Figure4, where the plastics cylinder foils can be put in various systems. [4 - 8] The structure of the development anti-flood barriers from recycled plastics is composed from metal and plastic sources.

Figure 2. Quick dam water curb Realitycheckextreme.com [7, 8]

Figure 3. system with one or two cylinder plastic foils barriers [4, 6]



Figures 4. System with three-cylinder plastic foils barriers [5, 6]

Some plastic flood barriers are made by plastic mould injection technology. The examples are shown in the Figure 5 and Figure 6.

Figure 5. Flood fighting system from NOAQ [10]

Figure 6. Example of plastic concave flood barriers [9]

Examples of systems with water flood metal barriers, mainly from aluminium or steels and theirdetails are shown in the Figure, 7, Figure 8 and Figure 9. Their depths are based on bedrock and subsequent expected height of the barrier. They can be designed as a small ones for protection of doorsor have a large construction for protection of houses, streets or gardens.

Figure 7. Examples of large metal systems of flood barriers

Figure 8. Examples of small metal systems of flood barriers – door protection [11]

Figure 9. Examples of medium metal systems of flood barriers – garage or terrace [11]

The new possibility is to combine and design of anti-flood barriers from recycled plastics and from metal and other plastic sources. When designing the geometry and constructing the barrier, the first stage is to design a structure based on the shape of unified blocks made from PP and PE. [7, 8, 9]. The newest generation of the flood barriers system, from tested materials, was subject to burdening tests on the TOP 2016 conference ("Engineering for Environment Protection – TOP") where was used with basin with dimensions 5x10m and demonstration wall,12 m. In the Figure 10 and Figure 11 are shown the tested model of basin and the construction detail of demonstration wall [7, 8].

Figure 10. Modular flood barrier structure – test basin at TOP 2016 [7]

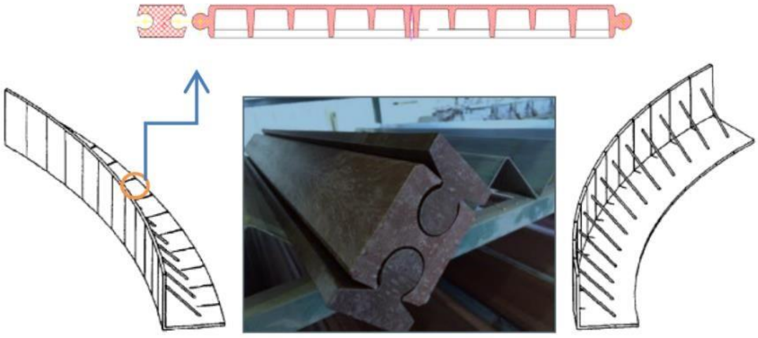


Figure 11. Convex and concave engineering solution of barrier joining [8]

EXPERIMENTAL VERIFICATION OF TESTED MATERIALS

The experiments were made in the Department of Engineering of Environment, Faculty of Mechanical Engineering, TU in Kosice. By mutual agreement and the requirements of TOPlast, Inc. Kosice, who is plastics recycled plates producer, was tested chosen types materials: the shape of the test specimens: rectangular prism, dimensions of test specimen: length l = 80 mm, width b = 35 mm, thickness h = 15 mm. The tested material was made from separated, shredded, mixed and coloured recycled plastics from polypropylene, polyethylene and additives, under material name as TOeco, produced by extruding [8] and were supplied as a boards, Figure 12. After conditioning of the test specimens, there were performed the bending tests according to Standard EN ISO 178.

Figure 12. Supplied plastic sorted semi- product and final plastics boards from recycled material

Bending tests, according to Standard ISO 178, were made on the testing machine TIRA Test 2300**,** the bending machine recommended parameters were:

1. the roller was fitted on the load tip with a radius of 5 mm,
2. 2 rollers were put on supports with a radius 5 mm,
3. setting longitude of support, L = 64 mm according to Standard EN ISO 178,
4. tested speed was set on 50 mm / min by using of program.

The testing samples were prepared and chosen from direction plastic material is shown in the Figure 13.

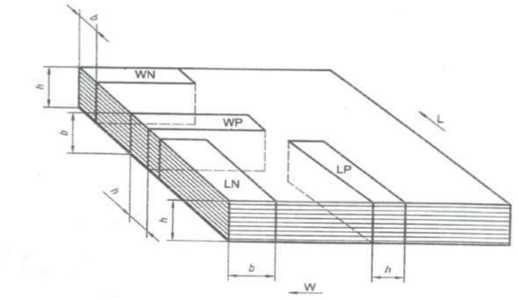


Figure 13. Position of test piece in relation to the direction of orientation of product

After loading of the test sample by a force, in most cases there were no ruptures in all the cross- section, but only on the outside of the bend specimens, while in the resulting crack of materials were visible fibres (Figure 14). The inner sides of the bend test specimen remained intact.

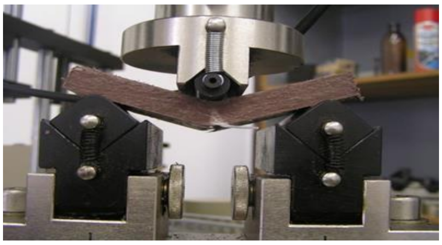


Figure 14. The detail of the bending test

The course of tensile test of recycled plastics board and its mechanical properties is shown in Figure 15.

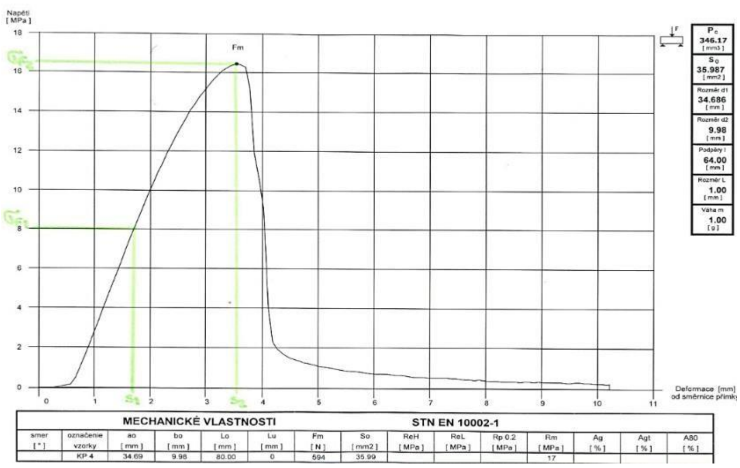
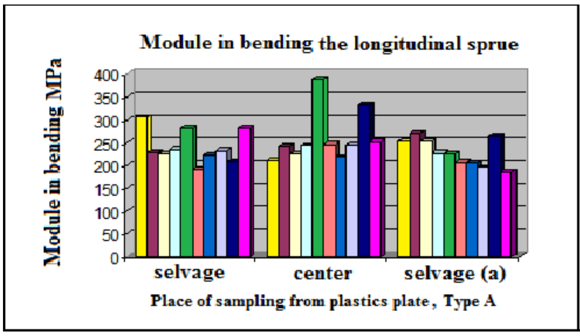


Figure 15. The course of tensile test of recycled plastics board and its mechanical properties

The graphs of Figure16 and Figure. 17 show the evaluation of values of flexural modulus, depending on the site of sampling, and according to the sampling direction (laterally or longitudinally in the filler).



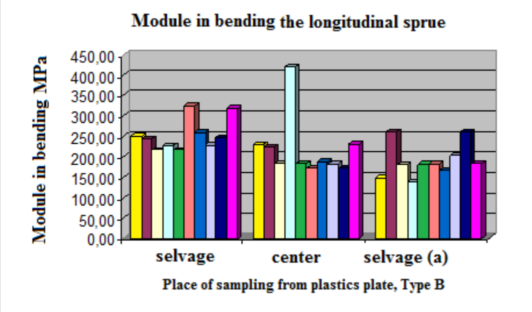


Figure 16. Bending in longitudinal sprue, Type A

Figure 17. Bending in longitudinal sprue, Type B

CONCLUSIONS

In the contribution dealt with the new trends in flood protection by using various types of materials. The protection of the people and the private properties, and the environment protection as whole one, are very important areas and the questions of protection have to be solved very quickly, because of rapid climate changing. After loading of the tested plastics samples, the samples were not cut in all the cross-section, but only in outside part of the bend specimen. The recycled plastics material as board or plate is possible to use as barriers, because there is loading on the whole area of board not exactly in one place. In the contribution, the authors tested the recycled plastics material – boards. A great number of producers utilize the plastics as a flood protection material for barriers, but only few ofthem utilize the recycled materials. This proposal solves two questions how to minimise the plastic waste and how to utilize the recycled plastics material in the practice and help to protect the environment. The production of recycled plastic materials has a great usage in the future, but it depends of their material structure and clearness, it means on mechanical properties. The importanceof utilization of plastic waste from production and from collection points is very favourable and useful, because this is the way, how to reduce the plastic waste, to save the production costs and to protect the environment.

ACKNOWLEDGEMENT

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SPATIAL EVOLUTION OF SURFACE WATER QUALTE, WADI KEBIR WATERSHED (North-East ALGERIA)

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Abstract: *Wadi Kebir which represents the downstream part of the Kebir-Rhumel watershed, is characterized by a dense hydrographic network, a rainfall varies from more than 600mm/year in upstream (Beni Haroun dam) to more than 1000mm/year at the mouth of wadi Kebir (Ledjnah region). Its waters present a resource for drinking water supply (upstream part), as well as for agricultural development in the downstream plains. The objective of our research work is to determine the quality of the raw water of wadi Kebir and its tributaries. A total of ten samples were taken during the period of high water (April 2017): six samples on the tributaries of the wadi and four samples in the waters of wadi Kebir from upstream to downstream. The physico-chemical parameters of the water (T, pH, EC) were measured in-situ, the major elements (Ca^{2+}, Mg^{2+}, Na^+, K+, HCO_3^-, SO_4^{2-}, Cl^-) and the indicators of pollution (NH_4^+, NO_2^-, NO_3^-, PO_4^{3-}) were analyzed at the Geological Engineering Laboratory (LGG). The results obtained show an organic pollution of the waters of Wadi Kebir and its tributaries with levels in the range of 0, 16 to 4, 72 mg/l in ammonium and 0.005 to 3, 67 mg/l in nitrite. The electrical conductivity varies from 1306 to 3460 s/cm indicating charged water. However, it remains below 1080 s/cm for the tributaries. The surface waters of the Wadi Kebir watershed are more or less alkaline (8, 19 - 8, 67). The most dominant hydrochemical facies is bicarbonate calcic-magnesian with minor hydrochemical facies such as sulfate-sodic-magnesian. Its chemistry is controlled by the weathering of the geological formations that characterize the watershed. The Organic Pollution Index (OPI) revealed a degradation of the water quality fromupstream to downstream, especially after the passage of the wadis through the different agglomerations such as those of Elmilia and Djamaa.*

Keywords: *Surface water, Wadi Kebir Watershed, Facies, Pollution, Electrical conductivity, Elmilia.*

INTRODUCTION

Algeria, like all Mediterranean basin countries, has endured from water stress as a result of climate change and urban and demographic development. The population growth and urban expansion, the development of industrial units and intensive agricultural activities contribute to a rise in the need for water and a degradation of its quality [1]. Earlier studies in different parts of the world [2-5] and Algeria [6-10] have indicated the influence of anthropogenic activities on the surface water quality andits changing scenario

Wadi Kebir is considered an important water resource for the different types of activities along the wadi, particularly urban, agricultural and industrial activities. However, the latter constitute riskfactors through its uncontrolled discharges. The objective of our work is to study the spatial evolution of the physicochemical quality of surface waters of Wadi Kebir and its tributaries. In order to assessthe current status of the physicochemical quality of water, characterize the quality of water tributaries, and define the risks of the impact of anthropogenic activities on these waters.

MATERIALS AND METHODS

Study area

Wadi Kébir is considered as the downstream part of the Kebir-Rhumel watershed, occupying 12.78% of the total area. The latter is located in the eastern part of Jijel, with a length of 47.45 km. It is fed by the dam of Bani Haroun. The wadi Kebir crosses several urban, industrial and agricultural areas from its upstream to its mouth in the Mediterranean Sea. The watershed of wadi Kebir is characterized by a dense hydrographic network, in which five wadis flow, the most important of which are wadi Boussiaba and wadi Mechta. The climate in the study area is Mediterranean, with rainfall ranging frommore than 600 mm / year upstream (Bani Haroun Dam) to more than 1000 mm / year at the mouth of the wadi Kebir (Ledjnah region).

From the geological point of view, the Wadi Kebir crosses several geological formations, from south to north (Fig. 1), the Tellian domain in the south, the domain of the Kabyle flysch in the center, and the Kabyle domain and the terrain it supports in the north [11].

Sampling and analysis techniques

The concentration of different physico-chemical parameters was known using 10 water samples taken along the wadi during the month of April 2017. Four samples were collected from Wadi Kebir and two samples from each tributary, one upstream and one downstream. The processing and preservation of the water samples were carried out according to the general guidelines [12]. The choice of sampling stations (Fig. 2) was made according to the level of human and industrial activities.

Parameters such as temperature, electrical conductivity (EC), redox potential (Eh), and hydrogen potential (pH) were determined in situ using a Multi 350i portable meter. The concentrations of Ca2+, Mg2+, Na+, K+, Cl-, HCO3-, NO3-, NO2-, NH4+, and PO43- were determined according to standard methods suggested by Rodier [13]. The error of the ion balance should be less than ±5% for a good measurement. But for surface waters, up to ±10% ion balance error (IBE) is acceptable [14-15].

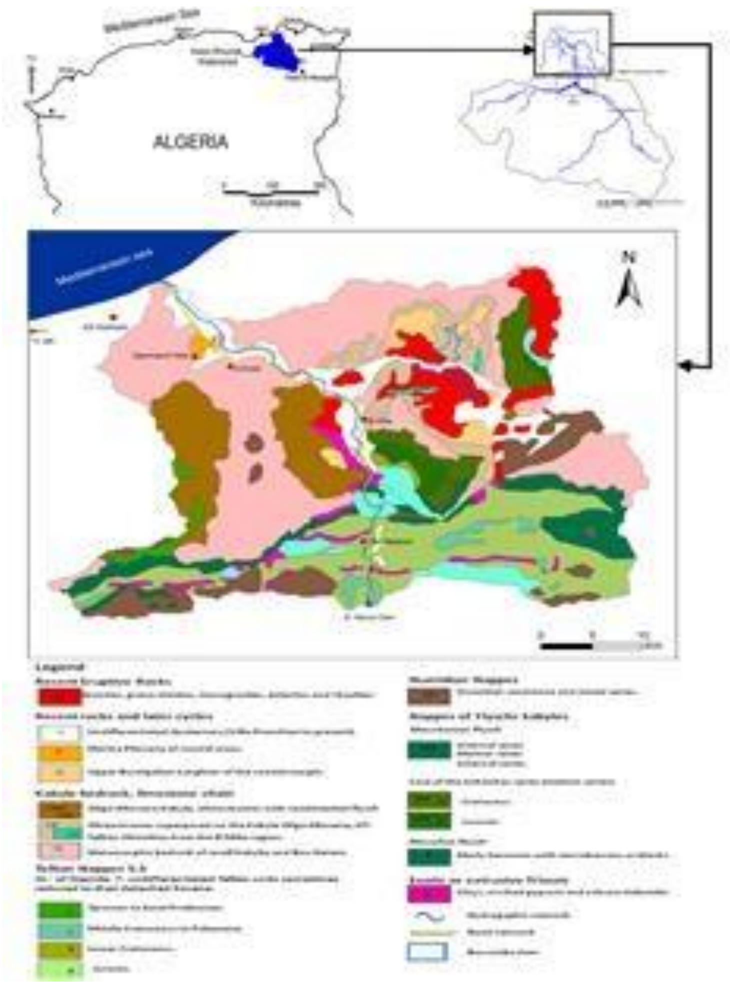

Figure 1. Geographical and geological location of the study area

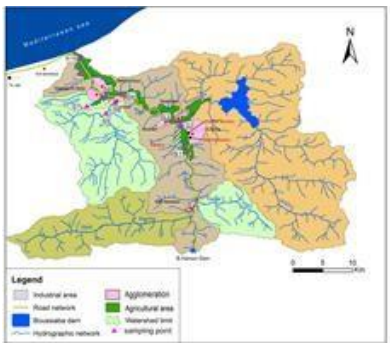

Figure 2. Inventory map of sampling point

RESULTS AND DISCUSSION

General hydrochemistry

The results of the physicochemical analyses of the surface waters of Wadi Kebir and its tributaries (April 2017) in terms of maximum (max), minimum (min), standard deviation (SD) and averagevalues are presented in Table (1).

pH is related to the buffer system developed by carbonate, bicarbonate and carbonic acid, etc. [16]. The water of all Wadis is found to be alkaline, (8.19 - 9.07), this could be explained by the geological nature (limestone, dolomite, marls and flysch) the land crossed, and the domestic discharges of the

different agglomerations. The temperature of the different stations varies between 18.96 and 25.5°C, this is due to the time of the temperature measurement and the variation of the air temperature. EC was found varied between 351 and 3410µS/cm (average is 1416.1 µS/cm). The highest values of electrical conductivity were recorded at Kebir wadi are interpreted by the combined effect of the contribution of the Beni Haroun dam [6] and the dissolution of evaporite formations in the upstream part of its watershed [10].
The decreasing order of abundance of the major cations was observed as $Mg^{2+} > Na^{+} > Ca^{2+}$ and almost all the samples did not exceed the maximum acceptable concentration of Mg^{2+} for drinking water (50mg/L) except for the waters of Kebir center wadi (S4) which present contents exceeding the standard admissible limit because of the contributions of Boussiaba wadi rich in Mg^{2+}.

Table 1. Statistical parameters of the chemical elements in Kebir wadi

Parameters	Unit	Min.	Max.	Mean	SD
EC	µS/cm	351.00	3410.00	1416.1	1060.78
pH	/	8.19	9.07	8.501	0.23
T	°C	18.96	25.50	21.24	2.12
Eh	mV	-24	282	216.60	84.73
NH_4^+	mg/L	0.16	4.72	1.16	1.32
NO_2^-	mg/L	0.005	3.67	0.56	1.06
NO_3^-	mg/L	0.33	2.92	1.16	0.80
PO_4^{3-}	mg/L	0	3.63	0.47	1.06
Ca^{2+}	mg/L	8.01	73.74	40.08	18.02
Mg^{2+}	mg/L	15.36	57.6	32.16	14.51
Na^+	mg/L	19.9	104.1	56.63	32.71
K^+	mg/L	4.8	17.5	8.27	3.46
HCO_3^-	mg/L	73.2	336.72	210.32	72.10
SO_4^{2-}	mg/L	11.83	306.05	129.53	119.84
Cl^-	mg/L	33.72	111.82	67.09	28.30

The decreasing order of abundance of the major anions was determined $HCO_3^- > SO_4^{2-} > Cl^-$. The concentration of anions in all samples did not exceed the maximum acceptable limit as prescribed for the drinking water. The dominant elements give a global facies of bicarbonated magnesium type. This facies reflects the presence of carbonate formations (limestone, marl, cipolin and shale).
The redox potential ranged from -24 to 282 mV which indicates an oxidizing-reducing environment.
High values of ammonium (0.16 - 4.72 mg/L), phosphate (0.00 - 3.63 mg/L), nitrite (0.005 - 3.68 mg/L) and bicarbonates (73.2 – 336.72 mg/L), linked to urban discharges that flow directly into these wadis during their passage by the main agglomerations of the region [7], and to the rejections of the Elmilia tannery (1.46 mgL^{-1} in ammonium and 0.83 mgL^{-1} of nitrite) at the Kebir wadi station before confluence.
The upstream waters of the wadis Ardjanna and Djamaa have similar physicochemical characteristics; an oxidizing medium with an Eh varied between 204-269 mV, whereas the electrical conductivity as (351-479 µS/cm), which is indicating low mineralization. The concentrations of nitrates (0.57 to 4.39 mgL^{-1}), nitrites (0.005 to 0.02 mg/L) and ammonium (0.16 to 0.29 mg/L) were found to be low. These nitrogenous compounds are related to the degradation of organic matter (vegetation cover that covers the mountains of its sub-watersheds).

Organic Pollution Index (OPI)

This indicator is calculated by integrating the concentrations of four chemical parameters associated with organic pollution: biological oxygen demand (BOD_5), ammonium ions (NH_4^+), nitrites (NO_2^-) and phosphates (PO_4^{3-}). The value of the OPI index varies from 1 to 5 (5 corresponds to the best quality). The contents are divided into (05) five categories of organic pollution index. After determining the class of each pollutant, an average is made to characterize the pollution.
After the calculation of the organic pollution index (OPI) for each station (April 2017), we proceeded to the graphical representation of the OPI, in order to facilitate the interpretation
According to the map (fig.3) during the period April 2017 we recorded a moderate OPI at the station S1 (wadi Kébir upstream) due to the influence of the agglomerations that are upstream of the study area, particularly the agglomeration of Sidi Maarouf, this index becomes strong after the passage of

the wadi through the industrial area of Bellara and the upstream part of the agglomeration of Elmilia. At the station S4 (wadi Kébir center) the OPI is always strong because of the combined effect of the discharges of agglomeration of Elmilia and the contributions of wadi Boussiaba characterized by a strong OPI.

Figure 3. Map of the spatial evolution of the organic pollution index in April 2017

At station S10 (Oued Kébir downstream) the OPI becomes moderate despite the confluence of Wadi Kebir with Wadi Ardjanna which presents a strong OPI and wadi Djamaa with a very strong OPI this is due to the self-purification power of Wadi Kebir. The wadis Ardjanna and Djamaa are characterized by a low OPI in these upstream parts (virgin areas). Then we note a degradation of water quality after the passage of these wadis by the agglomeration of ElAncer for wadi Ardjanna (high OPI) and the agglomeration of Djamaa for wadi Djamaa (very high OPI).

CONCLUSIONS AND RECOMMENDATIONS

Wadi Kebir is considered as one of the sources of drinking water supply for the upstream part of its watershed, as well as for the agricultural development in the plains of the downstream part. Thequality of surface water of Wadi Kebir and its tributaries are a function of several factors, physical, chemical, biological and lithological.

The determination of the chemical facies of the waters of the study area, showed the predominance of the facies Bicarbonate calcic-magnesian and sulphate sodium, organic elements. The organic pollution index map shows a strong to very strong OPI downstream of the tributaries. However, it is weak to null upstream of Wadi Kebir and its tributaries, which explains the impact of anthropic activities that cause a risk of alteration of water quality, which draws the alarm bell as to the protection of this resource and the limitation of discharges by the installation of wastewater treatment plants, especially for urban and industrial areas, and to educate farmers in agricultural areas to reduce the excessive use of fertilizers and pesticides.

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THE EFFECT OF SOIL COMPACTION UNDER DIFFERENT RATES OF BIOCHAR ON SOME PHYSICAL AND HYDRODYNAMICAL SOIL CHARACTERISTICS AND IN SOYBEAN (*GLYCINE MAX. L*) PRODUCTIVITY

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Abstract: *Biochar is proven to enhance soil fertility and increase crop productivity. Given that the influence of biochar on soil compaction remains unclear, selected physico-hydrodynamical properties of soil amended with wood-derived biochar will be assessed. Thus, agricultural land application of organic wastes, such as biochar, could alter soil properties to offset the degradation effects. This research would shed some light on the effect of the use of heavy agricultural machinery on compaction of the soil-biochar matrix which has yet to be studied in detail. A field experiment will be carried out over two consecutive seasons on a Sandy-loam soil in a completely randomized block design, which includes three rates of biochar (0,5,10%) and three levels of compaction (0, 199.04, 330 Kpa) and each treatment has three replicates. Biochar will be produced by pyrolysis from woody residues at 450°C and added to soil with mineral fertilizers before 40 days of cultivation. The compaction procedure will be performed at the plastic limit with a tractor and a water trailer hanging on it. The weight can be controlled on the axle of the rear wheels of the trailer, where three different loads of the trailer will be used, and the weight of the trailer will be calculated. Trial plots will be prepared with an area of 5 m^2 per plot (2.5 m length* 2 m width) after that soybean seeds will manually be implanted on lines so that the distance between the lines is 50 cm, and 18cm between plants..*

Keywords: *Biochar; bulk density; soil compaction; soybean; soil shear stress; Unsaturated hydraulic conductivity*

INTRODUCTION

The proliferation of agricultural mechanization and excessive agricultural activities results in applying more pressure on the soils. Increased pressure application is detrimental to the soil quality, thereby adversely affecting fertility and sustainable use of soils. The increase of soil bulk density, penetration resistance (PR) and decrease of water and air permeability by depending on the applied pressure and soil properties weaken the plant root development, and subsequently this is accompanying with chemical, physical and biological degradation within the soil [1]. Soil compaction is defined as the densification and distortion of soil by which total and air-filled porosity are reduced, causing a deterioration or loss of one or more soil functions [2]. Biochar is viewed as a potential long-term amendment improving soil chemical and physical conditions while sequestering carbon [3].
It is produced by pyrolysis, a process whereby biomass material is decomposed in the absence of oxygen at temperatures ranging from 250 to 700°C [4]. The organic starting material can be drawn from a variety of types of biomasses, including wood chips, crop residues, manure, and animal waste.
Pyrolysis conditions and feedstock material are responsible for biochar characteristics such as chemical composition, surface chemistry, nutrient composition, adsorption capacity, cation exchange

capacity (CEC), pH, and physical structure [5].
The application of rice husk biochar by (6%) could increase soil pore structure parameters by 20 % and shear strength, as well as decrease soil swelling by 11.1% [6] expansive clayey soil (vertisol). Its application decreased the tensile strength of soil cores to 353.6 kPa from the initial 936.8 kPa at 6% addition rate [6] this reduction offers greater potential for root growth because the roots can bypass the zones of high mechanical impedance. Soil strength is affected by a number of factors including the properties of the particle surfaces, indicating that the use of biochar can reduce the risk of soil compaction [6].
n addition, biochar application at 100 t ha^{-1} rate could ameliorate compaction by over 10% [7] decrease bulk density from 1.47 to 1.44 mg m^{-3}, and increase porosity from 0.43 to 0.44 m^3 m^{-3} at 20 tha^{-1} application rate of woody biochar on sandy loamy soil [8]. However, 5% biochar treatment on clayey silty soil could increase base saturation percentage from 6.4 to 26 % and saturated hydraulic conductivity from 16.7 to 33.1 cm h^{-1}, decrease soil erosion rate from 1458 to 532 g m^{-2} h^{-1} [9].
Barus et al. [10] stated that adding 1 ton/acre of biochar increases the number of plant pods to 43.77 pods/plant compared to the control (34.77 pods/plant), and the number of empty pods decreased from (5.03 pods/plant) to (3.18 pods/plant), and the grain yield increased by 31% for L13 soybean cultivar and 51% when biochar was added at a rate of 5% and 10%, respectively, which is due to the increase in plant biomass and phosphorous uptake [11]. An increase in the weight of seeds/plant and the weight of seeds/hectare (18.6 g/plant) compared to the control (13.6 g/plant) without adding biochar and (5.4 ton/ha) compared to the control (3,922.50 ton/ha), respectively for the treatment 3 tons/dunum of biochar 12]. This research would shed some light on the effect of the use of heavy agricultural machinery on compaction of the soil-biochar matrix which has yet to be studied in detail.

GOALS

1. Studying the effect of soil compaction under different levels of biochar on some physical and hydrodynamical characteristics of soil.
2. Determination the threshold values of pressure at different levels of biochar for the soybean plant.
3. Identification the effect of pressure on underlying soil layers and the contribution of biochar in reducing this pressure.
4. the effect of pressure on soybean growth and productivity.

MATERIALS AND METHODS

1. **Plant material:** Soybean plant.
2. **Biochar:** it will be manufactured by pyrolysis with the two-barrel charcoal retort design.
3. **pyrolysis used residues** are from woody basis
4. **Used soil:** Sandy-loam

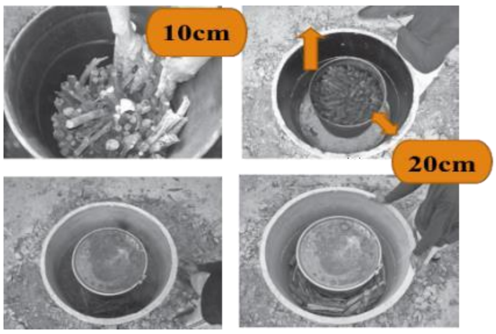

Figure 1

Soil preparation for cultivation
Biochar will be added at three rates before 40 days of cultivation:

C0: no amendment
C1: 5%
C2: 10%
Then, the soil will be plowed to the depth of 30 cm. Thus, fertilizers could be mixed with soil according to the fertilizer equation N-P-K:
Nitrogen fertilizer: three doses of urea 46%. First, 30 kg/ha during soil preparation. Second, 100 kg/ha after plant singularity. Third, 100 kg/ha at the beginning of flowering.
Phosphorous fertilizer: 160 kg/ha $P_2O5\%$ as TSP 46% before cultivation.
potassium fertilizer: 120 kg/ha as potassium sulfate $\%K_2O$ 50% before cultivation.
After plowing, the compaction will take place at three rates:
B0=0 kpa
B1=199.04 kpa
B2=330 kpa
However, the rotary hoe will be used to smooth the surface layer of the soil (0-5 cm). Next, trial plots will be prepared with an area of 5 m^2 per plot (2.5 m length* 2 m width) after that soybean seeds will manually be implanted on lines so that the distance between the lines is 50 cm, and 18cm between plants. As a result, each trial piece includes 3 lines.
Soybeans will be planted manually in a hollow on 20/6/2022 as an intensified grove, at a rate of 3 seeds in each hollow, subsequently the seeds will be covered well, after which the soil will be irrigated until the field capacity.

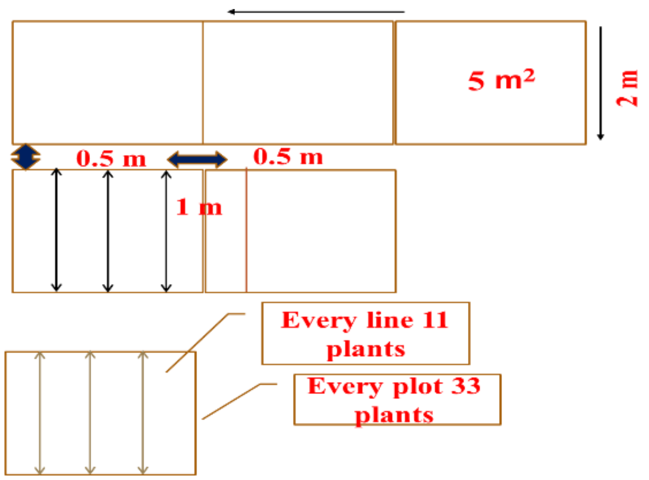

Figure 2

Compaction procedure

This procedure will be performed at the plastic limit (the appropriate moisture for conducting agricultural operations) with three replicates for each compaction level. We will prepare a tractor (Forat) and a water trailer hanging on it)the pressure system is composed of three axes). The weight can be controlled on the axle of the rear wheels of the trailer, where three different loads of the trailer will be used, and the weight of the trailer will be calculated. The tractor with the trailer, then the weight of the tractor front axle, the middle axle, and the rear axle (trailer axle) will be calculated by electronic weighing. The weight on the rear axle is the largest. As a result, it will be adopted, becauseit is the largest compressive force, as the weight on the rear wheels is relative to the required pressure levels, as shown in the Table (1)

Table 1. the pressures that the soil will be subjected

Treatment	Rear axle weight (kg)	Wheel load(kg)	Wheel contact surface with soil (cm)	Pressure (kpa)	Wheel load (KN)
B1	0	0	0	0	0
B2	1400	700	351.68	199.04	6.86
B3	2730	1365	414	330	13.39

After determining the load of the wheels (axles), the load of the single wheel will be calculated in kilo newton (KN), as it follows:

$$\text{wheel load (KN)}= \frac{\textbf{wheel load(kg)}*\textbf{9.81}}{\textbf{1000}}$$

The maximum wheel load of the tractor-trailed wheels during traffic will be as follows:
B1=0KN
B2=6.86KN
B3=13.39KN
After setting the wheel load in both KN and Kg: The contact surface area of the wheel with the largest load will be determined on solid soil surface where we will put a piece of cardboard and on top of it a piece of carbon paper. After passing the rear wheel on this piece at the required loads, the wheel location will be printed on the cardboard sheet. Afterward, the width of the wheel contact with the soil and the length of the contact in the case of standing will be determined, in effect it is in the form of ellipse, so that the area of the contact surface will be as follows:

$$A=\frac{a*b*3.14}{4}$$

a: The length of the ellipse (cm)
b: The width of the ellipse (cm)
A: Contact surface area (cm^2)
Where the wheel's contact surface area with the largest load (rear axle) according to the treatment is as follows:
A=0 (cm2) in B1
A=351.68 (cm2) in B2
A= 414 (cm2) in B3
Thereafter, the applied pressure will be calculated in kilopascals on the treatments as follows:

$$pa = \frac{P}{A} * 100$$

A= Contact surface area (cm2)
P=Wheel load (Kg)
The applied pressure levels corresponding to the rear wheel load of the trailer were as follows:
B0=0 kpa
B1=199.04 kpa
B2=330 kpa
Moving on, the soil compaction process will take place on the moistened soil via tractor and the trailer linked to it for the studied treatments. So that each treatment will be compacted with its duplicates for the entire treatment area, Since the wheel trajectory is adjacent to the subsequent wheel trajectory, firstly, B1 will be compacted. Secondly, we will move to the treatments with lesser compaction levels by emptying a quantity of the tank water, estimated by liters. To reach the lowest weight equivalent to the aforementioned studied loads, then weight it by electronic weight once again, so that the load of the rear axle always remains greater than the load of the middle and front axle. However, the tire pressure on the rear axle is greater than the pressure of the other wheels on the soil will be taken into account.

Experiment design

The experiment will be carried out over two consecutive seasons in a completely randomized block design, which includes three rates of biochar (0,5,10%) and three levels of compaction (0, 199.04, 330 Kpa) so there are 9 treatments, and each treatment has three replicates.

Table 2.

C0B0	C1B0	C2B0
C0B1	C1B1	C2B1
C0B2	C1B2	C2B2
C1B0	C2B0	C0B0
C1B1	C2B1	C0B1
C1B2	C2B2	C0B2
C2B0	C0B0	C1B0
C2B1	C0B1	C1B1
C2B2	C0B2	C1B2

C: biochar
C0: mineral fertilizer with no biochar
C1: 5%
C2: 10%
B: compaction level
B0: mineral fertilizer with no compaction
B1:199.04 kpa
B2: 330 kpa

Harvest procedures

1. Harvest will be done when the seed moisture becomes 15%.
2. The plant will be placed in paper bags for drying in an oven at 70 °C for at least 24 hours, towards taking the dry weight.

READINGS AND MEASUREMENTS

Soil physical properties

Non-destructive structure samples will be taken from versatile depths (20-40-60cm) after harvesting using metal cylinders from all treatments with three replicates from each treatment to determine:
Bulk density at different rates of biochar and compaction.
The distribution of the porous system at different rates of biochar and compaction.
And it will be defined in the pressure plate device according to this law:
$P_W=4\sigma W/d$
P_W: pressure (pascal),
d: pore diameter
σw: Surface tension of water N/m
After that, the size of the porous groups will be determined as follows:
PV %> 50µW=PV%-Wvol.pF1.8
PV %> 10µW=PV%-Wvol.pF2.5
PV % (10-50) µW=Wvol.pF1.8-Wvol.pF2.5
PV % (0.2-10) µW=Wvol.pF2.5-Wvol.pF4.2
PV %< 0.2 µW=Wvol.pF4.2
As WvolPF1.8 is the volumetric moisture at the end of the equivalent pressure to pF1.8
Soil's total porosity will be determined as follows:

$$PV\ \%=(1-\varrho d/\varrho s)*100$$

dϱ: bulk density g/cm^3
Sϱ: true soil density g/cm^3

Figure 3.

Soil moisture characteristic curves by pressure plate device at pF = 1.8-2.5-3-3.5-4-4.2

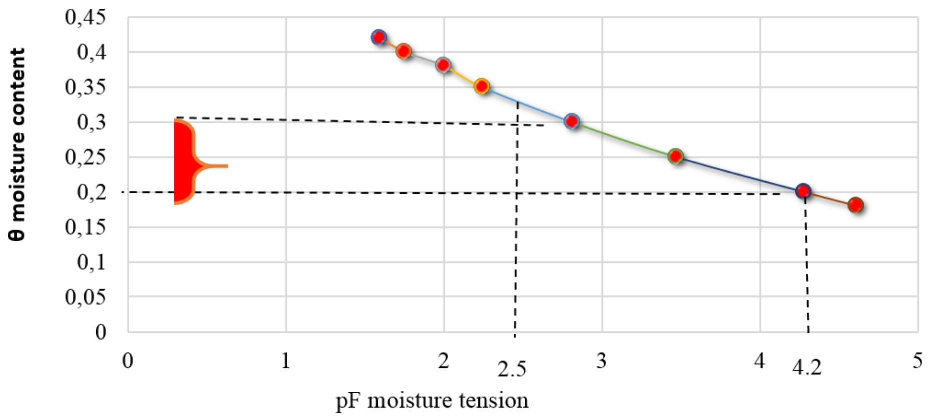

Figure 4.

Soil moisture characteristic curves will be determined using the pressure plate device by applying increasing pressures starting from pF1.8, pF2, pF2.5, pF3, pF3.5 and pF4.2 using soil cylinders with a height of 4 cm. Next, the moisture content will be calculated at different moisture tension levels, and the corresponding averages of moisture will be determined. At the end these values will be processed by computer, so the relationship between ψ and θ was from the form: $\psi = a\ \theta^b$.
The former equation represents the most used form by many researchers, including (Gardner et al.,1970) [13], and after determining the moisture content at different levels of pressure, the experimental equations and constants (a and b) will be reached at all rates of biochar and compaction.

Using these curves, we could determine:

1. available water
2. Specific capacity= $\partial\theta/\partial\varphi$ (1/cm)
3. Hydrodynamic constants

Saturated hydraulic conductivity Coefficient

Determining this parameter is very difficult due to the manifold of the pore system in the soil, in addition to the variations in the shape and length of the tubes. Based on Darcy's law [14] determined the conductivity coefficient in the laboratory:

$$Kf = q/\text{Grad}\ \varphi H$$

q: the amount of water flowing through the soil profile (m/day),
Grad Φh: hydraulic gradient, Where measurements will be carried out for all samples at one hydraulic

gradient, and in the case of continuous flow

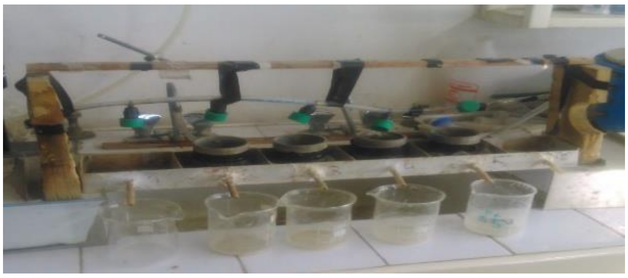

Figure 5

Unsaturated hydraulic conductivity coefficient based on hydraulic diffusivity which will be determined by hot air method [15]:

Figure 6.

After exposing the sample of 10cm height to hot air 220 C° until the upper layer dryness with saturation moisture at the bottom, which led to the creation of hydraulic gradients that allow water to move upward and within a short time. according to the following relationships:

After exposing the sample of 10cm height to hot air 220 C° until the upper layer dryness with saturation moisture at the bottom, which led to the creation of hydraulic gradients that allow water to move upward and within a short time. according to the following relationships:

Starting with Darcy's law $q = -K\frac{\varphi\partial}{\partial Y}$

It is a continuation equation $\frac{\partial\theta}{\partial J} = -\frac{\partial q}{\partial Y}$

We will have Richard relation $\Rightarrow \frac{\partial\theta}{\partial t} = \frac{\partial}{\partial x}[K(\varphi).\frac{\varphi\partial}{\partial Y}]$

$$\mathcal{D}_{(\theta)} = \frac{K(\varphi)}{\frac{\partial\theta}{\partial\varphi}}$$

$$\frac{\partial\theta}{\partial t} = \frac{\partial}{\partial x}[\mathcal{D}_{(\theta)}.\frac{\partial\theta}{\partial\varphi}.\frac{\partial\theta}{\partial x}]$$

$$\Rightarrow \frac{\partial\theta}{\partial t} = \frac{\partial}{\partial x}[\mathcal{D}_{(\theta)}.\frac{\partial\theta}{\partial x}]$$

$Y.t^{-\frac{1}{2}} = \lambda = \frac{x}{\sqrt{t}}$ using a Boltzmann number

$$\frac{\partial\theta}{\partial t} = \frac{\partial}{\partial x}[\mathcal{D}_{(\theta)}.\frac{d\theta}{\partial x}]$$

After summarizing, we get: $\frac{-x d\theta}{2t} = d.\mathcal{D}_{(\theta)}.\frac{d\theta}{\partial x}$

By integrating the previous relationship, we get:

$$\mathcal{D}_{(\theta)} = \frac{1}{2t}.\left(\frac{dx}{d\theta}\right).\int_{\theta x}^{\theta i} x\ .d\theta$$

It is the specialized basic equation for calculating hydraulic diffusivity at different levels of moisture tension

D: hydraulic diffusivity

K: unsaturated hydraulic conductivity

Ψ: moisture tension

t: time

θx: moisture at depth x

θi: initial moisture

After cutting the soil samples into slices with a thickness of 3 mm and determining their moisture, the relationship between volumetric moisture and sample height will be found.

Figure 7.

Then, the volumetric moisture numbers (Θ) and their corresponding values (x) will be given to the computer using the Q basic program to determine the hydraulic diffusivity at different levels of moisture tension after determining the hydraulic diffusivity value. And determining the values of dΘ/dφ from moisture characteristic curves, the hydraulic conductivity coefficient of unsaturated soils at different levels of moisture will be determined using the following relationship:

$$K = \mathcal{D}_{(\theta)}.\left(\frac{d\theta}{d\varphi}\right)_{(\theta)}$$

Ku values will be converted to m/day by converting the hydraulic diffusivity values (D) from mm^2/day to cm ^{2}/day by dividing on 100, then we will multiply the result of D cm^2/s with dθ/dφ estimated by 1cm, as a result, we will get Ku estimated by cm/s, then we multiply the result by 864 to convert from cm/sec to m/day.

After determining the unsaturated hydraulic conductivity coefficient at different levels of moisture tension, the relationship between moisture tension and the corresponding values of the unsaturated hydraulic conductivity coefficient for soil according to first-order correlations will be determined to find the hydrodynamic constants for this soil c and d Ku=c Ψd

These hydrodynamic constants are among the most substantial physical indicators of the ease of water absorption by the plant within the soil-plant-atmosphere system:

Compaction curves under different rates of biochar and compaction.

The ρ max and θ *opt* will be determined through the standard Proctor compaction test, following the procedure of ASTM (2007). Soil consistency limits will be determined according to (ASTM 2010)

Soil penetration resistance.

The PR of the compacted soil in the standard Proctor mold will be determined by a penetrometer

(FieldScout, SC900 Soil Compaction Meter) according to ASAE (2013) with a penetrometer cone diameter of12.83 mm and a cone angle of 30^{o}

Soil shear stress.

Torvane (Humboldt, H4221 Geovane Soil Shear Strength Tester) will be used to determine the SS of the compacted soil in the compaction mold according to ASAE (2016).

Aggregate stability

Using immersion method of artge and Horn [16].

Figure 8.

We take soil samples using a set of sieves with diameters 1-2-3-5-8 mm

Sift the soil and calculate the weight of the soil on each sieve. Then we collect the soil and moisten it carefully over a short distance and leave for the next day.

On the next day, they are placed on the upper sieve, then the sieves are submerged in water for five minutes, with a movement stroke distance of 4 cm, and the number of immersion times is 35 times per minute. After that, we calculate the remainder on each sieve.

The average change in the diameter of the secondary particles before and after immersion in water is determined according to the following equation:

$$\Delta GM = \frac{\sum ni.di - \sum na.di}{\sum ni}$$

ni: weight of completely dry grains of diameter di before wet sieving

na: the weight of completely dry grains of diameter di after wet sieving

∑ni: weight of completely dry soil before sieving

>1.2 mm high stability

1.2-4.5 mm medium stability

>4.5 Poor stability

Then the percentage of secondary grains for dry and wet sieving will be calculated as a cumulative sum curve and the graphs are plotted:

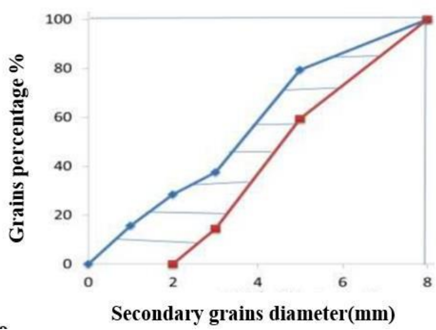

Figure 9.

Thus, the mutual area between the two lines gives an idea of the structure stability, as the greater this area, the less the stability of the building and vice versa.

CHEMICAL ANALYZES

Table (3): The most important chemical analyzes that will be conducted for the sandy-loam soil

The used method	analysis
wet digestion Ryan and others (2003) [17]	Organic matter
Ryan and others (2003) calibration	Calcium carbonate
Ryan and others (2003) Dorino	Effective lime
(2003) Ryan and others Sodium acetate	Cation exchange capacity
Ryan and others (2003) Kjeldahl	Mineral nitrogen
Ryan and others (2003) Olsen	Available phosphor
Ryan and others (2003) ammonium acetate	Available potassium
PH- METER	pH
EC-METER	(EC) Electrical conductivity

PLANT'S CHARACTERISTICS

Morphological traits:

- Average leg length (cm):

2- The number of main branches
3- first horn height (cm)
4-leaves numbers on the plant

Productive traits:

1- The number of seeds per pod
2- of one seed Weight (g)
3- Weight of seeds per pod (g)
4- Weight of one horn (g)
5- The number of pods in the plant
6- The weight of the pods in the plant
7- 100 seeds weight (g)
8- Number of seeds per plant (g)
9- Weight of seeds per plant (g)
10- Seed yield kg/ha

Physiological traits:

1- Area of one leaf: leaf length x leaf width x correction factor for beans (0.583)
Paper area: leaf area x number of leaves in the leaf according to jonkheree et al. [18]
2- The area of leaves per plant/cm^2: the area of one leaf x the number of leaves on the plant (Jonkheree et al., 2004)
3- Leaf area index = the area of the leaf surface of the plant / the area of land it occupies
4- Average dry weight of the plant (g)
5-Total chlorophyll (mg/g/leaves): The total chlorophyll in leaves will be estimated according to Machinney [19] method.

Qualitative traits:

1- Oil percentage %:
2-Protein content %: according to the Kjeldahl method
Protein percentage = nitrogen content x protein coefficient (6.25).
3-Estimation of the amount of oil and protein per unit area kg/h

STATISTICAL ANALYSIS

Experimental data will be subjected to the analysis of general variance (ANOVA) according to

sources of variance and replicates.
Calculating the averages and determining the value of the least significant difference (LSD) at the 5% level of significance, using the SAS statistical program (SAS Institute, 1999)

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HYDROGEOLOGICAL STUDY OF THE SAF-SAF WATERSHED SKIKDA NORTH-EAST ALGERIA

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Abstract: *The control of water resources is a necessity whether superficial or underground, in order to understand the circulation and origin of groundwater in the downstream part of the Saf-Saf watershed located inthe city of Skikda, North-East Algeria. A detailed qualitative and quantitative study was carried out and 15 analyses were carried out. The results were shown from ground water. The generally do not present a risk of alcalinisation, but a moderately high risk of sanilisation due, on the one hand, to marine invasion and, on the other hand, to discharge of wastewater of industrial origin. Soduim chloride facies is the most predominant. The study of the suitability of groundwater for irrigation of agricultural land shows that the majority of water wells have an acceptable quality for irrigation. The analysis of hydro-climatological data allowed an estimate of the water resources of the watershed, thus attributing a Mediterranean climate, characterised by two distinct seasons: one wet and clod and the other dry and hot. The hydrogeological data reveal the existence of two superimposed layers of unequal impotence, the first superficial sandy of the Quaternary and the other of a deep gravel. These two reservoirs present an important resource for exploitation.*

Keywords: *Algeria, Saf-Saf watershed, groundwater, circulation, salinisation, irrigation.*

INTRODUCTION

With the increasing population, water is becoming increasingly scarce, especially since it has not been distributed uniformly. This water scarcity is multiplied by the needs and development of different uses of human activity that directly affects the quality and quantity of water resources and more particularly groundwater. The watershed of the Saf-Saf wadi is one of the coastal sub-basins of Constantine center. It covers an area of 1158 km^2 with a population of about 471 000 inhabitants. This water resource contains a relatively important water potential. It is represented by the groundwater of the alluvial layer of quaternary age and surface water. In recent years, there has been an economic development, particularly in agriculture, which has resulted in an increase in the demand for water on the one hand, and deterioration in the quality of the water on the other. This study focused on hydrogeological study in order to determine the spatial distribution of the groundwater flow and the physicochemical characterization. In this approach, an inventory of 30 wells was carried out for the piezo metric part and a sampling of 15 water points was analysed for the hydro chemical part.
There are six oil exporting harbours in Libya namely; Al Zawia, Al Sidra, Ras Lanuf, Al Breqa, Al Zwitina and Al Hariqa. They may subjected to various levels of oil effects on the components of ecosystem either abiotic such as sea water and beach sediments or biotic components such as micro and macro organisms. At the Al Hariqa harbour, three stations located at coastal part of the Tobruk Gulf, NE Libya (Figure 1) are subjected to sampling for this study. The Al Hariqa Oil harbour, which is located in Tobruk city is crowded with oil tankers, this problem encourage us to investigate and

monitor this active harbour. The coastal water needs close investigation and attention because it is the only marine environments in contact with human activity (swimming, fishing etc.) as well as other biological productivity of marine organisms. This study will draw the attention of the government to oil pollution, and environmental education to people who are not care to this problem.

STUDY AREA SETTINGS

The watershed of the Saf-Saf wadi is part of Skikda province. It is located in the North-Eastern part of Algeria between the longitude 6°65' and 7°08' East and the latitude 36°87' and 36°35' North with an area of about 1158 km^2 [1]. It is one of the sub-basins of the central Constantinian coast. The main watercourse is the Saf-saf wadi with a length of about 55km, which flows into the Mediterranean Sea.

This exoreic basin is limited in the North by the Mediterranean Sea and in the South by Djebel Hadja and Djebel Oucheni, in the West by the massif of Collo and Djebel Boukhalouf and in the East by Djebel Alia and Djebel Tengout [1]. The watershed is located in the small Kabylia, which is part of the alpine chain of maghrebide. The most dominant geological formations are the alluviums and the ancient dunes of Quaternary age [2].

The climate of the region is of Mediterranean type belonging to the Humid to Sub-humid domain whose average annual pluviometry is irregular of the order of 788.762mm. Only 13,80% infiltrates in the water table, the remainder leaving in the form of evaporation (65,64%) and of runoff (20,74%)with an average annual temperature of 19,17°C [3].

The relief is globally diversified with very uneven terrain. The folds of the mountains are generally oriented West-East [4]. The altitudes varied between 1166m at the level of Djebel Hajar and 225m at the level of Djebel Soubouyou [5].

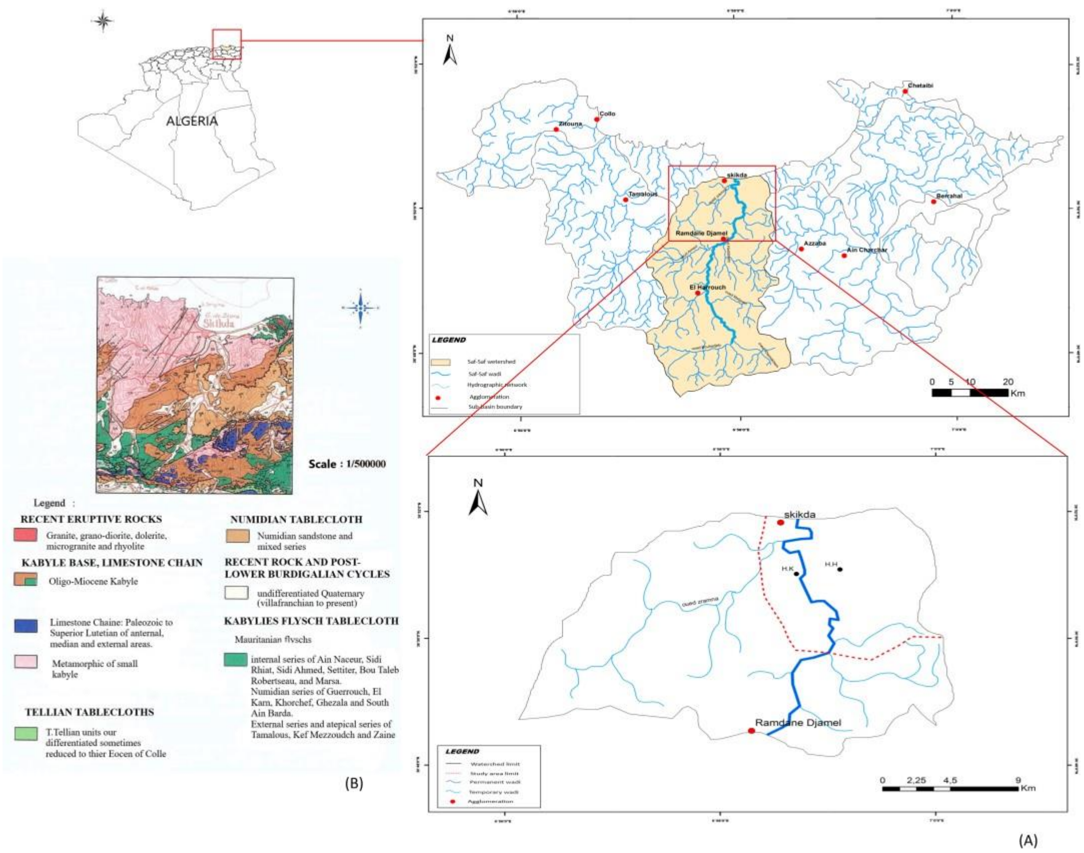

Figure 1. (A) Geographical location of the study area, (B) Geological map (J.M.Vila 1977).

MATERIALS AND METHODS

ESTABLISHMENT OF THE PIEZOMETRIC MAP

The piezometry is a fundamental importance of the analysis and the schematization of the capacitive and conductive functions of the reservoir, as well as the hydrodynamic characteristics of the aquifer [6]. From the data obtained from the direction of hydraulics of Skikda (DHW) and the communal office of hygiene of various commune (Skikda, Hamrouch Hammoudi and Beni Béchir), we measured the piezometry of 30 points of water (wells) during the period of the low waters (September 2020) to specify the evolution of the level of water of the surface water.

These wells are located throughout the surface of the downstream part of the Saf-Saf watershed. The piezometric level was measured with the use of an electric probe. Interpretation of the piezometric map to determine the direction of flow, the main area of groundwater circulation and recharge of the water table and finally to calculate the hydraulic gradient

SAMPLE ANALYSIS

The sampling campaign carried out in September 2020 made it possible to sample 15 water points concerning only the groundwater of the surface water table. For each water point, we measured in situ the physicochemical parameters such as temperature and electrical conductivity of the water. The samples were stored in plastic bottles of 1.5L capacity and transported in a cooler at a temperature of about 4°C until they were analysed. The analysis of chemical elements (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, SO_4^{2-} and HCO_3^{-}) was carried out at the laboratory of geology and environment at the University of Constantine 1 (Algeria). Conductivity was measured by a Hanna conductivity meter (HI 9035); pH and temperature were determined by a pH-meter E520 Metrohm Herisau.

The TH hardness and the calcium and magnesium ions are determined by the volumetric method with 5 ml of KOH and one pinch of Murexide; titrate with E.D.T.A until the carmine pink color (purple) appears [7]. Chloride ions are determined by the volumetric method with 5 ml of HNO_3 6N, 10 ml of $AgNO_3^{-}$, 1 ml of ferric alum and titrate with thiocyanate until the orange-red color appears. Carbonates are determined by the volumetric method with H2SO4 (N/50). The Piper diagram was used torepresent the hydro-chemical facies of the groundwater in the area. The chemical quality of water directly affects the yield of agricultural land and the preservation of soil, to this end and given that, thewatershed of wadi Saf-Saf is agricultural. A chemical study of water for irrigation was conducted to highlight the danger that can present certain chemical elements for plants and soil.

RESULTS AND DISCUSSION

Aquifer System Identification

It was found that the knowledge of aquifer horizons allowing the establishment of relationships between geology and groundwater. The plain of Skikda is characterized by the existence of two superimposed layers of unequal importance [8]. These two layers are separated by a resistant horizon more or less clayey. The first layer of Quaternary age is essentially constituted of finer elements (sand) with a thickness varying between 8 to 30 m [9], rests on an impermeable clayey substratum. It is in relation with the surface. The alimentation of this water table is carried out on the one hand by the abundant atmospheric precipitations of the wet season, which constitute the principal source and onthe other hand of the hydrographic network in particular the wadis of Zremna and Saf-Saf.

The deep water table of the Tertiary is a captive water table, located below the surface water table. It consists of pudding, sandstone and conglomerates [8]. The feeding of the gravelly water table is carried out from the vertical flows coming from the draining of the superficial water table in the semi- permeable areas in the south with the change of facies by clayey-sandy rock, by the effective precipitations on the zone of alimentation and by the hydrographic network such as Saf-Saf wadi and Zramna wadi [9].

Piezometry

The piezometric map of the surface water table is based on data from 30 wells located in the downstream part of the Saf-Saf watershed (Figure 02). The flow of water from the surface is generally

South-North towards the sea with some peculiarity of which the spacing of the piezometric curves increases going from South to North due to the fast flow in the South, which becomes slower in the North.
The piezometric map (Figure 02) shows that the southern part is distinguished by concentric and very tight piezometric curves. This translates a strong hydraulic gradient of 9.10^{-3} hence a low permeability. The direction of flow is generally in all directions with the appearance of an alimentation zone south of Beni Béchir.
Whereas in the northern part, the piezometric curves are spaced, indicating a low hydraulic gradient of $2.4.10^{-3}$. It is a more permeable area whose arrows showing the direction of flow are oriented towards the surface course (Wadi Saf-Saf); this indicates that the wadi drains the water table during the dry period.

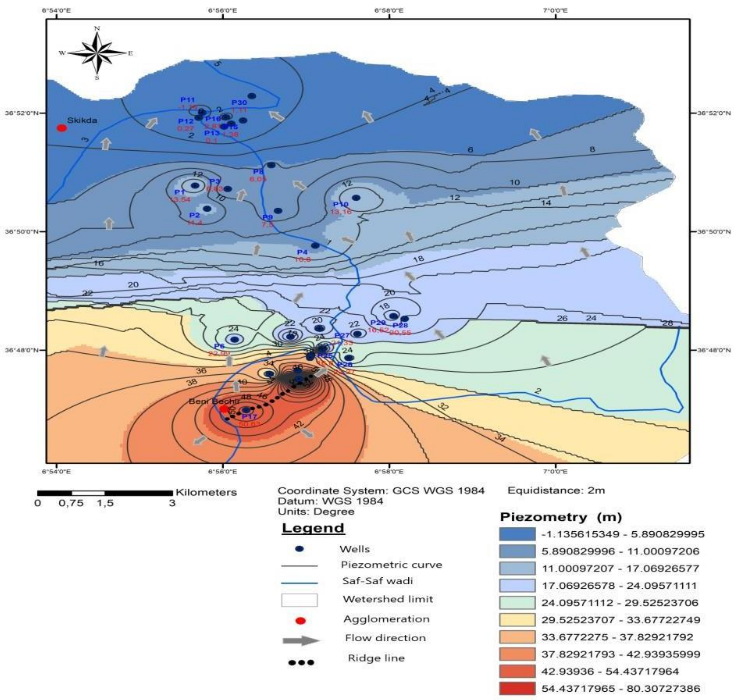

Figure 2. Piezometric map of the lower Saf-Saf valley (September 2020 period)

Sample Analysis
The qualitative study of the groundwater of the surface (Table 1) was revealed by a physicochemical analysis of the water sampled at 15 wells. It appears that the temperature of the water varied between 17°C and 25°C. According to the Algerian standards, the majority of these samples analysed have high conductivity contents ranging from 541µ/cm -5330µ/cm that reflects a strong mineralisation. It is due to the existence of certain chemical elements in high concentration (HCO3-, Cl- and Na+) caused by the dissolving of crossing soils (carbonated rock, saliferous formations, clay) or by marine invasion, notably in the Western North[10]. From a spatial point of view, the distribution of conductivities is heterogeneous, increasing with the direction of flow. The results of the chemical analyses (Table 1) show that the sodium and potassium content varies between 43.47 mg/l and 323.38 mg/l, the high values are represented by the wells (P7, P8, P1, P2) which are located in the NW. Calcium and magnesium contents vary respectively from 6.41mg/l, 154.71 mg/l and 15.36mg/l, 85.68mg/l. The
spatial distribution of these two elements shows that the high contents are located in the northern part. The chloride and bicarbonate contents vary between 23.43 mg/l, 333.7mg/l and 109.8mg/l, 695.4mg/l.

Table 1. Chemical analysis results (September 2020).

N° of Well	T °C	pH	Conductivity (μs/cm)	TAT °F	TH °F	Ca^{++} (mg/l)	Mg^{++} (mg/l)	Na^{+}+K^{+} (mg/l)	$HCO3^{-}$ (mg/l)	$SO4^{-}$ (mg/l)	Cl^{-} (mg/l)	b.e.i
1	21	6,7	1924	15,7	37,6	56,11	56,52	220,34	191,54	238	319,5	-0,06
2	20	6,9	1962	18	53	74,55	82,44	189,06	291,58	242	319,5	0,09
3	19	7	2760	16,1	39,2	60,92	57,48	220,8	196,42	260	312,4	-0,09
4	22	7,4	827	28	30,8	96,19	16,2	43,47	341,6	86	23,43	-1,86
5	21	9,2	1088	30,7	8	6,41	15,36	143,06	374,54	42	28,4	-6,78
6	24	7,5	1743	26,2	46,6	97,8	53,16	171,12	319,64	193	266,2	0,01
7	24	7,3	5330	57	74,4	154,71	85,68	321,08	695,4	386	333,7	-0,49
8	22	7,4	2200	48	30,8	88,98	20,52	232,38	585,6	193	234,3	-1,13
9	25	7,8	1302	9	14,8	32,87	15,84	117,99	109,8	18,5	209,4	0,13
10	21	8,4	2690	21,5	31	58,52	39,24	283,59	262,3	270	305,3	-0,43
11	21	7,5	3180	26,1	54,8	102,6	69,96	221,26	318,42	363	276,9	-0,23
12	21	8,4	1496	12	32	60,92	40,2	80,96	146,4	140	163,3	0,23
13	22	7,6	1292	13	35	78,56	36,84	66,01	158,6	80	198,8	0,49
14	17	7,2	541	14,8	18	36,07	21,55	60,95	180,56	18,5	102,9	0,09
15	21	6,9	4330	39,1	31,4	48,1	46,56	290,03	477,02	80	333,7	-0,34

Explanations: TH: hydrotimetric degree, TAT: total alkalinity titration, b.e.i: Base Exchange index. Source: own study

The majority of the well waters analysed have a Base Exchange index (b.e.i) lower than 0, this is due to the disintegration of the crystallophyllous soils in our area. The rest of the waters have an exchange index higher than 0 because of the lithological nature of the grounds which is sedimentary (sand, sandstone and alluvium). To determine the chemical facies of the groundwater, the data from the chemical analyses of the sampling campaign during the period September 2020 were represented on the piper diagram. The representation of the water points on the triangular diagram allows to identification two main types of chemical facies:

[1] Sodium and potassium chloride waters.

[2] Sodium and potassium bicarbonate waters.

The most dominant facies is the sodium chloride with a rate of 60% of the total samples analysed, which confirms the influence of the lithology on the water chemistry [4].

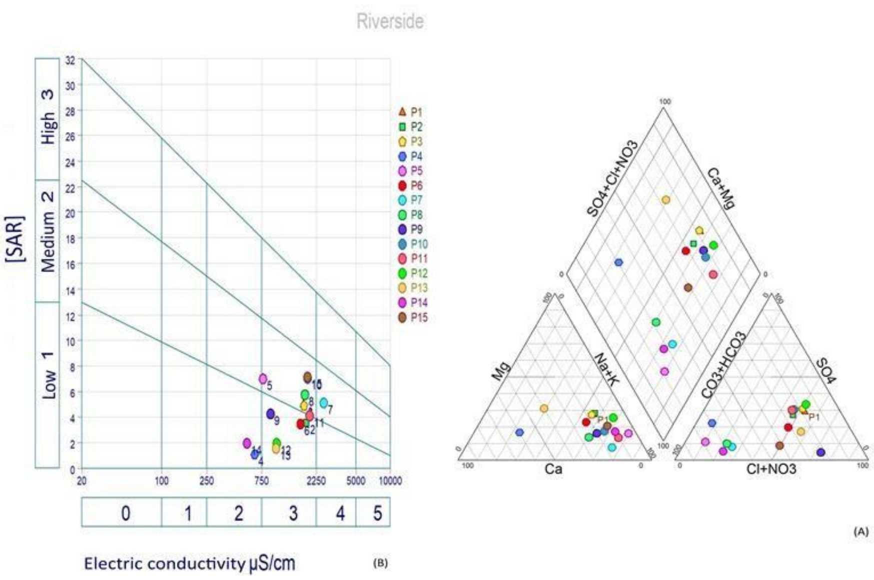

Figure 3. (A) Piper classification, (B) SAR diagram

To define the drinkability of the studied waters, we are going to base on norms that have been

established by the World Health Organization (W.H.O.), the drinkability of the waters of our studyarea is varied between very good (P4, P5, P8, P9, P1) to not potable (P2, P3, P6, P7, P10, P11, P15).
Salt-laden water can pose a risk to irrigation, and this risk is determined using the absorbable sodium value. The representation of the test samples on the Riverside diagram shows three states of use according to the classification of the water by degree of suitability for irrigation by the sodium Absorption Ration method:

- 2 samples (13.34%): in general, water that can be used without control in particular for the irrigation of plants moderately tolerant to salts on soil.
- 12 samples (80%): in general, water suitable for irrigation of salt tolerant crops on well drained soil. However, the evolution of salinity must be monitored.
- 1 sample (6.66%): highly mineralized water that may be suitable for the irrigation of certain salt-tolerant and well-drained species.

The waters of our study area generally present a medium high salinisation due to their proximity to the sea, with a low danger of alkalinisation**.**

CONCLUSIONS

This hydrogeological study deals with the downstream part of the Saf-Saf watershed, which is one of the coastal sub-basins of Constantine, central to the Algerian Northeast. The hydrogeological data have highlighted the existence of two superimposed layers of unequal importance: the first sandy surface of the quaternary, it is in relation with the surface and the other deep gravelly. These two layers are separated by a more or less clayey resistant horizon. The alimentation of this system is generally done either by the atmospheric precipitations of the wet season or by the floods of the wadis.The examination of the piezometric map shows that the Saf-Saf wadi drains the surface water table during the low water period (September 2020) with a flow direction that is generally from south to north. The hydraulic gradient decreases from south to north with a high value of 9.10-3 in the southernpart at the level of Beni Béchir, while the value is low in the north at 2.10-3. The qualitative study of groundwater shows that the most dominant chemical facies in the lower Saf-Saf valley is sodium chloride. The drinkability of these waters is not potable to very good according to WHO standards, which presents a health risk, but they are admissible for irrigation. The chemical analysis of the study area shows that the groundwater has high values of conductivity, due to the existence of certain chemical elements with high findings (HCO_3^-, Cl^- and Na^+); this excess is due to the marine invasion.

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FORAMINIFERS AS POLLUTION BIO-INDICATOR AT AL HARIQA OIL HARBOUR OF TOBRUK, LIBYA

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Abstract: *The main objective of this work is to use foraminifera as a pollution bio indicator at Al Hariqa Oil Harbour in Tobruk, northeast Libya. Ten beach sediments samples have been collected and analyzed to define and examine their foraminiferal contents. About ninety-six abnormal foraminiferal tests out of total 1220 picked foraminiferal tests have been encountered in this study. Selected specimens were analyzed and micro-photographed by Scanning Electron Microscope to highlight their morphological variations. The abnormalities in the encountered foraminiferal tests are largely in form of: i) corrosion, smoothing and polishing of test surfaces due to post-morten action which may attribute to water chemistry. ii) coil twisting, deformed chamber size, disturbed suture, dislocated aperture and twinned individuals, which are attributed to high concentration ofheavy metals such as Cadmium and Lead in the studied samples. However, the dirty black or brown colors are also documented on some tests, which may attribute to the reducing conditions as a result of human and industry-related drained wastes respectively.*

Keywords*: bioindicators, heavy metals, pollution, foraminifera, Libya*

INTRODUCTION

The pollution of marine water by anthropological domestic and industrial wastes becomes a major field of researching activity. Several studies on foraminifers were dealt with using benthic foraminifers in detecting the impact of the pollution with heavy metals in marine ecosystem, some of these studies [1, 2, 3, 4, 5, 6]. Morphological deformities of benthic foraminiferal tests in response to pollution by heavy metals proved as well to be useful in studies related to pollution monitoring. [3, 4, 5, 7] were used the "deformation" for abnormalities formed during life of the individual. The foraminiferal test abnormalities can be used to detect high concentration of heavy metals in sea water, this is supported by many studies in world including Libya (e.g., [2, 3, 4, 5, 8]).
The foraminifers have many applications in paleoclimatic and paleo-environmental determination, also it can be used to detect the pollution in marine water by recording the degree of morphological deformities of their tests because of their sensitivity to pollution in different forms and degrees. Test deformities have been linked to a number of environmental factors [2] such as change in temperature, reduced or elevated salinity, lack or overabundance of food, type of substrate, low dissolved oxygen content, insufficient light, and high concentration of heavy metals in area. This is confirmed by many worldwide studies e.g., [8, 9] including Libya e.g. Muftah, [5].
The morphological abnormalities are features occurring among benthic foraminifers, in both cold and warm water [2]. The well-known reasons for abnormalities as proved from experimental studies were salinity [7], acidification [10], food supply [11], and elevated levels of heavy metals [8], low oxygen [12, 13]. The test abnormalities for environmental pollution assessment must be considered in the

instable environments [14].

The presence of abnormal tests is a sign of natural environmental stresses, e.g., changes in ecological parameters [15], extreme environmental conditions [16] or pollution [17], for a long time, it has been difficult to distinguish between abnormalities resulting from natural or anthropogenic stresses. Yanko et al [2] found out that the abnormal (deformed) specimens contain much greater values of Cu and Zn than non-deformed specimens.

Samir and El-Din [18] pointed out those tests with twisted, compressed, and abnormal growth characterized by higher values of heavy metals than forms with protuberances. In order to recognize the probable effects of pollution on Al Hariqa Oil Harbour, ten beach sediments have been collected and analyzed to define and examine their foraminiferal contents. The harbour may receive the pollution from oil tankers by many ways, in particular, oil spill during tanker loading, spillage from the bunker manifold valves or from corrosion of the line and remove water and unwanted sediments, and water balance.

LOCATION

There are six oil exporting harbours in Libya namely; Al Zawia, Al Sidra, Ras Lanuf, Al Breqa, Al Zwitina and Al Hariqa. They may subjected to various levels of oil effects on the components of ecosystem either abiotic such as sea water and beach sediments or biotic components such as micro and macro organisms. At the Al Hariqa harbour, three stations located at coastal part of the Tobruk Gulf, NE Libya (Fig. 1) are subjected to sampling for this study. The Al Hariqa Oil harbour, which is located in Tobruk city is crowded with oil tankers, this problem encourage us to investigate and monitor this active harbour. The coastal water needs close investigation and attention because it is the only marine environments in contact with human activity (swimming, fishing etc.) as well as other biological productivity of marine organisms. This study will draw the attention of the government tooil pollution, and environmental education to people who are not care to this problem.

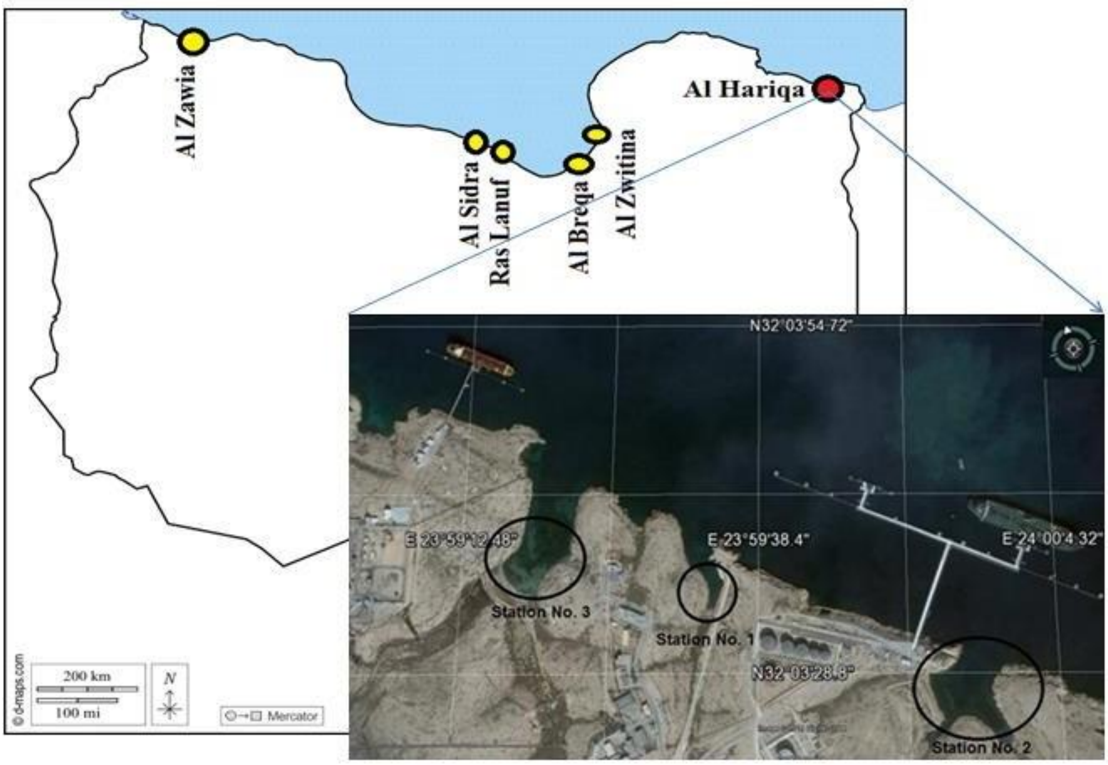


Figure 1. Location map of Libya shows all oil exporting harbors and the Satellite image with studied stations at Al Hariqa harbor in Tubruk.

OBJECTIVES

The objectives of this study are to:
1- Confirm the importance of the benthic foraminifers in detecting the pollution.
2- Sense the coastal environment of Tobruk Oil Harbour by using foraminifers to investigate the pollution from oil tankers.

MATERIALS AND METHODS

Samples were collected from the Al Hariqa harbour, from three stations depending on the nature and topography of the study area (3 to 4 samples of each station). Samples were essentially collected from the coastal nearshore ediments to represent the covered uppermost 30cm of the beach sediments in the sea. Wet samples were washed and sieved through a 63-µm sieve to remove clay and silt.
The residual fraction was dried at 60°C. One thousand two hundred and twenty empty specimens were picked from studied samples. The foraminiferal genera classification is based on [19]. Selected specimens were examined and microphotographed using scanning electron microscopy (SEM). All foraminiferal slides are deposited in the micropaleontology unit of the Department of Earth Sciences, University of Benghazi in Libya.

FORAMINIFERAL STATISTICAL ANALYSIS

The picked foraminifers form the collected samples are mainly representing by empty tests. They are mostly belonging to miliolids "porcelaneous" benthic foraminifers, such as *Peneroplis*, *Quinqueloculina, Triloculina*, *Spiroloculina*, *Sorites*, *Trisegmentina*, and *Adelosina*, with some rotaliids such as *Amphistegina*, *Lobatula* and *Planopulvinulina*.
Tobruk beach sediments from which the foraminifers are retrieved subjected to geochemical analyzed by Mohamed et al. [20] (Table 1).

Table 1. Chemical analysis data (heavy metals in ppm) of the Al Hariqa beach sediments [20].

Sample No.	As	Cd	Cu	Zn	Co	Ni	Cr	Pb	Hg	Se
6	4.50	1.07	291	334	92.24	326	468	73.45	11.77	0.12
9	5.00	1.10	292	335	93.63	337	479	74.82	11.89	0.14
10	4.77	1.09	291	334	92.35	337	479	73.54	11.83	0.11
12	4.70	1.10	291	334	92.36	336	478	73.50	11.80	0.12
13	3.90	1.05	290	333	91.35	335	477	72.54	11.76	0.14
14	3.67	1.02	290	333	91.26	335	477	72.50	11.72	0.14
25	4.78	1.08	292	335	93.44	337	479	74.63	11.82	0.13
35	5.42	1.10	294	337	95.42	339	481	76.61	11.88	0.12
36	5.09	1.09	293	336	94.35	338	480	75.54	11.85	0.12
37	3.92	1.06	290	333	91.46	335	477	72.65	11.73	0.10

The result of the analysis showed the average values of Pb, Cr, As, Cd, Zn, Cu, Hg, Ni, Co and Sewere 73.98, 477.5, 4.58, 1.08, 334.4, 291.4, 11.81, 335.5, 92.79 and 0.12 ppm, respectively. These averages were much higher than the elemental composition of typical uncontaminated soil (10, 25, 1, 0.06, 50, 20, 5, 50, 25 and 0.08 ppm, respectively). As shown in http://www.dsa.unipr.it/phytonet/fertilia/partners/tcan4.htm.
Additionally, the Igeo values of the studied Tobruk beach sediments (As, Cd, Cu, Zn, Co, Ni, Cr, Pb, Hg and Sc) are 2.10, 4.97, 1.79, 1.93, 1.48, 1.48, 1.19, 4.27, 3.00 and 1.14, respectively [20].
The samples show very lightly polluted with Cu, Zn, Co, Ni, Cr and Se (grade 2), lightly polluted with As and Hg (grade 3) and highly polluted with Cd and Pb (grade 5). This study focuses on the deformed tests (Figures 2-5) as response to beach sediments pollution by heavy metals especially Cadmium and Lead that recoded by [20, 21].
Mohamed et al [20] suggested that the heavy metals may came from both domestic wastes and leaked

hydrocarbon from ships, boats, adjacent crude oil reservoirs and the refinery. The investigated foraminiferal assemblage displays indication of pollution due to different anthropogenic activities, such as domestic and / or oil tankers seepages, the leaks is during oil-loading process as proved by the oil impregnated foraminiferal tests.

Additionally tests are contaminated and stained with domestic sewage pollutants as detected by tests filled by organic materials. The fragmented tests have been documented in many retrieved specimens from the examined sediments of the investigated localities, although the fragmentation apart from predation, dissolution is more likely a post-morten signatures resulted from surface wave or sea currents action (Plates I_1, $II_{1,3,7}$, $III_{3,4,8}$).

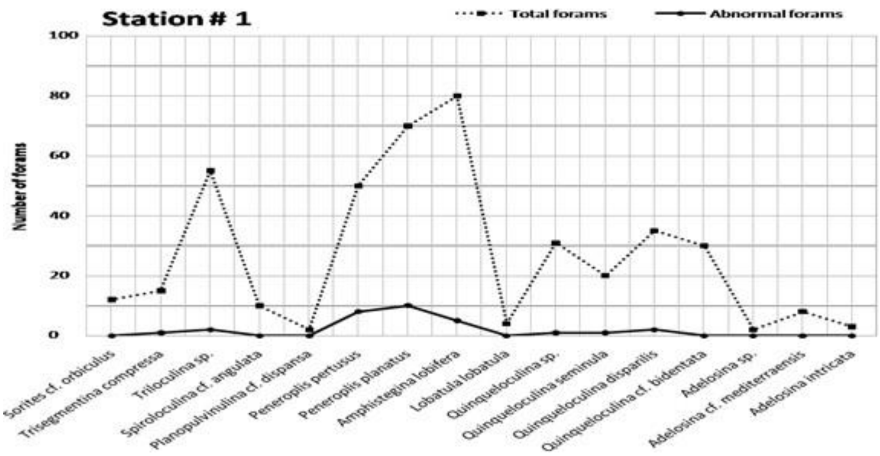


Figure 2. Binary diagram shows number of total versus abnormal foraminifers per 100gm of beach sediments in station No.1 at Al Hariqa oil harbor, NE Libya

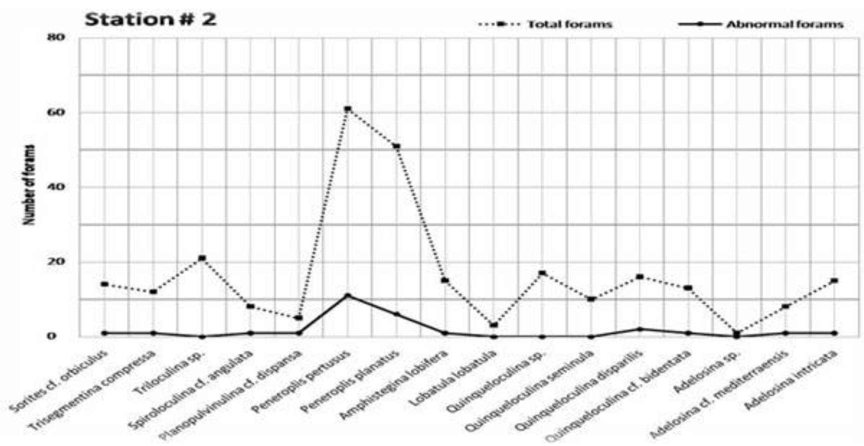


Figure 3. Binary diagram shows number of total versus abnormal foraminifers/100gm of beach sediments in station No. 2 at Al Hariqa oil harbor, NE Libya.

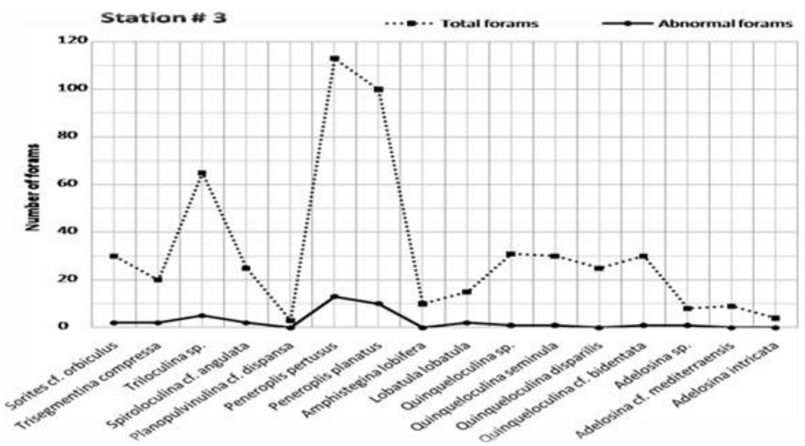


Figure 4. Binary diagram shows number of total versus abnormal foraminifers/100gm of beach sediments in station # 3 at Al Hariqa oil harbor, NE Libya.

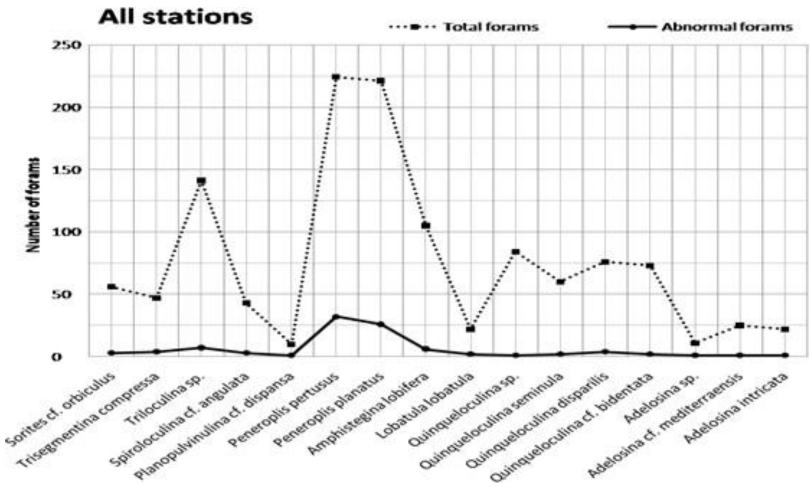


Figure 5. Binary diagram shows number of total versus abnormal foraminefers per 300gm of beach sediments in all stations at Al Hariqa oil harbor, NE Libya

FORAMINIFERAL RESULTS AND DISCUSSIONS

Discoloration of the foraminiferal test: In the investigated area, many post-morten discolored tests (change in normal color from milky to light orange - dark yellow) were observed from all sampled stations and/or partially stained on their surfaces which may attributed to the oil contamination and change in water chemistry. The other possible reason is due to petroleum activities at Al Hariqa harbour, especially in station no. 2. Additionally, the domestic wastes waters reflected as black stainedwithin foraminiferal tests as seen in some collected specimens from the studied station no. 3.

Abundance and Diversity of Foraminifera: The low diversity in living benthic foraminiferal assemblage is highly attributed to the decrease of salinity in brackish water bodies (i.e. the lagoon) El [22, 23] however, in normal marine waters, otherwise is due to increase in heavy metals [18, 24, 25]. Counting of picked foraminiferal tests form 100 grams of each beach sediments sample of studied stations show that the highest diversity and population are recorded at some localities such as station no. 1 (semi isolated water body) and station no. 3 (low current sandy beach). However, the lowest diversity and population are recorded in station no. 2 (open rocky beach), that can be interpreted as result of beach nature and pollution impacts levels at these localities (*see* tables 1-2). For taxonomical details [see 26]. The low diversity in the Manzala lagoon living foraminiferal contents [27] as well in the Burullus Lagoon [23] is more or less agreed with the present study.

P/B Foraminiferal ratio: Nguyen et al, [28]; Boltvoskoy and Totah, [29] confirmed that the decrease in P/B ratio is due to higher rate of dissolution in planktic than benthic assemblages. The foraminiferal tests dissolution lead to decline in foraminiferal diversity, this fact is proved experimentally by [28]. The studied assemblage is predominated by benthic foraminifers with almost lack of planktic foraminifers.

Foraminiferal abnormalities: According to Stouff et al, [7] definition, the malformations are abnormalities that take place during individual ontogeny, whereas deformity occurs during the life of the adult foraminifer. But the morphological abnormality is used when the origin of abnormality is not obvious. Herein, morphological abnormalities are detected, where, sixteen abnormal foraminiferal taxa have been documented (see Table 2 and Figures 2-5), with brief description, and these are:-
***Adelosina intricata*:** Only one abnormal specimen out of 22 from all stations (Plate I-1). The abnormal test with missing of the last part of chamber including aperture was collected from station no.2 (Figure 3). However, the other normal tests are from stations no. 1 and 3 (Figures 2-4). The general abnormality represents about 5% of all stations (Table 2 and Figure 5).

Table 2. Normal and abnormal tests of forams from Al Hariqa oil harbor - Tobruk - NE Libya. (N:Normal -D:Deformed - T:Total - D%: Abnormality percentage)

Species	Station no. 1				Station no. 2				Station no. 3				All stations			
	N	D	T	D%	N	D	T	D%	N	D	T	D%	N	D	T	D%
Adelosina intricata	3	0	3	0	14	1	15	7	4	0	4	0	21	1	22	5
Adelosina cf. mediterraensis	8	0	8	0	7	1	8	13	9	0	9	0	24	1	25	4
Adelosina sp.	2	0	2	0	1	0	1	0	7	1	8	13	10	1	11	9
Quinqueloculina cf. bidentata	30	0	30	0	12	1	13	8	29	1	30	3	71	2	73	3
Quinqueloculina disparilis	33	2	35	6	14	2	16	13	25	0	25	0	72	4	76	5
Quinqueloculina seminula	19	1	20	5	10	0	10	0	29	1	30	3	58	2	60	3
Quinqueloculina sp.	30	1	31	3	17	0	17	0	36	0	36	0	83	1	84	1
Lobatula lobatula	4	0	4	0	3	0	3	0	13	2	15	13	20	2	22	9
Amphistegina lobifera	75	5	80	6	14	1	15	7	10	0	10	0	99	6	105	6
Peneroplis planatus	60	10	70	14	45	6	51	12	90	10	100	10	195	26	221	12
Peneroplis pertusus	42	8	50	16	50	11	61	18	100	13	113	12	192	32	224	14
Planopulvinulina cf. dispansa	2	0	2	0	4	1	5	20	3	0	3	0	9	1	10	10
Spiroloculina cf. angulata	10	0	10	0	7	1	8	13	23	2	25	8	40	3	43	7
Triloculina sp.	53	2	55	4	21	0	21	0	60	5	65	8	134	7	141	5
Trisegmentina compressa	14	1	15	7	11	1	12	8	18	2	20	10	43	4	47	9
Sorites cf. orbiculus	12	0	12	0	13	1	14	7	28	2	30	7	53	3	56	5
Total population of studied species	427 / 100 grams				270 / 100 grams				523 / 100 grams				1220 / 300 grams			
Normal individuals of studied species	397 / 100 grams				243 / 100 grams				484 / 100 grams				1124 / 300 grams			
Abnormal individuals of studied species	30 / 100 grams				27 / 100 grams				39 / 100 grams				96 / 300 grams			
Abnormality % of studied species	7%				10%				7%				8%			

Adelosina* cf. *mediterraensis: Only one abnormal specimen out of 25 from all stations (Plate I-2). The abnormal test with termination of costae at upper half of test (the present of striation only restricted in the lower part of test) was reported only in specimen from station no.2 (Figure 3). However, the other normal tests are from stations no. 1 and 3 (Figures 2-4). The general abnormality represents about 4% of all stations (Table 2 and Figure 5).
Adelosina sp.: Only one abnormal specimen out of 11 from all stations (Plate I-3). Only abnormal test with smoothing of external surface and partial etching was collected only from station no.3 (Figure 4) these post-morten phenomena are more likely related to sea water chemistry. However, the other normal tests are from stations no. 1 and 2 (Figures 2-3). The general abnormality represents about 9%

of all stations (Table 2 and Figure 5). El-Din et al, [22, 27] and Orabi et al, [23] refer the low living benthic foraminiferal content and low number of *Adelosina* sp. in the Egyptian Manzala lagoon and the Burullus Lagoon respectively to the decrease in salinity, which is in agreement with the present study result.

Quinqueloculina* cf. *bidentata: Only two abnormal specimens out of 73 from all stations (Plate I-4). The abnormal specimens with partial dissolution of outer surface were collected from stations no. 2 and 3 (Figures 3-4). However, the other normal tests are from station no. 1 (Figure 2). The general abnormality represents about 3% of all stations (Table 2 and Figure 5).

Quinqueloculina disparilis: Four abnormal specimens out of 76 from all stations (Plate I -5,6). The abnormal tests with eroded aperture, etched or corroded test, as well as lack of ornamentation in earlier chambers of last whorl were collected from stations no.1 and 2 (Figures 2-3). However, the other normal tests are from station no. 3 (Figure 4). The general abnormality represents about 5% of all stations (Table 2 and Figure 5).

Quinqueloculina seminula: Only two abnormal specimens out of 60 from all stations (Plate I-7). The abnormal tests with slightly disturbed sutures were collected from stations no.1 and 3 (Figures 2-4). However, the other normal tests are from station no. 2 (Figure 3). The general abnormality represents about 3% of all stations (Table 2 and Figure 5).

***Quinqueloculina sp.*:** Only one abnormal specimen out of 92 from all stations. This rare twinned test has been detected on this species, five chambers and two apertures in the visible side of tests. The abnormal specimen was collected from station no. 1 (Figure 2). However, the other normal tests are from stations no. 2 and 3 (Figure. 3-4). The general abnormality represents about 1% of all stations (Table 2 and Figure 5).

***Lobatula lobatula*:** Only two abnormal specimens out of 22 from all stations (Plate II-1, 2, 3). The abnormal tests with corroded chambers and abnormal test surface were collected from station no. 3 (Figure 4). However, the other normal tests are from stations no. 1 and 2 (Figures 2-3). The general abnormality represents about 9% of all stations (Table 2 and Figure 5).

Amphistegina lobifera: Six abnormal specimens out of 105 from all stations. **(**Plate II- 4, 5)**.** The abnormal tests with corroded chambers were collected from stations no. 1 and 2 (Figures 2-3). However, the other normal tests are from station no. 3 (Figure 4). The general abnormality represents about 6% of all stations (Table 2 and Figure 5).

Peneroplis planatus: Twenty-six abnormal specimens out of 221 from all stations **(**Plate II- 6, 7)**.** The abnormal tests with slightly twisted last portion of test, corroded chamber with coiling and chamber size problem were collected from all stations (Figures 2-4). The general abnormality represents about 12% of all stations (Table 2 and Figure 5).

Peneroplis pertusus: Thirty-two abnormal specimens out of 224 from all stations (Plate III- 1, 2, 3, 4, 5, 6)**.** The abnormal specimens represented by one or more of the following:

1) Coil problem in last chambers (twisted) of the last formed whorls of the test.
2) Destruction of test due to dissolution.
3) Chamber size problem.
4) Partially serrated suture.

The abnormal specimens were collected from all stations (Figure. 2-4). The general abnormality represents about 14% of all stations (Table 2 and Figure 5).

Planopulvinulina* cf. *dispansa: Only one abnormal specimen out of 10 from all stations (Pate III- 7). The abnormal specimens represented by incomplete test (i.e. the last part of the test is partially corroded) was collected from station no. 2 (Figure 3). However, the other normal tests are from stations no. 1 and 3 (Figures 2-4). The general abnormality represents about 10% of all stations (Table 2 and Figure 5).

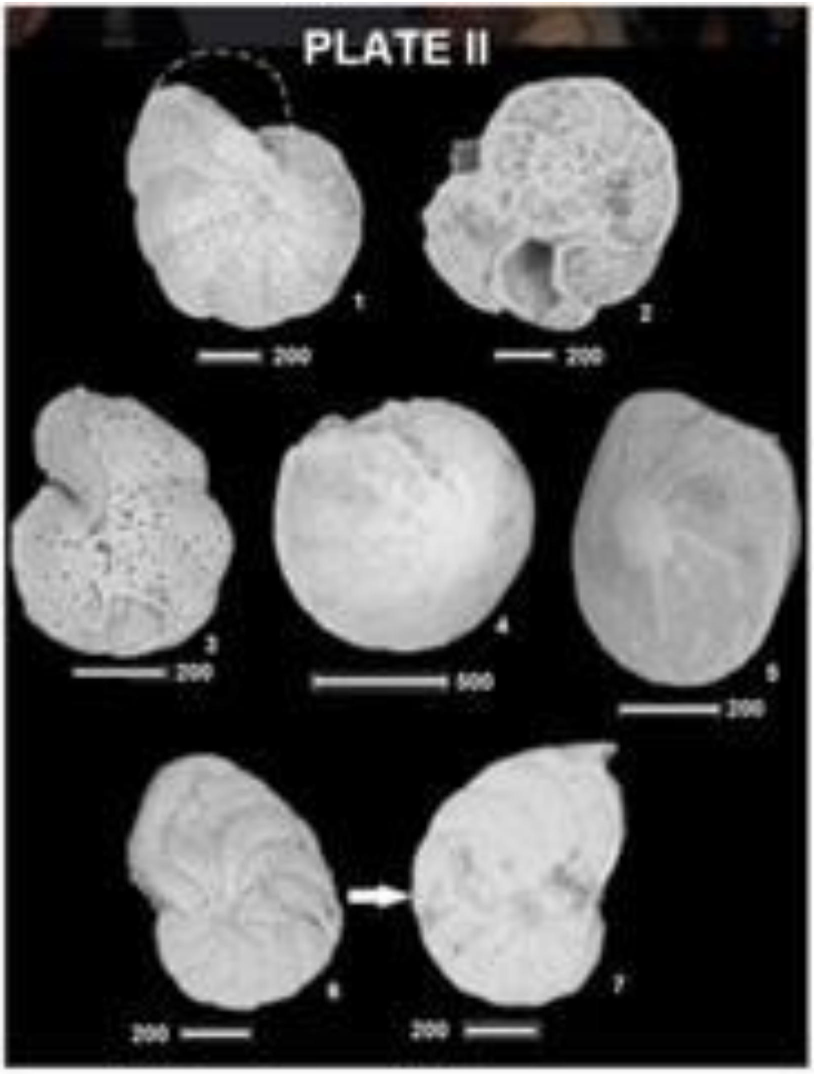
Spiroloculina* cf. *angulata: Three abnormal specimens out of 43 from all stations (Plate III -8). The abnormal specimens with margin's etching were collected from stations no. 2 and 3 (Figures 3-4). However, the other normal tests are from station no. 1 (Figure 1). The general abnormality represents about 7% of all stations (Table 2 and Figure 5).

Triloculina sp.: Seven abnormal specimens out of 141 from all stations. The abnormal specimens with dislocated and slightly twisted aperture were collected from stations no. 1 and 3 (Figures 2-4). However, the other normal tests are from station no. 2 (Figure 3). The general abnormality represents about 5% of all stations (Table 2 and Figure 5).

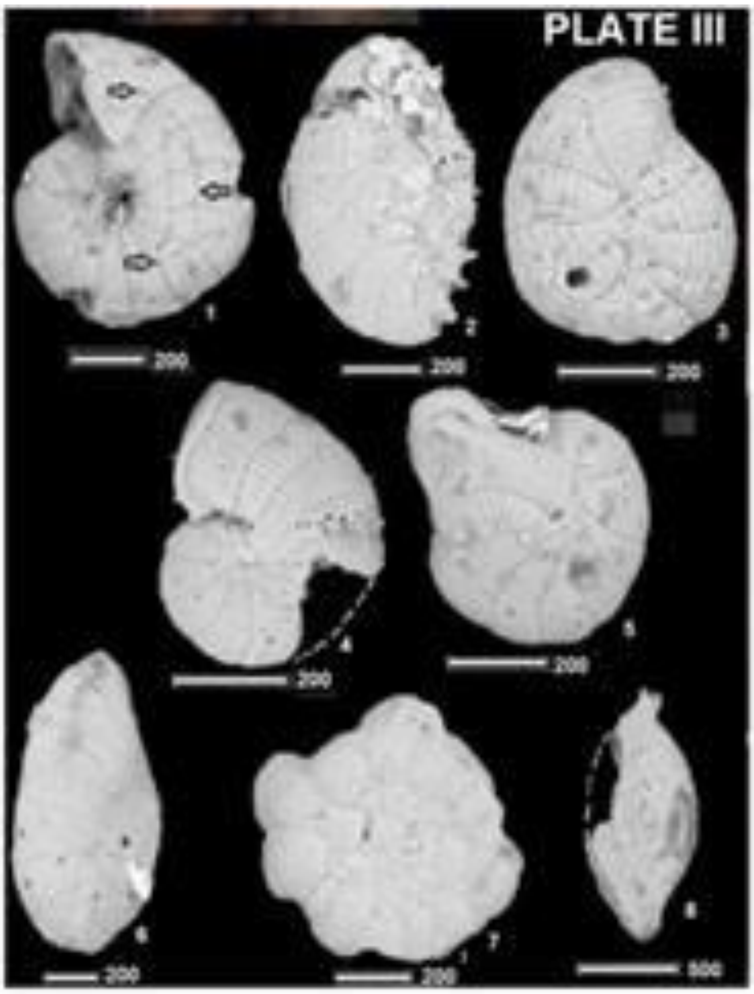
Trisegmentina compressa: Four abnormal specimens out of 47 from all stations. The abnormal test with deformed last chamber was collected from all stations (Figures 2-4). The general abnormality represents about 9% of all stations (Table 2 and Figure 5).

***Sorites* cf. *orbiculus*:** Three abnormal specimens out of 56 from all stations. The abnormal twisted tests were collected from stations no. 2 and 3 (Figures 3-4). However, the other normal tests are from station no. 1 (Figure 2). The general abnormality represents about 5% of all stations (Table 2 and Figure 5).

EXPLANATION OF PLATE I (Bar scale is in µm): Example of SEM photographs for deformed forams collected from studied stations at Al Hariqa crude oil exporting harbor, Tobruk - NE Libya. (1): Fragmented *Adelosina intricata* shows missing part of the last formed chamber including aperture, Station no.2. (2): *Adelosina* cf. *mediterraensis* abnormal test shows termination of costae at upper half of test, station no.2. (3): *Adelosina* sp. abnormal test shows smoothing of external surface and partial pitting, station no. 3. (4): *Quinqueloculina* cf. *bidentata* shows corroded test, Station no.3. (5-6): *Quinqueloculina disparilis*. 5 shows eroded aperture, Station no.2. 6 shows ornamentation missed in earlier chambers of last whorl, fragmentation is also featured, Station no.1. (7): *Quinqueloculina seminula* shows slightly disturbed suture, Station no.3.



EXPLANATION OF PLATE II (Bar scale is in µm): Example of SEM photographs for deformed foraminifers collected from studied stations at Al Hariqa crude oil exporting harbor, Tobruk - NE Libya. (1-3): *Lobatula lobatula*. 1 Ventral view shows collapsed chambers, 2 Dorsal view shows corroded chamber. 3 Ventral view shows abnormal test surface, Station no.3. (4-5): *Amphistegina lobifera* ventral and dorsal view shows corroded last chambers, Station no.2. (6-7): *Peneroplis planatus*. 6 Shows slightly twisted last portion of test. 7 Shows corroded chamber with coiling and chamber size problem (arrowed), Station no.1.



EXPLANATION OF PLATE III (Bar scale is in µm): Example of SEM photographs for deformed forams collected from studied stations at Al Hariqa crude oil exporting harbor, Tobruk - NE Libya. (1-6): *Peneroplis pertusus*.
1 Shows coil problem in early portion of the last formed whorl of the test and microboring activities (arrowed).
2 Half of the last whorl eroded.
3 Chamber size problem and some etching signs.
4 Corroded chamber, microzigzaged and highly serrated suture.
5 Deformed last part of test including aperture.
6 Reduced size of last chamber, Station no.1 and 3.
(7): *Planopulvinulina* cf. *dispansa* shows partially eroded last part of test, Station no.2.
(8): *Spiroloculina* cf. *angulata* shows peripheral etching, Station no. 2.

CONCLUSIONS

Ninety-six abnormal foraminiferal tests out of 1220 have been encountered in this study. The abnormalities of foraminiferal tests in the studied area include: coil twisting, deformed chamber size, disturbed suture, smoothing and polishing of some test surfaces, dislocated aperture and twinned individuals as well as dissolution or corroded tests. In addition to a dirty black or brown color are also noticed on some tests. This is attributed to the reducing conditions due to human and industry-related drained wastes. The diversity was low in some localities which may attribute to pollution by oil; this is slightly applied to station no. 2. Absence of agglutinated foraminifers is also attributed to polluted water [30]. However, the documented foraminiferal abnormalities in the studied area are more likely linked to some degree of pollution such as the high concentration of some heavy metals, which have been recorded in the geochemical analyzed of the coastal sea water, molluskan shells and beach sediments samples from the same studied localities [21]. Accordingly, the heavy metals which drained from both domestic wastes and leaked hydrocarbon from ships, boats and the refinery may be considered as the possible sources. On the other hand, the examined foraminiferal assemblage shows that a high percentage of the tests display post morten test corrosion (dissolution) along their periphery, or on the surface, due to change in water chemistry or wave and current transportation.

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OIL POLLUTION IN THE PORT OF BENGHAZI CITY, NE LIBYA

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Abstract: *This work represents the first comprehensive survey of polycyclic aromatic hydrocarbons (PAHs) in beach sands of the Port of Benghazi city northeast Libya. The analysed PAHs are originated mainly from pyrolytic sources. The carcinogenic PAHs such as benzo [a] anthracene (BaA), chrysene (Chr), benzo [b] fluoranthene (BbF), benzo [k] fluoranthene (BkF), benzo [a] pyrene (BaP), Dibenzo [a,h] anthracene (DahA) and indeno [1,2,3-cd] perlyene (IP) are observed in all samples. The risk evaluation revealed the exceedingly high environmental risk of PAHs in the beach sands.*

Keywords: *Aromatic Hydrocarbons, environment, Libya, Oil Pollution, Polycyclic, Port of Benghazi.*

INTRODUCTION

Benghazi city is located in northeast of Libya; it is the second largest city in Libya. The Port of Benghazi (32° 6′ 33″ N 20° 2′ 51″ E, Figure 1) is a major seaport in the city. There are three main sources of pollution in the port, namely oil (ship fuel), sewage disposal and paints. The aim of this work is to assess the oil pollution in the Port of Benghazi. To achieve this goal, we evaluated thelevels of polycyclic aromatic hydrocarbons (PAHs) in the beach sands of the port. The port is clearly contaminated with oil (Figure 2).

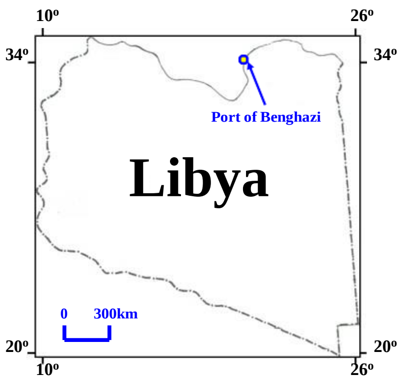

Figure 1.: Location map of the Port of Benghazi.

Figure 2.: Oil pollution in the Port of Benghazi.

On the basis of published papers, we believe that this study is the first evaluation of PAHs in the Port of Benghazi. There are some studies on PAHs in other areas of Libya (e.g., Bonsignore et al., 2018; Alsarawi, 2021). However, most of the pollution studies on the Libyan coast have focused on heavy metals (e.g., Hamouda and Wilson, 1989; Shaltami, 2012, 2014, et al., 2019).

METHODOLOGY

Three samples were collected from the studied sands. We took the samples from a depth of 30 cm. The samples were stored at -20°C until analysis. Identification of PAHs were done using HPLC (Perkin Elmer series 200) with photodiode array detector. The analysis was carried out in the StratoChem in Egypt.

RESULTS AND DISCUSSION

1. Levels of PAHs

Table 1 shows the concentrations of PAHs in the studied sands. The carcinogenic PAHs (BaA, Chr, BbF, BkF, BaP, DahA, and IP) are detected in all samples. There is a large difference in the concentrations of individual PAHs (e.g., Flu ranges from 635.61 to 5892.82 ng/g) and total PAHs (44073.19-*75580.65* ng/g). However, the highest concentration of total PAHs is recorded in sample b2. There are four groups of relative pollution level, namely low (0-100 ng/g), moderate (100-1000 ng/g); high (1000-5000 ng/g); and very high (>5000 ng/g) (Baumard et al., 1998). Obviously, the pollution level in the studied sands is very high. The composition patterns of PAHs by ring size in the studied sands are presented in Figure 3.

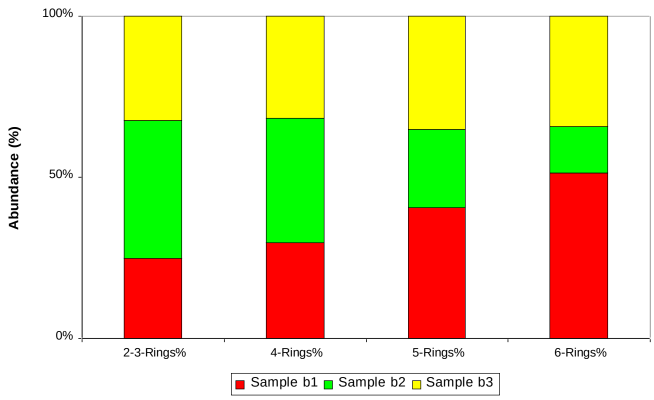

Figure 3.: Distribution of PAHs in the beach sands of the Port of Benghazi according to the number of aromatic rings

Table 1. Concentration of PAHs (ng/g) in the beach sands of the Port of Benghazi

Parameters	Sample No.		
	b1	b2	b3
Nap	2520.40	16103.33	2109.52
A	521.55	1301.42	7971.91
Ace	5743.55	4631.52	7441.50
Phe	722.19	1193.14	202.93
F	462.00	639.54	739.64
Ant	922.91	8291.64	784.48
Total 2- to 3-Ring	10892.60	32160.59	19249.98
Flu	635.61	5892.82	1870.45
Pyr	701.76	8482.76	2500.34
BaA	1834.87	1775.30	1993.77
Chr	6220.20	4720.98	7304.64
Total 4-Ring	9392.44	20871.86	13669.20
BbF	804.70	359.50	910.08
BkF	18443.51	19402.67	22011.71
BaP	589.67	483.54	660.92
DahA	1011.43	899.97	1009.74
Total 5-Ring	20849.31	21145.68	24592.45
BP	2253.17	1073.78	2413.90
IP	685.67	328.74	255.94
Total 6-Ring	2938.84	1402.52	2669.84
Total PAHs	44073.19	75580.65	60181.47

Source of PAHs

There are two sources of PAHs in marine sediments, namely pyrogenic and petrogenic. In general, petrogenic substances include crude oil and refined crude oil products such as gasoline, heating oil, asphalt, and coal. Pyrogenic substances are complex mixtures of primarily hydrocarbons produced from organic matter subjected to high temperatures but with insufficient oxygen for complete combustion.

Pyrogenic PAHs are produced by fires, internal combustion engines, and furnaces. They also are formed when coke or gas are produced from coal or oil. Coal-tar based products, such as roofing, pavement sealers, waterproofing, pesticides, and some shampoos contain pyrogenic PAHs (Lingle, 2008).

Pyrolytic PAHs are characterized by compounds with four or more aromatic rings, whereas petrogenic PAHs contain only two or three aromatic rings (Wang et al., 2010).

The ratios of low molecular weight PAHs (LMW) to high molecular weight PAHs (HMW), Phe/Ant, Flu/(Flu+Pyr) and BaA/(BaA+Chr) were used to identify the source of PAHs in the studied sands. Sediments with low values of LMW/HMW and Phe/Ant (<1 and <10, respectively) indicate pyrolytic sources, whereas high values of LMW/HMW and Phe/Ant (>1 and >10, respectively) is typical of petrogenic source (Ahmed et al., 2017).

In this study, the LMW/HMW and Phe/Ant ratios (Table 2) suggest that pyrogenic sources are the main origin of the analyzed PAHs (Figures. 4 and 5). Moreover, the binary diagrams (Figures. 6 and 7) indicate the dominant of liquid fossil fuel combustion.

Table 2. Isomeric ratio of PAHs in the beach sands of the Port of Benghazi

Parameters	Sample No.		
	b1	b2	b3
LMW	10892.60	32160.59	19249.98
HMW	33180.59	43420.06	40931.49
LMW/HMW	0.33	0.74	0.47
Phe/Ant	0.78	0.14	0.26
Flu/(Flu+Pyr)	0.48	0.41	0.43
BaA/(BaA+Chr)	0.228	0.273	0.2144

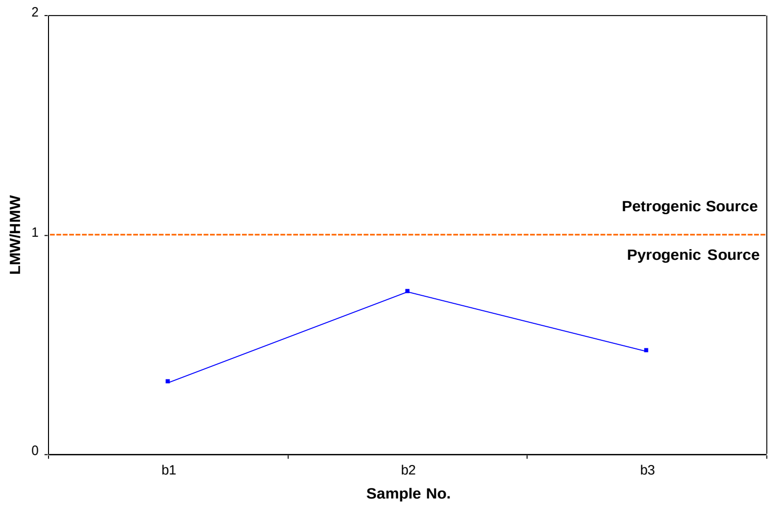

Figure 4.: Binary diagram showing the source of PAHs in the beach sands of the Port of Benghazi (fields after Ahmed et al., 2017).

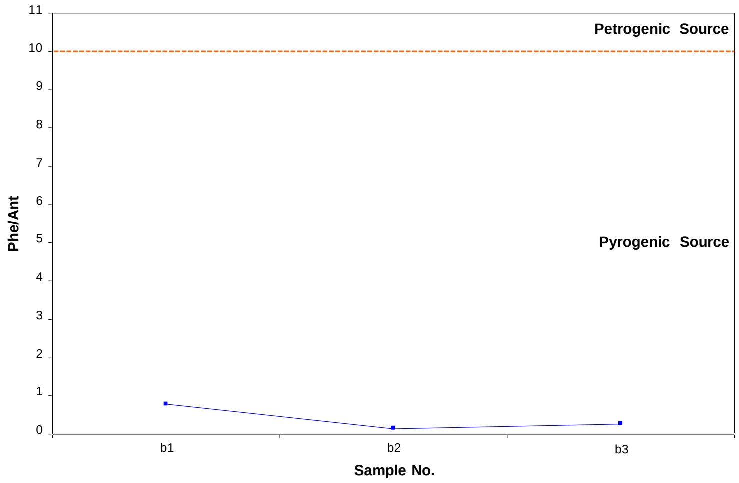

Figure 5.: Binary diagram showing the source of PAHs in the beach sands of the Port of Benghazi (fields after Ahmed et al., 2017).

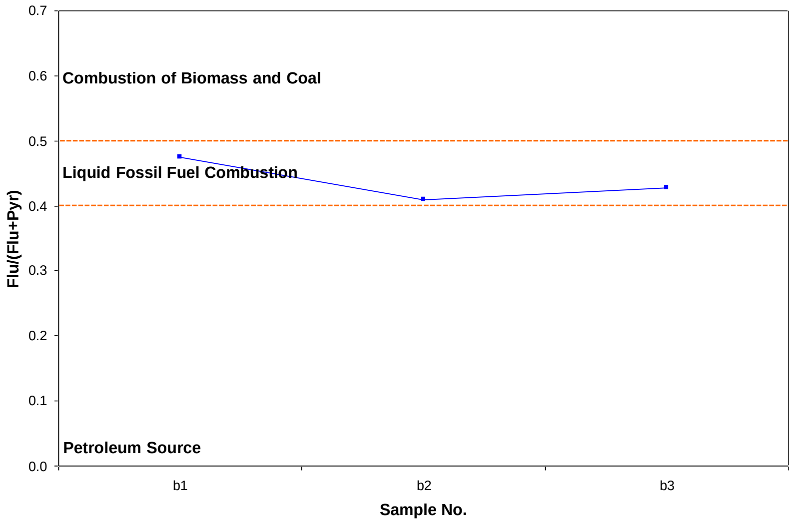

Figure 6.: Binary diagram showing the source of PAHs in the beach sands of the Port of Benghazi (fields after Yunker et al., 2002).

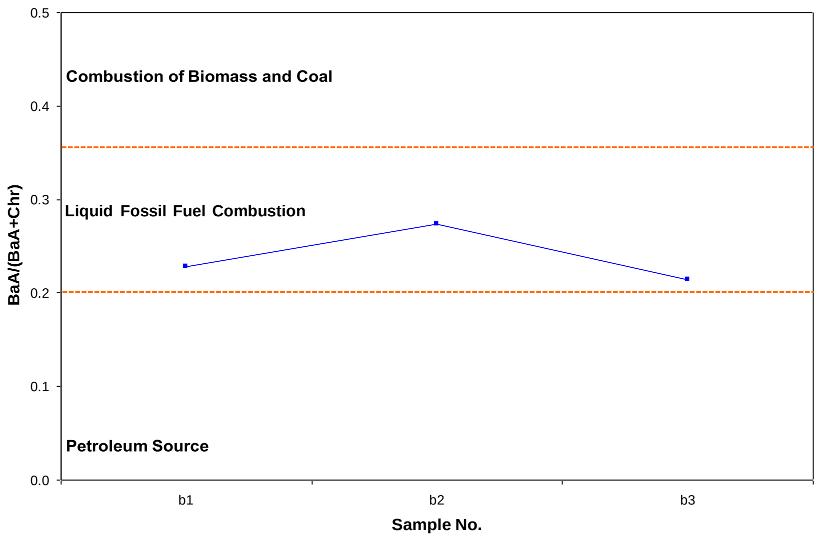

Figure 7.: Binary diagram showing the source of PAHs in the beach sands of the Port of Benghazi (fields after Yunker et al., 2002).

Where: Nap = Naphthalene, A = Acenaphthylene, Ace = Acenaphthene, Phe = Phenanthrene, F = Fluorine, Ant = Anthracene, Flu = Fluoranthene, Pyr = Pyrene, BaA = Benzo [a] anthracene, Chr = Chrysene, BbF = Benzo [b] fluoranthene, BkF = Benzo [k] fluoranthene, BaP = Benzo [a] pyrene, DahA = Dibenzo [a,h] anthracene, BP = Benzo [g,h,i] perlyene, IP = Indeno [1,2,3-cd] perlyene

Sediment Quality Guidelines (SQGs)

Sediment Quality Guidelines (SQGs) provide two target values: effects range low (ERL) and effects range median (ERM), which are established using the 10th and 50th percentiles, respectively, in a database of increasing concentrations associated with adverse biological effects. PAH concentrations lower than ERL are considered not to be harmful to organisms, while concentrations higher than ERM are considered to be harmful frequently. PAHs with concentrations between ERL and ERM are considered to be harmful occasionally (MacDonald et al., 2000). The SQGs are shown in Table 3. Clearly, the ERM is below the concentrations of Nap, A, Ace, BaA, Chr, BkF, DahA and Bp, while the concentrations of F, Phe, Ant, Flu, Pyr, BbF, and BaP are between the ERL and ERM (Figure 8).

Table 3. Sediment Quality Guidelines (after MacDonald et al., 2000)

	Guideline SQG	
	ERL	ERM
Nap	160	2100
A	16	500
Ace	44	640
F	19	540
Phe	240	1500
Ant	85.3	1100
Flu	600	5100
Pyr	665	2600
BaA	261	1600
Chr	384	2800
BbF	320	1880
BkF	280	1620
BaP	430	1600
DahA	63.4	260
BP	430	1600

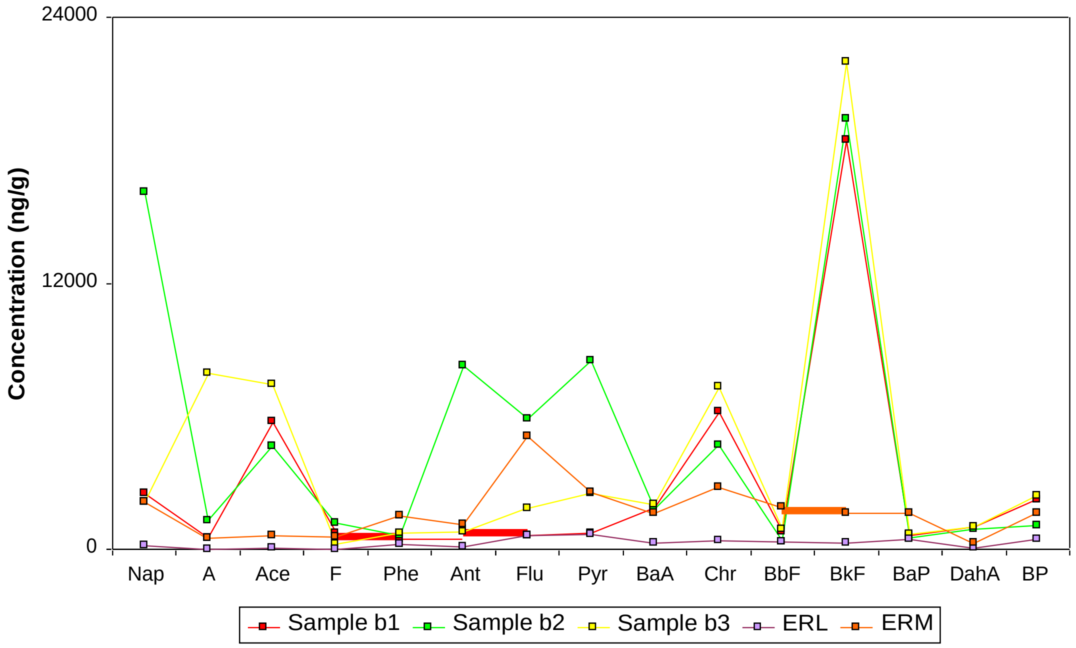

Figure 8.: Comparison of ERL and ERM with PAH concentrations in the beach sands of the Port of Benghazi.

Moreover, the levels of PAHs are compared against their corresponding quality values to evaluate potential ecosystem risk of PAHs in the studied sands. Table 4 shows the reference values that were used in this study. We applied equations (1) and (2) to determine the values of RQNCs and RQMPCs:

$$RQNCs = CPHAS/CQV(NCs) \quad (1)$$

$$RQMPCs = CPHAS/CQV(MPCs) \quad (2)$$

Table 4. NCs and MPCs of PAHs in sediments (concentrations in ng/g, after Cao et al., 2010)

Parameters	NCs	MPCs
Nap	1.4	140
A	1.2	120
Ace	1.2	120
Phe	5.1	510
F	1.2	120
Ant	1.2	120
Flu	26	2600
Pyr	1.2	120
BaA	3.6	360
Chr	107	10700
BbF	3.6	360
BkF	24	2400
BaP	27	2700
DahA	27	2700
BP	75	7500
Total PAHs	364.7	36470

Where CPAHs is the concentration of certain PAHs in the studied sands, CQV(NCs) and CQV(MPCs) are the quality values of the NCs and MPCs of PAHs in sediments, respectively. However, the risk classification of individual PAHs and total PAHs is presented in Table 5. Generally, the values of RQMPCs of the individual PAHs (except for Flu, Chr, BaP, DahA and BP) and total PAHs are higher than 1 (Table 6), which indicates that the biota in the beach sands of the Port of Benghazi is at high risk and suffered from severe toxicity.

Table 5. Risk classification of individual PAHs and ΣPAHs (after Cao et al., 2010)

Class	Individual PAHs		Class	ΣPAHs	
	RQ_{NCs}	RQ_{MPCs}		$RQ_{\Sigma PAHs(NCs)}$	$RQ_{\Sigma PAHs(MPCs)}$
Risk-free	0		Risk-free	0	
			Low-risk	≥1;<8	0
Moderate-risk	≥1	<1	Moderate-risk$_1$	≥800	0
			Moderate-risk$_2$	<800	≥1
High-risk		≥1	High-risk	≥800	≥1

Table 6. RQNCs and RQMPCs values in the beach sands of the Port of Benghazi

Parameters	Sample No.					
	b1		b2		b3	
	RQ_{NCs}	RQ_{MPCs}	RQ_{NCs}	RQ_{MPCs}	RQ_{NCs}	RQ_{MPCs}
Nap	1800.29	18.00	11502.38	115.00	1506.80	15.07
A	434.63	4.35	1084.52	10.85	6643.26	66.43
Ace	4786.29	47.86	3859.60	38.60	6201.25	62.00
Phe	141.61	1.42	233.95	2.34	39.79	0.40
F	385.00	3.85	532.95	5.33	616.37	6.16
Ant	769.09	7.69	6909.70	69.10	653.73	6.54
Flu	24.45	0.24	226.65	2.27	71.94	0.72
Pyr	584.80	5.85	7068.97	70.69	2083.62	20.84
BaA	509.69	5.10	493.14	4.93	553.83	5.54
Chr	58.13	0.58	44.12	0.44	68.27	0.68
BbF	223.53	2.24	99.86	1.00	252.80	2.53
BkF	768.48	7.68	808.44	8.08	917.15	9.17
BaP	21.84	0.22	17.91	0.18	24.48	0.24
DahA	37.46	0.37	33.33	0.33	37.40	0.37
BP	30.04	0.30	14.32	0.14	32.19	0.32
Total PAHs	120.85	1.21	207.24	2.07	165.00	1.65

CONCLUSIONS

The main conclusions are as follows:
1) The PAHs pollution in the beach sands of the Port of Benghazi is mainly caused by pyrogenic sources.
2) The carcinogenic PAHs (BaA, Chr, BbF, BkF, BaP, DahA, and IP) are detected in all samples.
3) The biota in the beach sands is at extremely high environmental risk.

RECOMMENDATION

There are several techniques for the degradation of PAHs in sands such as biostimulation techniques.

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CONNECTION BETWEEN EARTHWORMS AND SOIL PARAMETERS

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Abstract *Earthworms play a determining role in forming soil organic matter, their presence is a good indicator of soils' biological activity and soil health. The main question of the research was if there was any effect of earthworms on soil characteristics, especially the organic matter content or vice versa. The investigated area was the Gödöllő Hillside. Ten sites were chosen, mainly in semi-natural areas. The earthworms were counted and soil samples were collected from 25×25×25 cm pits, 5 pits per site. Soil samples were analysed by a NIRsoil scanner device. Four earthworm species were found during the research: Aporrectodea rosea, Lumbricus terrestris, Lumbricus caliginosa and Eisena fetida. There were 4 sites characterized by sandy texture where no earthworms were present. The NIR device measured pH, humus, N, K, clay content and cation exchange capacity. There were significant connections between the number and the weight of adults and the soil parameters, and there was no significant connection in the case of the number of juvenile earthworms, however. Based on the medium strength of the correlation between the soil parameters and earthworm characteristics, we can conclude that more soil parameters have effects on earthworm numbers and weight than what was measured.*

Keywords *soil-earthworm relation, soil organic matter, soil texture, soil moisture, species richness*

INTRODUCTION

Perhaps none of the terrestrial animals are as important as earthworms [1]. Earthworms play an essential role in natural soil formation processes such as humus formation. Few animals play an important role in the history of topsoil [2]. In earlier articles of Salomé et al. (2010) earthworms are mentioned as having an important role in nature, whereby they play the role of „ecosystem-engineers" in natural soils [3-4]. Worldwide they can be divided into 23 families and within those families 700 genera and 7000 species [5]. Earthworms are greatly affected by environmental factors. Soil moisture content and temperature are perhaps the most important factors. They rest in winter due to the cold andin summer due to high temperatures [6]. An increase in precipitation has a negative effect on earthworm occurrences [7]. A large percentage of earthworms are found in the upper 20% of the soil [8]. Research suggests that some species can even survive for months in a 100% H_2O medium [9].
As a result of the mixing of the soil in forests, grains became more resistant to frost and their quality also improved [10]. Debris from withered leaves (they grind the plant food with small gravel grains via their intestinal tract) and the excrement of earthworms results in a rich, thick layer of humus [2]. However, if the soil is adequately saturated with organic matter, it will not feed on plant parts. Their ability to mix soil is determined by their nutritional requirements. Not only do they play an important

role in soil cultivation, but also in changing the chemical composition of the soil [6]. The less the soil is disturbed, the greater the positive effect it has on the presence of earthworms [11]. The size of the soil fractions is important in the movements and feeding of earthworms. Dekemati et al. [10] measuredthe soil distribution between the grains at a depth of 0–20 cm. At the same time, the abundance of earthworms was also measured. The granules were air-dried and carefully sieved. Bouché [12] categorised them into 3 main types, firstly, the dead leaf dwellers (epigeic) species, secondly, those that penetrate deep into the soil (anexic), and thirdly those feeding on organic matter that has undergone certain humification processes, secondary degrader (endogeic) species. According to their role, they are classified into these 3 groups.

Zicsi [6] sampled 25×25 cm soil slices in the Gödöllő Hills, which he measured and examined their vital functions in different media (water only, sand only, topsoil, natural soils). Their weight and biomass were measured. We conducted our research based on these same methods with some minor changes. Dekemati et al. [10] used the methodology of earlier publications in the field, used 25×25 cmsampling pits at a depth of 30 cm, seven times with four replicates. The method of manual sorting (which is the most common and most frequently used method today) was chosen according to the ISO 2006 standard. The sites were randomly selected and the distance between the points was approximately 5–10 m. Horváth et al. [13] worked with 50×50 cm quadrants at a depth of 15 cm both in fenced and non-fenced areas. They examined the vegetation and number of earthworms and compared the number of earthworms, with the effects of wild boar rootings.

Salomé et al. [14] studied the abundance of earthworms at different mountain altitude levels. Biomass and other study categories were examined by the ANOVA analysis of variance method. Soil parameters, vegetation, forest elevation levels were monitored and earthworm communities were compared. Samples were taken in alpine, sub-alpine mountain and upland areas, as far as possiblefrom human influences. The mustard-extract method was used. The sampling pits were 20×20×20 cm. In the research, 27 species were identified (11 sub-alpine, 11 at mountain level and 19 at highland levels).

Due to the mosaic nature of the Gödöllő Hills Landscape Protection Area, the diversity of the physical genetic groups of the soil, the nature of the vegetation, as well as climate change and environmental effects, a diverse and rich earthworm population occurrence could be expected. In this respect, the sampling took place in the natural or near-natural areas of the land protection area for almost 2 years. The aim was to determine the biomass and number of earthworms and compare these with soil parameters to find out the relation between the two.

MATERIALS AND METHODS

The investigated area, the Gödöllő Hillside

The area of investigation was the Gödöllő Hillside (Figure 1.). The area's geology is characterized by the presence of loess materials and sand. The areas where the elevation is above 200 m above sea level (a.s.l.) are characterised by cool and moderately dry, while below 200 m a.s.l. is a warm and dry climate. The number of hours of sunshine per year is around 1950. The average annual temperature is 9.5–9.7°C in the north and 9.7–10.0° C in the south. This average temperature is expected for 194–198days. Frost-free period 186–190 days in the North, 195 in the South. The long-term average summer maximum is 32.5–33.0° C, the average winter minimum is -16°C.

Annual rainfall is relatively low, ranging from 540 to 580 mm. The average number of days covered by snow in the area is 36–40, with a maximum snow thickness of 22 cm. NW wind direction is predominant. Higher areas are used for forestry; lower ones are suitable for growing vegetables and other crops (Dövényi et al. 2010). Microclimates are different due to the diversity of habitats, and the climate is generally neither lowland nor mountainous (Láng, 1967). The wettest part is the area bordered by Gödöllő-Bag-Kistarcsa-Budapest-Rákospalota-Isaszeg-Pécel, the area bordered by Monor-Zsámbok-Veresegyháza is the driest (Demény, 2007).

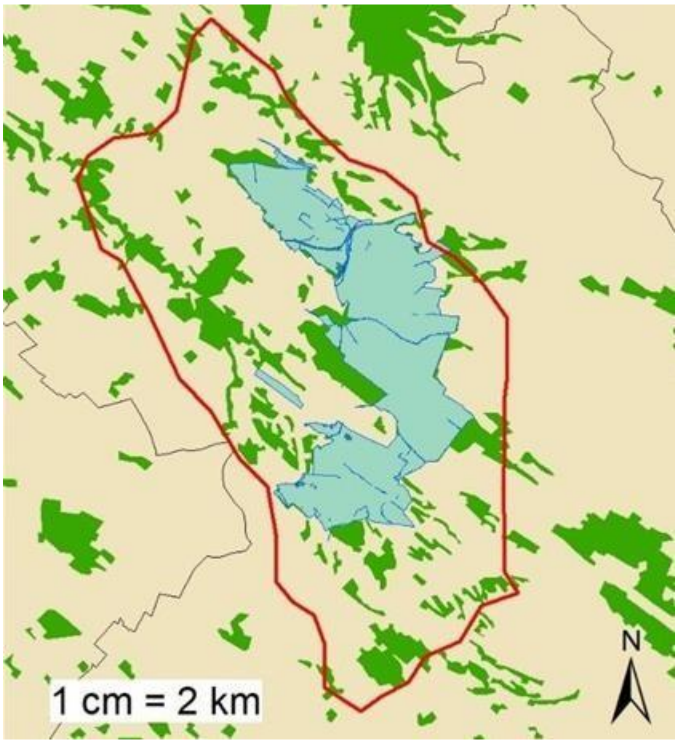

Figure 1. The area under investigation for soil-earthworm relations, the Gödöllő Hillside (green areas are forested, the red contour line is the limit of the hillside, while blue areas are marked for the Gödöllő Hillside Landscape Protection Area (mostly forested as well))

The Gödöllő Hills micro-region covers the watercourses on the left bank of the Danube, the rivers on the right side of the Galga and the catchment area of the Upper Tápió source region. The flow and flow of water move between extremes, resulting in a fairly dry area. They try to compensate for the water deficit with reservoirs, so there is a lot of it in the area, such as. Lake Isaszegi, Vácegresi fishpond, Babati reservoir (Dövényi et al. 2010). Lake Álomhegy in Veresegyháza is an important habitat for birds.
Groundwater is found at a depth of 5-6 m, only in the valleys and on the edges. These are moderately hard waters of calcium, magnesium, hydrocarbonate and low sulfate content. The depth of artesian wells is around 100 m (Dövényi et al. 2010). The water flow of watercourses fluctuates because water-permeable rocks are found on the surface (Láng, 1967).

Field measurements
The investigated area belongs mostly to the naturally protected area, so most of the samplings were done in forested land. Before the field sampling, Google Earth, geography, soil types and vegetation was analysed (Dövényi et al. 2010). Samples were taken at least 20 meters from human interventions, such as roads, fences, buildings, electric lines, etc. 25×25×25 cm pits were dug and earthworms were hand-picked. Five replicates were done at each site. Soil samples were collected from the same pit for analysis.

Measurements in the laboratory
Earthworms were classified in the laboratory. Juveniles and adults were separated and weighed. A handheld Near Infrared Reflectance (NIR) device (1300–2600 nm) was used for soil analyses in the laboratory. Soil organic matter (m/m%), cation exchange capacity (CEC, mmol/kg), pH(H_2O), total N (g/kg), plant-available P (ppm), exchangeable potassium (mmol/kg), clay (m/m%), soil moisture (m/m%) and on almost half of the samples exchangeable calcium (mmol/kg), exchangeable magnesium (mmol/kg), total aluminium (g/kg) and total iron (g/kg) were measured. Plant available potassium was calculated by the multiplication of the exchangeable potassium (mmol/kg) by 39.0983.

Statistical analyses
The statistical analyses were done based on ANOVA and linear regression.

RESULTS AND DISCUSSION

Earthworm classification of adult individuals resulted in 4 species as follows (numbers and species are related to the replicates, if there are less than five lines, it means that there were replicates with no data):
Gödöllő, university forest:
- *2* Aporrectodea rosea, *1* Aporrectodea caliginosa
- *1* Eisenia fetida
- *2* Eisenia fetida

Szada, Margita Hill:
- *3* Aporrectodea caliginosa, *2* Aporrectodea rosea
- *1* Aporrectodea rosea

Domony, Black Forest:
- *3* Aporrectodea caliginosa, *2* Aporrectodea rosea
- *1* Aporrectodea rosea

Gödöllői Botanical Garden:
- *1* Lumbricus terrestris
- *7* Aporrectodea rosea
- *1* Aporrectodea caliginosa

Bag, Hajagvölgy Spring:
- *1* Aporrectodea rosea

Vácegres, alder forest:
- *1* Aporrectodea rosea

The results cannot be compared as no former data was found related to the earthworm species of the landscape protection area.

The basic statistical data of the number and weights of the earthworms
The basic statistical values of the number of earthworms are in Table 1.

Table 1. The basic statistical data of the number of earthworms found in the Gödöllő Hillside Landscape Protection Area

Name of sampling site	Number of earthworms (individual per square meter)				
	Maximum	Minimum	Median	Sum of squares	Average
Gödöllő, university, forest	64	0	16	26.29068	19.2
Szada, Margita Hill	352	0	32	146.2053	96
Domony, Black forest	16	0	0	8.763561	6.4
Gödöllő, University Campus, Botanical Garden	176	0	16	74.53321	51.2
Bag, Hajagvölgy Spring	16	0	16	8.763561	9.6
Vácegres, alder forest	48	0	0	22.62742	16

It is important that 4 of the 10 sites had no earthworms when examined in the field. In general, these areas are very sandy and thus very dry. The maximum numbers varied greatly, the lowest was 16 while the highest was 352. The highest maximum number was in Margita Hill where sampling was done on a former sampling site, in the same pits, so these pits can be considered as artificial wild boar rootings. It highlights that the loosening of compacted forest soil is favourable for earthworms. The second biggest number is related to the botanical garden that can be because of the good natural status of the area, compared to the ones under forestry use.
The basic statistical values of the weights of earthworms are in Table 2.

Table 2. The basic statistical data of the weights of earthworms found in the Gödöllő Hillside Landscape Protection Area

Name of sampling site	Weights of earthworms (grams per square meter)				
	Maximum	Minimum	Median	Sum of squares	Average
Gödöllő, university, forest	23.67	0	5.92	9.71	7.21
Szada, Margita Hill	223.55	0	25.09	9.76	61.66
Domony, Black forest	11.83	0	0	5.33	3.61
Gödöllő, University Campus, Botanical Garden	107.29	0	18.90	44.75	29.08
Bag, Hajagvölgy Spring	12.9856	0	2.88	5.36	4.19912
Vácegres, alder forest	9.69	0	0	4.24	2.70

The biggest maximum weight is also connected to the Margita Hill site. The second biggest maximum weight value was also similar to the second biggest maximum number that was in the botanical garden.

The basic statistical data of the measured soil parameters

The basic statistical data of the pH (H_2O) values of the examined soils are in Table 3.

Table 3. The basic statistical data of the pH (H_2O) of the examined soils in the Gödöllő Hillside Landscape Protection Area

Name of sampling site	pH (H_2O)				
	Maximum	Minimum	Median	Sum of squares	Average
Gödöllő, university, forest	7.4	6.8	7	0.22	7.06
Szada, Margita Hill	7.6	6.5	7.4	0.44	7.22
Domony, Black forest	7.1	6.5	6.8	0.23	6.88
Gödöllő, University Campus, Botanical Garden	7.3	6.6	6.8	0.30	6.88
Bag, Hajagvölgy Spring	7.3	6.7	7.2	0.25	7.10
Vácegres, alder forest	7.9	7.4	7.7	0.19	7.70

The pH of the upper 25 cm is mainly in the neutral, slightly acid and slightly alkalic categories. This is most likely the effect of the big lime content in the parent material (loess) that is due to the anthropogenic effects that can be found close to the surface sometimes. The basic statistical data of thesoil organic matter or humus content (m/m %) values of the examined soils are in Table 4.

Table 4. The basic statistical data of the soil organic matter or humus content (m/m%) of the examined soils in the Gödöllő Hillside Landscape Protection Area

Name of sampling site	soil organic matter or humus content (m/m%)				
	Maximum	Minimum	Median	Sum of squares	Average
Gödöllő, university, forest	6.2	2.3	2.8	1.59	3.62
Szada, Margita Hill	13.2	2.7	3.4	4.39	5.44
Domony, Black forest	2.4	1.6	1.8	0.33	1.86
Gödöllő, University Campus, Botanical Garden	5.2	2.2	4	1.13	3.94
Bag, Hajagvölgy Spring	6.8	1.3	2.3	2.20	2.96
Vácegres, alder forest	5.7	1.7	2.8	1.73	3.48

The highest maximum value belongs to Margita Hill (again) where the biggest maximum number and weights of the earthworms were found. However, the averages can be considered normal for forest soils. The Domony area had the lowest average and the Bag area had the lowest minimum values. The basic statistical data of the total nitrogen content (g/kg) values of the examined soils are in Table 5.

Table 5 The basic statistical data of the total nitrogen content (g/kg) of the examined soils in the Gödöllő Hillside Landscape Protection Area

Name of sampling site	total nitrogen content (g/kg)				
	Maximum	Minimum	Median	Sum of squares	Average
Gödöllő, university, forest	3	1.1	1.4	0.76	1.74
Szada, Margita Hill	6	1.3	1.7	1.95	2.6
Domony, Black forest	1.3	0.9	1.1	0.17	1.06
Gödöllő, University Campus, Botanical Garden	3.1	1.7	2.4	0.63	2.46
Bag, Hajagvölgy Spring	3.6	0.8	1.3	1.09	1.72
Vácegres, alder forest	3.3	1	1.9	0.88	2.1

The values are very low. The highest maximum value belongs to Margita Hill again, just as well as the highest average. Furthermore, the lowest minimum values are in Domony and Bag again. It is normal as total nitrogen is connected with soil organic matter content. The basic statistical data of the plant-available potassium (ppm) values of the examined soils are in Table 6.

Table 6. The basic statistical data of the plant-available potassium (ppm) of the examined soils in the Gödöllő Hillside Landscape Protection Area

Name of sampling site	plant-available potassium (ppm)				
	Maximum	Minimum	Median	Sum of squares	Average
Gödöllő, university, forest	222.86	175.94	195.49	17.92	195.49
Szada, Margita Hill	316.69	175.94	203.31	79.20	228.07
Domony, Black forest	164.21	39.09	43	53.85	73.498
Gödöllő, University Campus, Botanical Garden	195.49	46.91	152.48	52.79	123.546
Bag, Hajagvölgy Spring	195.49	113.38	152.48	32.83	152.48
Vácegres, alder forest	140.75	50.83	86.02	34.37	88.364

The highest maximum value belongs to Margita Hill again, just as well as the highest average. The lowest minimum values belong to Domony and the Gödöllő botanical garden that is also very similar to the alder forest of Vácegres. The basic statistical data of the clay content (m/m %) values of the examined soils are in Table 7.

Table 7. The basic statistical data of the clay content (m/m %) values of the examined soils in the Gödöllő Hillside Landscape Protection Area

Name of sampling site	clay content (m/m %)				
	Maximum	Minimum	Median	Sum of squares	Average
Gödöllő, university, forest	22.5	14.1	15.4	3.40	16.52
Szada, Margita Hill	33.2	10.8	18.4	9.10	20.42
Domony, Black forest	21.4	15	17.1	2.36	17.68
Gödöllő, University Campus, Botanical Garden	24	16	39	3.44	21.4
Bag, Hajagvölgy Spring	24	10	16	5.55	16.6
Vácegres, alder forest	29	16	22	5.45	21.8

The highest maximum value belongs to Margita Hill again, just as well as the highest average. The lowest minimum values belong also to Margita and the Bag. Averages are between 16.52 and 21.8, so the areas can be considered similar. The basic statistical data of the CEC (mmol/kg) values of the examined soils are in Table 8.

Table 8. The basic statistical data of cation exchange capacity (mmol/kg) of the examined soils in the Gödöllő Hillside Landscape Protection Area

Name of sampling site	cation exchange capacity (mmol/kg)				
	Maximum	Minimum	Median	Sum of squares	Average
Gödöllő, university, forest	277.5	111	150.5	64.02	169.46
Szada, Margita Hill	352.7	137	240.4	83.53	241.66
Domony, Black forest	149.1	80.5	89.8	27.63	103.18
Gödöllő, University Campus, Botanical Garden	232	138	197	43.11	185.2
Bag, Hajagvölgy Spring	209	119	159	32.43	161
Vácegres, alder forest	269	116	202	55.19	200.8

The highest maximum value belongs to Margita Hill again, just as well as the highest average. The lowest minimum value belongs to Domony. CEC can be related to soil organic matter, so in this case, it is also explained why Margita has the highest maximum value.

Statistical analyses of the connection between earthworms and soil data

The correlation (R) between the earthworm and soil data is moderately strong, and the R^2 value (coefficient of determination) shows that these soil data explain the variability in the number of adult earthworms by 50.5%. It means that other factors were not measured but affected the occurrence of earthworms.

The number of adult individuals was mostly influenced by the humus content in the negative direction, as the B (slope) value is -18.722 with humus (p=0.005). The clay also had a negative correlation (B=-3.177, p=0.002). The CEC has a small positive effect (B=0.374, p=0.017).

No significant connections were found in the case of the juvenile individuals.

The number of all earthworms was also influenced by soil characteristics but here the correlation is already weaker (R and R^2 values). Clay content was a stronger negative influencing factor (B=8.655, p=0.005), while CEC had a slightly positive influence (B=1.366, p=0.005) number of pieces.

The weight of the adult individuals was also influenced by the soil data (ANOVA table), the relationship is slightly weaker (R and R^2 values) than the number of individuals. Clay content was a negative influencing factor (B=-3.158, p=0.004), while CEC had a slightly positive influence (B=0.465, p=0.006) related to the number of pieces.

In contrast to the number of young individuals, there is already a correlation between their mass and soil characteristics. In this case, the clay content was also a negative influencing factor (B=-2.576, p=0.004), while the CEC had a slightly positive effect (B=0.42, p=0.003) on the number of pieces.

There is also a correlation between the mass of all earthworms and soil properties. In this case, the clay content was also the negative influencing factor (B=-5.732, p=0.003), while the CEC had a slightly positive effect (B=0.885, p=0.003) on the number of pieces.

CONCLUSIONS AND RECOMMENDATIONS

One of the main results of the research is the new data on earthworm species. We can not conclude about the diversity of the species as there were no former data found in the literature. So, the conclusion is that there is a data gap and the recommendation is that further researches are greatly needed in this area. The other results are related to the earthworm-soil relations. We can conclude that there is a relationship between soil data and the number of adult earthworms, as shown by the ANOVA of linear regression.

Based on the data, we can conclude that the main influencing measured factors are the clay content and the cation exchange capacity. Interestingly in the case of the adult individuals, there was a negative correlation between the number of adult individuals and the humus content We should expect it vice versa. Also interesting is that there were no significant connections found between the Ca-, Mg-, Al- and Fe-content of the soil. There should be as Ca is one of the major elements that is always cited in relation with earthworms, so we can conclude that there is more data needed.

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GREEN CHEMISTRY: IONIC LIQUIDS IN INDUSTRIAL APPLICATIONS

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Abstract: *Chemical reactions are generally performed in the presence of volatile, flammable, and toxic organic solvents, whether on a small scale in the laboratory or on a large scale in the industry. Every year, approximately 20 million tons of volatile organic chemicals are discharged into the atmosphere. Consequently, the change in global climate, air pollution, and health issues have come into the forefront. Thus, alternative, andgreen solvents are becoming more popular within years. Fluorinated solvents, water, and supercritical liquids are utilized as alternatives to volatile organic solvents. The interest of ionic liquids as green solvents is due to their several advantages such as low vapour pressure, low flammability, a wide liquid range, excellent thermal stability, adjustable polarity, and miscibility with other organic and inorganic chemicals. Ionic liquids are an ideal "environmentally friendly solvents" alternative to organic solvents used today for synthesis, homogeneous catalysis, and chemical processes. They have developed as reinforcing family of chemicals for the applications of electrochemistry, organic synthesis, catalysis, gas separation, protein preservation, as well as other applications due to their outstanding characteristics and vast combinations of the cations and anions. Consequently, this review focuses on the use of ionic liquids, especially in biotechnology and leather manufacturing.*

Keywords: *biotechnology, green solvent, green chemistry, ionic liquid, leather, organic solvents*

INTRODUCTION

Chemical reactions are generally carried out in the presence of volatile, flammable, and poisonous organic solvents and every year, nearly 20 million tons of volatile organic chemicals are discharged into the atmosphere. Due to the environmental and health issues, new processes of synthesis that do not use solvents or employ ecologically benign alternative solvents are becoming more popular. Fluorinated solvents, water, and supercritical liquids are utilized as alternatives to volatile organic solvents, but ionic liquids, which are a new class of solvents made entirely of ions, have received a lot of attention as green solvents in recent years. [1-3]

Ionic liquids are salts that contain an organic cation and an organic or inorganic anion and have a melting point less than 100°C. Ionic liquids, which are liquid at room temperature, have a melting point less than 25°C at atmospheric pressure and they are referred to as "room temperature ionic liquids. Low vapour pressure, low flammability, a wide liquid range, excellent thermal stability, adjustable polarity, and miscibility with other organic and inorganic chemicals are the advantages of ionic liquids. Today, they are ideal "environmentally friendly solvents" alternative to organic solvents for synthesis, homogeneous catalysis, and most of the chemical processes due to the mentioned advantages. [4-6] In general, they represent fewer hazards or environmental risks compared to conventional solvents when they used in 'closed' processes. [2,7]

Bulky organic cations such as imidazolium, pyridinium, piperidinium, ammonium, phosphonium, and sulfonium, as well as comparatively tiny anions like tetrafluoroborate, hexafluorophosphate, bis(trifluoromethanesulfonyl)imide, methanesulfonate, trifluoromethanesulfonate, and nitrate, are used in ionic liquids. [6] However, imidazolium has reported weakly biodegradable and has low biocompatibility among the enormous number of ionic liquids despite the great qualities. [8]
The influence of ionic liquids on biomacromolecules can be explained by the cosmotropicity and chaotropicity of the ions. [9] Based on their capacity to interact with water, ions are classed as cosmotropic or chaotropic. The ions are chosen based on the Hofmeister series' descriptions of cosmotropic and chaotropic activity. Proteins are supposed to be stabilized by chaotropic cations and cosmotropic anion, while they are believed to be destabilized by cosmotropic cations and chaotropic anion. [10,11] A cosmotropic anion is said to interact with water more strongly than it interacts with itself, which stabilizes the protein structure by promoting irreversible H-binding. The interaction of anions with proteins in aqueous media is explained by inference from the behaviour of Hofmeister series ionic liquids on protein stability. Therefore, ion selection is crucial in the stabilization and destabilization of proteins. [12-14]

DEVELOPMENT OF IONIC LIQUIDS

During the last 30 years, ionic liquids have been reported in several industries because of their beneficial features such as negligible vapor pressure, non-flammability, non-explosiveness, electrochemical and thermal stability, easy recovery, and high conductivity characteristics. [12,15-17]
For nearly a century, substances that meet the definition of ionic liquid have been known. However, the contemporary era of ionic liquids can be regarded to have begun in the second half of the twentieth century with several research projects targeted the use of ionic liquids in electrochemical applications and generating molten salts at the lowest temperatures conceivable. [4,18,19]
Paul Walden (1914) created the first known ionic liquid, ethylammonium nitrate $[C_2H_5NH_3]^+[NO_3]^-$, by neutralizing ethylamine and concentrated nitric acid. It has a melting point of 12-14°C. This study, which drew little attention at the time, is now regarded as a pioneering work in the field of ionic liquids. [17,20,21] Since that time, the synthesis of ionic liquids containing various cations and anions has accelerated, and the number of scholarly articles and patent studies has exploded. More than 2000 publications in 2006 on the synthesis of novel ionic liquids and the investigation of the physicochemical properties of ionic liquids as well as their usage as a solvent or in various domains were published. [4, 20,22,23]
Aryl-/alkyl imidazolium ionic liquids were developed for the first time by Ahrens et al., (2009) that electronic effects can alter depending on not only the sigma system but also the pi system. [24]
Thus, this change reflected the ionic liquid properties and next generation ionic liquids is the name that given to these ionic liquids. [25-26]

PROPERTIES OF IONIC LIQUIDS

To generalize the common qualities for all ionic liquids is challenging due to the enormous number of members of this family of chemicals. [4] The complicated correlation between Coulomb- and Van- der-Waals-interactions, solutes, and surfaces, as well as possible hydrogen bonds between ions in ionic liquids, lead to multifarious features. Ionic liquids have a comparatively high viscosity and density when compared to molecular solvents. Additionally, they have great solubility and miscibility. Ionic liquids also fit well into the Hofmeister series, often known as the lyotropic series, in which the solubility of a variety of salts, proteins, and their secondary and tertiary structure is defined by their stabilizing effects on solution. [17,27,28]
When the chemical properties in general are summarized; [2,23,29-33]

1. Melting point

Ionic liquids have different melting points depending on the nature of the cation and anion.

2. Density

Ionic liquids have a density of 1.0 to 1.6 g/mL, which is higher than the water. The density of the ionic liquid drops as the length of the alkyl chain in the cation grows.

3. Viscosity

Ionic liquids have viscosities that are 1-3 times greater than water and molecular organic solvents. It ranges from 10 mPa.s to 500 mPa.s at ambient temperature.

4. Thermal stability

Ionic liquids have been employed in a variety of high-temperature applications, including analytical applications such as mass spectrometry as a matrix and gas chromatography as a stationary phase. The correct and safe use of ionic liquids at high temperatures necessitates the determination of thermal breakdown temperatures. The structure of the anions has a direct impact on the thermal stability of ionic liquids.

5. Conductivity

Ionic liquid conductivity is a critical characteristic for electrochemical applications. Because ionic liquids are made up entirely of ions, they have a high conductivity. However, many ionic liquids have lower conductivity than expected. Ionic liquids have a higher conductivity than the molecular organic solvents but have lower conductivity than the concentrated aqueous solutions of ionic liquids. The quantity of free charge carrier ions and their mobility determine the conductivity of solutions. The ion mobility and conductivity decrease as the size of the ions increases.

6. Electrochemical window

The electrochemical window (EW) is the range of electrochemical potential in which the electrolyte is not oxidized and reduced at the electrode. The EW value reflects the electrolyte's electrochemical stability. In the usage of ionic liquids in semiconductors and metal electroplating, the EW value is a critical parameter and usually quite large.

7. Miscibility with water and organic solvents

The nature of the anion determines the miscibility of ionic liquids with water. Ionic liquid miscibility with organic solvents is determined by the polarity of the ionic liquid.

8. Refractive index

The dielectric response of the electric field induced by electromagnetic waves and it is referred as the index of refraction. Ionic liquids have different refractive indexes based on the nature of the cation and anion. As a result, it is a polarizability indicator for cations and anions.

9. Steam pressure

Ionic liquids are regarded compounds with low or insignificant vapor pressure even at high temperatures due to their ions. Ionic liquids, unlike organic solvents, do not easily evaporate due to their features. The other advantage of low vapor pressures is the easy separation of volatile products from ionic liquids by distillation.

Controlling the outcome of a process by creating the best solvent for the desired output has a lot of promise for both fundamental and applied research. The structures of ionic liquids, unlike those of traditional molecular solvents, can be easily changed. As a result, using 'action-specific' ionic liquids in a range of processes can give extra benefits. [7,8,34-35]

IONIC LIQUID APPLICATIONS

Ionic liquids are utilized as solvents or catalysts in synthesis, catalysis, nano-chemistry, multiphase reactions, and leaching processes, as well as electrolytes in lithium-ion batteries, dye-sensitized solar cells, fuel cells, and metal plating, due to their unique features. [36-40] They are also used aslubricants and plasticizers in the field of engineering. [41] In analytical chemistry, they are used as a stationary phase for HPLC, as a column material in gas chromatography, and as a matrix in mass spectrometry, and in biology, they are employed in biomass processing, drug release, personal care products, and embalming operations. [15,12,21,36,42]

Ionic liquids are reinforcing family of chemicals and can be utilized in electrochemistry, organic synthesis, catalysis, gas separation, protein preservation, and other applications due to its outstanding characteristics and vast combinations of cations and anions. [8,20,34,43-46] They are an excellent stabilizing medium for cytochrome C, lysozyme, and nucleic acids, allowing them to be stored for longer periods of time without losing function. [13,36,,47] Choline ester ionic liquids are widely used in protein-based medicinal formulations and cellular therapies. [48,49]

The use of ionic liquids in dissolution, regeneration, and modification of biopolymers is gaining popularity as a viable alternative to conventional, ecologically unfriendly organic solvents. [50] Ionic liquids, as a next-generation solvent for natural polymers, offer a new platform for the effective usage and conversion of high-value biopolymer derivative products. However, there are a few issues to be resolved. [5,17] Toxicology, biodegradability, and the influence on human health are unknown; second, the dissolution mechanisms of starch, β-CD, lignin, and protein, as well as the reaction mechanisms of biopolymers in ionic liquids, are not well understood. [12,13,51] Finally, the biopolymer / ionic liquid solution's physicochemical properties, the relationship between the properties and structure of the biopolymer, and the physicochemical properties of biopolymer derivatives should all be thoroughly investigated. [7,17,52-54]

Ionic liquids have the potential to reduce the environmental effect of chemical industrial processes by a significant amount. [1,2,7,23,33,55] Ionic liquids have been used to dissolve and regenerate natural polymers such as cellulose fibers, silk fibroin fibers, wool keratin fibers, chitosan, starch, and collagen fibers. Only a few imidazolium ionic liquids, such as [BMIM]Cl, [EMIM]Cl, and [AMIM]Cl, have been employed in ionic liquids for collagen fiber disintegration and regeneration. [6,8,36,56]

CONCLUSIONS AND RECOMMENDATIONS

Ionic liquids have replaced volatile organic solvents as environmentally friendly alternatives. Ionic liquids, made up of cationic and anionic components, can be created to have a variety of properties. The term "tailor-made" has been used to describe the chemical reaction potential of the ecologically friendly ionic liquids. They're called "action-specific ionic liquids" since they're particularly formulated solvents that can be tailored to certain reaction circumstances. Ionic liquids are currently used in domains as diverse as catalysis, electrochemistry, spectroscopy, and materials research, despite their origins as solvents.

Ionic liquids have been successfully used in a variety of catalytic applications, demonstrating significant catalytic activity and reducing the detrimental effects of typical organic solvents or other catalysts during catalytic reactions. It has been revealed that, ionic liquids have the ability to affect the proteins at various hierarchical levels depending on the nature and type of cation and anion. This ability makes ionic liquids popular at the leather and biotechnology fields as an alternative green solvent. Regeneration and dilution of keratin and collagen fibers has been the most popular subject for ionic liquids since 2005. Because it has been found that ionic liquids could refract hydrogen and ionic bonds of collagen and α-helix structure of keratin. Studies on ionic liquid syntheses are acceptable for the intended features and applications of ionic liquids should be continued.

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STUDY OF THE RECYCLING OF SOLID BARITE WASTES AS MAIN CONSTITUENT IN CERAMIC COMPOSITION

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Abstract: *Large amounts of Solid Barite Wastes (SBWs) materials are discarded in the Boucaïd’s mine located in the North of Algeria ((Tissemsilt) producing an average of 50 wt% of barite rejects after the physico-chemical treatment. This work investigates the incorporation of solid barite waste (SBWs) as a raw material into a clay body, replacing feldspar material by up to 20 wt%. Ceramic pieces were produced at temperatures varying from 1200 to 1300°C. The technological properties of the ceramic pieces (e.g., linear shrinkage, apparent density, water absorption, and compressive strength) have been determined. The leaching toxicity of the fired pieces has also been determined. The results showed that SBWs could be used in ceramic materials (porcelain type), in the range up to 10 wt%, as a partial replacement for feldspar. Mineralogical analysis of SBWs, shows that it is mainly composed of calcite (22%), barite (25%), cerusite (13%) and hemimorphite (27%). After sintering, mullite, anorthite and quartz are the main mineralogical phases appeared at 1200 °C; when the temperature roses at 1300 °C, celcian phase appears, beside anorthite and quartz phases. The obtained ceramic samples exhibit better mechanical properties compared to the reference ceramic samples (0% SBWs). However, up to 10 wt% additions of SBWs in the ceramic bodies, micro-hardness and the Young's modulus have higher values, reaching 480 kg/mm^2 and 41.27 GPa respectively at 1300 °C. Besides, the evaluation of the release of various chemical species (Pb^{2+}, Zn^{2+}, $Ba^{2+}$and Cu^{2+}) contained in the ceramic samples indicates successful inertizationof the pollutants. The results show that solid barite wastes can be used as substituent of feldspar to produce eco- friendly ceramic materials.*

Keywords*: Barite wastes, Boucaid’s mine, ceramic, mechanical properties, microstructure, environment.*

INTRODUCTION

The mining activity generates significant quantities of solid waste with no economic value, causing environmental degradation [1,2]. The magnitude of these releases risks becomes important mainly when it comes to the extraction and the processing of polymetallic deposits or industrial minerals rich in lead, zinc and barite sulfides, as in the case of a number of polymetallic and barite mines in Algeria,namely Boucaid’s mine.. The sulphides displacement from discharges by the action of water and windcauses environmental pollution [3]. The mine tailings dissolution and oxidation can generate high concentrations of heavy metals, sulphates and acidity, and the chemical alteration of sulphide minerals in particular pyrite, pyrrhotite, chalcopyrite and sphalerite in mine waste deposits, generates acid mine drainage, which is a source of contamination [4], of soil, plants and water [1,4]. It was found that dissolved oxygen values in water were low and well below 5.0 mg /l, whereas the average pH values are acidic [5]. The mining waste accumulation, due to the extraction and processing of barite ore from abandoned mines, leads to the contamination of water by the heavy metals such as (As, Ba, Fe, Hg, Mn, Ni, Pb, Zn) with very high concentrations [6,7].

Barite-based ceramics ($BaSO_4$) have been widely used in various industrial fields, namely in electronic and medical applications, due to their low thermal expansion, their high melting points [8,9] and their low constant dielectric.

They are used as fluxing agents in the ceramic industry enamels and in ceramic materials. In the construction industry, they are used as a protective wall against X-rays and gamma rays [10,11]. The shielding capacity against these radiations is remarkable and can constitute a good material of protection against these rays, in order to protect the human beings against this type of ionizing rays [12]. Barium oxide is added to improve the refractive index of optical glass, and promote sintering andlower the viscosity of molten glass [13]. Recently, ceramics based on a combination of barite-kaolin derivative developed as a perfect medium, in the form of shielding for walls in diagnostic X-ray radiology [12].

The aim of this work is to study the reuse of Solid Barite Wastes (SBWs) as a raw material into a clay body, replacing feldspar material by 0, 10,20, 30 wt% of SBWs namely PCRB0, PCRB1, PCRB2, and PCRB3 respectively. Ceramic samples were produced at temperatures varying from 1200 to 1300°C. Microstructures, physical properties as porosity, density, mechanical and thermal conductivities were studied. The evaluation of the release of various chemical species (Pb^{2+}, Zn^{2+}, $Ba^{2+}$and Cu^{2+}) contained in the ceramic samples were also studied.

MATERIALS AND METHODS

The elaborated of the ceramic samples named PCRB0 is based on 50 wt% of kaolin; 20 wt% of sand and 30 wt% of feldspar. This last raw material is substituted by different amount of SBWs (10, 20 and 30 wt %) labeled, PCRB1, PCRB2, and PCRB3 respectively. The different mixtures were milled with 25 ml of distilled water during 2 hours in a planetary ball mill (Pulverisette 7 (Fritsch, Germany) using alumina balls as the grinding media. The obtained slurry was dried for 24 hours at 105° C. The mixture was manually ground for 20 minutes and sieved with 63 µm sieve. Finally the powders were pressed under uniaxial pressure (without added binder) at 55 MPa for 10 min to form pellets of 30 mmdiameter and 4 mm thickness. The pellets were calcined in air on a Nabertherm electric kiln furnace at 1200°C and 1300°C with a heating rate of 10°C/min with soaking time of 2 hours.

The chemical composition of the raw material is determined by X-ray fluorescence type PanAnalyticalPerl'X3. Mineralogical analysis of the samples and the raw materials were carried out on Bruker D2 Phaser X-ray diffractometer using CuKα radiation, a step size of 0.02 degrees 2θ, and a counting time of 10 s per step. Particle size analysis was carried out by laser particle measurement (laser Malvern MAL 1000 18 analyzer). The determination of bulk densities were achieved by the Archimedes's method in water, and absolute densities were measured by helium pycnometry (MicromeriticsAccuPyc). Bulk and absolute densities were used to calculate the total porosity of the samples. Ultrasonic Echography at 600 kHz, with an ultrasonic transmitter-receiver (Panametrics; model: 5072 PR) was used to obtain the elastic property (Young's modulus). The Vickers hardenss of the pellets was carried out on polished samples using an indentation of 9.8 N for 15 s. An average value was obtained from 10 indentations with a (microdormeter (Zwick/Roell HPE). Conductivity of the ceramic samples was determined at 10 °C using a FOX 50 Heat Flow Meter (TA Instruments) in accordance with ISO 8302:1991. The environmental assessment consisted in determining the mobility of pollutants based on the Toxicity characteristic Leaching Procedure (TCLP) established by the EPA (Environmental Protection Agency) in its Method 1311:1992. The concentrations in the filtrate were measured with an Inductively Coupled Plasma-Atomic Emission Spectrometer (ICP-AES Agilent 7500).

RESULTS AND DISCUSSION

As it is shown on Table 1, kaolin, sand and feldspar, used as raw materials for the elaboration of porcelain, contain relatively high amount of SiO_2 and Al_2O_3 which are 42.40, 95.21, 74.6 wt% and 37.8, 0.97, 12.9 wt% respectively. However, fluxes agents as Na_2O and K_2O are slightly in same amount in raw feldspar (3.7 and 4.6 respectively), TiO_2 is relatively high in the raw kaolin with 1.99 wt%. In other hand, SBWs contains a significant amounts of CaO (22.36) beside, metal oxides as

Fe_2O_3 (3.19 wt %), BaO (14.14 wt %), ZnO (1.29 wt %) PbO (1.48 wt %).
Moreover, these metal oxides could play a positive role as fluxes agents. SBWs is slightly poor in Al_2O_3 and rich in metal oxides, Hence, it could be replaced by feldspar.

Table 1. Chemical composition of the raw materials

Oxides	Kaolin (%)	Sand (%)	Feldspar	SBWs
SiO2	42.4	95.21	74.6	8.42
Al_2O_3	37.8	0.97	12.9	2.67
Fe_2O_3	0.55	0.23	1.73	3.19
MnO	0.07	/	0.04	0.09
MgO	0.05	0.01	0.4	1.61
CaO	0.26	1.32	1.08	22.36
Na_2O	0.03	0.27	3.7	0.27
K_2O	0.02	0.4	4.6	0.36
TiO2	1.99	0.01	0.3	3.71
P_2O_5	0.01	/	0.03	0.04
ZnO	/	/	/	1.29
BaO	/	/	/	14.14
PbO	/	/	/	1.48
P.F.	16.78	1.58	0.71	40.17

As presented on Fig.1, SBWs is mainly composed by quartz, dolomite, barite and calcite. However, mineralogical composition analysis, shows that it is mainly composed by quartz (4 wt%), calcite (22%), barite (25%), cerusite (13%) and hemimorphite (27%). These last mineralogical phases were not identified by XRD patterns of the reject SBWs.

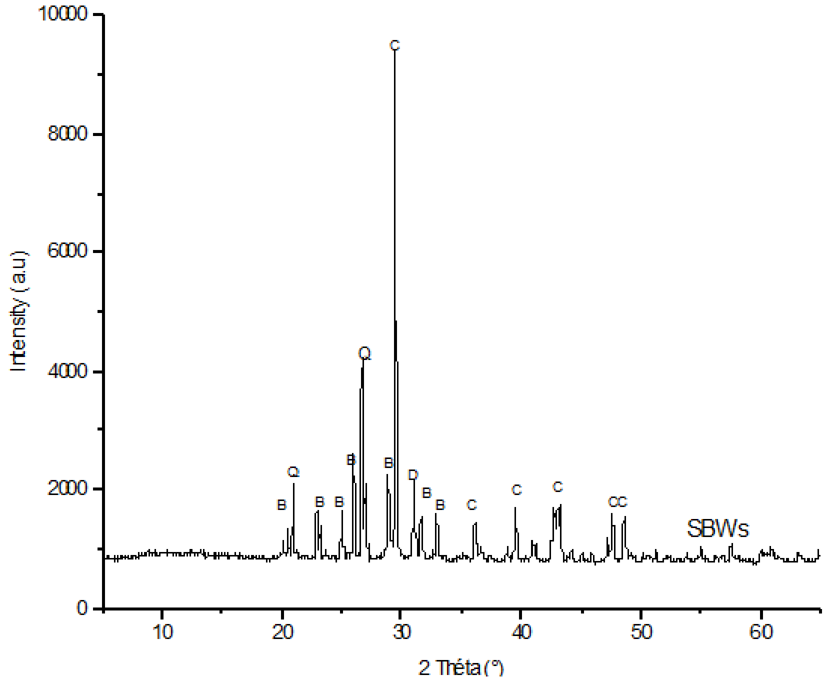

Figure 1. XRD patterns of SBWs raw material

The photos of the sintered ceramic samples based on SBWs addition are presented of Figure 2. The samples became more and more colorless compared to PCRB0, this is due to the presence of iron which plays an important role to give reddish color of the ceramic samples.

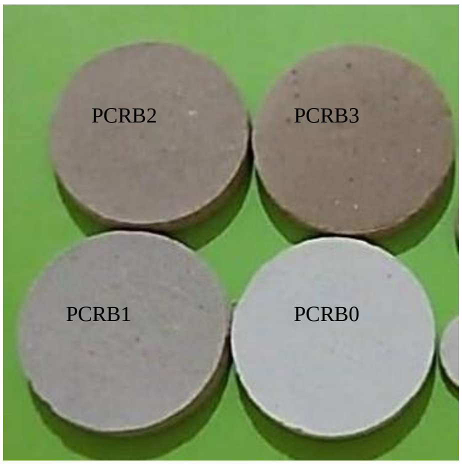

Figure 2. Photos of the ceramic samples sintered as function of *SBWs* addition sinterred at 1200°C.

The results of the sintered ceramic materials are shown on Figure 3 and Figure 4 for the samples sintered at 1200 and 1300°C respectively. Hence, mullite, anorthite, and quartz beside rutile were the main mineralogical phases found in the samples fired at 1200 °C. Indeed, Peaks of quartz and mullite decrease as function of SBWs addition. This is due to the fact that quartz participates to form in glassy phase, which is formed because of the addition of fluxing agent existing in the reject [14]. Moreover, peaks of anorthite began to rise when only 10 wt % of SBWs were added, whereas peaks of cristobalite tend to disappear as function of SBWs addition.

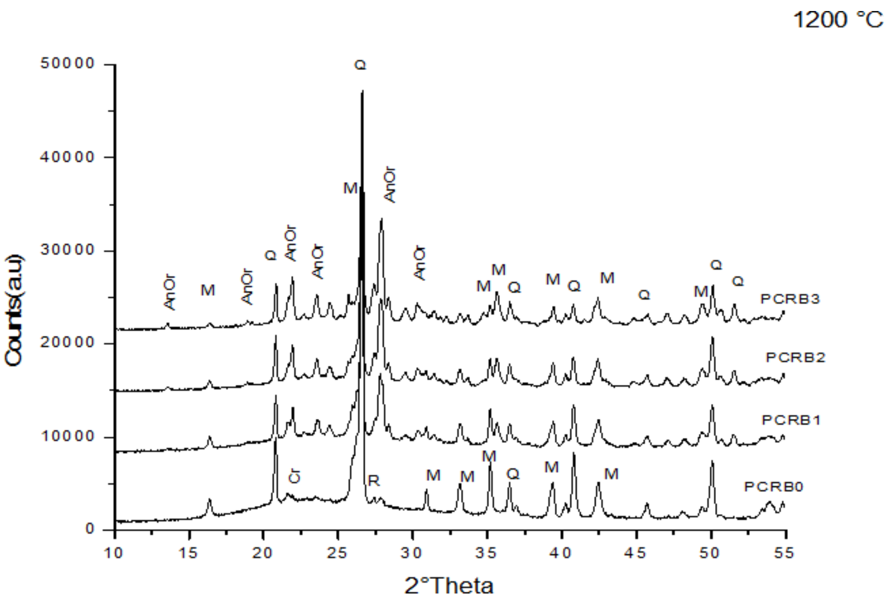

Figure 3. XRD patterns of the ceramic samples fired at 1200°C (M: Mullite, Q: Quartz, R: Rutile, AnOr: Anorthite, Cr: Cristobalite).

The behavior of the samples sintered at 1300°C (Figure 4) is different, when the firing temperature rose to 1300°C. Indeed, as the amount of reject increased, intensity of peaks of mullite and quartz decreased, it is due to the transformation of silica to vitreous phase probably promoted by the presence of fluxes agent as Fe_2O_3, CaO, PbO and ZnO, playing a role of network modification [soro, baziz]. In opposite, anorthite phase ($CaAl_2Si_2O_8$) appeared and increased as function of SBWs addition, this is due to the presence of excessive amount of CaO in the reject (22.36 wt%). A new phase correspondingto the formation of crystallite of celcian ($BaAl_2Si_2O_8$) is appeared in PCRB3, in this region of triaxial composition (SiO_2-Al_2O_3-BaO), celcian can be formed in the high silica region [15, 16], At this same temperature, rutile phase desappered as the amount of SBWs increased, it was been probably incorporated in the mullite phase [17].

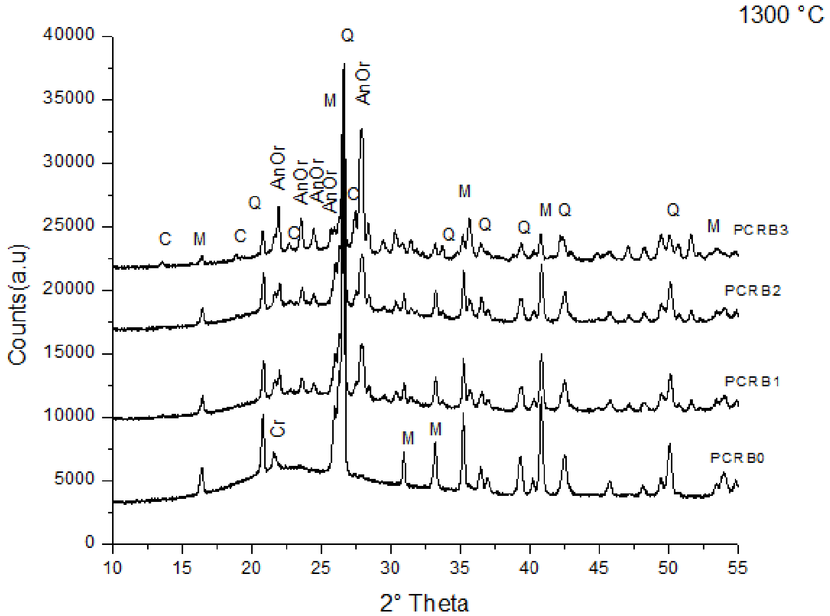

Figure 4. XRD patterns of the ceramic materials fired at 1300°C (M: Mullite, Q: Quartz, Cr: Cristobalite, AnOr: Anorthite, C: Celcian)

According to the Figure.5, Young's modulus increased as a function of the SBWs addition, and as function of the sintering temperature; when 10 wt % of SBWs were added to the mixtures, Young’s modulus of the samples reached 26.9 and 41.27 respectively at 1200 and 1300°C. They are still low compared to the dense ceramic. This behavior can be justified by the appearance of the amorphous phases and mullite network at high temperature. Young’s modulus may be improved with the increase in the content of mullite in the microstructure according to the mullite strengthening theory [18,19]. Thus the increase in sintering temperature induced the formation of mullite which plays an important role in improving the mechanical properties. However, when the amount of SBWs addition increased above 10 wt%, these properties tend to decrease in both firing temperatures. This is due, in one hand to the decrease of the mullite phase and in other hand to the increase of porosity (24.2%).

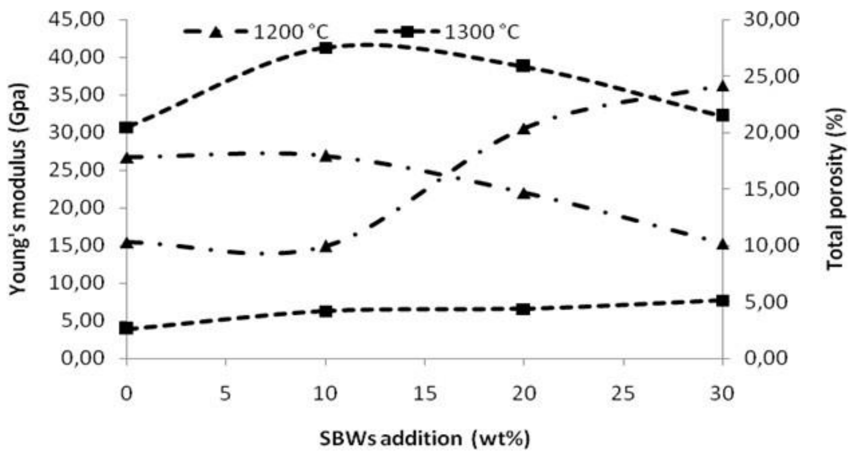

Figure 5. Young’s modulus and total porosity as function of SBWs addition of the samples fired 1200 and 1300°C

Thermal behavior of the samples decreased as function of SBWs addition and as firing temperature. This property is directly linked to the porosity of the samples since the thermal conductivity of the samples diminished as the porosity increased [20]. Indeed, there is relationship between total porosity and the thermal conductivity of the ceramic samples.

This could indicate that factors such as type, size and distribution of the pores are important factors that are controlling the thermal conductivity of the ceramics that incorporate barite rejects [21, 22]. As the temperature is increased from1200 to 1300°C, thermal conductivity of the sample PCRB0 is increased from 0.376 to 0.633 W/mK. Thermal conductivity of fired clays are affected by their mineralogical compositions, consequently, their physical properties (ie: porosity and density) were affected with the increasing of the sintering temperature [22].

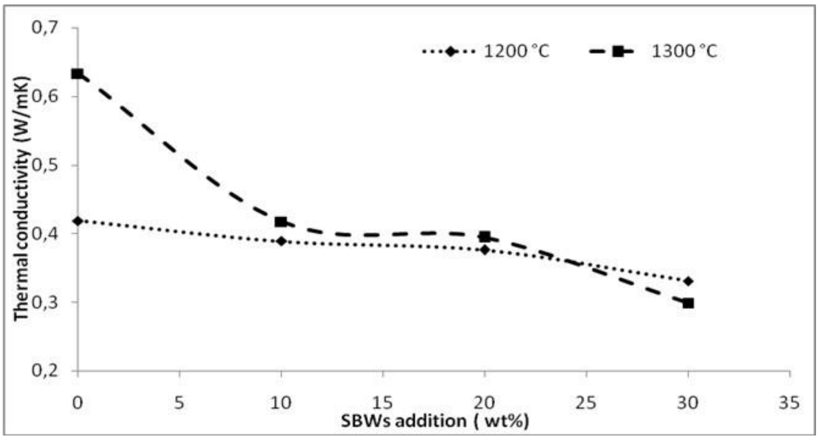

Figure 6. Thermal conductivity and total porosity as function of SBWs addition of the samples fired at 1200 and 1300°C

The environmental study carried out on the sample PCRB1 (Table 2), calcined at 1200 and 1300°C respectively, was performed to evaluate the degree of metal immobilization that can be achieved. Leaching tests [23] were applied to ground ceramic samples. The leachate concentrations have been compared with the US Environmental Protection Agency (USEPA) limits. As shown on the Table 2, the leachate concentrations of the samples fired at 1200°C is higher than those fired at 1300 °C; this is probably due to the vitrification process of the heavy metals into the ceramic matrix. However, the values met the USEPA regulated TCLP limits. Consequently, the leaching test indicated a degree of immobilization of the heavy metals suggesting that the incorporation of 10 wt % of the reject into ceramic products is an efficient inertization method.

Table 4. USEPA TCLP test results (ppm) of PCRB2 fired at 1200 and 1300°C and the maximum concentration of contaminants for toxicity characteristics

	PCRB2		
Components(ppm)	1200 °C	1300 °C	Limits US-EPA (ppm)
Pb	0.089	0.054	5
Zn	0.070	0.030	300
Ba	1.053	0.456	100
Cu	0.047	0.012	5

CONCLUSIONS AND RECOMMENDATIONS

According to the found results and their discussion, it was shown that Solid Barite Wastes contains metal oxides as well as quartz and barite. Based on its mineralogical and chemical compositions, SolidBarite Wastes is an appropriate candidate to substitute feldspar material. However, due to its chemical composition, this reject contains heavy metals that affect the environment. During sintering intensities of mullite and quartz in the ceramic samples decreased in the favor of apparition of anorthite phase which is promoted by calcite which belongs to SBWs material.

However, celcian ($BaO.Al_2O_3.2SiO_2$) phase is present only in PCRB3, when the firing temperature reached 1300 °C. Fluxing agents as Fe_2O_3, PbO, ZnO, present in SBWs material play a positive role to promote formation of glassy phase.

The compressive strength of the samples increased with the addition of up to 10 wt% of SBWs for the bricks fired at 1200 and 1300 °C respectively. The factor that determined the mechanical properties was the total porosity, since the microstructure of the ceramic samples is hardly modified with the addition of SBWs at both firing temperatures, as indicated by the XRD data study. Optimum values of compressive strength are 26.90 GPa and 41.27 GPa, they were obtained for PCRB1 ceramic sample fired at 1200 and 1300 °C, respectively. Thermal conductivities of all samples were low; they were ranged from 0.419 to 0.361 and from 0.633 to 0.299 for the ceramic samples fired at 1200 and 1300°C respectively. They are considered as insulator materials. Solid Barite Wastes (SWBs)can be considered as a material which can substitute feldspar and could be used as raw material, to produce eco-friendly ceramic materials insulators. This might be an alternative and reliable method for the disposal of this reject to preserve the environment.

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AIR POLLUTION MODELLING SOFTWARE PERFORMANCE COMPARISON - A CASE STUDY OF KOMÁROM ROAD

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Abstract: *Recent economic development in many countries has shown an increase in the number of vehicles in urban areas, which further results in an increase in pollutant emissions. This paper presents the results of modelling the simulation of carbon monoxide (CO) distribution in ambient air on roads in Komárom inHungary. The modelling was performed in two modelling software in ADMS and IMMI software. This paper presents a case study of air pollution of bypass road No. 131 in Komárom, Hungary. Modelling in IMMI software was done before and after the construction of the bypass road, based on the simulation in IMMI software, the new bypass helps reduce pollutant emissions in the city. To compare the modelled concentrations from the IMMI software, a comparative analysis was performed with ADMS software. The analysis showed that there is a difference between the concentrations from both software.*

Keywords: *ADMS, IMMI, air pollution, carbon monoxide*

NTRODUCTION

Clean air is essential for our health and the environment. But since the beginning of the industrial revolution, the quality of the air we breathe has deteriorated significantly, mainly due to human activities. Although, the last decades of care for the environment and human health have led to a significant improvement in air quality, people are constantly exposed to pollution in urban areas. Air quality can be determined based on basic emissions that are emitted into the air from both stationary sources (industry) and mobile sources (mainly road traffic). It often happens that the emissions of pollutants are above the prescribed limit values. [1]
Motor vehicles were the single largest source of ambient carbon monoxide during the 1960s and 1970s, even in the most developed countries of the world carbon monoxide is one of the most present and most toxic pollutants. It causes widespread physiological dysfunction in humans mainly due to its haemoglobin binding affinity. Low levels and long-term human exposure to carbon monoxide cause headaches, fatigue and exhaustion, and higher human exposure to carbon monoxide significantly reduces oxyhaemoglobin in the blood, which can endanger human life by reducing the oxygen supply to vital organs, especially the brain and heart. [2].
To prevent high concentration of this pollutant in ambient air, limit values (LV) are defined by various institutions. Hence, according to the United States Environmental Protection Agency (US EPA)national ambient air quality standards for carbon monoxide intakes must not exceed an average of 10 mg/m^3 over a period of eight hours or an average of 40 mg/m^3 over a one-hour period once a calendar year [3]. According to the World Health Organisation (WHO) guidelines, defined LV for CO [4] are lower in comparison to the US EPA standards for one-hour CO concentration. Limit values for CO in ambient air in legislation of Republic of Serbia [5] were defined in more details, defining LV for

different averaging times (1h, 24h and 1year). However, LV for CO defined in EU directives, referring only for maximum daily 8 hour mean [6] (Table 1).

Table 1. Limit Values for CO

Agency	Situation	Maximum CO	Duration
US EPA	Outdoor/Ambient air	10 mg/m³	8 hours
WHO		40 mg/ m³ 10 mg/m³ 30 mg/m³	1 hour 8 hours 1 hour
Serbia		10 mg/m³ 5 mg/m³ 3 mg/m³	8 hours 24 hours 1 year
EU		10 mg/m³	8 hours

The air quality assessment should involve detailed procedures that are approved by the national authority. Very often it includes complex the processes, techniques and steps that leads to the valid and reliable data. Hence, the most reliable technique is appropriate measurement of pollutant concentration, but very often it is time and finance consuming process. However, modelling of the pollutant distribution and its concentration in ambient air is sometimes approved in order to obtain indicative information on pollutant levels in environment. The reference modelling techniques is not defined by Serbian legislation in this moment but at the same time Serbian legislative defines modelling uncertainty for different pollutants.
In this paper, a modelling distribution CO was done by the ADMS Urban model to make a comparative analysis with concentration obtained by IMMI presented the master thesis “Environmental impact assessment of air pollution using a dispersion model”, Eötvös Loránd University, Faculty of Natural Sciences, Centre for Environmental Science, Budapest 2018 performed by Bushra Afteh [7]. The thesis deals with the influence of the bypass road construction in the vicinity of the city of Komárom, Hungary on air quality.

MATERIALS AND METHODS

Study area and Sensitive Receptors

Komárom a small town in northern Hungary has nearly 20,000 inhabitants. The town is located on the right bank of Danube River close to the border with Slovakia. The subjects of this paper are influence of 3 roads located in the town Komárom on air quality. Road 3 is a bypass road, recently built, and has the task of relieving the amount of traffic through the town by Road 1 and Road 2 (Figure 1).

To achieve a full perception of the influence of CO on the surrounding area, sensitive and vulnerable receptors are selected for calculation of CO concentration (Figure 1 and Table 2).

Figure 1. Research area

Table 2. Sensitive receptors

	Name	Description
R1	Petőfi Sándor Általános Iskol	School
R2	Egressy Béni Elementary Art School	School
R3	Helen Doron Early English Nyelviskola	Kindergarten
R4	Komáromi Gesztenyés Óvoda	Kindergarten
R5	Komáromi Tóparti Óvoda	Kindergarten
R6	Extra-med Health and Sport Kft	Medical
R7	Selye János Hospital - Clinic	Medical

Modelling software

The IMMI pollutants module calculates the dispersion of gas, dust, and odour, according to both the particle model (TA Luft 2002/AUSTAL2000) and to the Gaussian model (TA Luft 1986). IMMI also allows for the combining of the calculation of air pollutants with the forecast of noise, two environmental impacts which often have the same cause. IMMI integrates data from the dispersion of air pollutants and noise out in the open (traffic, industrial and recreational noise) into a universal software for emission forecasting. [8]. In this paper, IMMI output data were used for comparative analysis with ADMSS Urban software.

ADMS-Urban is the most comprehensive version of the atmospheric modelling system. ADMS-Urban is an improved Gaussian model (Figure 2) that is intended for modelling the dispersion of pollutants in the atmosphere released from industry, households, as well as road traffic in urban areas. Unlike other

Gaussian models that use the classification of atmospheric stability using the Pasquil-Gifford empirical curve, ADMS-Urban defines the structure of the boundary layer over the Monin-Obuch boundary layer length and height. The ADMS-Urban software package is required in terms of finding data. In addition to defining the source of pollution (surface, point, line) and the interest of pollution, for real conditions and obtaining the most reliable data, it is necessary to define additional parameters. This includes terrain data (terrain roughness, geometry - width and height of the road, etc.) [9].

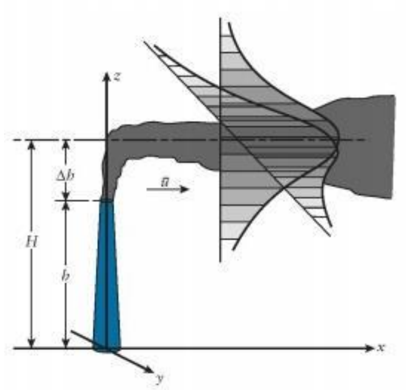

Figure 2. Gaussian dispersion model [10]

Gaussian model dispersion is expressed with following equation:

$$c(x, y, z) = \frac{Q}{\pi u \sigma_y \sigma_z} \exp\left(-\frac{1}{2}\left[\frac{y^2}{\sigma_y^2} + \frac{(z-H)^2}{\sigma_z^2}\right]\right)$$

where: Q-continual emission from point source (g/m³), σ_z- dispersion coefficients (m), y- average wind speed (m/s), H- point source height (m).

RESULTS AND DISCUSSION

To obtain modelled concentration of CO from ADMS Urban software, following input data were processed:

Meteorology - Meteorological data (temperature, wind speed and direction) for the period of 1st July to 1st August 2019, were used for model development. In that period, the maximum measured temperature was 40.7°C, while the minimum value was 14.2 °C. The observed period was characterized as a dry season with no precipitation. In June of 2019, the most dominant wind direction was SW, reaching the speed ranging from 1 to 15m/s. Wind speeds below 1m/s, ADMS Urban recognize as "silence" (Figure 3).

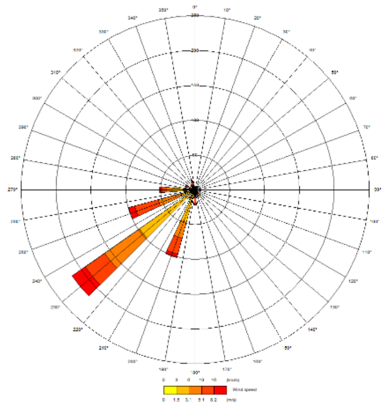

Figure 3. Wind rose

Emission factor for CO – ADMS urban model calculates emission rate from traffic according to the traffic flow and fleet composition. According to the data on traffic flow from Afteh (2018), the emission rate was defined for all three roads, including both light vehicles and heavy vehicles (Table 3).

Table 3. Emission factors (in g/km) for cars and heavy trucks for speed 50 km/h

Source	EF [7]	EF [11]
Light vehicle	0,170	0,753
Heavy vehicle	0,800	0,697

After defining the emission factors for all three roads as well as for light and heavy vehicles, and defining meteorological data, a modelling was performed. The CO concentrations obtained by modelling ranged from 17 μg/m^3 to 172 μg/m^3 (Figure 4).

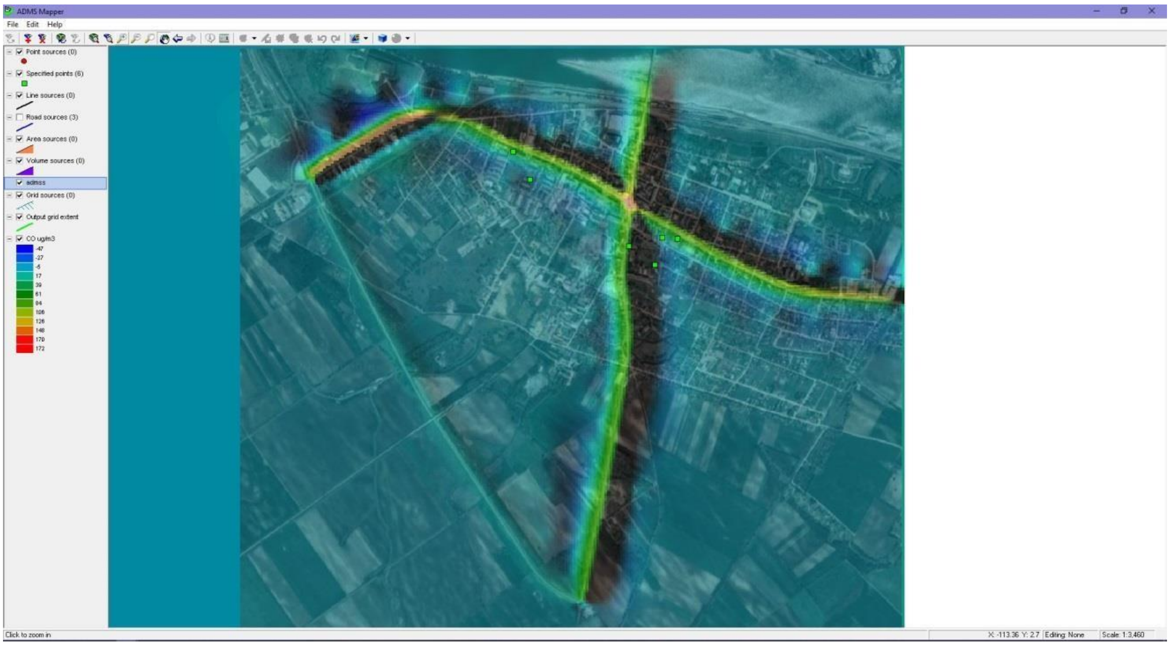

Figure 4. Modelled CO concentration for defined domain of research

Since the dispersion concentrations of the carbon-monoxide for the whole domain were not available in the Afteh (2018), for the comparative analysis, additionally modelling of CO concentrations in the sensitive receptors was performed. Table 4. shows modelled concentration by ADMS Urban software, that were calculated according to the available hourly data on meteorology.

Table 4. Modelled concentration (μg/m^3) by ADMS Urban software using hourly meteorological data

Receptor	CO (IMMI)	CO (ADMS Urban)
R1	19,132	0,0121
R2	6,65	0,0080
R3	5,351	0,0117
R4	17,822	0,0707
R5	3,599	0,0115
R6	3,86	0,0017

Although we deal with models based on Gaussian distribution, the obtained results by ADMS were significantly lower than those obtained by IMMI. One of the reasons could be attributed to the different types of input data needed for each model, especially meteorological data, and emission rat from vehicles as well (Table 3). To avoid that, the most probable scenarios for modelling were selected as performed in Afteh (2018) [7] results.

Since the ADMS Urban defines the structure of the boundary layer over the Monin-Obuch boundary layer length and height, instead of Pasquil-Gifford classes, daytime solar insolation (W/m^2) was used for D class of stability sed in Afteh (2018) [7]. Hence, the D class of stability, were defined as slight daytime solar insolation (> 300 W/m^2). Concerning dominant wind direction and speed, given in Afteh (2018) [7], two scenarios were selected: S1 for SW wind direction and S2 for SSE wind direction. Wind speed of 1.5 m/s was used for both scenarios. The emission factors were not possibleto predefine in ADMS Urban software.

Comparative analysis of modelled CO concentration, calculated for sensitive receptors, obtained by IMMI and ADMS, in case of scenarios S1 and S2, are presented in Table 5.

Table 5. Modelled CO concentration (μg/m^3) in sensitive receptors by IMMI and by ADMS for two scenarios.

Receptor	CO (IMMI)	CO for S1 (ADMS)	CO for S2 (ADMS)
R1	19,132	0,013	0,0023
R2	6,65	0,011	0,0006
R3	5,351	0,005	0,0037
R4	17,822	0,029	0,0490
R5	3,599	0,002	0,0045
R6	3,86	0,002	0,0002

The obtained modelled CO concentration by ADMS Urban for S1 and S2 scenario were still much lower in comparison to the modelled concentration obtained by IMMI. That leads to the conclusionthat the performance mostly depends on availability of adequate meteorological data.

CONCLUSION

This paper shows modelled CO concentrations, obtained by dispersion simulation of pollution from vehicles. The case study covered 3 roads near sensitive facilities in town Komárom, Hungary with the goal to identify CO concentration levels and the impact on vulnerable facilities. The modelling was performed initially in IMMI software and after that, for comparative analysis, the modelling was performed in ADMS-Urban software. The concentrations obtained from the ADMS-Urban software are significantly lower than the concentrations obtained by the IMMI software. Although each software operates by the Gaussian modelling method, the differences in the obtained concentrationsare reflected due to different types of input data especially data on prevailing meteorological conditions.

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MANAGEMENT AND SUSTAINABLE DEVELOPMENT OF ECOTOURISM DESTINATIONS

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Abstract: *The accelerated development of ecotourism reflects through an almost equally rapid increase in the number of researchers who draw attention to potentially harmful and destructive consequences of tourism development. Sustainable tourism and ecotourism destinations are essential for sustainable development, which arose as a logical necessity to stop the expansive economic growth based on the uncontrolled use of available resources. A positive approach, designed to reduce tensions and conflicts that create complicated interactions between the tourism industry, visitors, the environment and the communities that host tourists, advocates the concept of sustainable tourism. Tourism and the environment are interconnected and dependent, while environmental protection is of fundamental importance for the future development of tourist destinations. The motivation of modern tourists is increasingly tied to destinations guided by the principles of sustainable development, so the decision-makers and the local community should pay more attention to the regulations related to environmental protection and the effectiveness of its implementation. Environment protection aims to properly constitute new or implement existing protection measures to achieve positive environmental and social results of a long-term nature. Despite numerous studies regarding ecotourism, there is a particular gap regarding the management of ecotourism destinations. This article provides better insight into ecotourism destinations' management and sustainable development through a comprehensive literature review of groundbreaking researches and articles from state-of-art journals. The concept of ecotourism destination management requires finding new and revising various management strategies to preserve biodiversity in tourism destinations and educate about the importance of sustainable development.*

Keywords: *Eco-management, ecotourism destinations, strategic planning, sustainable development, tourism.*

INTRODUCTION

Travelling for vacation has become an inevitable part of a modern lifestyle. The idea of travelling for pleasure, visiting attractive landscapes, meeting other cultures, or experiencing the environment in some other way, for about 900 million people participating in international tourism, is an unavoidable part of life at the beginning of the 21st century [1].

As a multidisciplinary phenomenon, tourism has a high, above all, economic significance; it represents a significant driving force of economic development. However, in addition to economic, tourism has a broader social and political significance that strongly impacts the overall development of manycountries. Therefore, in tourism development, particular attention must be paid to its sustainable development [2].

When it comes to tourism and sustainable development, these are two interdependentvariables. The concept of sustainable tourism development is the protection and sustainability of all tourism resources and is based on meeting the needs of all generations [3].

Modern tourism has undergone numerous changes during its development. In line with the spirit of change, where sustainable development is becoming the leading criterion for development, numerous changes occur in the international tourism market. Changes in the structure of tourist demand have led to the emergence of new, modern forms of tourism where it is necessary to satisfy the different interests of tourists [4]. According to some estimates, ecotourism covers five to seven per cent of the world tourism market, while other authors state that this share reaches as high as twenty per cent [5].

SUSTAINABLE TOURISM AND DEVELOPMENT

Sustainable tourism implies an industry with a minimal negative impact on the environment and local culture while creating numerous economic outcomes on the environment in which it develops, such as earning money, creating new jobs, and financing the protection of local ecosystems. The degree of development of sustainable tourism largely depends on the relationship it has with the environment. These relations are two-way [6]:

17. The impact of the environment on the development of sustainable tourism, and
18. The impact of tourism on the environment.

If sustainable development is observed as a goal and a process, it is clear that it is a dynamic concept with many dimensions. Both global and local aspects of sustainable development are essential for tourism. This concept endeavors to create a better world where economic, social, cultural, and environmental factors are balanced. One of the most significant research challenges related to sustainable tourism development is the operationalization of this concept and its consideration as a process that should be applied at the local level, at the level of tourist destination, through activities of tourists, businesses, and other participants. There are certain specifics of tourism, due to which it has a unique role in achieving overall sustainability. Tourism is not a consumer of non-renewable resources, both natural and cultural [7].

The relations between tourism and the environment are complex and reciprocally conditioned. This conditionality and complexity depend principally on the scope and intensity of tourist activity and the level of tourist development in the environment [8].

The fundamental characteristic of the environment is the turbulence of tourism, its variability, and the unpredictability of changes. In a relatively short time, rapid changes that affect the quality of tourism and changes that occur in tourism affect the number, volume, and quality of elements.

The primary forms of environmental impact on tourism activities are [9]:

- Difficult possibility of connecting the causes and consequences of a particular phenomenon, it is complicated to isolate two aspects and determine the impact on each other due to the action of many variables;
- The unpredictability of changes - the connection between predicting events in the environment is significantly reduced because the future movements of actions and interactions of many autonomous participants that are very difficult to influence;
- Difficulty achieving goals - achieving the desired business results is significantly important, but also challenging to predict the elements of the environment; and
- Limited ability to control future events due to the effects of accelerated changes, a considerable number of interdependent participants, and characteristics of change, which are under the action of the environment itself.

It is important to include the working environment of a person when environmental protection is mentioned.

Figure (1) shows the model of sustainable tourism in which tourists, by satisfying tourist needs, positively influence the living and working environment, the tourist economy, and the local community itself.

Figure 1. Sustainable tourism model

Having in mind the current theoretical views, interpretations, and definitions, as well as practical solutions in the implementation of sustainable tourism, five key goals can be singled out, none of which must be dominant to the others [7]:

- Protection of life and work environment and conservation of natural resources;
- Preservation of the social integrity of the local community;
- Protection of the cultural heritage of the destination and respect for the cultural specifics of the domicile population;
- Recognition of economic benefits in and from tourism, and
- Optimal satisfaction of tourists' needs through the offer of high-quality tourist products.

The study of human needs from an economic point of view is a vital and wide area. For this study, the scientific conclusions of macroeconomic and microeconomic research are used and the scientific outcomes of sociology and psychology.

There are many classifications in the literature, which take different criteria as a starting point, and for the purpose of this article, the need will be divided in the following way [10]:

- Necessary needs (related to the existence of the individual in the biological sense);
- Additional needs (general cultural needs and luxury needs).

ENVIRONMENT AS AN ECOTURISM DESTINATION

Tourism as an economic activity depends more than any other activity on the quality of the environment. Therefore, the unbreakable link between tourism and the environment can be considered as symbiotic. Furthermore, tourism is an activity that also valorises those elements of large areas of preserved nature that are of marginal interest for other activities [1].

Some authors defined tourism as the sum of process activities and outcomes resulting from interactions between tourists, service providers, local authorities, host countries, communities, countries of origin, universities, community colleges and NGOs, in the process of attracting, transporting, hosting and managing tourists, other visitors and stake-holders [11]. Tourism uses the environment, and its specificity is that it is not an irreversible consumer of natural elements. Therefore, the controlled development of tourism and the construction of appropriate facilities lead to the improvement of the environment [12].

Although nature has always been the subject of human interest, a significant contribution to the development of nature-based tourism was made in the late 18th century. In Romanticism, nature became the ideal of artistic creation [1]. In that period, as today, the shores of the sea and ocean are considered tourist destinations that are in the first place, ahead of national parks, lakes, rivers and forests. Researchers even agree that the attractiveness of wild, natural, and predominantly coastal areas are undeniable for now [13].

The term ecotourism was first formulated by Ceballos-Lascurain, a Mexican architect and ecologist, as follows: environment results in a small impact of visitors and enables the local population's functional

and active socio-economic involvement. Ecotourism preserves certain values: protection and preservation, ethics, sustainability, education and benefits for the local community [14].
Certain authors underline that the term "ecotourism" first appeared in 1985 in the literature and as a new topic. It promptly attracted the attention of a large number of researchers. The same authors singleout British scientist Darwin, who visited the Galapagos Islands as the first ecotourist [15].
Ecotourism is an integral element of the concept of sustainable tourism. However, there is an essential difference between these terms. Ecotourism focuses more on environmental protection and educating guests about the local, natural environment, while sustainable tourism concentrates on travel with the least possible negative impact on the environment and local communities.
The International Society for Ecotourism emphasises the following principles of ecotourism [16]:

- Minimising physical, social, behavioural and psychological impact;
- Building environmental and cultural awareness;
- Providing a positive experience for guests and hosts;
- Creating direct financial benefits for nature conservation;
- Generating financial benefits for both the local population and the private sector;
- Delivering unforgettable experiences for guests, which enable raising awareness of the political, environmental and social climate of the host country;
- Design, construction and management of facilities that have a low impact on the environment;
- Recognition of the rights and spiritual beliefs of the native population to strengthen them and preserve their authenticity.

Figure (2) shows the graphical representation of sustainable glocal tourism as a circular matter, which must achieve its natural circulation with minimal human guidance through the satisfaction of all facts. The term glocal is a word created by crossing words globally and locally.

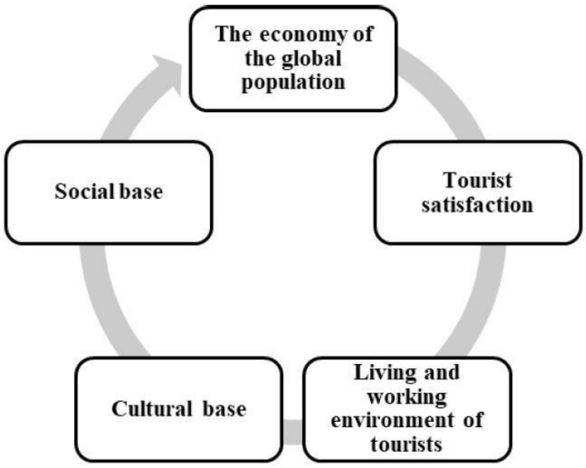

Figure 2. Sustainable glocal tourism

The primary characteristics of an eco-destination are [17]:

i. Preserved natural attractions within the protected landscape;
ii. Low density of development;
iii. Tourism does not harm nature;
iv. Development of small local enterprises owned by residents;
v. Places intended for outdoor recreation are designed to protect sensitive resources;
vi. Improving accommodation facilities that provide genuine hospitality by friendly and motivated staff;
vii. Diversity of local festivals and festivities, by which the local community manifests a sense of pride in the natural environment and cultural heritage;
viii. Clean public facilities used by both tourists and residents, such as public showers or toilets;
ix. Mutual friendly relationship between locals and visitors at meeting places, such as local shops or benches by the sea.

The definition of environmental management means the management and development of the company, which takes care of the environment. Environmental management is a decision-making process that regulates the impact of human activities on the environment not to disrupt the environment's capacity for sustainable human development. Environmental management in all company functions takes into account the interaction with the environment and includes it with full responsibility in all business decision-making processes.
As presented in Figure (3), the VICE model provides a framework that destination management can use to ensure the sustainability of its actions. The VICE model defines tourism in a destination as the interaction between [18]:

i. Visitors staying in a tourist destination;
ii. Tourism economy provides travellers with services;
iii. A local community hosts and reacts to various impacts of tourism; and
iv. The environment in which this interaction takes place and includes natural and built resources on which tourism products are based in the broadest understanding.

Figure (3) shows interconnectivity between key destination stakeholders.

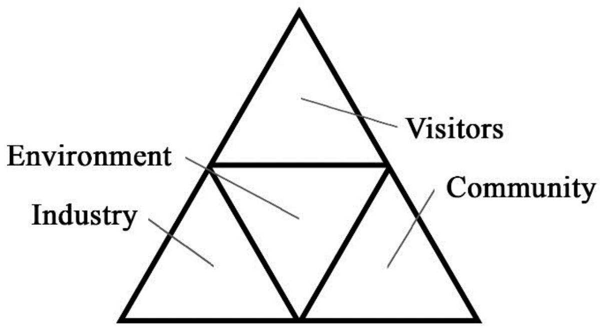

Figure 3. VICE model

Although it may seem that the VICE model is presented in a relatively simplified way, it integrates the fundamental areas of destination eco-management activity with the tourist destination's key interest groups [19]. Optimal use of natural resources provides a better quality of life for residents and visitors [20]. The task of destination eco-management is to shape its own specific set of local VICE elements and to create a tourist destination management plan through the deployment of local partnerships, by which the destination [9]:

i. Welcomes and hosts tourists and meets their needs;
ii. Creates a profitable and prosperous tourism economy;
iii. Includes and creates benefits for the local community, and
iv. Protects and enriches the local environment.

CONCLUSIONS AND RECOMMENDATIONS

Interconnectivity and codependence between tourism and the environment are undoubtful, implying that environmental protection is significantly important for developing tourist destinations. Local and national decision-makers need to recognize the need and importance of sustainable tourism postulates and ecotourism principles and implement them, to improve and further develop ecotourism destinations. Without strategic planning and management of sustainable development, tourism can cause significant damage to the destination environment and cause social and cultural conflicts in the local community. Therefore, it is necessary to plan and manage every aspect of ecotourism and sustainable tourism. Planning and managing are essential for developing ecotourism destinations and all stakeholders, contributing to the quality of life of the local population improve its natural and cultural environment.
Furthermore, sustainable development of ecotourism destinations is vital for the environment and local population because it is necessary to create new jobs, diverse possibilities for new investments and

enhance economic development.
This paper addresses the existing gap regarding ecotourism destinations and provides better insight into ecotourism destinations' management and sustainable development. The recommendation for further research is to conduct an even more extensive literature review to have more precise insight into the management and sustainable development of ecotourism destinations.

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REPRODUCTION OF POTENTIAL SOIL FERTILITY AND THE STATE OF THE ENVIRONMENT AT THE WASTE APPLICATION FROM PIG COMPLEXES

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Abstract *The increase of the livestock and waste concentration per unit area of agricultural land determines a qualitatively different nature of the impact on the indicators of potential soil fertility and the state of the environment. Livestock breeding complexes for fattening up to 70 thousand pigs per year are located in the Polissya zone on typical sod-podzolic soils. However, large pig complexes cause an increase in the chemical load on ecosystems in waste disposal sites due to technical and organizational reasons related to the capacity of effluents per unit area. The research aimed to establish the parameters of changes in soil fertility and the ecological state of the environment in the conditions of the intensive waste load of pig complexes. It has established that the use for 25 years of low doses of the solid fraction of effluents from the Agricultural Open Joint-Stock Company «Agrocombinat Kalyta» as well as their combination with straw and green manure in the long-term stationary experiment of the National Science Center «Institute of Agriculture NAAS» caused widespread reproduction of sod-podzolic soil fertility. The highest fertility parameters were achieved by applying the solid fraction of effluents at a dose of* N_{75}*, where the humus content was 0,28 % higher than control (without fertilizers) and was – 1,17 %. At the norm of the effluents solid fraction of* N_{75}*, the content of mobile phosphorus in the soil increased to control 1,4 times, and at doses* N_{300} *– 3,2 times, which caused high soil phosphating. The content of mobile potassium in the soil at the application of the solid fraction of effluents at the dose of* $N_{100-200}$ *remained low (70-75 mg/kg), which is required the additional application of potassium fertilizers at the dose* K_{60-120}*. At the fertilizing of the soil with the pig effluents, the dose of their application should not exceed 200-225 kg/ha in terms of nitrogen has been established. At doses of* N_{400} *and above, there were a sharp increase in soil acidity, a decrease in the amount of absorbed bases by 1,9 times, an increase in the content of mobile phosphates by 25 times to the natural background, and contamination of groundwater with nitrates. At high effluents loads (*N_{400}*), nitrogen leaching from nitrates in the soil thickness to 500 cm is increased 14,6 times compared to the control: at the control - 102 kg/ha, at the dose of excess activated sludge* N_{225} *- 657, dose* N_{675} *- 1488 kg/ha. At the intensive effluents loads, there was defined the inhibition of the development of mostphysiological groups of soil microorganisms, in particular, actinomycetes and ammonifiers. However, the number of denitrifying and phosphate-mobilizing microorganisms increased 13 and 4 times, respectively, at the increasing intensity of organic matter mineralization. It was significantly affected the processes of nitrate pollution and phosphating of the soil. The use of a solid fraction of livestock effluents in the dose of* N_{75} *provided crop rotation productivity at the level of 4,10 t/ha of grain units at the dose of* $N_{75} + K_{90}$ *– 4,57. The highest productivity of crop rotation (5,65 t/ha) was achieved at the application of excess activated sludge at a dose of* N_{225}*, while a similar indicator at the control was 2,56 t/ha. Further increase of the products doses of biological processing of livestock effluents reduced the payback per unit of fertilizer by 4-5 times and created an environmental hazard in the environment.*

Keywords: *sod-podzolic soil, fertility, waste of pig complexes, environmental protection, soil microorganisms, surface soil water.*

INTRODUCTION

Industrial livestock complexes and poultry farms in Ukraine are in the basins of small rivers. The products of their life create situations of extreme environmental stress, which affects the deterioration of the quality of soil cover, groundwater, and even artesian water. Environmental pollution in areas of industrial livestock is complex, in which there is chemical, biological, bacterial, and helminthic pollution. In world practice, the way out of a complicated environmental situation had found in the regulatory waste application to ensure their quality use [1, 2, 3, 4]. A significant contribution to solving the problem had made by German [5, 6, 7] and European scientists [8, 9] and in Canada and Japan [10, 11].

Ukrainian scientists, in particular O.O. Batsula, E.G. Degodyuk, M.K. Linnik, V.I. Gamalei, have made a significant contribution to the utilization of litter-free manure of large and small livestock complexes [12].

However, the problem of using livestock waste from industrial complexes turned out to be much more complicated. It requires not only utilization but also the transformation of their firm part during bioconversion into digestible forms.

There was the least of all attention to the environmental consequences of systematic stress on the environment at planning large pig complexes. Theoretical issues of ecosystem functioning in such cases were considered even less [13].

Under stress loads of livestock effluents, this balance is disturbed, and decomposition processes do not have time to stabilize with the arrival of new portions of effluents. It sharply inhibits the passage of self-cleaning of the soil, which occurs in the natural environment during one growing season. Thus, in such situations, the production of introduced organic matter exceeds the decomposition, creating favorable conditions for the development of harmful microflora and the preservation of putrefactive processes and diseases. It is known that animal excrement is a source of more than 100 diseases ofboth animals and humans.

Many cases of aggravation of the ecological situation due to ill-considered choice of location of complexes and unsuitability of agricultural land for prompt and uniform application of effluents are in the practice of industrial animal husbandry.

After all, large complexes for fattening up to 100 thousand pigs per year are equated to an industrial center with a population of 400-500 thousand people. In connection with the transition to concentrated feed, which includes various premixes, in the mass of manure pigs content of copper was 1064 kg, zinc 5800 kg, manganese 2600 kg, while in the manure of complexes for 12 thousand heads, respectively, 145; 110 and 340 kg [15]. The liquid flowing from the fattening sites contains 30 times more ammoniacal nitrogen, 4 times more nitrate, and 75 times more phosphorus than in the wastewater from the fields under cultivation. The sewage water of complexes, getting into reservoirs,at a concentration of nitrogen of 0,3 mg/l and phosphorus of 0,2 mg/l, cause rapid development of phytoplankton and death of fish [16].

The ecological danger is posed by the infrastructures of large complexes, which involve the use of large areas under the buildings of treatment facilities and settling ponds, increasing the volume of irreversible water supply (up to 90%), salinization and waterlogging of irrigated fields, phosphating intensively fertilized fields with biological treatment products, reduced yields and deterioration of product quality. And especially it should be noted - increasing the incidence of the population [17].

The area of activity of large livestock complexes is a model of sudden and stressful load on agricultural landscapes, where are including mechanisms of action on nature, which were previously uncharacteristic of it on such a scale.

Livestock effluents are a special type of anthropogenic organic residues. It is uncharacteristic agroecosystems for the entire previous history of civilization [18]. At the same time, it has been established that under conditions of a moderate load of livestock effluents at the complexes with ecologically sound livestock, livestock waste is not harmful to wildlife. And it can play an important role in a balanced cycle of nutrients.

It has been established by many both domestic and foreign scientists [19, 20, 21]. In the last decade in Western Europe, North America, East Asia, violations of norms and standards of hygiene and ecology of the environment by livestock waste products are legally prohibited and strictly controlled by relevant government services, bodies, and public organizations [22].

MATERIALS AND METHODS

A long-term experiment has based in the area of the Left-Bank lowland Polissya (Chornobyl' agro-soil district) on the sod-medium-podzolic sandy soil of the Agricultural Open Joint-Stock Company (AOJSC) "Agrocombinat Kalyta" of the Brovary district of the Kyiv region. The experiment examined the effectiveness of increasing doses of solid fraction (N_{50-400}) of livestock effluents of Kalytyansky pig complex with fattening 70 thousand pigs per year, as well as the efficiency of mineral fertilizers, crop by-products, and green manure in field crop rotation with the following alternation of crops: lupine - winter wheat – corn for silage – winter rye – spring barley – vetch-oats – corn for silage – soybeans. The experiment was deployed in three fields. It had 13 options and 3 repetitions. The sown area of the plot was 120 m^2, accounting – 60 m^2. During field research, we took soil samples at the endof the growing season before harvesting crops to a depth of 0–20 cm and a depth of 1–5 m every 20cm with a soil drill.

In the selected soil samples were determined: the content of total humus according to State Standard of Ukraine (SSU) 4289:2004; pH_{H_2O} and pH_{KCl} - potentiometrically according to SSU ISO 10390:2007; hydrolytic acidity - according to Kappen (SSU 7537: 2014); hydrolyzed nitrogen content - according to Cornfield; the content of mobile phosphorus and mobile potassium (in sod-podzolic soil) - according to Kirsanov (SSU 4405:2005). Yield accounting was carried out in every area by direct combining.

RESULTS AND DISCUSSION

The results of the research have shown that physicochemical parameters of soils have stabilized at a level close to nature at the use of moderate doses of liquid and solid wastes of industrial livestock, as well as their combination with crop by-products and green manures. Based on environmental and economic considerations, the average crop rotation dose of liquid waste and products of their processingin the amount of 150–200 kg of total nitrogen per 1 ha of crop rotation area was determined as one that provides natural reproduction of soil fertility.

In sod-podzolic soil at the once liming in 8-field crop rotation at a dose of 6 t/ha of ameliorant (sugar beet production waste) (60 % $CaCO_3$) and systematic application of biological processing products of livestock effluents, the degree of bases saturation was increased during crop rotation from 46,6 to 53,4 % at the moderate doses of excess activated sludge (N_{50-100}). While at high doses of redundant activated sludge ($N_{450-900}$), it decreased to 10 absolute percent, with a corresponding increase in hydrolytic acidity to 5,16 mg-eq/100g of soil and a shift in the reaction of the soil solution from the values of weakly acidic (pH_{KCl}=5,1) to acidic (pH_{KCl}=4,9).

Optimal physicochemical parameters at the use of products of biological processing of drains have formed at moderate doses (N_{75-150}) with crop by-products and green manures. At the application of increasing doses of the solid fraction of livestock effluents ($N_{200-400}$), there was an increase in hydrolyticacidity from 1,7 to 2,98 mg-eq/100 g of soil.

Humus condition of soils at the bioconversion of livestock waste. The highest content of total humus in sod-podzolic soil at the utilization of products by biological processing in field crop rotation was with the optimal dose of the solid fraction of effluents N_{75} – 1,17 % with an increase to control without fertilizers by 0,28 %. The humus content decreased to 1,05 % at a dose of solid effluent – N_{400}. It is due to the intensification of the processes of organic matter mineralization under high loads of products of biological processing of pig effluents.

The activity of soil microorganisms at the application of livestock effluents. There was a suppression of microbiological activity in sod-podzolic soil at high effluents loads and products of their biological processing (in doses $N_{450-900}$). The number of ammonifiers decreased by 2-3 times, actinomycetes – by 2-4 times. The number of nitrifying bacteria increased – 1,6 times, phosphate-mobilizing microorganisms increased 13 and 4 times, compared with the control without fertilizers and 1.8 times compared with a moderate dose of products of biological effluent processing.

Accumulation of nitrogen compounds in soils at the utilization of livestock effluents of AOJSC "Agrocombinat Kalyta" (excess activated sludge, solid fraction, sediments of vertical settling tanks). In a long experiment on sod-podzolic sandy soil, we have found that the content of hydrolyzed nitrogen under different crops in the arable (0-20 cm) layer, except for some years, corresponding to the gradation of low supply (57–84 mg/kg), regardless of the amount applied doses of fertilizers. This isdue to the low humus content (1,10 – 1,17 %) and enhanced nitrification and denitrification processes. Compared with the background content of N-NO_3 (156 kg/ha – 1992 and 102 kg/ha – 1994) in the soil thickness of 0-500 cm in the control without fertilizers at the application a double dose of activated sludge (N_{255}) the amount of nitrate-nitrogen per this depth increased in 1992 by 4,8 times, 6 doses of silt – (N_{675}) – by 8 times, in 1994 by 6,4 and 14,5 times, respectively. At the same time, the highest concentrations of nitrate-nitrogen (22-33 %) were concentrated in the upper soil layers and in the underlying rocks, which are close to groundwater – 25-46 % of its total amount. It can lead to a direct threat of nitrate contamination of crop products and groundwater (Fig. 1).

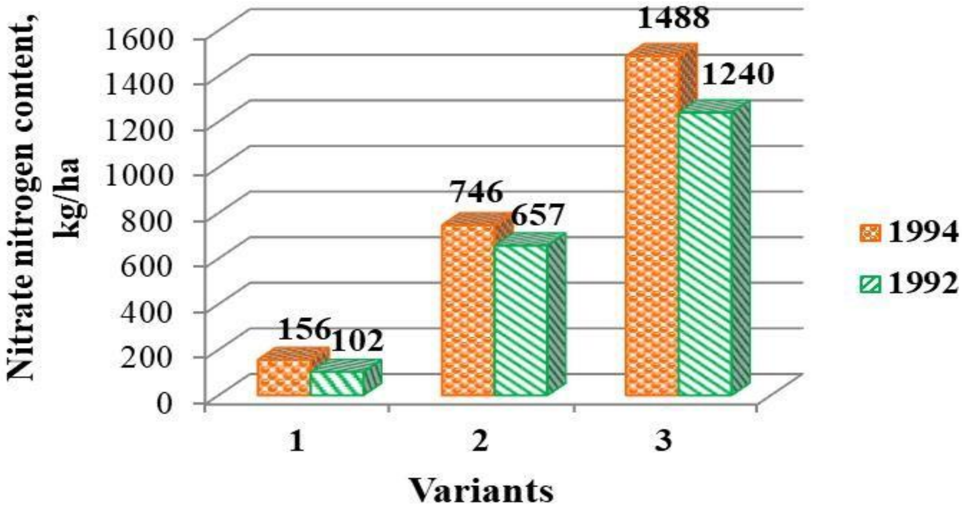

Figure 1. The effect of long-term application of excess activated sludge on the migration of nitrate-nitrogen in the profile of sod-podzolic sandy soil to a depth of 500 cm, AOJSC "Agrocombinat Kalita":
1 – without fertilizers (control); 2 – N_{225} – (2 doses); 3 – N_{675} (6 doses)

According to our calculations, the average load of effluents in the fields of the farm of AOJSC "Agrocombinat Kalyta" reached 700 kg N per 1 ha, which is almost 5 times more than the existing standards. During a full load of pigs livestock (108 thousand), the average content of nitrates in the wells of the village of Kalyta in the early 90s of the twentieth century was 412 mg NO_3 per 1 liter of water, in 1996 - 644 mg/l, which is 8 and 13 times higher than the maximum permission concentrations for drinking water. During the period of inactivity of the complex (1996-2000), the concentration of nitrogen nitrates in the village' wells decreased to 50 mg/l. In 2006 at the fattening 78 thousand pigs mostly exceeded the maximum permission concentrations by 2-4, maximum – 6 times.

Accumulation of phosphorus in soils with the use of livestock waste

At the intensive application of products of biological processing of effluents, due to chemical sorption, there was a noticeable accumulation of mobile forms of phosphorus in the soil, which caused phosphate pollution of the environment. The content of mobile phosphorus in the arable (0-20 cm) layer of sod-podzolic soil was 320 mg of P_2O_5 per 1 kg at the laying of a field experiment in 1978. Between 1990 and 2000, it decreased to 283 mg/kg or 12 %. With the systematic application of moderate and high doses of the solid fraction of livestock effluents, further soil phosphating occurred. With the systematic use of products of natural pig complexes for 20 years with the application of the average dose of solid fraction N_{100} (25 t/ha of physical weight), the content of mobile phosphorus increased by 156 %, and the dose of N_{200} (50 t/ha) – 3,2 times and N_{400} (150 t/ha) 4,9 times compared to the control without fertilizers. In a long-term experiment, the accumulation limit of mobile P_2O_5 was established, which on average reaches 1156 mg/kg. Phosphate pollution had reduced by 30 %

with the combined use of straw and products of biological processing of livestock effluents. According to the materials of the agrochemical survey, the area marked P_2O_5 "elevated, high and very high" accounted for 75 % of the farm's agricultural land. Land areas with low P_2O_5 content did not exceed 2-4 %. Our control agrochemical survey of the farm soil cover showed that the average reserves of mobile P_2O_5 in the field crop rotation reached 2030 kg/ha of soil, which is 25 times higher than the natural background.

Table 1. Change of phosphate regime of soil cover of agricultural lands of AOJSC «Agrocombinat Kalyta»

Surveyed area	Areas, with different provision of movable forms P_2O_5, ha					
	very low	low	medium	increased	high	very high
3728,4	–	71,2	325,9	868,7	1321,7	1140
± until 1985		+01,9	-0,1	+4,1	+21,6	-27,5

The noticeable influence of industrial effluents on the phosphorus content in the well waters of Kalyta village has been determined. The phosphorus content ranged from 0,18 to 3,4 and 7,4 mg/l depending on the distance of wells from fertilizer fields. In surface waters, the phosphorus content was up to 0,32 mg/l at the ecologically safely standard - up to 0,05 mg/l.

Accumulation of mobile potassium in soils

In the products of mechanical and biological processing, potassium passes into the liquid fraction, and, therefore, there is a need to balance this element through the application of mineral fertilizers and by-products of crop production. The ratio of N:P:K in the wastewater of AOJSC "Agrocombinat Kalyta" was 1:0.75:0.3, in the solid fraction – 1:0.24:0.10.

Due to potassium deficit in the soil in the second rotation of field crop rotation, variants with the addition of waste with potassium mineral fertilizers introduced into the experimental scheme. Under moderate loads of excess activated sludge and solid fraction of effluents, the content of mobile potassium in the soil remained at a low level, even with the addition of potassium fertilizers (K_{60-120}). The migration of this form of potassium along the soil profile to a depth of 1 m increased markedly in spring (May) and was 1.3 times higher than the maximum dose of excess activated sludge ($N_{450-900}$),1,6 times higher than the mineral fertilizer system, and 1.6 times higher combination of excess activated sludge and NPK – 3,8 times compared to the control without fertilizers.

Excessive use of effluent of pig complexes in the farm fields, depending on the distance to them, caused an increase in potassium content in well waters of village Kalyta from 1-8 to 500-800 mg/l, in ponds – from 10 to 185 mg/l.

Definition of the nutrient balance in the crop rotation of the experiment on sod-podzolic soil has shown that the intensity of nitrogen balance at high doses of fertilizers increased from 100 to 210 %. The intension of phosphorus balance at moderate backgrounds (N_{75-150}) was 173 %, at high backgrounds ($N_{450-900}$) – 616 %. The intensity of the potassium balance did not exceed 70 %.

Productivity of field crop rotation on sod-podzolic soil at the waste utilization of livestock pig complexes

Under loads of the crop rotation area with excess activated sludge (N_{75-150}), the productivity of the crop rotation unit (fodder beets, oats, vetch-oats, winter rye) was 5.21 t/ha of grain units with an increase of 68 % to control without fertilizers (3,09 t/ha), with a double dose of excess activated sludge (moderate load) – 83 %. Further increase of doses on 1 and 2 intervals ($N_{150-225}$ and $N_{450-900}$) increased crop rotation productivity only by 8 % compared to moderate effluent loading. The addition of K_{90} to an average dose of excess activated sludge provided twice the crop rotation productivity compared to the control without fertilizers. Application of solid fraction of effluents in the fodder crop rotation link (spring barley, corn for silage, winter wheat, lupine) at the dose of N_{75} provided an increase up to 77 % with productivity on control without fertilizers 2,32 t/ha of grain units. Productivity increased by only 3 % at the application of high doses ($N_{150-300}$ + K_{85}). At the same time, the payback per unit of the solid fraction by the increase of crop rotation productivity was three times lower compared to the moderate load of crop rotation effluents.

It found that the application of solid fraction of effluents (N_{100} + straw) has provided an increase to control of 37 %, and at an average dose of nitrogen (straw 5 t/ha + N_{50}) – 42 % to control without fertilizers.

CONCLUSIONS AND RECOMMENDATIONS

In AOJSC "Agrocombinat Kalyta" the field experiment for 2 rotations of 8-field crop rotation identified minor changes in physical-chemical parameters at moderate effluents load. We have established the negative impact of high doses of excess activated sludge (N_{675}) on all physicochemical parameters of the soil. At the initial content of total humus of 1,1 % in the arable (0-20 cm) layer of sod-podzolic soil during 2 rotations of crop rotation, its content increased in the control variant without fertilizers to 1,37 % due to the crop rotation factor, and on moderate backgrounds of effluents to 1,43 %, at the application of a high dose of excess activated sludge (N_{675}) – 1,35 %. It has been found that all groups of soil microorganisms developed most steadily under moderate loads of products of biological processing of livestock effluents in doses N_{100}-N_{200}. At high doses (N_{300}-N_{400}), the number of nitrifiers increased sharply, and the number of phosphate-mobilizing microorganisms increased 2,9-4,0 times compared to control without fertilizers.
At the horizontal and vertical migration of nitrate-nitrogen to a depth of 6 m in a long experiment on sod-podzolic soil with gravitational water effluents, there was an accumulation of 533 kg/ha N-NO_3, after 5 years –1088 kg/ha, and on moderate backgrounds of effluents (N_{225}) – 4 times and at high – 18 times more than the control without fertilizers. The content of mobile phosphorus in sod-podzolic soil in the control variant without fertilizers was 235 mg/kg. It increased by 2,6 times at moderate sewage loads and high - by 4.9 times, which indicates its phosphating. The content of mobile potassium in sod-podzolic soil on the control without fertilizers was 52,4 mg/kg, and at the systematic application ($N_{200-300}$) of the solid fraction – 65 mg/kg of soil, which corresponds to a low level of supply. The use of a solid fraction of livestock effluents in the dose of N_{75} has provided crop rotation productivity – 4,10 t/ha of grain units, at the dose of N_{75} + K_{90} – 4,57 t/ha with exceeding control without fertilizer twice. The highest productivity of crop rotation (5,65 t/ha of grain units) has been achieved at a dose of N_{225} at the application of excess activated sludge, exceeding the control without fertilizers by 2,56 t/ha. Further increase in the doses of biological products of livestock effluents reduced the payback per unit of fertilizer by 4-5 times and created ecological tension in the environment.

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HYDRAULIC INFRASTRUCTURES MANAGEMENTIN KETOU MUNICIPALITY IN REPUBLIC OF BENIN (WEST AFRICA)

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Abstract: Motivation/Background*: The insufficient management of the hydraulic infrastructures of Kétou commune limits access to drinking water for households in this commune. This research aims to analyze the management methods of hydraulic structures in Kétou commune.* ***Method****: For this propose, documentation, observations, and field surveys in 150 households selected according to the low or medium level of access to water infrastructures were carried out. Likewise, resources such as local elected officials and those in charge of water management of those infrastructures. The data collected was compiled in Word and Excel 2010 on Windows, descriptive statistics were used for the processing of these data and QGIS 2.14.6 was used for the creation of buffer zones which spatially prioritize the density, the average and weakness of the service points in water points as well as human concentrations.* ***Results****: As results, the drinking water supply rate for the Kétou commune is 42.75 %. This commune has 182 hydraulic structures (FPM, PM, PEA, AEV) unevenly distributed, of which 106 structures are functional, ie a rate of 58 % and 76 are broken down, ie 42 %. This situation leads households in unserved localities travel long distances to obtain drinking water. It urges that communal, local and government actors in collaboration with the population of Kétou define strategies for easy access to drinking water for households in the commune.*

Keywords: ***B****enin, Kétou, unequal distribution of hydraulic structures, difficult access to drinking water*

INTRODUCTION

Water is a very precious natural resource and essential for the survival of human beings. Water is a finite and vulnerable resource essential for life, development and the environment. Water is a precious and necessary good for all ecosystems (M. Adoubiaran, 2008). It is very present on our earth and poorly distributed between countries, regions and people. Some suffer from water stress: a critical situation characterized by water unavailability. It is currently a scarce resource whose spatial and temporal distribution is unequal (B. A. Zannou, 2011). Fresh water represents only 2.5% of the total water that covers the planet (DGE, 2008). According to the United Nations (UN) estimates in 2005, more than a billion people are deprived of the right of access to drinking water. Africa is the continent most affected by the problems of access to drinking water where half of the population is affected by water-related pathogens (PHAC, 2012).

In West Africa, Benin is not on the sidelines of this situation of access to water. Benin has relatively large water resources. The average annual rainfall is between 700 mm and 1400 mm (L. Odoulami and M. Boko, 2009). Surface water resources are estimated at 14 billion cubic meters of water and the annual groundwater recharge capacity is estimated at 1.87 billion cubic meters (National WaterPartnership of Benin, 2007). But these resources are unequally distributed over the entire national territory and great difficulties are still linked to the supply of drinking water, especially in rural areas.

They undergo degradation and their quality becomes more and more critical. Thus, Benin has integrated in its Agenda 21 and in its Growth and Poverty Reduction Strategy Paper (DCRP), the protection of its water resources and adopted within this same framework, the Management Program. Integrated Water Resources (IWRM) through the Kouhounou declaration. But, it is clear that, until now, there are still problems of scarcity and inequality in the distribution of this resource.

In the commune of Kétou the problem of water supply is acute. People who do not have easy access to drinking water resort to dubious sources which are, among others, rivers, backwaters and sometimes even runoff, which has enormous consequences for their health. Geospatial technologies such as Geographic Information System (GIS) can be of significant contribution to drinking water supply problems. They are an alternative for studyingthe problems of drinking water supply. They offer the possibility of combining multi-source, multi-scale data and of regularly updating data essential for continuous monitoring of the production and supply of drinking water. This is what justifies the choice of this subject, which relates to the management of hydraulic infrastructures by geographic information systems in the commune of Kétou in Benin.

By assuming that GIS is an essential tool for establishing the diagnosis of water supply in order to make decisions for better coverage, the objective of this research is to understand by means of the Information System Geographic (GIS) problems related to the supply of drinking water in the commune of Kétou. GIS is simultaneously an analysis, management and simulation tool (E. Raynard, 2000). It allows to describe the structure of the studied reality and to model its functioning. It is also a set of spatially referenced principles, methods, instruments and data, used to capture, manage, analyze,model, simulate and map phenomena and processes distributed in geographic space. The data is analyzed in order to produce the information necessary to help decision-makers (N. Mbaye, 2011). As part of this research, GIS is a tool that allows you to enter, store, update and analyze georeferenced data to extract information useful for decision-making.The commune of Kétou is located at the northern end of the Plateau department, between latitudes 7 ° 10 'and 7 ° 41' 17 "North on the one hand and between longitudes 2 ° 24'24" and 2 ° 47 ' 40 "East on the other hand. It covers an area of 1775 km^2, or 1.55% of the national territory and 54.38% of the Plateau department. It is limited to the north by the Municipality of Savè, to the south by the Commune of Pobè, to the west by thecommunes of Ouinhi and Zangnanado and to the east by the Federal Republic of Nigeria.It is accessible by a permanent carriage road generally in good condition and is located 108 km from Porto-Novo, the capital of Benin. The Municipality is divided into six (06) districts which are: Adakplamè, Idigny, Kétou, Kpankou, Odomèta and Okpomèta. These districts are subdivided into 28 villages and 10 city districts. Commune is Kétou, located 138 km from Cotonou, the economic capital of Benin (figure 1).

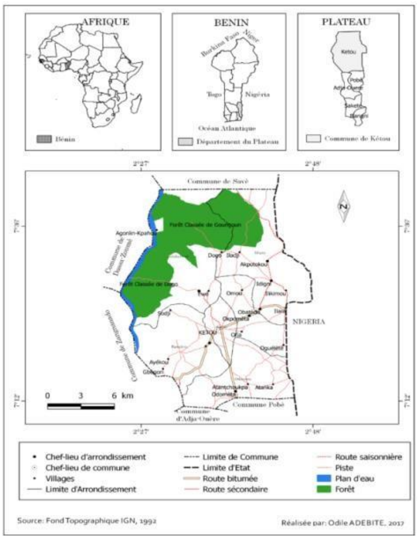

Figure 1. Geographical location of the municipality of Kétou
Source: Topographic Fund, IGN, 1992

MATERIALS AND METHODS

The methodological approach used to carry out this study revolved around documentary research, data collection and data processing. The documentary research helped to better define the main research questions. It consisted of visiting documentation centers and libraries, specialized institutions, the Internet, and other organizations capable of providing information relating to the water sector.
The reasoned choice technique was used to identify the households surveyed. The criterion of choice is based on the villages most affected by the problem of drinking water supply. The statistical unit is the household and only the head of the household is taken into account. This person can be the head ofthe household or his wife. But if both are present, the wife is privileged because it is the wife whotakes care of the water management better. To determine the sample, fourteen (14) villages are targeted. These are the villages most affected by the problem of drinking water supply. Thus, out of 28,059 households (INSAE, 2013) in the commune of Kétou, one hundred and fifty (150) households with an average size of 04 to 10 members (per household) were surveyed. The distribution is made according to the demographic weight of each district. This sample was supplemented by a list of 21 resource persons investigated. In total, 171 people were interviewed during the fieldwork. All of the data and information collected has been processed.
The information collected from the questionnaires developed is processed manually. The questions are first differentiated into two sub-groups: questions whose answers can be the subject of statistical analysis and those whose answers are to be summarized.
The statistics of the different variables obtained from the counting are put in tables or in figures. The mapping of the water points available in the municipality was made taking into account the database of the coverage of water points in the municipality of Kétou. These data are supplemented by those collected in the field. The formula used by PCEAU (2013) was used to calculate the drinking water supply rate.

$$TD = \left[(NbrEPE * 250) + (NbrabS * 12)\right] * 100 / EffPopuT$$

where $$TD = PopuD / EffPopuT$$

With, TD = Taux de desserte; NbrEPE=Number of water point equivalent;
NbrabS= number of subscribers of theSoneb; EffPopuT= Total number of the population;
PopuD= Served Population.

The service rate is an indicator of the satisfaction of the populations' drinking water needs. Thus, the calculation of the service rate takes into account public water works such as FPM, BF, PM, PEA and active connections of SONEB.
The georeferenced statistical data has undergone various cartographic processing (the creation of a hydraulic infrastructure database which enabled us to produce the maps). Geographic coordinates are projected for each type of infrastructure.
QGIS 2.14.6 software is used for this processing. Their distribution is assessed by district and according to the demographic weight of each locality.
An analysis is based on the national standard in force for the distribution of hydraulic infrastructures and which is 250 inhabitants for 1 water point with a coverage of 1000 m of radius (DGH, 2005) was made.
Buffer zones are created in order to determine the service area of the water points. This technique makes it possible to visualize spaces where the coverage of hydraulic infrastructures is very dense, therefore very good physical accessibility.
The Strengths, Weaknesses, Opportunities and Threats (SWOT) model made it possible to analyze the management mode of the municipality's water infrastructure, the opportunities and threats are the external factors linked to the management of the infrastructure and which have an effect positive or negative on the water supply. Then, strengths and weaknesses are internal factors that contribute to or prevent the good management of drinking water supply and sanitation systems in Kétou Commune.

RESULTS AND DISCUSSION

Hydraulic works in the municipality of Kétou

The populations of the commune of Kétou are supplied by various sources of drinking water supply, including the water supply network of the National Water Company of Benin (SONEB) and the village water supply.

SONEB, which is in principle the leading supplier of drinking water throughout the national territory of Benin, covers only one district out of all six districts in the municipality. This is the Kétou district. However, network coverage within this arrondissement is still partial.

The communities of the districts of Idigny, Kpankou, Okpomèta, Odomèta and Adakplamè which do not yet have access to the SONEB water supply, benefit, thanks to the support of the various partners, from village water supply services in through the Adductions d'EauVillageoise (AEV), the BornesFontaines (BF), the Manual Pumps (PM), the Boreholes equipped with Human Motricity Pumps (FPM), the Autonomous Water Stations (PEA) and modern wells .

These various infrastructures bring the drinking water supply rate in the municipality to 42.75%. This rate hides, however, the difficulties of access for populations, especially rural ones, to drinking water. Several situations are at the origin of the populations' poor access to drinking water. These are: the low coverage of drinking water facilities, the non-functioning of some existing facilities and the high cost of water. Figure 2 shows the distribution of hydraulic infrastructures in the municipality of Kétou.

Figure 2: Spatial distribution of hydraulic infrastructures in the municipality of Kétou

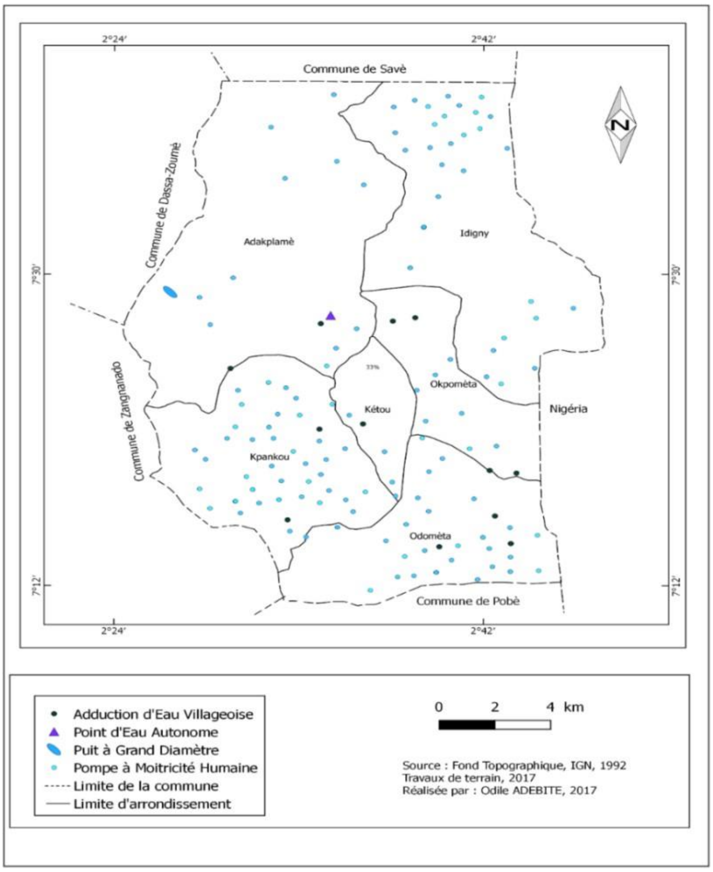

Figure 2 The infrastructure is concentrated in the south and northeast of the municipality.
Source: Topographic Fund, IGN, 1992

The North West and the Center are almost devoid of infrastructure. TDCs are the most important structures; then come the AEV, the PEA, and the PGD. This unbalanced distribution is explained by the presence, in the northwest of the municipality, of tributaries of the Ouémériver and of the iron ion. The North-West and Center parts are almost devoid of it because of soil constraints. The districts concerned are Adakplamè and Kétou. This situation can be explained in part by the geographical position of these districts. Several infrastructures are sometimes installed in the same place because of the demographic weight of the surrounding localities. Thus, each infrastructure can serve a specific area and can support a limited demographic load for its sustainability. The various proximity analyzes based on buffers made it possible to determine areas of high concentration. The result of this process isshown in Figure 3.

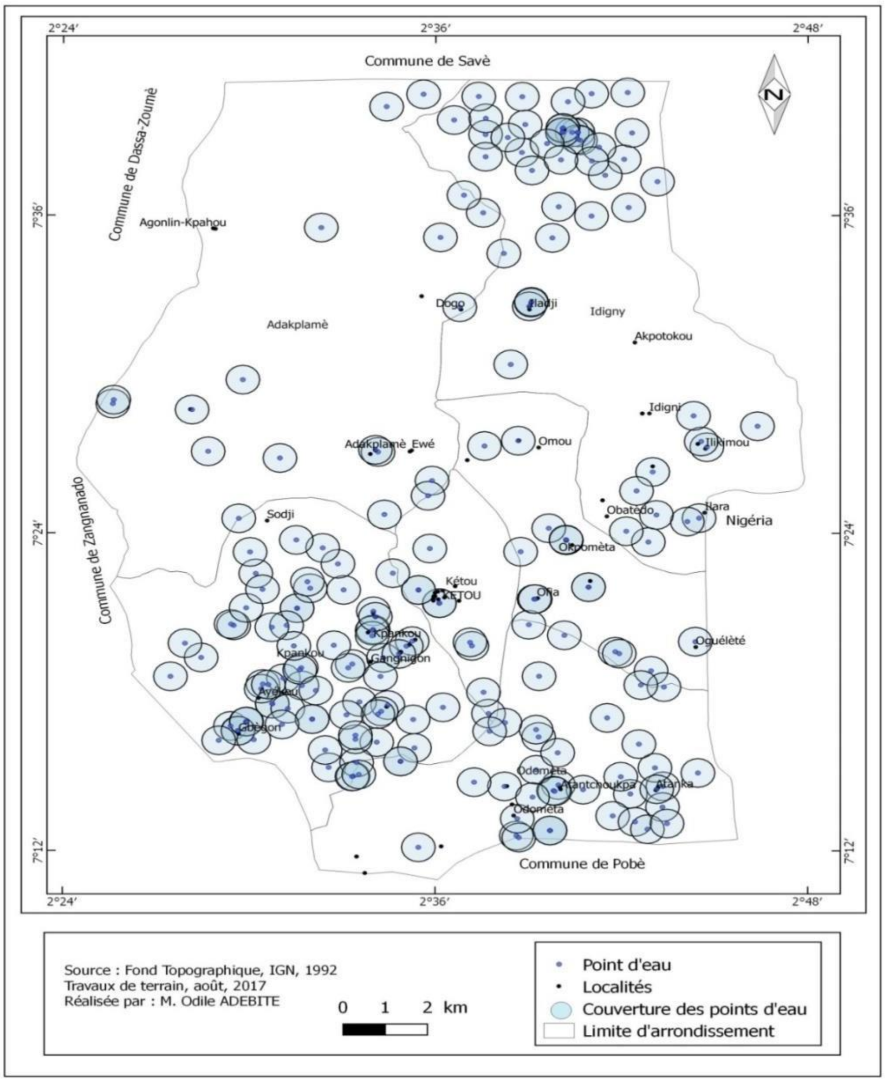

Figure 3. Service area for hydraulic structures
Source: Topographic Fund, IGN, 1992

The analysis of this figure shows that some localities are better served and others are less so because within a radius of 1km the hydraulic structures only cover 48 localities, i.e. a population of 44,958 out of the 157,352 inhabitants in this area. common.

The boreholes do not cover all the localities of the municipality and are therefore insufficient in number. It is therefore urgent to set up hydraulic relay infrastructures in areas not covered in order to alleviate the suffering of the populations who reside there. This means that populations beyond one or two kilometers will no longer have to travel a great distance before obtaining supplies.

Management methods for hydraulic structures
Management of modern structures

Modern structures such as large-diameter wells, PEAs, FPMs and AEVs are generally managed by the following few structures and individuals: the Association of Drinking Water Consumers (ACEP), the Permanent Commission, the Commission de Energy and Water, farmers and delegates. These structures and individuals are not remunerated for the service they provide, only they can obtain supplies from these different water points for free. Likewise, they are not invested with a mandate because in the event of mismanagement, they are systematically replaced by others.
It should be remembered that two modes of management of structures are practiced in the municipality: delegation for simple structures and leasing for complex structures.

Management by delegation
It concerns simple works. These are modern large diameter wells and boreholes equipped with hand pumps.
Modern large diameter wells
They are managed by the committee elected by the villagers. the committee receives training with technical support from the town hall, water service agents, in the management of hydraulic works. Unfortunately, there are no repair agents in the town. You therefore have to travel to Porto-Novo or Cotonou to find it. As a result, repairs take a long time and sometimes even these works are abandoned.
Boreholes equipped with human-powered pumps
They are also the responsibility of the committee which sells the water and maintains the borehole. The management of the borehole poses serious problems due to the frequent breakdowns caused by the high number of people using the pump, the insufficient competence of the maintenance teams, the careless handling by the users, the poor design of the thing. public. These failures sufficiently tire the populations who, in the worst case, end up abandoning the water point. Management is carried out by the delegates proposed by the village chiefs or district chiefs. Management fees are set work by work and on a case-by-case basis depending on the supply and the geographical position of the work. Finally, contracts are signed between the municipality and the repair agent for the maintenance of the structures.

Management by affermage
This new situation has been underway throughout the country since 2008, especially at this time when the town hall is the contracting authority. It specifically concerns AEVs and consists in contractually entrusting their management to a private person (company, natural person). Today AEVs are managed by farmers under management contract. The cost of water per m3 is 600 FCFA in the commune, or 25 FCFA per 35-liter basin.

Mechanical maintenance or maintenance
Routine maintenance is an easy task for the village pump repairer. It consists of ensuring the correct functioning of the pump on a daily basis. Thus, the village pump repairer is responsible for lubricating and replacing worn parts if possible. But we notice that in all the commune of Kétou there are no repair agents. In the event of a breakdown, these structures and individuals are obliged to appeal to the municipal authorities who are obliged to go to Porto-Novo or Cotonou, to seek a repairer.

Sanitary maintenance
Sanitary maintenance concerns the cleaning of the surroundings of the boreholes. The stagnant waters become the breeding ground for mosquitoes and wandering animals.

Financial management
Financial management concerns the maintenance of water points in the event of a breakdown. Thus, it becomes necessary to sell the water. In the localities where water is sold, there is a fund where the

funds are kept. But there is often no transparency in the management of this fund. In some localities, financial participation is requested from the populations for a possible technical intervention.

Geographic accessibility of populations

The populations of Kétou commune face various problems in obtaining water supplies. These are the remoteness of waterworks and the high cost of water. The penalties that people endure to have access to drinking water facilities depend on the position of their home in relation to the drinking water point.In the district of Kétou, 11.81% are close to the works and 88.19% are far, in Kpankou, 24.32% are close to the works and 75.68% are far, in Idigny, 10.52% are close to works and 89.48% are far, in Adakplamé, 19.29% are close to works and 80.71% are far, in Odométa, 15.78% are close to works and 84.22% are far and Okpométa, 15% are close to the structures and 85% are far (Figure 4).

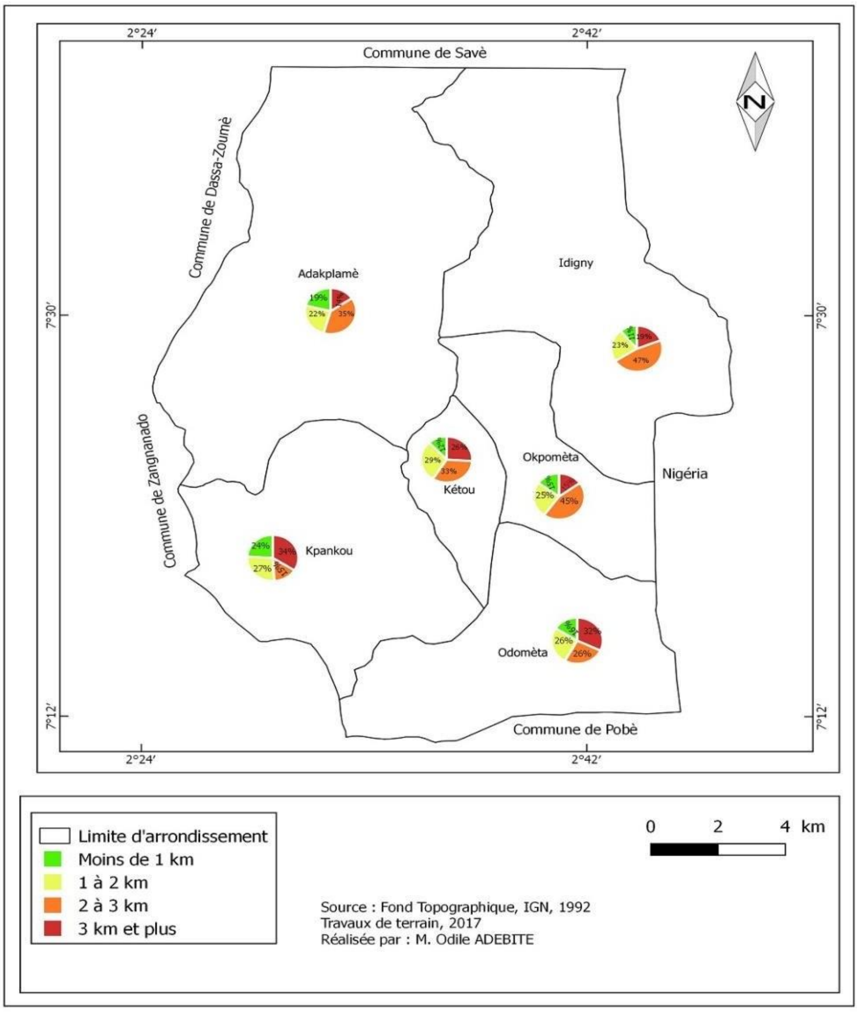

Figure 4. Distance traveled to obtain drinking water
Source: Topographic Fund, IGN, 1992

Figure 4 shows the distance traveled by the population of Kétou to obtain drinking water. It emerges from this figure that the majority of the populations of the commune of Kétou travel very long distances (2 to 3 km) before obtaining drinking water.

DISCUSSION

Access to drinking water and poor coverage of hydraulic infrastructure in the municipality of Kétou

The inventory of hydraulic infrastructure in the municipality of Kétou identified four (4) types of structures. These structures are large-diameter wells, autonomous water points, village water supplies and human-powered pumps, which are in the majority. Indeed, most of these infrastructures are located in the South and North-East of the municipality with a virtual absence in the North-West. These results obtained are similar to those obtained by (E. Evens and P. Lindskog, 2000), who also noted the unequal distribution of hydraulic infrastructures in the Republic of Haiti.

In the commune of Kétou, the hydraulic infrastructures are not equitably distributed. Prior work should be done in order to involve the population in the installation of the structures. These observations are also made in the work of I. Douelle (2008) who showed the importance of taking into account the opinions of the populations in the identification of the place of installation and the possibleform of said structures. This would certainly avoid problems of supply at the source and the egalitarianuse of standpipes. This is the case of AEVs whose service areas do not cover all the localities of the municipality. In addition, each infrastructure will have to support an average of 865 inhabitants. This overload often creates queues for supplies and wastes people's time. This sometimes results in situations of water scarcity and the orientation of populations to unimproved sources to save time, allof which seriously compromises their health. This is where GIS is so helpful. These facts reinforce the findings of I. Assouma (2011), who showed in his study that GIS is of paramount importance in understanding the problems of access to water. The establishment of a database allows authorities at various levels to have an idea of the distribution of these infrastructures in order to make useful decisions for the happiness of the populations.

GIS and hydraulic infrastructures

GIS therefore offers the possibility of having historical and up-to-date data on the quality of the resource, its availability, its management and allows them to be optimized by focusing on cartography.The issue of access to water resources is addressed for all through the look at infrastructure to ensure the quality of their distribution. The results obtained within the framework of this study concerning theutility and the role played by GIS in the hydraulic field is similar to those of (A. El Garouani and A. Merzouk, 2006). These authors, have aimed in their work a fundamental objective which is based on the improvement of national knowledge on water resources and their protection.

In this current context, GIS has played a major and quite important role. It provided an idea of the typology of these infrastructures and their distribution over the entire municipal territory. A similar study was carried out by S. C. Hounguevou et al (2013), in the locality of Zè in Benin. Indeed, througha GIS approach for a spatial analysis of hydraulic infrastructures, these authors used the proximity analysis based on the buffer zones in order to assess the spatial distribution and to determine theservice area of the waterways. water points. In conclusion, they showed an unequal distribution of infrastructures on the territory of the municipality. The same is true of H. Smida et al. (2006) whohave shown in their studies that the importance of GIS lies in its ability to predict the deficit of hydraulic infrastructures and to ensure distribution for the happiness of the beneficiary population. Forthese authors, the contribution of GIS lies in its large capacities for data storage, processing, analysis and visualization. The aim is to develop a geographic database and determine the most favorable areas for recharging.

CONCLUSION

At the end of this study, we can retain that the hydraulic infrastructures of the municipality of Kétou are poorly distributed. This leads to an insufficiency of drinking water points in the area, which pushesthe populations of this town to obtain supplies from undeveloped doubtful sources such as: courtyards and water bodies. In addition, the lack of a mechanism for good management, poor maintenance and overexploitation observed on the said structures are all factors limiting the population's access to drinking water. The right of access to water is a fundamental right, a right to life and to development. In addition, the benefits arising from the use of GIS are enormous, especially in terms of infrastructure distribution. It saves time, facilitates access to water resources and information. Given these enormous opportunities offered by GIS, the next study will focus on Geographic Information System (GIS) and drinking water supply in the Plateau department in Benin.

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FEASIBILITY OF USING GREEN TEA POWDER AS A NATURAL ANTIOXIDANT AND STEVIA AS A SWEETENER IN NON-FERMENTED LAYER CAKE

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Abstract: *Today there is an increasing demand for low-calorie and functional food products worldwide. Green tea powder has antioxidant property due to its phenolic structure which makes it a good natural replacement for synthetic antioxidants. Stevia is a calorie-free product which can be substituted for sucrose in foods. The aim of this study was to investigate the feasibility of using green tea powder and stevia instead of flour and sugar respectively in the formulation of non-fermented layer cake. To do so, different concentrations of green tea powder (10, 20, 30% w/w) and stevia (40, 60, 80% w/w) were incorporated into the formulation of cake. Ten treatments were designed and the rheological properties of dough including pharinograph and extensiograph characteristics were measured. Three dough samples with superior rheological properties along with control sample were baked. The physicochemical and sensory properties of the selected samples were compared with those of control sample. The layer cakes containing 10% green tea powder and 40, 60 and 80% stevia were selected as the superior treatments and their quality properties were compared with those of control sample. Increased concentration of stevia significantly reduced the specific volume and increased the firmness of the layer cake samples. Since there was no significant difference in total acceptance between the layer cakes containing green tea powder and stevia and control sample, the treatment containing 10% green tee powder and80% stevia was selected as the superior treatment regarding the nutritional and quality properties.*

Keywords: *Non-fermented layer cake; Green tea powder; Stevia*

INTRODUCTION

The cereal industry is among the largest sectors of the food industry worldwide and products such as biscuits, cookies and cakes are the most popular products due to their convenient consumption and long shelf life (usually about four weeks). Cakes as bakery products come in mary varieties and are popular among the people especially children and adolescents. Layer cake is among the most commontypes of cakes with a crispy crust and a soft crumb [1]. Different sweeteners are used in bakery products which affect their sweet taste, appearance, volume, color and texture [2, 3]. The main sweetener used in these products is sugar. It makes the product sweet and tender, develops a brown crust and keeps the product fresh longer [3, 4]. Schantz [5] reported that using high amounts of sugar in sweets reduced the plasticity of gluten thereby decreasing their volume. Also sugar causes tooth decay and obesity. On the other hand, due to the lack of metabolism of glucose resulted by sucrose
hydrolysis in the body in the absence of insulin and increased level of blood sugar in diabetics, there is

a growing demand for special foods for diabetics [5]. Today the consumers pay more attention to the quality and health of foods. So there is a great demand for healthy and low-calorie food products [6]. Bakery products such as non-fermented layer cakes and sweets are widely consumed however nutritionists recommend their low consumption because of their high sugar and fat content. Therefore healthier products can be marketed by improving the nutritional value of the above-mentioned products. Mariotti et al. [7] studied the effect of food industry on health and growth as well as the public interest in using the sucrose replacers and reported that the consumers were tended to consume low-calorie products [7]. Today attempts are being made to use sugar replacers such as invert syrup, glucose syrup, date syrup, molasses, stevia, etc. in such products [1, 3]. Stevia is the "steviol glycoside" which is the extract of Stevia rebaudiana bertoni. It is a natural calorie-free sweetener with its extract being 250-300 times sweeter than sucrose. The research has shown the beneficial effects of stevia on diabetes and hypertension. Stevia is known as the best sugar replacer for diabetics. Its positive effect on improving the flavor, taste, color and smell of foods has been demonstrated. Kroyer
[4] conducted extensive research on stevia and its beneficial effects on diabetes and hypertension and reported that it was one of the best sugar replacers for diabetics [4]. Green tea powder has phenolic compounds resulting in antioxidant activity which extends the shelf life and also makes a healthy product. Green tea powder exerts healthful effects on the consumer such as preventing cancer,diabetes, hypertension, etc. [8]. Lu et al. [9] added green tea powder to sponge cake and found that theamounts of protein, fiber, ash and different catechins of the cake samples increased while the cake volume decreased [9]. Najafzadeh et al. [6] investigated the addition of green tea to sponge cake, measured its chemical properties and stated that the protein content of cake increased due to the protective effects of green tea and the reduced denaturation of the flour proteins [6]. Savita et al. [10] studied the chemical and functional properties of stevia and reported that increased water retention by stevia leaf powder was due to its protein content (10 g/100 g dry matter) and that with increasing the stevia concentration the protein content of the cake samples increased. Also they stated that increased level of stevia could increase the ash content of the samples due to the minerals content of stevia [10]. Stevia is a natural and calorie-free product which can improve the aroma, flavor and color of foods and exert beneficial effects on the people suffering from diabetes and high blood pressure. Green tea powder also has antioxidant properties and healthful effects such as preventing cancer and diabetes, reducing the incidence of arthritis, etc. The objective of this study was to investigate the feasibility of using green tea powder as a natural antioxidant as well as stevia in non-fermented layer cakes.

MATERIALS AND METHODS

Materials

The materials used in this study included null wheat four (Setareh Co., Iran), green tea powder (Golestan Co., Iran), stevia powder (Takfa Co., Iran), salt (Hedieh Co., Iran), sugar (Golestan Co., Iran), baking powder (Hermin Co., Iran), liquid oil (Naz Co., Iran), egg (Telavang Co., Iran), vanilla (Golha Co., Iran) and skim milk powder (Caseinate Co., Iran). All chemicals were prepared from Merck company (Germany).

Chemical tests of wheat flour

The moisture, ash and protein contents, flour Falling number (FN) and pH value were determined according to Iranian national standards No. 2705, 103, 2863, 4175 and 37, respectively [11, 12, 13, 14, 15].

Rheological tests of dough

Rheological tests of dough included pharinographic (AACC method No. 21-54) and extensiographic tests (standard ICC method No. 114) which were performed by pharinograph and extensiograph (Brabander, Germany) [16, 17].

Non-fermented layer cake preparation

The control layer cake dough was prepared according to the method of Gavlighi et al. [23]. The ingredients required for preparing the layer cake were determined on the basis of 100 g of null flour. To do so, lukewarm water (114.3 g), egg (50 g), sugar (118 g), liquid oil (33.3 g), vanilla (2 g), skim milk powder (10 g) and salt (2 g) were mixed thoroughly using Moulinex mixer (Model depose 13025, France) at 380 rpm for 3 min .Then null wheat flour (100 g) and baking powder (2.8 g) were added and mixed for 3 min to make the desirable dough. The prepared doughs of equal weight were baked in oven (Model Saiva, Germany) at 220℃ for 12 min. To prepare the treatments of interest, green tea powder at 10, 20 and 30% (w/w) instead of flour and stevia at 40, 60 and 80% equivalent to sucrose sweetness were incorporated into the control formulation (Table 1). It should be noted that different ratios of green tea powder and stevia were determined based on the pretreatment to produce layercakes with desirable quality properties.

Table 1. Non-fermented layer cake treatments

Treatments	Descriptions
0	Non-fermented layer cake without stevia and green tea powder (control)
1	Non-fermented layer cake containing 10% w/w green tea powder + 40% stevia
2	Non-fermented layer cake containing 10% w/w green tea powder + 60% stevia
3	Non-fermented layer cake containing 10% w/w green tea powder + 80% stevia
4	Non-fermented layer cake containing 20% w/w green tea powder + 40% stevia
5	Non-fermented layer cake containing 20% w/w green tea powder + 60% stevia
6	Non-fermented layer cake containing 20% w/w green tea powder + 80% stevia
7	Non-fermented layer cake containing 30% w/w green tea powder + 40% stevia
8	Non-fermented layer cake containing 30% w/w green tea powder + 60% stevia
9	Non-fermented layer cake containing 30% w/w green tea powder + 80% stevia

Post-bake tests: Protein, ash and moisture were determined using AACC 150-1, AACC 08-08 and AACC 44-16, respectively [16]. Catechin (antioxidant) concentration was determined by HPLC using the method of Lu et al. [9]. The specific volume of the cake samples was measured by the method presented by Henry Simon company (UK) using a volume measuring device in cm^3/g [18].

Texture measurement: The texture of the cake samples was measured by standard AACC 74-09 upon production, 12 and 48 hours after production using universal tesing machine (Instron, Model 1116, UK) [16]. To prepare the sample for texture measurement, the crust was removed and then the crumb was cut into 2.9 cm square cubes.

Sensory evaluation: The sensory properties were evaluated by 6 trained panelists by using 5-point hedonic scale. The cake samples were baked, cooled, cut and coded. Then they were evaluated by the panelists 24 hr after production.

STATISTICAL ANALYSIS

Data were analyzed by ANOVA and Duncan test using Minitab software version 16 at 95% confidance interval.

RESULTS AND DISCUSSION

Results of chemical test of wheat flour

The results of chemical tests are shown in Table 2.

Table 2. Chemical properties of wheat flour

Sample test	Moisture (%)	Ash (%)	Protein (%)	Falling number (S)	pH
Wheat flour	12.50±0.19	0.4±0.01	8.5±0.35	659±34	5.85±0.05

Rheological tests of layer cake dough

Results of pharinograph test: The results of pharinograph test are presented in Table 3. As shown in the Table, the lowest and the highest rates of water absorption were observed for treatment 3 and treatments 4 and 7, respectively ($P \leq 0.05$). Lai et al. [19] added green tea powder to flat cake and reported that higher amount of green tea powder resulted in increased water absorption by fibers [19]. Yu et al. [20] investigated the effect of green tea powder on the rheology of dough and stated that the water absorption of dough increased at higher concentrations of green tea powder. The increased water absorption is attributed to the presence of fiber and cellulose compounds, gums, dextrin, pectin and starch in green tea leaves [20]. As indicated in Table 3, the longest and the shortest dough expansion times were found for treatments 7 followed by 4 and treatments 3 followed by 2 and 1 showing no significant ($P>0.05$) difference. Zhumaliyeva [21] showed that the addition of 5, 10 and 15% stevia to wheat flour significantly increased the dough expansion time however 20% stevia decreased the expansion time significantly [21]. Also the lowest consistency and stability were observed for treatments 7, 8 and 9 and the highest ones were found for treatments 1 followed by 2. Lin et al. [18] studied the effect of ultra-refined green tea powder on the rheological properties of wheat flour and stated that increased amount of green tea powder resulted in a significant increase in the dough stability. The polyphenolic compounds of green tea can form very strong bond with the proteins of wheat flour resulting in an increase in dough stability [3]. The highest degree of dough softening was found for treatment 9 after 12 min followed by treatments 8 and 7 showing a significant difference from control and other samples. Treatment 1 had the lowest degree of dough softening being significantly different from control and other treatments. Yu et al. [20] also examined the effect of green tea powder on dough rheology and reported similar results as high concentrations of green tea powder (GTP) increased the degree of dough softening [20]. The greatest and the smallest quality numbers were observed for treatments 3 and 2 and treatments 9, 8 and 7, respectively.

Table 3. Results of pharinograph test

Sample	Water absorption (%)	Dough expansion time (min)	Dough consistency and stability (min)	Degree of dough softening after 10 min (Brabender)	Degree of dough softening after 12 min (Brabender)	Pharinograph quality number
0	52.60 ± 0.15^{d}	2.10 ± 0.01^{ab}	2.80 ± 0.15^{bc}	38.00 ± 0.15^{b}	88.00 ± 0.50^{de}	68.0 ± 0.00^{g}
1	52.30 ± 0.10^{d}	1.90 ± 0.20^{a}	5.00 ± 0.10^{e}	34.00 ± 0.25^{ab}	73.00 ± 0.10^{a}	73.0 ± 0.10^{h}
2	51.30 ± 0.35^{c}	1.85 ± 0.12^{a}	4.75 ± 0.25^{e}	36.00 ± 0.15^{bc}	75.00 ± 0.00^{b}	74.00 ± 0.24^{ahi}
3	44.50 ± 0.22^{a}	1.80 ± 0.10^{a}	3.55 ± 0.15^{d}	30.00 ± 0.10^{a}	76.00 ± 0.20^{b}	76.00 ± 0.00^{i}
4	66.00 ± 0.30^{e}	3.05 ± 0.10^{cd}	2.10 ± 0.15^{ab}	38.00 ± 0.40^{bc}	87.00 ± 0.50^{d}	60.0 ± 0.50^{f}
5	51.00 ± 0.35^{c}	2.09 ± 0.10^{c}	3.30 ± 4.25^{cd}	41.00 ± 0.00^{bc}	89.00 ± 0.20^{ef}	58.0 ± 1.00^{e}
6	49.40 ± 0.32^{b}	2.00 ± 0.20^{a}	2.73 ± 0.55^{bc}	43.10 ± 0.10^{bc}	80.00 ± 1.00^{c}	53.0 ± 1.00^{d}
7	72.20 ± 0.36^{ab}	3.50 ± 0.10^{d}	1.98 ± 0.50^{a}	40.00 ± 0.00^{bc}	90.0 ± 0.15^{f}	48.0 ± 0.50^{c}
8	52.80 ± 0.35^{d}	2.40 ± 0.10^{c}	1.90 ± 0.20^{a}	48.00 ± 0.10^{bc}	98.00 ± 0.00^{g}	45.0 ± 1.00^{b}
9	52.30 ± 0.12^{d}	2.00 ± 0.10^{a}	1.50 ± 0.10^{a}	50.00 ± 0.00^{c}	105.0 ± 0.20^{h}	43.0 ± 1.00^{a}

Values are expressed as mean±SD.
Dissimilar letters in each column represent significant difference at 5% significance level.
Ingredients: (O) wheat flour, (1) 40% stevia + 10% GTP, (2) 60% stevia + 10% GTP, (3) 80% stevia + 10% GTP, (4) 40% stevia + 20% GTP, (5) 60% stevia + 20% GTP, (6) 80% stevia + 20% GTP, (7) 40% stevia + 30% GTP, (8) 60% stevia + 30% GTP, (9) 80% stevia + 30% GTP.

Results of extensiograph test: The results of extensiograph test are shown in Table 4. The highest tensile strength and maximum tensile strength were observed for treatments 9 followed by 6 and the lowest ones were found for control sample. The highest tensile strength within 90 min was found for treatments 9 and 6. Also tensile strength of control sample was significantly lower than that of other treatments ($P \leq 0.05$). Within 135 min, the highest tensile strength was found for treatment 9 which was significantly ($P \leq 0.05$) lower than control and other treatments and the lowest tensile strength was observed for control. Yu et al. [20] studied the addition of green the powder to wheat flour dough and reported that tensile strength of dough increased as the amount of green tea increased [20]. Within 45, 90 and 135 min, the highest and the lowest tensile strengths were observed for control and treatment 9, respectively. Within 45 and 90 min, the smallest and the greatest numbers were found for control and treatments 8 and 9 showing no significant ($P \leq 0.05$) difference. Within 135 min, the smallest and the greatest numbers were found for control + treatment 3 and treatment 9, respectively being significantly ($P \leq 0.05$) different from other treatments. Within 45 min, the highest and the lowest amounts of energy were observed for treatments 9 and 5, respectively. Within 90 and 135 min, the highest and the lowest amounts of energy were observed for treatment 9 and control. Yu et al. [20] added green tea to wheat flour and reported that within 45 and 90 min, the area under the dough curve increased significantly as the concentration of green tea increased and decreased within 135 min [20].

Table 4. Results of extensiogreph test (A: used energy or area under curve, R 50: Resistance to stability (50 mm), E: Elasticity)

Treatment	A (cm^2)	A (cm^2)	A (cm^2)	R50 (B.U)	R50 (B.U)	R50 (B.U)	E (mm)	E (mm)	E (mm)	R50/E (Bμ/mm)	R50/E (Bμ/mm)	R50/E (Bμ/mm)
	45′	90′	135′	45′	90′	135′	45′	90′	135′	45′	90′	135′
0	123^{e}	111^{a}	131.85^{a}	527.1^{a}	580.1^{a}	690.10^{a}	151.8^{e}	125.7^{d}	131.8^{h}	3.47^{a}	2.52^{a}	5.05^{a}
1	115^{Cd}	122.3^{b}	136.3^{b}	680.85^{b}	782.9^{b}	790.9^{d}	111^{d}	130.5^{e}	121^{e}	6.13^{b}	2.67^{a}	6.53^{bc}
2	119^{d}	124.3^{b}	140.3^{c}	700.9^{c}	760.9^{bc}	810.9^{f}	108.75^{d}	120^{b}	110^{c}	6.44^{b}	3.3^{b}	7.36^{cd}
3	120.5^{d}	127^{c}	135^{b}	800.5^{d}	710.9^{d}	699.9^{b}	76.85^{b}	122.5^{c}	129^{g}	10.41^{a}	2.85^{ab}	5.41^{a}
4	116^{c}	135^{d}	149^{d}	780.05^{e}	790.1^{c}	800^{e}	89^{c}	130^{e}	118^{d}	8.79^{c}	2.42^{a}	6.77^{c}
5	103^{a}	150^{e}	157^{e}	785.3^{f}	810.15^{d}	899.1^{h}	86^{c}	118.5^{ba}	104.5^{b}	9.13^{cd}	3.37^{b}	8.64^{e}
6	130^{f}	157^{f}	171^{f}	790.25^{i}	799^{c}	812.4^{j}	80^{b}	129^{e}	100.5^{a}	9.87^{de}	2.53^{a}	8.12^{de}
7	120^{d}	$160.^{g}$	170^{f}	783.8^{j}	870.1^{f}	700.9^{c}	89^{c}	125^{d}	1236.5^{f}	8.80^{c}	2.46^{a}	5.54^{ab}
8	107^{b}	167^{h}	175^{g}	845.4	835.35^{e}	890.1^{i}	73.9^{ab}	120^{b}	105.5^{b}	11.43^{f}	2.94^{ab}	8.43^{de}
9	137^{g}	171^{i}	179^{h}	862^{l}	890.9^{g}	900.9^{j}	70.5^{a}	118^{e}	100^{a}	12.22^{f}	3.3^{b}	8.19^{de}

1- Values are expressed as mean±SD.
2- Dissimilar letters in each column represent significant difference at 5% significance level.
Ingredients: (O) wheat flour, (1) 40% stevia + 10% GTP, (2) 60% stevia + 10% GTP, (3) 80% stevia + 10% GTP, (4) 40% stevia + 20% GTP, (5) 60% stevia + 20% GTP, (6) 80% stevia + 20% GTP, (7) 40% stevia + 30% GTP, (8) 60% stevia + 30% GTP, (9) 80% stevia + 30% GTP.

Determination of specific volume of selected treatments

As shown in Table 5, treatment 1 had the largest dough volume showing a significant ($P \leq 0.05$) difference from control and other treatments and the lowest specific volume was observed for treatment 3. Lu et al. [9] investigated the quality and antioxidant properties of green tea and stated thatas the amount of green tea increased the volume of cake decreased significantly. Increased level of flour replacement with cellulose led to further weakening of the gluten network and since the gluten network is responsible for gas retention in bakery products, the volume of cakes decreased [9]. Walter [22] added stevia to bakery products and stated that the cake sample containing 100% stevia was denser and less voluminous than other treatments containing stevia and sugar 25 and 50% stevia resulted in increased specific volume while the addition of 75 and 100% stevia decreased the specific volume of the samples [22].

Table 5. Results of specific volume test

Treatment	0	1	2	3
Specific volume (cm^3/g)	1748.55 ± 7.15^{a}	2103.48 ± 5.20^{b}	1616.08 ± 2.12^{a}	1580.55 ± 1.12^{a}

- Values are expressed as mean ± Sd.
- Dissimilar letters in each column represent significant difference ($P \leq 0.05$).

Ingredients: (0) wheat flour, (1) 40% stevia + 10% green tea powder, (2) 60% stevia + 10% green tea powder, (3) 80% stevia + 10% green tea powder

Results of texture test of selected treatments

As shown in Table 6, the results of compression test by Instron machine demonstrated that with increasing time and stevia concentration in the formulation of cake, its firmness increased significantly ($P<0.045$). The highest and the lowest levels of firmness were observed for treatment 3 (80% stevia + 10% green tea powder) and treatment 1 (40% stevia + 10% green tea powder). Also Lu et al. [9] studied the quality and antioxidant properties of green tea cake and stated that with increasing greentea powder concentration the firmness of cake increased significantly [9].

Table 6. Results of texture measurement by Instron machine (N)

Treatment	Baking data	24 hr	48 hr
0	0.0 ± 91.15^{c}	0.0 ± 97.11^{c}	0.0 ± 99.06^{c}
1	1.0 ± 04.11^{c}	1.0 ± 08.09^{c}	1.0 ± 11.13^{c}
2	1.0 ± 32.13^{b}	1.0 ± 37.10^{b}	1.0 ± 41.12^{b}
3	1.0 ± 61.18^{a}	1.0 ± 65.13^{a}	1.0 ± 69.15^{a}

Values are expressed as mean ± Sd.

Dissimilar letters in each column represent significant difference ($P\leq0.05$).

Ingredients: (0) wheat flour, (1) 40% stevia + 10% green tea powder, (2) 60% stevia + 10% green tea powder, (3) 80% stevia + 10% green tea powder

Results of chemical test of selected treatments

The results of chemical test are shown in Table 7. The highest and the lowest moisture contents were found for control and treatment 3, respectively however there was no significant ($P<0.05$) difference in moisture content between the treatments.

Lu et al. [9] also reported that with increasing green tea powder concentration the moisture content of the sponge cake samples remained constant [9].

The highest and the lowest ash contents were found for treatment 3 and control showing no significant ($P>0.05$) difference.

Najafzadeh et al. [6] added green to sponge cake and reported higher ash content for the cake samples containing higher green tea concentration [6].

The highest and the lowest protein contents were observed for treatments 3+2 and control, respectively. Najafzadeh [6] investigated the chemical properties of sponge cake containing green tea and stated that increased amount of green tea resulted in higher protein content which was attributed tothe protective effect of green tea and reduced denaturation of the flour proteins [6].

Since epigallocatechin gallate is the most abundant catechin in green tea, its content was measured in the present study which was found to be significantly higher in all treatments as compared to control sample.

Lu et al. [9] added green tea powder to flour and showed that protein, fiber, ash and different catechins contents of the cake samples increased while their volume decreased [9].

Table 7. Chemical properties of cakes containing green tea and stevia

Sample test	Moisture (%)	Ash (%)	Protein (%)	Catechin (EGCG) (mg/100g)
0	29.30 ± 0.35^{a}	0.83 ± 0.20^{a}	7.30 ± 0.80^{a}	0.000 ± 0.00^{a}
1	29.26 ± 0.60^{a}	0.97 ± 0.15^{a}	8.30 ± 0.20^{ab}	161.02 ± 2.00^{b}
2	29.00 ± 0.42^{a}	1.02 ± 0.35^{a}	8.91 ± 0.32^{b}	160.29 ± 0.50^{b}
3	28.60 ± 0.5^{a}	1.17 ± 0.450^{a}	9.01 ± 0.10^{b}	159.10 ± 1.20^{b}

Values are expressed as mean ± Sd.

Dissimilar letters in each column represent significant difference (P≤0.05).
Ingredients: (0) wheat flour, (1) 40% stevia + 10% green tea powder, (2) 60% stevia + 10% green tea powder, (3) 80% stevia + 10% green tea powder

Results of total acceptance of selected treatments

As shown in Table 8, there is no significant (P>0.05) different in total acceptance between the selected treatments and control sample.

Table 8. Results of total acceptance of cake samples

Treatment	0	1	2	3
Total acceptance	5.00±0.00^a	5.00±0.00^a	5.00±0.00^a	5.00±0.00^a

Values are expressed as mean ± Sd.
Dissimilar letters in each column represent significant difference (P≤0.05).
Ingredients: (0) wheat flour, (1) 40% stevia + 10% green tea powder, (2) 60% stevia + 10% green tea powder, (3) 80% stevia + 10% green tea powder

CONCLUSION

The results demonstrated that the addition of different levels of green tea and stevia had significant effect on rheological parameters and texture of the produced non-fermented layer cakes. Also therewas no positive relationship between the addition of green tea powder and pharinograph and extensiograph characteristics. The added green tea powder increased water absorption and dough expansion time and decreased quality number, consistency and stability of dough as the samples containing 10% green and 80% stevia had the highest quality number, consistency and stability as compared to control and other treatments. Since there was no significant difference in total acceptance between the selected samples containing green tea powder + stevia and control, treatment 3 (80% stevia + 10% green tea powder) was selected as the superior treatment due to its lower calorie and improved nutritional properties.

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ENVIRONMENTAL ODOR PROBLEM IN HUNGARY, LEGISLATION, MEASUREMENT POSSIBILITIES

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Abstract: *Legislation and regulations concerning the state of ambient air in the European Union have been harmonized by the member states. Exceptions to this are environmental odours, the legal regulation of which has been transferred to national competence by the European Union. Each Member State regulates odor-related activities differently. Some Member States allow a certain percentage of annual hours to be emitted into the ambient air with an odor that disturbs the population. In Hungary, design guidelines have been set for which higher odor concentrations are not permitted in ambient air. Limit values are expressed in odor units to which odor concentrations determined by standard olfactometric measurements can be compared. In recent years, significant measurement experience has been gained in connection with certain odor-emitting technologies, which have been published in Hungarian-language publications.*

Keywords: a*ir pollution, environmental odour, legislation, olfactometric measurements*

Among the effects of human activity on the environmental elements, the pollution of ambient air with odors has a special place. The peculiarity of the odor pollution is due to the fact that its nature and extent are directly perceived by the population, so it is common to investigate the validity of measurement task. [1]

Legislation and regulations concerning the state of ambient air in the European Union have been harmonized by the member states. Exceptions to this are environmental odors, the legal regulation of which has been transferred to national competence by the European Union. Each Member State regulates odor-related activities differently. Some Member States allow a certain percentage of annual hours to be emitted into the ambient air with an odor that disturbs the population. [2]

Hungarian regulations are based on technology-specific limit values for the limitation and control of odor emissions and the concentration of odors in ambient air. [3,4]

The legislation defines the most important concepts related to odor, including the concept of odor itself, the unit of odor (odor unit, OU), and the concept of concentration:

"Odor: an air pollutant substance or mixture of substances with an odorous effect which is not clearly characterized by its constituents, is strange to the local environment and interferes with the intended use of the area concerned;"

"Odor unit: the quantity of odor containing in 1 m3 gas in the standard state which already gives rise to an odor sensation in 50% of the detectors; "

"Odor concentration: the number of odor units in 1 m3 gas in the standard state; unit of it is the odor unit / cubic meter (OU / m3)" [3]

The regulation also allows the authority to require the installation of equipment to reduce odor emission. Among the passive and active methods of reducing the odor effect, in the case of livestock farms, the passive methods are dominated by the very frequent use of a protective forest strip or various cover films. Other activities related to animal husbandry, such as the processing of slaughterhouse by-products or animal carcasses, use active odor reduction methods, in most cases biofilters. [5]

The primary purpose of the regulation is to prevent the population from being disturbed by odors, and therefore it prohibits the exposure of the population to ambient air. The degree of disturbance to the population is clarified by legal regulations with technology-specific limit values for ambient air, so-called design guidelines. [6]

Given that no legal or technical regulation improves the condition of the environment, if its observance or fulfillment cannot be objectively controlled, it is necessary that the odor emission (emission) and the odor effect (immission) appearing in the environment can be quantified and measured.

In addition, the proper operation and reduction efficiency of equipment must be regularly determined [7], which requirements are also set out in the permit of the licensing authority.

Using the emission data measured at the odor source, it is possible to perform a model calculation to determine the impact area of the source. The result of the model calculation and the size of the impact area determined by the calculation are influenced by the type of the applied model, the input data of the model (mainly atmospheric data and the emission data of the source) and the value of thepermissible concentration in the ambient air. [8]
Both the legislation and the technical standards contain restrictions on the models used and the input data, so if they are used (high-atmosphere meteorological data, annual hourly wind data, etc.), the model calculations can give comparable results. In the case of propagation modeling of odor emissionsfrom odor sources, it is of paramount importance that the odor emission data used in the model calculation be real, measured data, as even small differences in technology can significantly changethe amount of odor emission. [5]

CALCULATION

In the model calculation, the boundary of the impact area is given by the envelope along which the concentration of the tested air pollutant decreases to the expected value (fixed by law).

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THE IMPORTANCE OF SUSTAINABLE DAIRY FUNCTIONAL FOOD PROCESSING

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***Abstract** The functional food is one of the main directions of healthy lifestyle and sustainable food production, due to its positive influence on health because of the usage of raw materials of natural origin. Therefore, it attracted the interest of consumers and manufacturers concerning human healthy lifestyle and sustainable economic growth. In addition to this, the importance of supplying local food markets with healthy alternativesfor consumers by small and medium enterprises (SMEs). For this purpose, our study will discuss the importance of functional food for better sustainability, especially in dairy functional food in the Hungarian marketby reviewing previous studies and logical analysing for better comprehension and recommendations for SMEs inthe Hungarian market.*

***Keywords**: Sustainability, Functional Food, Dairy, SMEs, Healthy Food.*

INTRODUCTION

Functional food has become one of the main directions of a healthy lifestyle and sustainable food production due to its promising positive impact on health and its relationship with the use of natural ingredients [1–3]. Therefore, It has attracted great interest from consumers and manufacturers who are concerned about human welfare and sustainable economic development [4]. Not surprisingly, new socio-demographic trends (e.g., longer life expectancy, promotion of healthier lifestyles, better health care, etc.) supported the functional sector to become an increasingly attractive segment of the food industry with a rapidly growing market [5]. Many mid- and long-term developments in society, and socio-demographic trends in favor of functional food, have led to the belief that functional food represents a sustainable category in the food market [6,7].
High value-added functional foods have become the fastest growing area of the food industry. According to Euromonitor's estimate, the share of functional foods in the global food market has increased by 33 billion USD to 176.7 billion USD between 2000 and 2013, accounting for approximately 5% of the total food market [8]. The global market of functional foods is expected to cross $192 billion by 2020 [9,10]. In line with global trends, the market share of functional foods facesexplosive growth in Central and Eastern Europe as well, and research into the habits, expectations and attitudes of targeted consumer groups is of prime importance for the development of adequate regionalmarketing strategy. The growing importance of food product functionality was recognized even before the turn of the millennium by the food industry, which accelerated the development of new products. However, new products have a high market failure rate, because most of them have not been preceded by a deeper exploration of consumer demands [11]. Other ways to improve traditional food processing have increased over the past decade. In addition, the development of new dairy products is gaining attention due to the increase in the demand for palatable, healthy, well-made more sustainable products. Ultrasonic processing orsonication is a promising alternative technology in the food industry as it can improve

the technology and functional properties of dairy and dairy products [12]. In our globalized world the mindset and business practice of companies has changed, it is constantly changing. The instability of Global Markets, the Sustainability crisis, and the constant changes in Consumer Demand are few of the local and global challenges. Companies are facing tough times to stay and stay competitive. The secret of successful companies has many facets, one of which is a well -chosen competitivestrategy. Most of the national companies use different types of strategies and practices to Adjust to the national capabilities [13]. In our research project mostly SMEs are involved, therefore the literature review will focus in this sector.

The spread of diet- and lifestyle-related diseases of civilization is continually increasing around the world, and obesity, hypertension, cardiovascular disease and diabetes carry severe personal, economic and social burdens on a global scale. Consequently, the role of disease prevention has become strategically important and a growing scale of consumer groups has realized that proper nutrition can beneficially influence their quality of life [14,15]. This new trend presents new challenges for the food industry: companies mustdevelop and commercialize food products that, due to their health preservation values, are capable of preventing the spread of diseases of civilization. The increasing number of consumers requiring a special dietdue to health problems or lifestyle decisions has opened up new opportunities for operators in the food chain.This could designate the directions for the development of products of the Hungarian food industry. Since functional food products can only be successful in the market if they meet consumer expectations.

LITERTURE REVIEW:

Functional Food

Functional foods are unprocessed or industrially processed natural foods that have beneficial health effects beyond their basic nutritional value when consumed regularly [16]. In addition to the aforementioned, the production of functional foods with the application of innovative technologies is becoming increasingly popular (e.g. juices, dairy, etc.) due to increasing government requirements and support to decrease high spending and the elimination of toxic chemicals and energy [17]. Every year the main trends regarding functional food products are announced. It is obvious that the specific items on this list vary from year to year. However, there is a constant message about the future of functional foods. This future depends on strong, proven evidence of the health-related and sustainability issues benefits of functional foods for consumers. In keeping with trends in the food industry, functional foods have become popular around the world as part of the daily diet [18]. These days, the importance of food has shifted from providing essential nutrients to sustain life and growth to preventing or even curing various forms of disease. Functional foods are intended to be consumed as part of the normal diet and contain biologically active components that reduce the risk of major diseases [19]. Another definition of functional food as ‘foods similar in appearance to conventional foods that are consumed as part of a normal diet and have demonstrated physiological benefits and/or reduce the risk of chronic diseases beyond basic nutritional functions [20].’ Food can be called a ‘functional food’ when it consists of a food component (whether a nutrient or not) that positively affects one or more predetermined functions in the human body [21]. It can also include foods from which a potentially harmful component has been removed by technology.

As the development of new functional components and the solution of technological challenges is a highly costly and risky matter, the analysis of consumer behavior influencing the purchase of products is paramount for manufacturers to avoid investment failure. Companies must therefore monitor changes in consumer attitudes towards functional foods and ensure that their newly developed products meet consumer expectations. Furthermore, it is recommending that functional food research and development departments, research and development departments of manufacturing companies, as well as their marketing experts, devote their resources to developing and communicating products that help prevent diseases that are most accepted by consumers. All this would also help to facilitate this view that the planned development of functional foods should focus on the prevention of a disease that consumers would like to prevent by consuming functional foods, which has been included as a basis for evaluating international or national grants.

In this way we can expect the consumption of functional foods to increase significantly and play a more important role in improving the health of society [22]. New food processing technologies are focused on the production of palatable, healthy, safe, nutritious and minimally processed food. The search for such alternative processes has drawn attention to new food technologies, such as non-thermal technologies, in order to avoid changes in the taste or nutritional content of foods during production. High-intensity ultrasound (HIU) is a promising emerging technology, especially designed for economy, simplicity, and energy efficiency. HIU has attracted considerable interest in food science and technology due to its wide range of applications, either in processing or evaluation of products [23,24].

Dairy Functional Food

Functional dairy foods are innovative products in the dairy industry, and also the fastest growing segment of the dairy market [25,26]. Milk and dairy products are almost indispensable staple foods, which are an important source of most nutrients [27]. Although the first description of lactose sensitivity is from Hippocrates 400 BC, clinical symptoms have only been fully documented in the last 50 years [28]. Today, nearly 70% of the world's population suffers from hypolactasia, which often remains hidden and can lead toa lasting deterioration in quality of life [29]. Lactic acid bacteria in fermented dairy products can reduce the symptoms of lactose sensitivity, while they remain an important source of protein and calcium [30]. Increasing the widespread distribution, consumption and awareness of functional foods can contribute to enhance public health statistics [31]. Therefore, the development of lactose-free functional foods to meet the needs of consumers is one of the priority areas in the food industry today. Research shows that consumer behavior in Hungary is slowly changing, and a positive trend has emerged, but it will take time to develop a strong conscious consumer base about the importance of FF and its benefits for sustainability and healthy life[32].

Food fortification is one of the most important processes for improving the quality and quantity of nutrients in food. It can be a very affordable public health intervention. Due to the high consumption of dairy productssuch as yogurt, fortifying these products will effectively reduce or prevent diseases related to nutritional deficiencies. The use of a specific organism in a specific product relies on its probiotic and health promoting effects. Bifidobacterium bifidum and Lactobacillus reuteri were considered the most important probiotic bacteria for human health. Some probiotic effects attributed to these bacteria including improved lactose utilization, prevention of diarrhea, colon cancer, hypercholesterolemia, improved vitamin synthesis, calcium absorption and also showed anticarcinogenic activity [33,34]. Ingestion of probiotics usually induces the reduction of serum cholesterol, alleviation of lactose intolerance, reduction of indigestion, and other intestinal disorders [35]. It also reduces cancer risk and resistance to enteric pathogens and increasesantihypertensive effects. The health beneficial activities of probiotics have been incorporated in Figure. 1

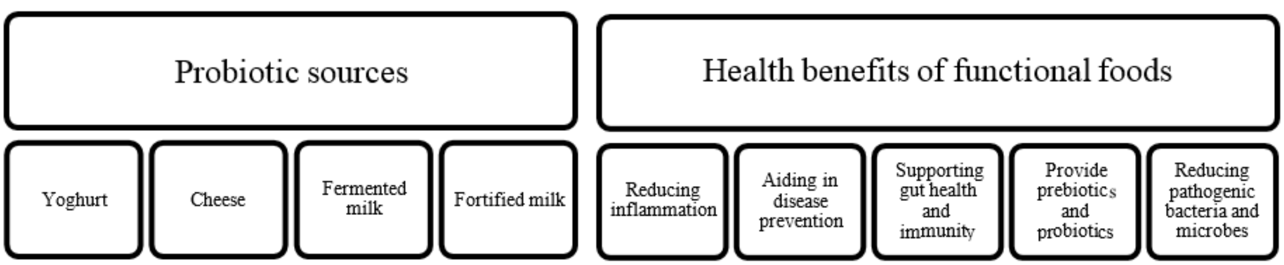

Figure 1. Health benefits of functional foods and dairy natural sources of probiotic [36][37]

Bioactive functional foods have occupied a promising position in modern food markets due to their role in combating oxidative stress and various biophysiological disorders. Yogurt is consumed as a functional food due to its high nutritional contents, and its health benefits can be enhanced by adding probiotic bacterial strains and bioactive compounds. Besides, fortifying yogurt with natural compounds will enhance the antioxidant properties that can help in utilizing natural resources [38]. Therefore, it could benefit from the development of a project and/or application of commercial industries for the production of bioactive peptides from fermented milk products, milk spoilage can be reduced to a greaterextent and also a new industry in agricultural agriculture can be planned. An integrated initiative could provide employment opportunities to a wide range of people who can contribute to a country's GDP and national socio-economic development. Although the bioactive peptide has the potential to be used in the production of functional foods with health promoting properties, safety concerns should first be confirmed [38].

Small and medium enterprises

Milk production and processing is one of the main agro-food sectors in Hungary, and Hungarian milk sector plays an important role in the Central-European region. Among Member States which acceded the European Union as from 2004, Hungary has the second largest share (1.2%) from the total EU-27 milk production,after Poland (6%) [39]. In the case of agri-food SMEs, relevant and reliable information on a product's ingredients and production processes is needed so that companies can recall their products in case of food safety concerns [40]. Those food processing in SMEs which are adequately financed still lack qualified professional staff, only half of the SMEs prepare a business plan, a quarter of them does not even have a vision in writing, there is no brand building or marketing strategy [41].

Unfavourable tendencies of the profitability, efficiency and financial position of the Hungarian agricultural enterprises have started after the political changes, and the financial performance of the Hungarian agricultural enterprises have not improved significantly in the examined period (between 2002 and 2009) [42]. It was highlighted that there is a significant difference between Hungarian agricultural enterprises according to their size; the small sized enterprises (mostly family farms) are unable to develop and they are lagging behind the better-developed large agricultural companies [43]. analysed the difference between size categories of milk processing enterprises and results showed a much higher realized return on assets in the case of large companies compared to smaller ones [39]. However, dairy companies with Hungarian ownership could raise their financial performance and market share in the last few years [44].

According to the Eurostat database, 127 enterprises operated in milk processing sector in 2016, with a sample of (37 enterprises) covers 30% of the total population. SMEs are emphasized more due to the higher number of SME companies and higher market influence. The Hungarian SMEs sector has innovationshortage and shareholder communication is not conceptual and productive enough [45]. SMEs survival rate and business entry is different all over the world depending on the business environment. SMEs sector need different strategy approaches both in Hungary and internationally. Productivity discrepancies translate into unequal wages in the SMEs sector compared to large companies [46]. On the other hand, SMEs take much smaller share of the export than large companies. Most of the European SMEs (90%) are successful on the local market, typically within their own region [47].

Hungarian dairy industry shows a rather diverse picture. The majority of the dairy sector is not up-to-date and modern enough [48]. Despite growth and opportunities, challenges are expected for milk processing companies, one of the main problems could be the environmental sustainability environmental sustainability in the forthcoming period [49]. The length and the degree of complexity of food supply chains depend on the product and market characteristics [50]. One of the biggest problems is the high rate of stocks and receivables; the financing between creditors and receivers has many problems. Most of the agricultural enterprises have liquidity problems [42]. After analyzing the performance of the Hungarian agricultural enterprises and the food-processing sector, results show that most of the agricultural enterprises cannot take the advantages of several supports (e.g. tax allowances) because of their poor financial performance [51]. The advantages of the accession translated to expanded market, the co-financed investments and modernization programmers, the higher income level increased by the payments etc. But advantages could not be utilized by most of the farms [52]. According to the results of collected information concerning to the general market orientation is typical of the respondents, and few of them have particular information about their own product. Otherwise they believe that their market research activity is at the required level.

It shows that they are unaware of the lack of information and do not believe it is a barrier from the point of view of their market success. [53]. Managers say the biggest problems for them are selling their products. They claimed that the trading companies had stronger marketing positions and that they could not compete with foreign dairy products. According to company executives, they want to innovate different products butit costs more and are not well paid by the market. From a corporate point of view, it was shown that retail stores and wholesale stores (chains) are the main activities of daily product sales; direct marketing was marginally present. Consumers report that there is more demand for direct sales from companies. Processors should pay more attention to this type of application in the future. Direct selling can be developed in two ways in case of the companies. The first one is to run own shops in towns/villages, or even in markets. Secondly, online selling will prove to be an extremely good alternative of producers considering direct selling [48].

It is difficult to fulfil the new technological conditions for milk producing [54]. Research and development costs have a negative impact on the innovation performance in the case of small and medium sized enterprises operating in the Hungarian food supply chain [55]. The results also indicate the sustainability challenges that dairy manufacturers have to face, and the authors implemented an energy consumption model [56]. The competitiveness of dairy manufacturers can be increased through cost reduction that is enabled by environmentally sound technologies [57].

Functional Food Customer Motivation

Over the past three decades, consumer behavior and buyers' habits in developed countries have changed radically. On one hand, the foods that contribute to maintaining life and reducing health caused by diseases of civilization are detriments to the growing aging societies, on the other hand with the development of health care more and more nutritional diseases have become apparent. It is understood that food and nutritionplay a major role in treatment and prevention [58]. All of this creates new type of consumer expectations for the market, whether it be the price of special diet products or the willingness to pay extra cost.

Healthy behavior is a complex system that involves physical activity, mental health, hygiene, and avoiding harmful recreational drugs to supplement informed dietary choices, in addition to the awareness about environmental sustainability issues. In summary, according to the findings of the study, there is a significant relationship between lifestyle, healthy behavior, and demand for functional food products. According to most consumers. They eat dairy products as part of Their healthy and effective diet. When examining how well consumers know the producer and the brand and what the difference is between them, it became clear that people who consciously live healthy know the manufacturer and do not confuse them with the definition of brand/branding [48].

Today, consumers are increasingly looking for products that are safe and natural, have a generally recognized safe status and are manufactured using sustainable and/or environmentally sound technologies. For this reason, the term “functional food” is becoming increasingly popular in the social and scientificfields, so that the industry is continuously investing in the development of an industry that can offer productswith additional benefits for the health of consumers [59].

Different surveys showed that consumer acceptance of functional foods is far from being unconditional, with one of the main conditions for acceptance pertaining to taste, besides, product quality, price, convenience and trustworthiness of health claims. As a rule, consumers seem to evaluate functional foods first and foremost as foods. Functional benefits may provide added value to consumers but cannot outweigh the sensory properties of foods. By purchasing functional foods in general consumers may achieve a modern andpositive impression of themselves. These products provide consumers a modern way to follow a sustainable and healthy lifestyle, which differs from the conventionally healthy diet defined by nutrition experts. In general, the attitude both to functional foods and to their consumers is positive, so such a concept representsa sustainable trend in a multi-niche market [60]. For group tested in Hungary (n=195), assuring the low priceand availability, they can be addressed with the issues of health and taste. Furthermore, people of this group are most likely to choose imported goods if those are cheaper than domestic ones. That is why they need tobe oriented towards Hungarian products. It would be beneficial for producers to produce unique, functional products for this group, the ability to afford these products would not mean a problem to them. The disadvantage of this group is that their loyalty is hard to maintain, their demands need to be observed constantly [48]. Hungarian consumers are still more likely to be price sensitive [61].

On the basis on the review of the literature, it was shown that health benefits as well as motivation for use are the strongest positive determinants of functional food acceptance. Independent of socio-demographic factors, inadequate nutritional knowledge could limit functional food acceptance. It should be emphasized that health problems of family members increase consumers’ interest in functional products. People who regard functional food as necessary products are perceived as innovative. Because of the complex nature of consumer motivations and expectations, proper strategy for functional food design, technological development and marketing is crucial. Simultaneously, effective educational programs should be implemented [62].

Consumers are aware of the risks of non-communicable diseases and they are worried about them, and depending on the disease, only a small group of the concerned is not willing to make a financial sacrifice to avoid them. Lifestyle changes are the most preferred methods for most of the diseases, such as for the prevention of cardiovascular diseases and unbalanced mood/apnoea and a high level of cholesterol, while dietary supplements are chosen to prevent a weakened immune system [63]. It is important to point out that with several diseases, the smallest ratio of respondents chose dietary supplements. Further results indicate that consumers are the most concerned about cancer-related diseases. This is the only disease where, besides lifestyle changes, consumers consider taking medicaments as the best option. Main health problems people are most affected by and worried about compared to the acceptance of mitigation and prevention with functional foods are shown in Figure 2. Results include a group of respondents (n=1002) who would be willing to pay to prevent or mitigate these health problems, and also those who are concerned/worried, but would not like to spend money on it. The second group could also be a potential target group for product development due to their involvement. Moreover, the inclusion of foods with functional properties in dietcan be carried out without further significant expenses, despite other solutions (dietary supplements, medicines, medical treatments) [64]. However, in another study concerned in lactose intolerance, more people choose not to consume dairy products when they are experiencing unpleasant symptoms and it is usually because of their lack of knowledge. Instead of legal definitions, consumers receive information aboutthe functional properties of food through advertisements and labels [26]. Moreover, another results also showthat in relation to disease prevention, the gender of the consumer does not have a significant effect on choosing functional foods [63]. Numerous literature sources [65–67] emphasize the important role of gender,age, and completed education as key demographic factors influencing the consumption of functional foods. Clear differences between men and women appear in the field of functional components, which are significantly more important for women than for men. Young consumers are more open to high-technology food processing.

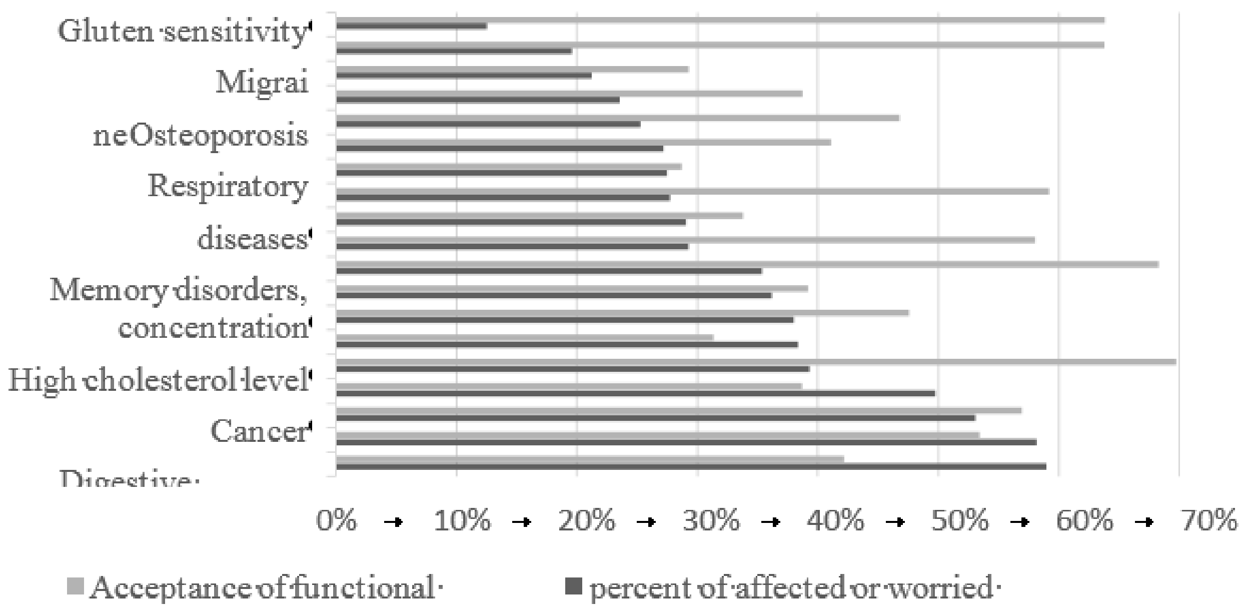

Figure 2. Assessing the worrisome/affecting health problems of Hungarian consumers and the suitability of functional foods to prevent or mitigate these problems [64]

Since health knowledge increases the interest in functional foods, while lack of health knowledge reduces it [68], Marketing specialists should use psychoactive techniques by providing information to help consumers visualize the health consequences of behaviors and lifestyles. Advertisers also need to pay attention to endorsers in advertising [69]. It is known that the perception of risk is lower for the consumer in functional food advertisements with negative message framing as well as in highly credible advertisements. This is why common aspects can be more effective in targeting rationally motivated consumer groups [69]. Consumers who consider themselves conscious consumers of local products are less familiar with milk producers near their hometowns. Improving local patriotism will create a potential market for dairy factories. For a small company with low capacity, the brand may not be enough to be recognized by local consumers. On the other hand, If it becomes known by the consumer, they are likely to search for or buy the product in the future. The motivators of consumer choice of food do not include concern for health, and the pleasure of flavours and eating is much more pronounced. According to the recent findings, more than 50% of the Hungarian population are not willing to change or improve their eating habits and are not interested in following a healthy lifestyle [58,70]. The re-structuration of food consumption patterns in Hungary would serve both the public health, ecologic and sustainability and ecological goals [71]; moreover, it would mean a hugepotential market for companies producing functional food if this large segment of non-health-conscious customers could be made motivated.

CONCLUSIONS AND RECOMMENDATIONS

Functional foods with application of innovative technologies with high added value are becoming increasingly popular and the fastest growing area of the food industry because of health issues or lifestyle decisions. After long research we can sum up the definition of functional food as food containing components that positively affects the human body by fortifying the food with extra nutrition or eliminate harmful components using innovation methods and technologies. Bioactive functional foods, Food fortification and Ultrasonic processing or sonication is a promising alternative technology in the food industry as it has potential to improve the technological and functional properties of milk and dairy products.That could designate the directions for product development of the Hungarian food industry. Since functional food products can only achieve market success if they meet the consumers' expectations.

We could find that the biggest problem of SMEs Managers is to sell their products, because retail companies have stronger bargaining positions and they cannot compete with cheap foreign dairy products, and consumers show a greater demand for direct selling as opposed to companies. That's why SMEs could succeed on the local market, typically within their own region after considering different strategy approaches. Besides that, Processors of dairy products need to pay more attention to this sort of consumer demand in the future. We could witness that direct selling could be developed and approached in two effective ways in the case of the SMEs. The first way is to run own shops in local markets and towns/villages; and the second way, using online sell which consider high potational as direct selling. However, development of new functional components and the solution of technological challenges arehighly costly and risky business, and new products have a high failure rate on the market, because most of them were not preceded by a deeper exploration of consumer needs, and Hungarian SMEs sector has innovation shortage, and the dairy sector is not up-to-date and modern enough. That's why, it is recommended that functional food developmental research and manufacturing companies' research and development departments, as well as their marketing experts dedicate their resources to develop and communicate about products such as dairy functional food and its importance for sustainability and healthy life which could attract a large population of consumers. helping to attract consumer acceptance. And it would mean a huge potential market for companies producing functional food if this large segment of non- health-conscious customers could be made motivated.

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URBAN AND INDUSTRIAL SURFACE WATER POLLUTION AND THEIR IMPACTS ON THE ENVIRONMENT. CONSTANTINE CITY CASE STUDY. NORTH-EAST OF ALGERIA

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Abstract: *The study area is located in Constantine, at the North-East of Algeria; it regards the segments of wadi Rhumel and its branch wadi Boumerzoug. It is characterized by a semi-arid climate. This work focused on the assessment of the physical-chemical quality and the level of contamination by hydrocarbons (oils and greases) and metallic trace elements (TMEs) (As, Cd, Cu, Fe, Ni and Zn). 14 samples were collected spread the wadi, and were analyzed. Results show the order of abundance of the cations in the majority of the samples is: Na> Ca> Mg> K. The concentrations ranking is: Na (66.812-396.493 mg/l), Ca (90.11-96.66 mg/l), Mg (18.96-30.52 mg/l), K (9.494-13.988 mg/l). For TMEs, the analyses showed relatively high concentrations. The abundance ranking in most elements is: As >Fe > Cd > Ni > Zn > Cu. The concentrations ranking is: As (1.316-0.436 mg/l), Fe (0.119-0.170 mg/l), Cd (0.054-0.099 mg/l), Ni (0.007-0.043mg/l), Zn (0-0.08 mg/l), Cu (0.008-0.016 mg/l). All analysis shows oils and greases concentrations are extremely high (88.2-390.6 mg/l). The correlation matrix and the PCA between all metal elements reflect the signature of anthropogenic and domestic inputs at the same time. The SEQ-Water: qualifies very poor quality according As and Cd contents, good to fair for Ni and good quality for Cu and Zn. This situation reveals a direct influence of anthropogenic inputs conveyed by the wadis. Oils and greases, their contents are found to be very high and reflect an intense uncontrolled activity linked to the use of hydrocarbons and derivatives.*

Keywords: *Anthropogenic, contamination, oils and greases, SEQ-Water, TME, wadi Rhumel, wadiBoumerzoug.*

INTRODUCTION

The phenomenon of oil pollution is a major concern for those involved in the protection of the environment, health and the economy. This pollution can have a direct or indirect impact on human health and the balance of ecosystems, both marine and continental. Service stations are a major source of urban pollution, which is why they are the subject of this study. The operation of this type of activity represents a potential source of nuisance (traffic, noise, atmospheric pollution, soil and water pollution) for the immediate neighborhood, but also for the environment in general. The phenomenon of pollution from service stations can be divided into two categories: on the one hand, chronic pollution lasts for a long time and is most often due to the corrosion of tanks and underground pipes. On the other hand, accidental pollution due to oil spills when filling station storage or fuel distribution or even during engine maintenance operations [1]. This state of affairs prompted us to initiate this study to assess the state of health of watercourses following these types of activities. Several approaches are used to assess the degree of contamination of water, among these approaches a field survey to determine the different pollutants and another in the laboratory to quantify these pollutants and assess the degree of contamination and several studies have been made [2, 3, 4 and 5]. The study area is located in the North East of Algeria and concerns the segments Rhumel and Bouerzoug Wadis which passes through the city of Constantine and its immediate surroundings. The objective of this study is the assessment and quantify the physico-chemical quality and the level of contamination by hydrocarbons (oil and grease) and metallic trace elements (TME) (Cd, Cu, Ni, Fe, Zn and As) that were discharged into the waters of the main wadis in the study area. Samples were taken from the main Rhumel and Boumerzoug rivers and their tributaries.

Geological and hydrogeological settings

The study region is located in the North-East of Algeria, part of the Tell Constantinois and belongs to the Kebir-Rhumel watershed. It covers the city of Constantine and its periphery (Figure 1). It is bordered on the North and South by parallels 36°35'N to 36°10'N and on the East and West by meridians 6° 25'E to 6°45'E. The city of Constantine and its periphery is part of the external zones of the Maghrebids, allochthonous domain, a relatively complicated geology, of an essentially detrital lithological nature, characterized by an essentially rocky relief and a poor vegetal cover, and are drained by a relatively dense hydrographic network. The Rhumel is the main river and the Boumerzoug its main tributary. The hydroclimatological study allowed us to conclude that the study area is characterized by a semi-arid climate with influences, a sub-humid regime in the North and a semi-arid regime in the South. The annual average precipitation is 477.34mm, with the month rainiest is February (70.18mm) and the driest month is July (2.11mm). Average annual temperatures are around 16.24°C. As for the thermal regime, we have two very distinct seasons: a hot and dry season and another cold and humid. Since our study took place at this time of year (September 2020), our analytical results would be largely influenced by the dryness of the campaign.
The largest and most harmful industrial discharges are located within a radius of 20 km around the city of Constantine; these are the discharges (partly treated) from the mechanical construction industries of Oued Hamimime and Ain Smara, as well as those generated by the textile and dairy units of Constantine (Chaabet Rsas), by the tobacco complex and the hydrocarbon depotat El Khroub, by the El Hamma B cement plant [4], by the building materials units, and other PMI in Didouche Mourad,the discharge of Bardo crafts from brassware, their receiving environment is the Wadi Rhumel and its main tributary the Boumerzoug, which functions as real open sewers.

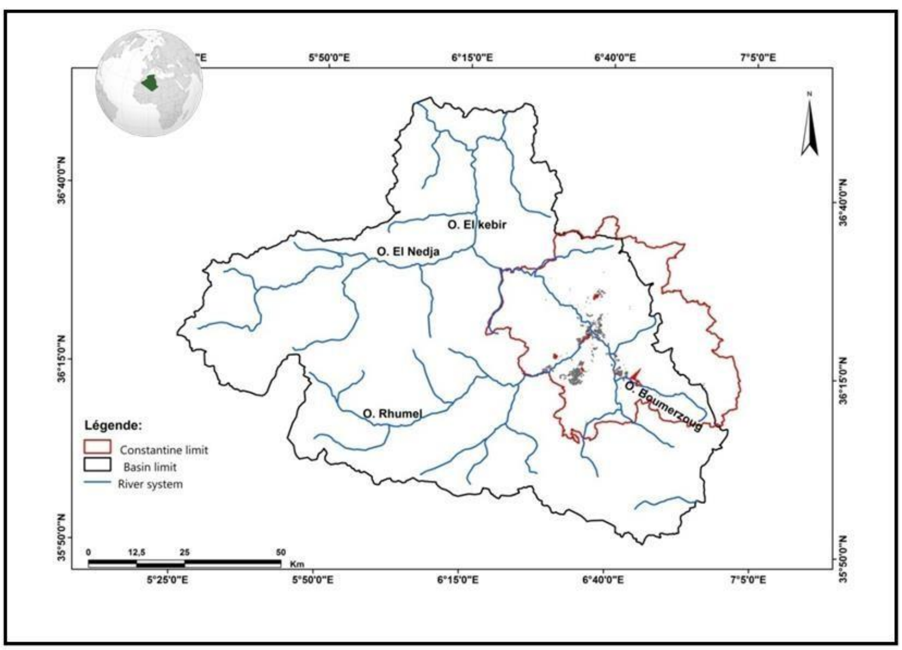

Figure 1. The study area situation

MATERIALS AND METHODS

Sampling and analysis: The samples analyzed were collected at the 14 stations, spread over five rivers, namely the wadis Rhumel, Boumerzoug, El Barda, Hamimime and Ziad. The sampling campaign took place in September (September 1st to 2 nd, 2020). The stations have been chosen so as to integrate as much as possible the influence of certain areas, by placing themselves upstream and downstream of them. The selection criteria for our stations were based on the proximity to the three industrial zones: Palma, Boumerzoug and Khroub upstream and downstream of these (Figure 2); but also in relation to the service stations which are located near the wadis and which are liable to discharge their discharges directly into the latter. The samples were taken from bottles rinsed beforehand with distilled waterand also with the water sample to be taken, stored in the laboratory at a temperature of 4°C [6].

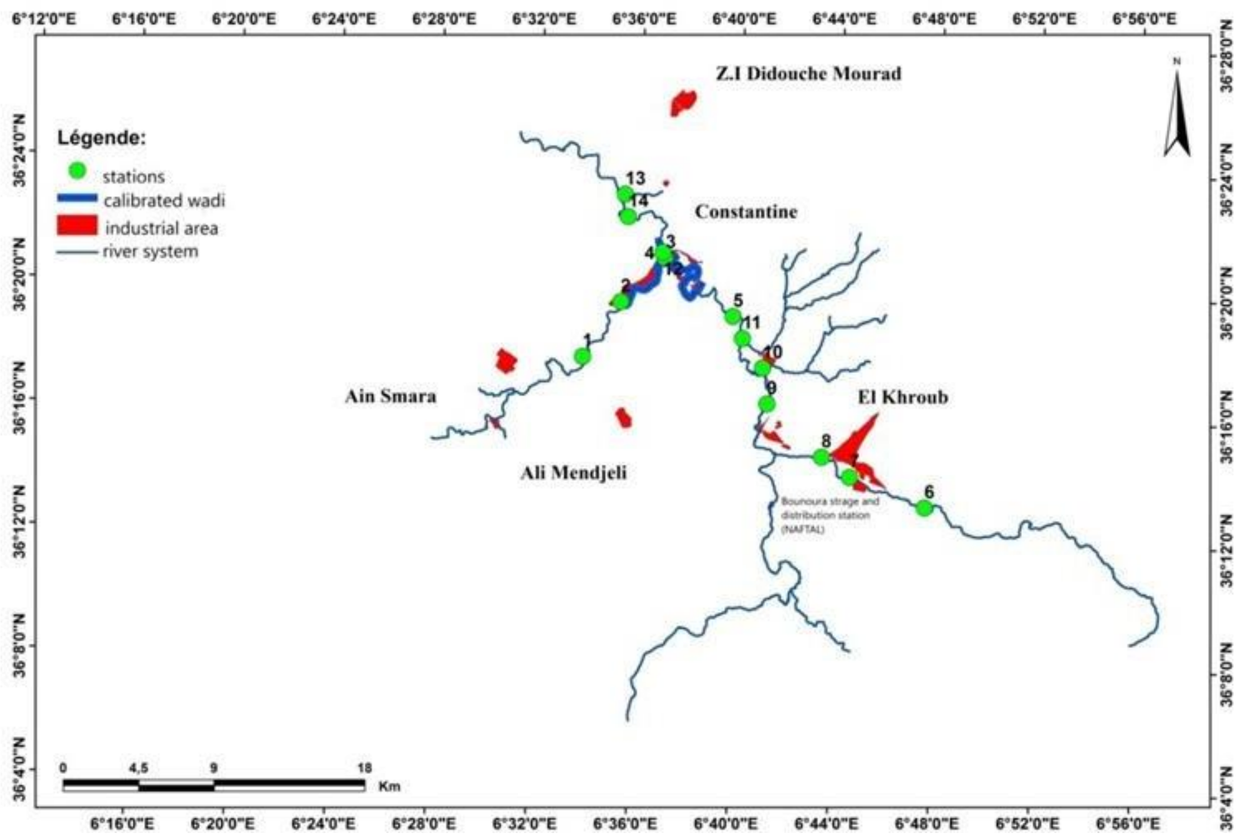

Figure 2. Different stations localization

Electrical conductivity and temperature are measured using an in-situ field conductivity meter where the thermometer is included in it. The results are expressed successively in µS/cm and in °C. The pH is taken with a model electrometric pH meter (pH-meter E520 Metrohm Herisau), in the laboratory, by immersingthe electrode in water approximately 6 to 8cm from the surface. The pH meter is calibrated with a solution of distilled water. The determination of ETMs (Cd, Cu, Ni, Fe, Zn and As) and of the major elements (Ca, K, Na, and Mg)were carried out by Flame Atomic Absorption Spectrophotometry (AAS) of the Perkin Elmer A Analyst type.200.The BOD5 is measured using a BOD meter type BSB-Controller Modell 1020T, for 164ml of sample, three NaOH capsules are added, and incubation for 5 days in the dark, the result is multiplied by a factor of 10 in mg/l. Nitrites are measured by DR/2000 spectrophotometer;
Finally, for the determination of the concentration of oils and greases is carried out mainly in three stages: acidification with HCl (pH>4), then extraction with hexane, then drying with ($NaSO_4$), they are determined by gravimetry.

STATISTICAL ANALYSIS AND GRAPHICAL PRESENTATION

Principal component analysis (PCA): The Principal component analyses (PCA) are multivariate statistical techniques commonly used by scientists on hydrochemistry to classify water samples [7, 8]. These techniques allowed the exploration of the multivariate data holding several variables. The compliance of these parameters by the mean principal component analysis (PCA) is inspected by the Kaiser-Meyer-Olkin (KMO) and Bartlett sphericity tests applied to all the data. KMO was> 0.5 and Bartlett's sphericity shows that $\chi 2$ (observed) is greater than $\chi 2$ (critical) at 105 degrees of freedom, indicating that our analysis results are suitable for PCA. The relationships between the analyzed elements were tested using the Pearson coefficient. The results of all the physico-chemical analysis are shown in the next table (Table 1):

Table 1. statistics of physico-chemical characteristics and trace metal concentration

	CE µS/cm	Ca	Mg	Na	K	Fe	Cu	Zn	Ni	As	Cd	DBO5	O.G
Min	1582	90.11	18.96	66.81	9.49	0.119	0.008	0	0.007	0.436	0.054	6	88.2
Mean	1928.86	92.69	24.08	208.09	12.14	0.14	0.013	0.036	0.025	0.977	0.07	8.5	313.3
Median	1915.5	92.95	23.97	191.78	12.12	0.136	0.013	0.03	0.024	1.059	0.065	9	334.8
Max	2280	96.66	30.51	396.49	13.98	0.17	0.016	0.08	0.043	1.316	0.099	11	390.2
Std.Dev	165.32	2.23	3.34	118.21	1.359	0.017	0.002	0.028	0.010	0.272	0.01	1.454	83.78

RESULTS AND DISCUSSION

The pH values measured at the stations revealed a slightly alkaline pH, while the temperatures of the rivers vary little, and are mainly a function of that of the air. For conductivity, this parameter essentially depends on the presence and concentration of major elements. In general, the EC values are a little high, varying between 1582 and 2280µS/cm; this is due to industrial and urban discharges as well as to the nature of the terrain crossed.

For the major elements, the concentrations vary from one element to another; they increase upstream to downstream of industrial zones and towns. The order of abundance of cations at most stations is as follows: Na> Ca> Mg> K (Figure 3).

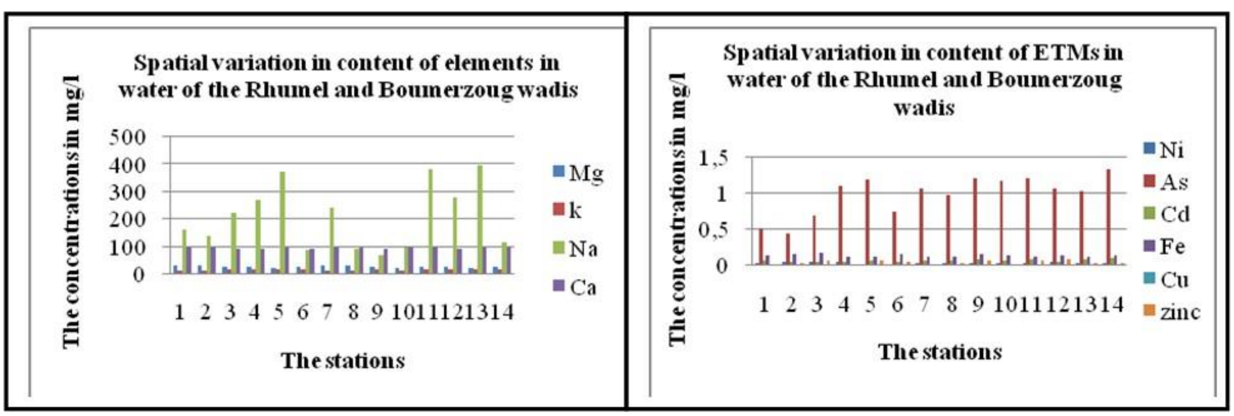

Figure 3. Spatial variation of chemical elements in the study area

The contents of Ca (90-96.66mg/l), Mg (18.96-30.51mg/l), and Na (66.81-396.49mg/l), the highest values are observed downstream of the city of Constantine (city collectors) and near industrial zones, Rhumel, Boumerzoug, Bounouara, Bardo, and finally O. Ziad (downstream of the Bekira activity zone) influenced by untreated domestic and industrial effluents. The concentrations of BOD5 observed in the various stations in the study area reflect not only the impact of the agglomerations, but also the agricultural and livestock activities developed in the upstream part of Boumerzoug Wadi. The concentration of oils and greases are extremely high, greatly exceeding the recommended standards this is due to the uncontrolled discharges which discharge directly into the wadis without undergoing primary treatment, adding to this the washing of the soil by the runoff water which leads to the pollution of surface water and deep water when there is infiltration. The service stations have a huge influence on the quality of the rivers in the study area in terms of oils and greases; the hydrocarbon industries company (NAFTAL) could be a significant contribution of these materials illustrated by high levels (390.6mg/l) (Figure 4) downstream of this industry.

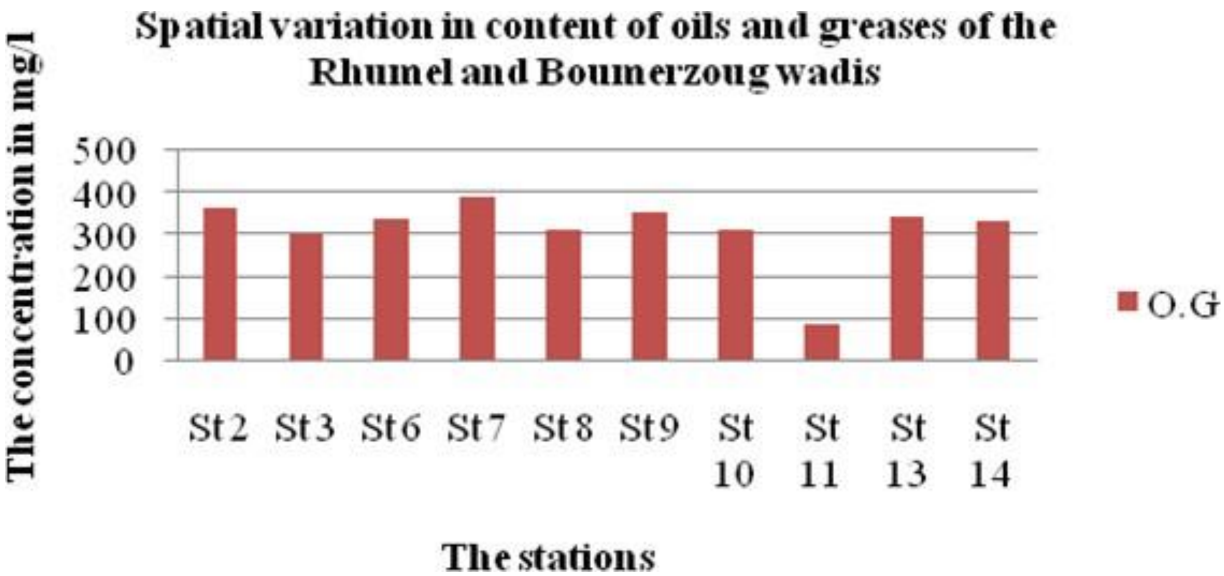

Figure 4. Spatial variation of oils and greases in the study area

For metallic trace elements, analysis showed relatively high concentrations of TME. The order of abundance in most elements is as follows: As> Fe> Cd> Ni> Zn> Cu (Fig.3). The Zn (0-0.008 mg/l) and Cu (0.008-0.016mg/l) contents are the lowest compared to other ETMs, but they remain quite high from a pollution point of view. The coexistence of the two elements in the same samples taken stipulates a common origin. They reach waterways either directly in urban effluents (the major source of which is corrosion of pipes for Cu), industrial and discharges from artisanal activities not connected to the sanitation network, or in a diffuse manner through runoff water especially those of riverbank soils cultivated for Zn (fertilizers and pesticides).
The concentrations of Fe (0.119-0.165mg/l), they increase upstream and downstream influenced by industrial discharges, the primary source of pollution of this element, but also domestic discharges.
Arsenic (0.436-1.316 mg/l), Cadmium (0.054-0.099mg/l), and Nickel (0.007-0.054mg/l), represent very high levels. Their concentrations increase from upstream to downstream especially along the Boumerzoug Wadiwhere the mechanical industries of O. Hamimime are located and the deposits of Rhumel Wadi, crafts, tannery, ceramics and the pharmaceutical industries. Small and medium-sized farms (PMEA) are developing along the Boumerzoug Wadi which can be a source of contamination (fertilizers and pesticides). Road traffic can be a source of contamination, as the samples are located not far from the road (runoff water). The greatest concentrations are downstream from the city of Constantine at El Menia, the point where all pollutants converge, as this site receives all of the surface runoff from Boumerzoug and Rhumel. The correlation matrix reveals that some variables are significantly correlated with each other. Thus, pH is negatively correlated with EC (r = -0.647), Zn (r = -0.564) and K (r = 0.509), and is positively very strongly correlated with NO2 (r = 0.836). The EC is positively correlated with K (r = 0.568), BOD5 (r = 0.680) and Zn (r = 0.577). Mg is negatively correlated with K (r = -0.582), the same for Na with Fe (r = -0.616). K, on the other hand, is positively correlated with BOD5 (r = 0.562) and Zn (r = 0.640). The latter is positively correlated with BOD5 (r = 0.622). Cu is negatively correlated with Ni (r = -0.560), positively with As (r = 0.604) and Cd (r = 0.779).
A principal component analysis (PCA) performed from data performed on a data matrix consisting of 14 samples for a total of 15 parameters shows that there is a broad relationship between these variables.

The main factor 1 comprises 27.28% of the total variance and has the high loads in pH, EC, K, BOD5, NO2 and Zn. This factor indicates that the EC is highly influenced by anthropogenic activity directly related to wastewater discharges. The main factor 2 contains 24.23% of the total variance and indicates high loads of metallic trace elements: As, Cd, Fe and Cu. Given the wide use of these elements in industry, this factor could indicate the signature of the industrial origin of this pollution.

The main factor 3 has 14.22% of the total variance and is related to Na, which in other places does not show such an influence which prompts us to question its possible origin. In addition, the projection of the water parameters of the fourteen sampling stations on the main plane (axes 1-2) (Figure 5) which covers 51.51% of the total information, makes it possible to detect a very dispersed total structure, which is normal for a period of low water limited by the inflow of water from climatic origin. However, this structure shows similarities and dissimilarities between the water parameters and between the stations. This representation indicates a structure dominated by the detachment of stations St5, St6, St9 and St11 which project from the positive side of axis 1 showing the highest contents of CE, BOD5, K and Zn. A second group is formed by NO2 and pH which contribute to the formation of axis 1 on the negative side reported to stations St4 and St8. This factor load, which represents 27.28% of the total variance, indicates that axis 1 is that of domestic waste.

Stations St10, St13 and St14 stand out on the positive side of axis 2, absorbing much of the information provided by this axis and marked by the high contents of As, Cd, Cu and Na. Finally, a last group is placed on the negative side of axis 2 formed by stations St1, St2, St3 and St12 dominated by the highest contents of Fe, Ni, Mg and Temperature. Axis 2 is undoubtedly the signature anthropogenic activity dominated by industrial waste. Station St7 which projects on the negative side of axis 1, standing out from the group, thus showing the highest levels of oils and greases.

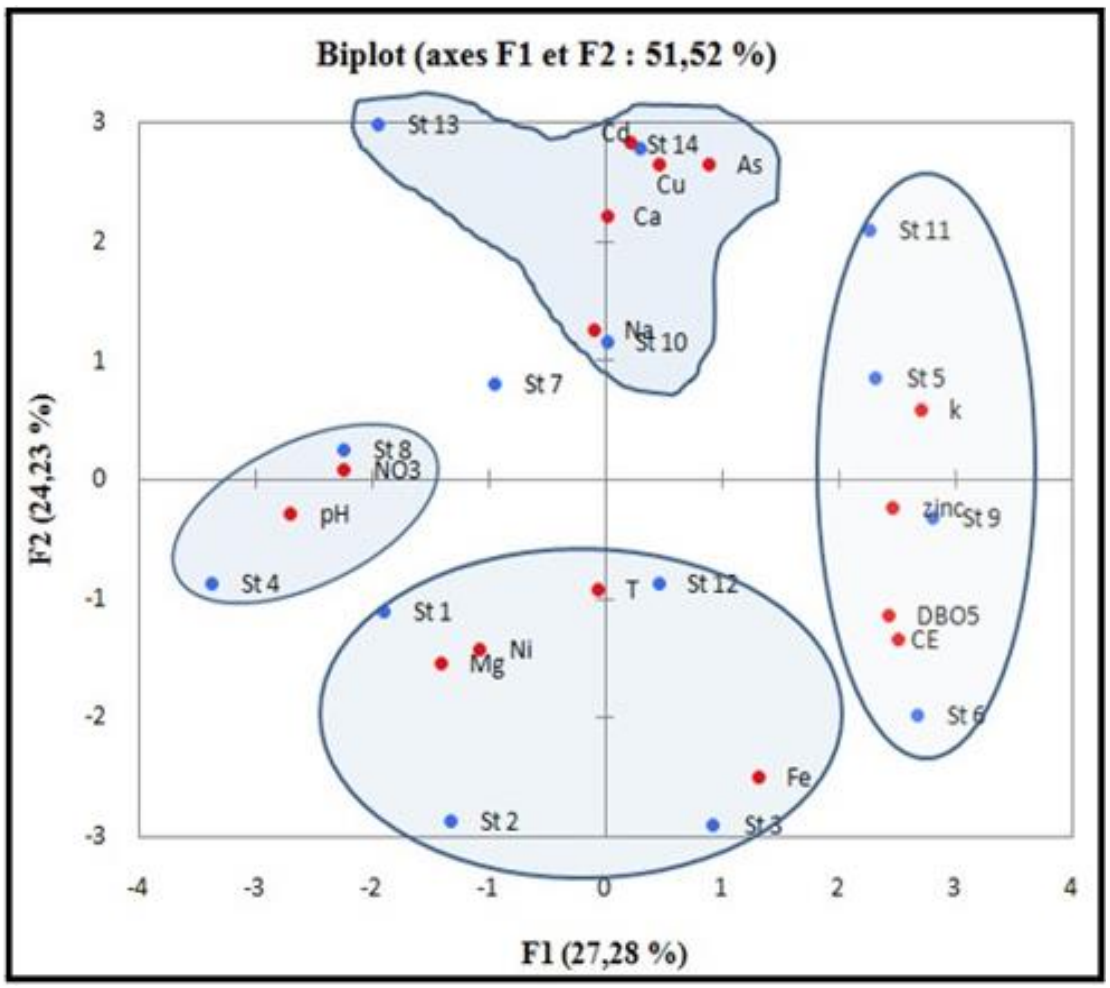

Figure 5. PCA of water parameters and projection of withdrawals

Table 2. The water quality of the 14 stations in the study area

Oueds	stations	T°C	pH	CE	As	Cd	Cu	Ni	Zn	NO_2	H.G
Oued Rhumel (Be.Co)	1	light green	blue	blue	red	red	green	yellow	blue	red	
	2	yellow	blue	blue	red	red	green	yellow	light green	red	red
	4	red	yellow	blue	red	red	green	yellow	blue	red	
Oued Bmerzoug	3	red	blue	blue	red	red	green	yellow	light green	red	red
	5	red	blue	blue	red	red	green	green	light green	red	
	6	orange	blue	blue	red	red	green	green	green	red	red
	7	red	blue	blue	red	red	green	green	blue	red	red
	8	orange	blue	blue	red	red	green	green	green	red	red
	9	yellow	blue	blue	red	red	green	yellow	green	red	red
	10	yellow	blue	blue	red	red	green	green	blue	blue	red
	11	yellow	blue	blue	red	red	green	yellow	green	red	red
Oued Rhumel (Af.Co)	12	yellow	blue	blue	red	red	green	yellow	green	red	
	13	yellow	blue	blue	red	red	green	green	green	red	red
	14	yellow	blue	blue	red	red	green	yellow	green	red	red

(Be.Co) : Rhumel Wadi before the confluence
(Af.Co) : Rhumel Wadi after the confluence

blue	Very good
green	Good
yellow	Fair
orange	Bad
red	Very bad

CONCLUSIONS AND RECOMMENDATIONS

According to the analysis carried out, it appears that industrial and urban discharges are responsible for a degradation of the physico-chemical quality of the waters of the Boumerzoug and Rhumel wadi, this pollution seems to have both a domestic and industrial origin linked to the discharge of untreated wastewater which flows directly into rivers.

However, the industries present in the study sector also have their share of responsibility for the degradation of the quality of these waters. The same is true for the metallic trace elements which seem to be present with relatively high concentrations, in particular for the Arsenic and Cadmium, which remains worrying, which make the quality of the water poor, as well as for oils and greases which are considered as hazardous waste. Although the number of elements analyzed is reduced, the wastewater of the city of Constantine remains overloaded with pollutants and constitutes a serious problem for the Beni Haroun dam, especially in the absence of a fully functioning wastewater treatment and purification station (WWTP).

So it becomes imperative to set up a monitoring and control program for the various sources of pollution and their effect on humans and the environment, by forcing these industries to equip themselves with a system for treating their discharges, as well as recycling and recovery of waste if necessary.

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THE ROLE OF SYMBIOTIC INTERRELATIONS IN THE AVAILABILITY OF NUTRIENTS FOR FIVE COVER CROPS

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***Abstract**: Biomass production of cover crops and relation with electrical conductivity (EC), soil glomalin content and the mycorrhiza frequency (F%). Cover crops (CC) serve as essential source of nutrients in the soil and improving of the soil properties. The production of cover crops is considered as a benefit of the soil quality; by protecting of the soil from erosion, reduce the weeds and the so-called soil-borne plant pathogens and increase soil biological activity. There are different varieties of cover crops that can be grown: such as legumes, non -legumes, brassica and grass-type of plants. Each of these cover crops have their own benefits to the soil system, the presence of cover crops helps in maintaining the nitrogen cycle as well as bolster the growth of nitrogen and phosphorus producing and/or solubilizing bacteria. Our examinations were carried out in pot experiments at MATE Buda Campus, in a heated greenhouse. The pot experiment was designed with five types of cover crops species (Phacelia tanacetifolia, P.t.; Brassica carinata, B.c.; Vicia faba, V.f.; Avena strigosa, A.s.; Vicia benghalensis, V.b.) and a mixture of the five species, placed in sandy soil (arenosol) in plastic pots in 4 repetitions. We measured soil biological activity, which can be the first step to achieve healthy soils. We assessed the saline content of the soils, i.e., the quantity of salts in the soil-plant environment. This parameter is considered as an indicator of soil health and fertility. Considering of the pot experiment the mixture of all the cover crops tended to show the maximum electrical conductivity quite significantly compared to the other cover crops. The formation of cover crops might support also the growth of the symbionts, such as the mycorrhiza fungi. Different plants can have variable interactions with the AM Fungi. We have measured the Frequency of mycorrhizal infection (F%). The percentage of mycorrhiza colonization was good in all CC except the mustard, B.c. (0%), which is known as a non-symbiotic plant. Wetch is responding positively to AM fungal inoculation. It is well known that the AMF has the ability to improve the uptake of the phosphorus (P) of the hosting plants as well as the performance of its growth (Finlay 2008). The hyphae of arbuscular mycorrhizal fungi produce a protein called glomalin. The glomalin concentration along with the cover crop can be very important in maintaining the soil quality and the aggregation-stability. It was found in the pot experiment, that the vetch (V.b.) has the highest capacity to retain glomalin concentration followed by mustard (B.c.) and the mixture of cover crops. Further aim is to test the benefits of mycorrhiza symbiosis and interrelation with their "helper" bacterial community in the secondary structure of soil.*

Keywords: cover crops, mycorrhiza symbiosis, soil nutrients, sustainable agriculture

INTRODUCTION

Cover crops which also known at some cases as catch crop plants are mainly cultivated after harvesting of a primary plant (Abdalla et al. 2019). Cover crops consisting of mixtures of different species have recently become popular, as mixing species with different properties produces a single crop that can perform various functions (Storkey et al. 2015). There are different benefits of cover crops such as in retaining the water capacity of the soil, improve of the activity of natural flora and fauna in the soil as well as contribution in maintaining the natural ecosystem processes. The presence of cover crops helps in maintaining the nitrogen cycle as well as bolster the growth of nitrogen and phosphorus producing and/or solubilizing bacteria (Dabney et al. 2010; Tonitto, David, and Drinkwater 2006; Brennan and Boyd 2012). Different crop alternatives are available to be used as vegetative cover such as legumes, and they have a great benefit to the soil. Cover crop rotation can increase microbial diversity (Schonbeck and Morse 2006), enhance the biodiversity of the agro-ecosystem, ensure organic matter, increase soil biological activity and can prevent soil from nutrient leaching (Kaye and Quemada 2017). It is, also known, that microbial community of the soil improve by the cover crops. It is also intensively studied, how the cover crops might provide mycorrhizal fungal abundance and in parallel, the microbial biomass of affected soils. The phosphorus availability of soils and activity of phosphatase enzymes was also reported (W. Zhang et al. 2016; Dudás et al. 2017). It is important to keep in mind that farm management decisions have large effects on the biological activity in the soil. In general, more activity is better for plant productivity and the use of cover crops is also suggested as part of the conservation agriculture (CA) practices. The approach has a wider advantage when looking at the resilience of the agro-systems and the livelihoods of those farmers who adopt it. The soil will be more resilient to disasters such as droughts and heavy rainfall from an ecosystem perspective, and at the same time, the soil will improve its quality. This improvement will benefit farmers, as they will be able to increase crop yields and be less vulnerable in terms of food security (FAO 2012).

Fungi coexist with the roots at most of the crops, monocots and dicotyledons, herbaceous plants and some fruit trees such as citrus fruits and apples...etc. The most common form of mycorrhiza is the arbuscular mycorrhiza fungi (AMF), which is known symbionts at about 80% of higher plants. It is well known that the AMF has the ability to improve the uptake of the phosphorus (P) of the hosting plants as well as the performance of its growth (Finlay 2008). These benefits of the arbuscular mycorrhizal fungi can easily be enhanced through studied agricultural management (Gosling et al. 2006; Ryan and Graham 2018).

The objective of the present study was to compare the effect of some most frequently applied cover crops on the soil microbiological activity, especially mycorrhiza (AM) fungi, and how these effects depend on the physical and chemical properties of the soil, which is the first step towards the soil-health improvement. Two different soil-enzymes were selected for the comparison study.

MATERIALS AND METHODS

Test plants and growth characteristics: As a test plant we used five cover crops (V.f.: Vicia faba also known as Broad bean, P.t.: Phacelia tanacetifolia, A.s.: Avena strigose also called as Black oat, B.c.: Brassica carinata, known as Ethiopian mustard and V.b.: Vicia benghalensis, known as Purple vetch) and a mixture of the five species. The plants were grown in sandy soil (Arenosol, Soroksar) in plastic pots. 10 plants were put in each pot in heated greenhouse at SZIE Buda Campus. The pot experiment was conducted from 12/10/2020 to 24/11/1010. The average temperature was 19℃ and the humidity was 52%. After one and a half month of growth, the plants were harvested.

Biomass-production: Fresh and dry shoot and root biomass above ground shoot weight were measured, the weight refers to the “dry weight” value after the plant tissue has been dried to a constant weight at 60°C, and the soil moisture was measured, tow enzymatic activities in the soil samples were determined at the end of the experiment. Four replicates per assay were used.

Enzyme activities: Dehydrogenase activity (DHA) was determined using the assay by Casida method (Casida, Klein, and Santoro 1964) on the basis of the reduction of triphenyl tetrazolium chloride (TTC) to triphenyl formazan (TPF). One gram of pots-moist soils was mixed with 1 ml 1.5% TTC thoroughly into test tubes. The samples were mixed on a vortex and the suspension was incubated for 24 at 30°C, the control contains only 1 ml tris buffer (without TTC). Then 4 ml methanol was added for each tube for extraction of TPF reflecting in red coloration. Samples incubated again for 2 h at room temperature.

Finally, the suspension was filtrated, and the density of the suspension was measured with the spectrophotometer at a wavelength of 485 nm using methanol as a blank. DHA was expressed as µg TPF per 1g dry soil matter. Average of 4 replicates is shown of DHA activities. Total microbial activity in the soils was measured by hydrolysis of fluorescein diacetate (FDA). FDA was determined using the assay by

(Green, Stott, and Diack 2006). During the process 7.5 ml was added of 60 mM phosphate buffer to each tube which containing 1 g of soil, to suspend the solution it is need to vortex, then 100 µl of stock solution FDA was added to each tube, shake it by hand and incubated for 3 h in the shaker incubator at 30℃ (200 rpm) after incubation 7.5 ml as added of acetone to each tube, shake again, then the solution was filtered into a clean falcon tube. The intensity of the fluorescent was measured by the coloration of samples, including the control on a spectrophotometer (wavelength 490 nm).

Electrical conductivity of soils: Electrical conductivity (EC) was measured in the soils of 5 cover crops and its mixture in a pot experiment, compared to a non-planted control soil. Four replications for each crop were measured by using electrical conductivity meter (EC meter) which measured the electrical conductivity in a soil solution.

Frequency of mycorrhiza (F%): general Mycorrhiza was measured which is root colonized by AMF + VMF+ hyphae, for the roots of 5 cover crops and its mixture, For the estimation of mycorrhizal development roots were prepared according to the modified method of (Phillips and Hayman 1970). After careful washing with tap water, the roots were softened in 7% KOH for 24 h, washed in water, acidified in 5% lactic acid in water for 1–24 h, and stained with 0.01% aniline blue in 5% lactic acid for 24h at room temperature. The stained roots were stored in lactoglycerol until they were used for slide preparation. Four parameters of mycorrhizal colonization were evaluated microscopically using thirty 1-cm root fragments per sample and calculated as percentages: frequency of mycorrhization of root fragments (F%).

Glomalin content of soils: Glomalin content was mesured in the soil of 5 cover crops and its mixture in a pot experiment in four repetation, compared to a non-planted, non-AMF-inoculated control plant. 50 ml of a 2 mol / l KCl solution were added to 10 g of dry soil, (2 M KCl: 1 liter of distilled water for 149 g of KCl salt), the suspension was shacked for1 hour, then centrifuge it. The intensity was measured by spectrophotometer (wavelength 595 nm).

Statistical analysis: IBM SPSS 23 program was used. Normality assumption was proven by Kolmogorov-Smirnov test ($p>0.05$) and the homogeneity of variance was checked by Levene's test ($p>0.05$). For evaluation of the results multivariate analysis of variance (MANOVA) test was applied.

RESULTS AND DISCUSSION

Biomass production of cover crops

Legume cover crops have better biomass production, than the other studied, non-legume plants. It is especially the bean, which was producing the greatest biomass (Figure 1), due to its complex root system, which might absorb water and minerals from the soil.

The hydraulic system can transport the nutrients to the whole plant; also the growth rate of it plays an important role with increasing the biomass. Biomass production differed substantially among the used mixes of the cover crops. Generally, the legumes of having simple and double symbiotic systems, might produce more cover crop biomass, than the mustard, which plant cannot be supported neither the N_2-fixing or the P-mobilizing symbiotic activities.

B. carinata usually do not produce as much biomass as other brassica leguminous plants. Biomass production of faba bean by shoot height, number of branches, root length, absolute growth rate, and number of leaves can be significantly higher than most legumes and non-legumes, the growth and biomass production by mustards in the winter is not usually as reliable as that of other cover crops such as legume or the mixture of the five crops.

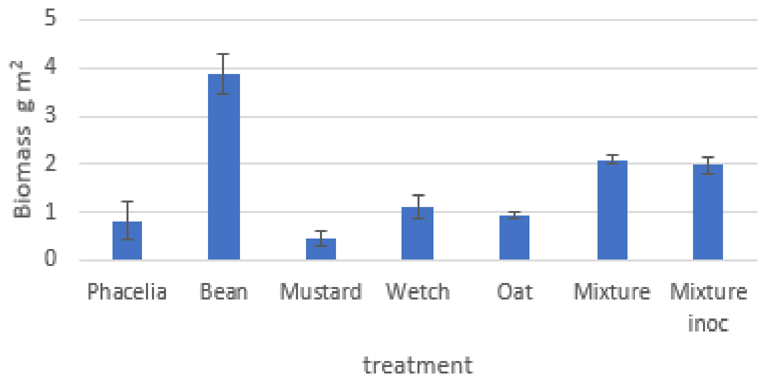

Figure 2. Plant biomass production, as dry weight (g m^2) of 5 studied cover crops species and their mixture, studied among green-house condition in pot experiment.
Cover crops: Phacelia-P.t., Bean-V.f., Mustard-B.c., Wetch-V.b., Oat-A.s.

Soil Enzyme Activities of DHA and FDA enzymes

Soil enzymes have been used as sensitive indicators of the fertility of the soil, soil productivity and quality. In addition, their operations can indicate microbial activity, decay rates and substrates for microbial or plant uptake availability (Zhang et al. 2015). The highest values of dehydrogenase activity (DHA; *Figure 2*) were detected after termination of the experiment. DHA values showed a significant ($p < 0.05$) difference between oat and other plants that's maybe because of hull acts as a physical barrier duringoat germination and prevents the loss of moisture, lipids, protein, carbohydrates and their seed derivatives.This fact may have positive effects on the activity of enzymes.

Furthermore, the mixture of five cover crops showed the biggest effect on the enzyme activities compared to the other samples. Among the 5 cover crops the mustard (B.c.) has the lowest enzyme activitycomparing of the other crop species. The mustard is the only cover crop plant, which cannot show any symbiotic interrelation with soil-microorganisms, influencing perhaps of the smaller growth.

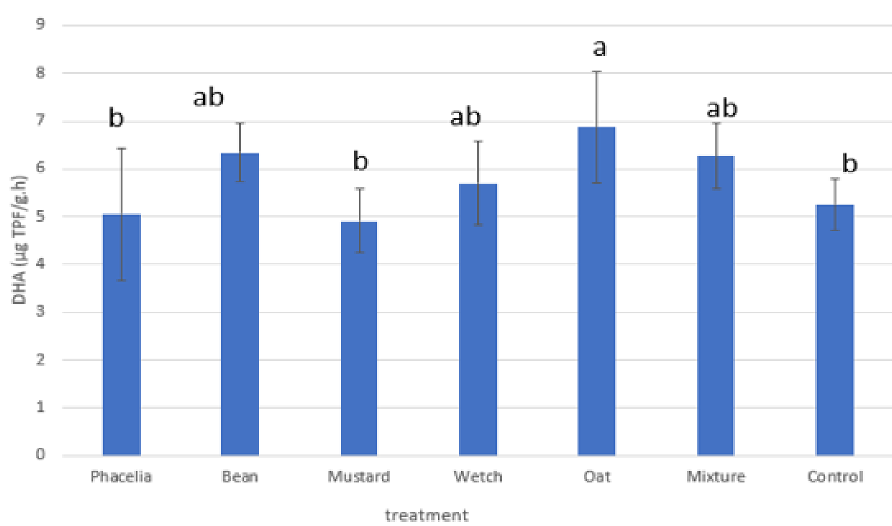

Figure 3. Dehydrogenase activity in the soil samples before the establishment and after the end of the experiment. Error bars indicate standard deviation, n = 3 (ANOVA; $p < 0.05$).
Cover crops: Phacelia-P.t., Bean-V.f., Mustard-B.c., Wetch-V.b., Oat-A.s.

The measured hydrolysis of fluorescein diacetate (FDA) was determined to assess the total microbial activity (Figure 3). FDA value were rather variable character (minimum=2 µg FDA/g.3h; the maximum=3.12) The wetch and mixture has the highest value in comparison to other variants. It is assumed, that the wetch has a strong root system that might contain N2-fixing nodules at an early stage, and those nodules might provide for the plants sufficient nitrogen and it is also can accumulate significant amounts for the following crops. (De Ron 2015). The mustard on the other hand might has the lowest effect on the soil microbial activity. Hydrolysis of fluorescein diacetate (FDA) is performed by a variety of enzymes including esterase, proteases, and lipases. Moreover FDA hydrolysis may be used as an indicator of microbial catabolic activity (Nikaeen et al. 2015).

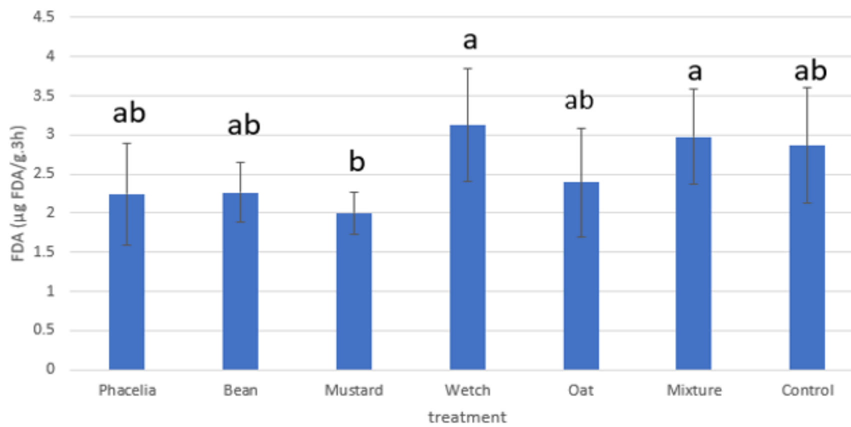

Figure 4. Hydrolysis of fluorescein diacetate (FDA) in the soil samples at finishing of the experiment.
Error bars indicate standard deviation, n = 3 (ANOVA; $p < 0.05$).
Cover crops: Phacelia-P.t., Bean-V.f., Mustard-B.c., Wetch-V.b., Oat-A.s.

As a summary for the two enzyme activity methods the mixture of the five crops showed higher enzyme activities compared to the other samples, cropping that's mean incorporation the cover crops into the field may increase enzyme activities and microbial community in soil and therefore improve soil quality and health. Thus, there may be qualities unique to each cover crop that increases the activity of specific enzymes and play an important role in ecosystem function and cycling of soil nutrition. However, Mustard has low enzyme activity comparing to other cover crops because mustard reduced total porosity of the soil to a higher extent. The porosity of soils is improving in case of a mycorrhiza symbiosis and also the mucigel production of N2-fixing symbiosis. The mustard cover crop cannot show such symbiotic microbes. The legume type of cover crops can better improve of the soil nutrient capacity, affecting as biomass-production and also as providing biological origin of nitrogen and other elements.

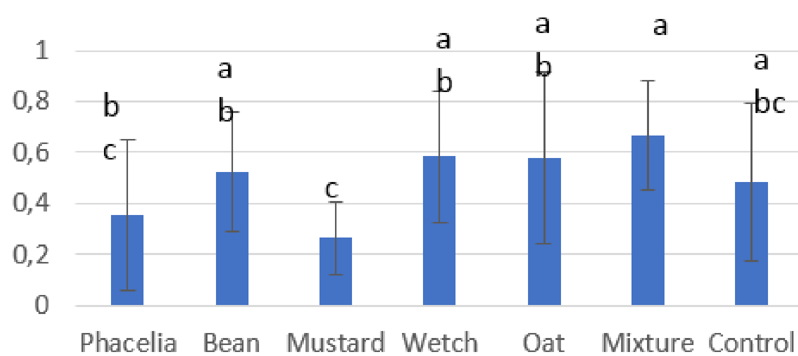

Figure 4. Summarized average result of the soil enzymatic activities, the dehydrogenase (DHA) and the fluorescein diacetate (FDA) of 5 cover crops and its mixture in a pot experiment, compared to non-planted control soils

Electrical conductivity of soils

Electrical conductivity level of soils gives as a potential of measuring the saline content of the soils. It measures the quantity of salts in the soil-plant environment, and it is considered as an indicator of soil

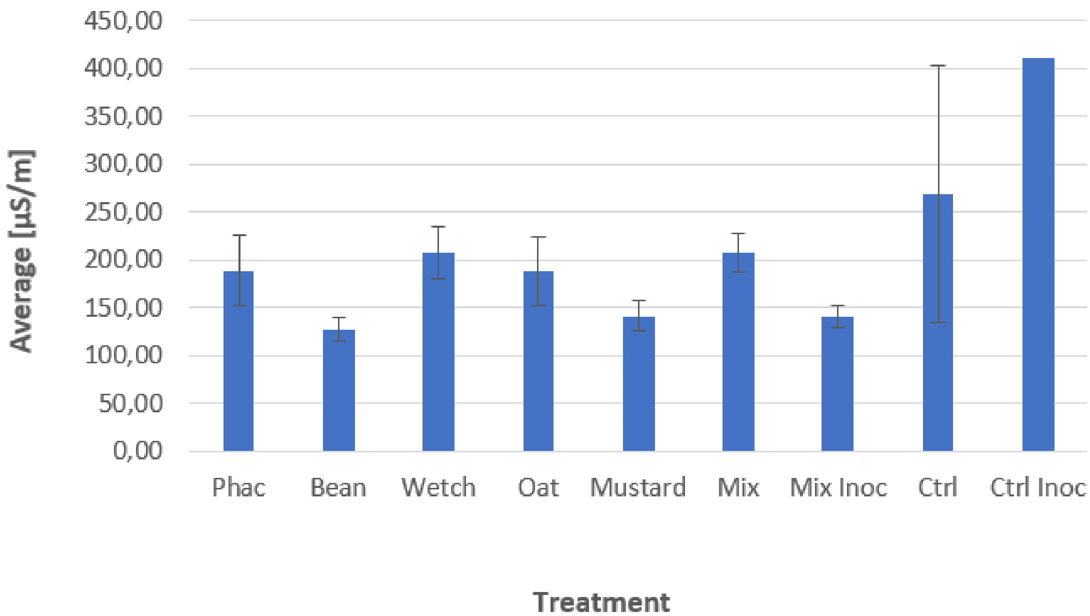

Figure 5. Electrical conductivity (EC) in the soils of 5 cover crops and its mixture in a pot experiment, compared to a non-planted control soil.

Frequency of mycorrhiza (F%):

Mycorrhiza enhance the production of cover crops. Type of Cover crops is the key-important factor in AM fungal colonization. Bean, as double symbionts have the highest mycorrhizal activity, and the mustard, as non-symbionts has 0% of mycorrhiza was good in all CC except the Mustard (0%). The Mustard is a non-symbiotic plant. Wetch is responding positively to AM fungal inoculation.

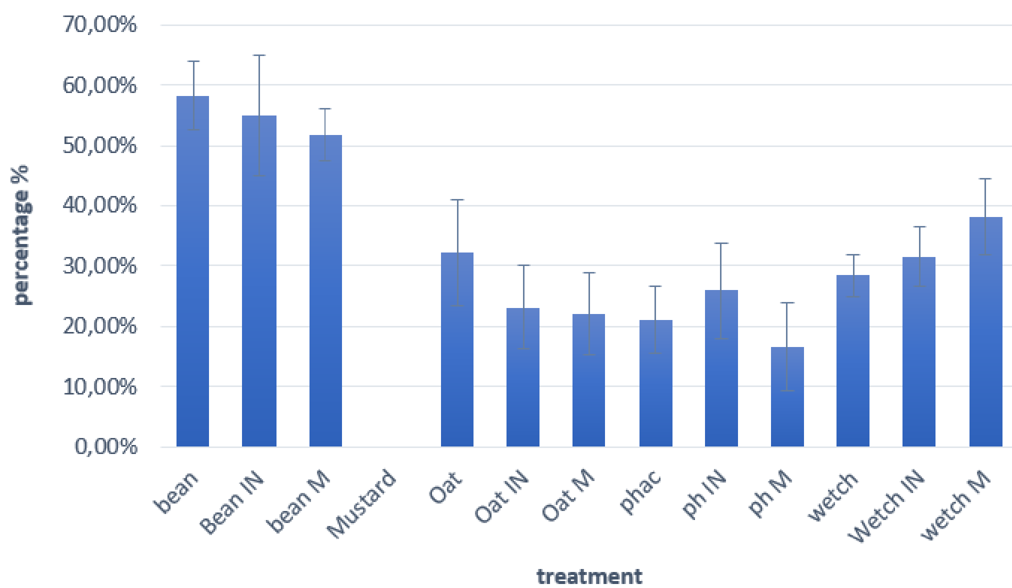

Figure 6. Frequency of mycorrhiza (F%) for the roots of 5 cover crops and its mixture

Glomalin concenteration:

Glomalin is a protein-like substance produced by the AM fungi in the soil-plant ecosystems. The glomalin concentration along with the cover crop can be very important in maintaining the soil quality and the aggregation-stability. It was found in the pot experiment, that the vetch (Vb) has the highest capacity to retain glomalin concentration followed by mustard (Bc) and mixture of the cover crops.

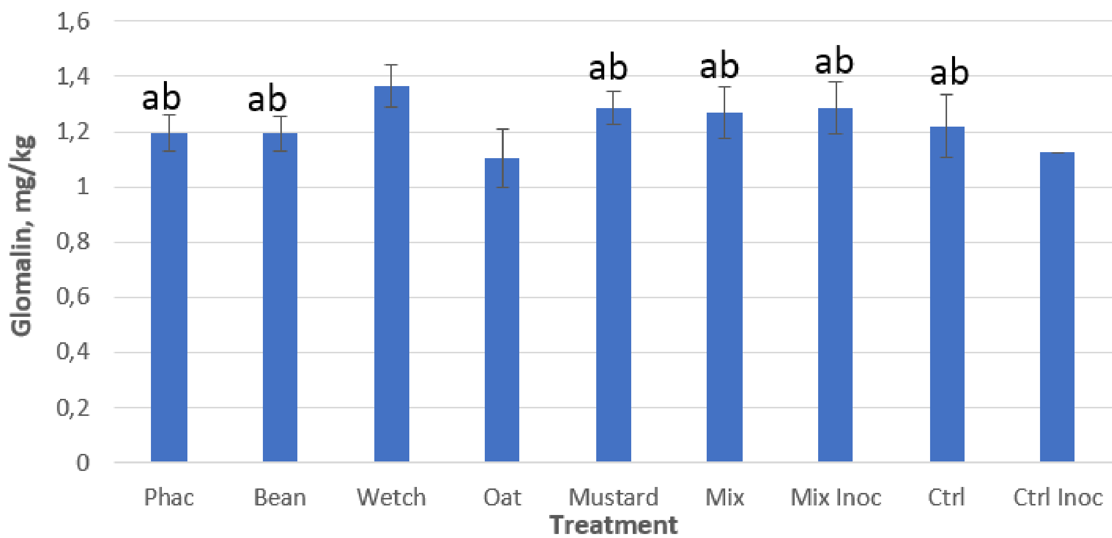

Figure 7. Glomalin content in the soil of 5 cover crops and its mixture in a pot experiment, compared to a non-planted, non-AMF-inoculated control plant.

CONCLUSIONS AND RECOMMENDATIONS

Based on our results cover crops can increase the soil nutrient status by their biomass production. Regarding the soil-biological functioning, the tested enzymes showed also improved activities and this result was also significant at certain cover crops. Legume and mixed cover crops tended to have more biomass production, comparing with the other studied cover crops. Mustard has the lowest enzyme activity, due to the missing symbiotic interrelation.

Total microbial catabolic activity in the soils was measured by monitoring the hydrolysis of fluorescein diacetate (FDA). This enzyme can show a great relation with the degradative capacity of microbial community, the degradation of soil organic matter is one of the main soil quality indicators. So, both the biomass production of cover crops and also the soil enzymatic activities can help to develop a sustainable growth, which is an important aspect, more particularly among organic agricultural productions. Mixed cover crop application can show the best performance of considering those aspects.

Mycorrhiza enhance the production of CC. Type of CC is the key-important factor in AM fungal colonization. Bean, as double symbionts has the highest mycorrhizal activity, and the mustard, as non-symbionts has 0%. Vetch (Vb) has the highest capacity to retain glomalincontent of soil. The new practice in the future needs to focus more efficiently on reducing of Fertilizersand find perfect replacement from the natural sources.

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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'06 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 h 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 (Meehl et al. 2005 & 2007). Urban areas are especially vulnerable to increased rainfall intensities, especially during convective summer storms (Smith et al. 2002; Water et al. 2003; Kundzewicz et al. 2007).

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. The Royal Netherlands Meteorological Institute (KNMI) developed four KNMI'06 climate scenarios that provide information on projected changes indaily precipitation.

These scenarios are based on a large number of 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 (Smith et al. 2002; Ntelekos et al. 2008).

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'06 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'06 scenarios and the ratio of 1 h and daily precipitation. The selection of the KNMI'06 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 Figure 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'06 scenarios with information about hourly precipitation extremes and quantification thereof. Explanatory climate variables that could be linked to the steering parameters in the KNMI'06 scenarios were selected to this end. These variables were then analyzed with hourly and daily precipitation.

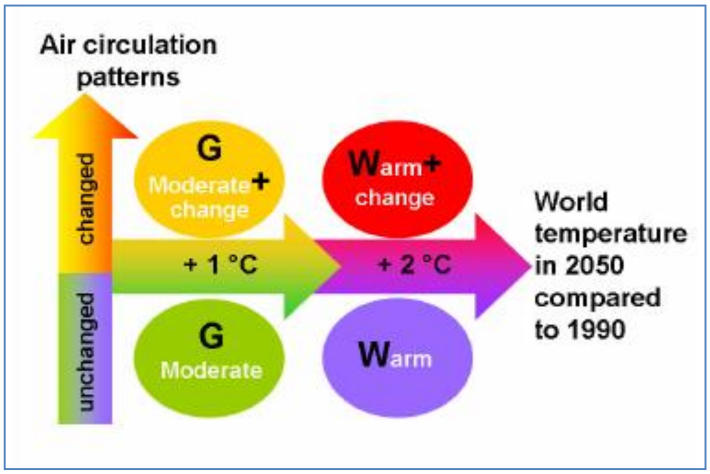

Figure 1. The Four KNMI'06 Climate Scenarios (Royal Netherlands Meteorological Institute, Climate Change Scenarios 2006 for the Netherlands, Scientific Report, WR 2006-01, De Bilt, The Netherlands 2006)

Selection of climate variables

The main variables that, *a priori*, could have an influence on extreme precipitation include:

1. wind (speed, direction) or wind at higher altitudes
2. air temperature
3. humidity
4. air pressure
5. 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 (Phillips and McGregor 2001; Gallego et al. 2005; Mitchell and Phillips 2006). KNMI concluded that wind direction but not wind velocity was an indicator for precipitation (Overeem et al. 2008). Wind direction or, better, geostrophic circulation (wind at higher altitudes) could be an explanatory climate variable linked with differences between the KNMI'06 scenarios. The wind direction at higher altitudes determines from where air masses are transported to The Netherlands, for example fromover 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-westis thought to be an important explanatory variable for precipitation. A data series was compiled based on data from the ERA-40 database (Lenderink and van Meijgaard 2008) 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.

Warm weather has been found to be key for short duration, high intensity rainstorms (Doswell et al. 1996; Chang 1998; Smith et al. 2002). 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'06 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'06 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 willnot 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 25years 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 ofthat order of magnitude (Graf 1977; Smith et al. 2002). 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 (Heijboer and Nellestijn 2002). 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 (Ntelekos et al. 2008) due to the urban heat island and that this effect is also not reflected in the time series of De Bilt.

STATISTICAL ANALYSIS AND GRAPHICAL PRESENTATION

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 on the basis of 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 senseof 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, Figure 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 Figure 2) do indeed occur during warmer temperature days of 20ºC 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 (STOWA 2004). The main focus of this research is extreme precipitation and therefore these months will be analyzed further.

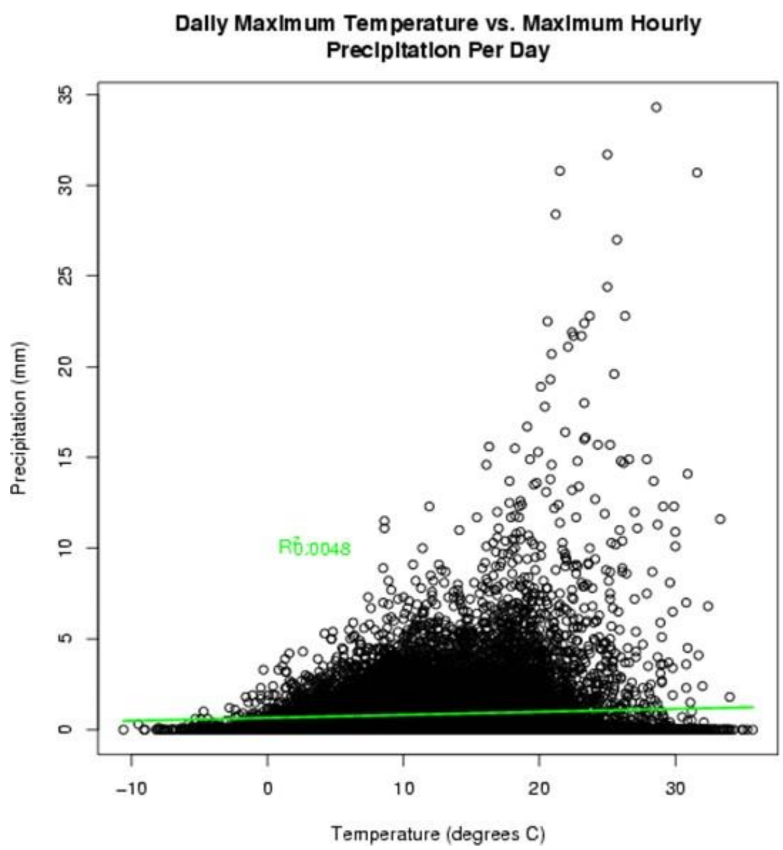

Figure 2. Maximum daily temperature vs. maximum hourly precipitation per day for De Bilt 1958-2006. *Green line* is the linear regression value of 0.0048

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. Figure 3 shows a scatter plot of G-west and daily precipitation for De Bilt during summer months June, July, and August. Figure 4 is a plot of G-west and maximum hourly precipitation per day.

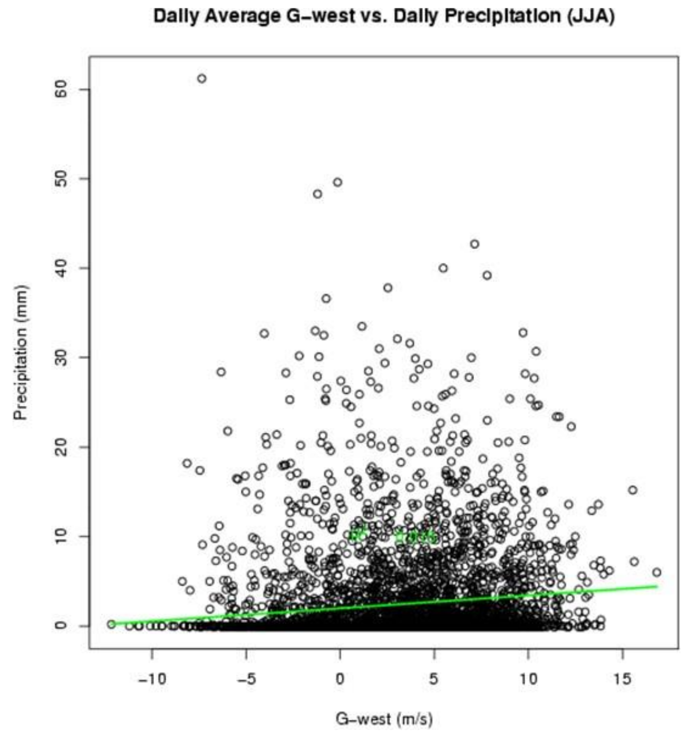

Figure 3. Daily average G-west vs. daily precipitation for summer months (De Bilt 1958-2006). *Green line* is the linear regression with a regression coefficient r^2=0.015

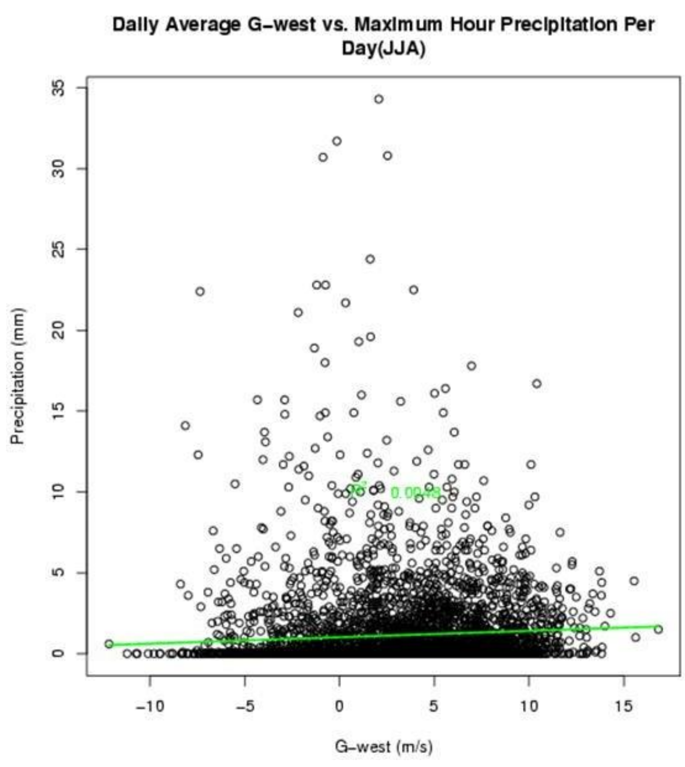

Figure 4. Daily average G-west vs. maximum hourly precipitation per day for summer months (De Bilt 1958-2006). *Green line* is the linear regression value with a regression coefficient r^2=0.0048

Both Figure 3 and Figure 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.

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 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.
Figure 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 Figure 5, lines indicate the percentage of data that are below the line (90% quantiles equals 90% below, 10% above). Figure 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 15ºC and 20ºC, 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.
Figure 7 presents a frequency representation of daily G-west and precipitation (only wet days). Figure 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.

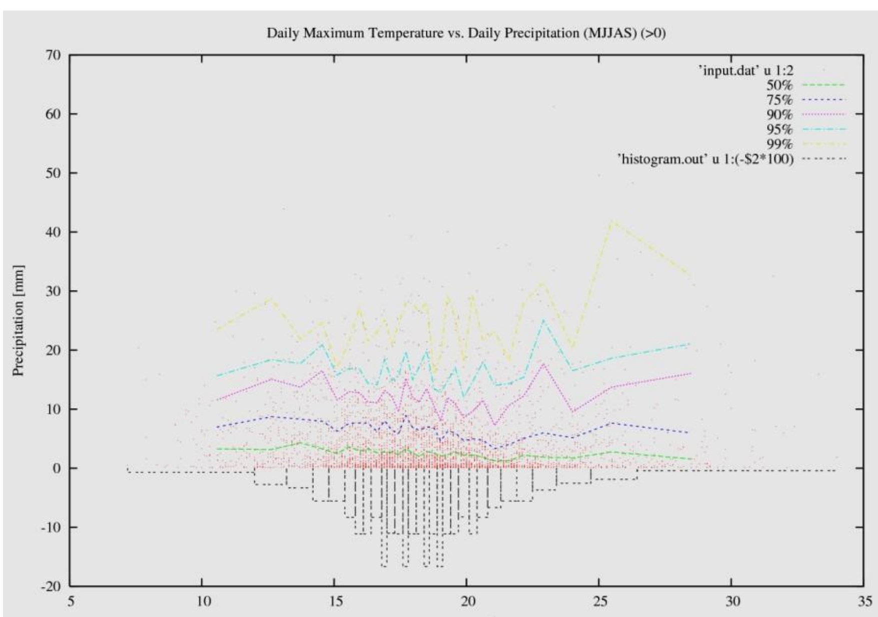

Figure 5. Maximum daily temperature vs. daily precipitation for summer months (May-September)

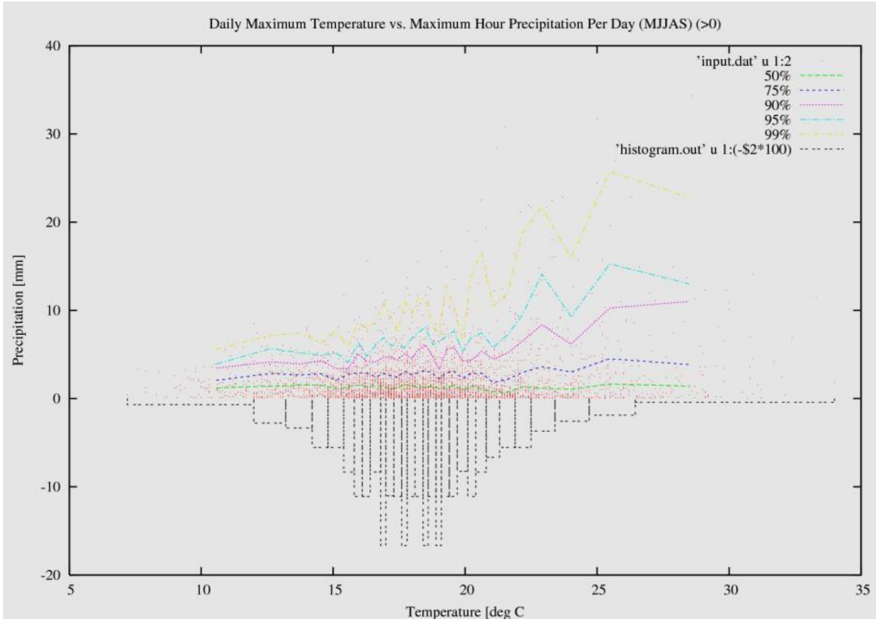

Figure 6. Maximum daily temperature vs. maximum hourly precipitation per day for summer months (May-September)

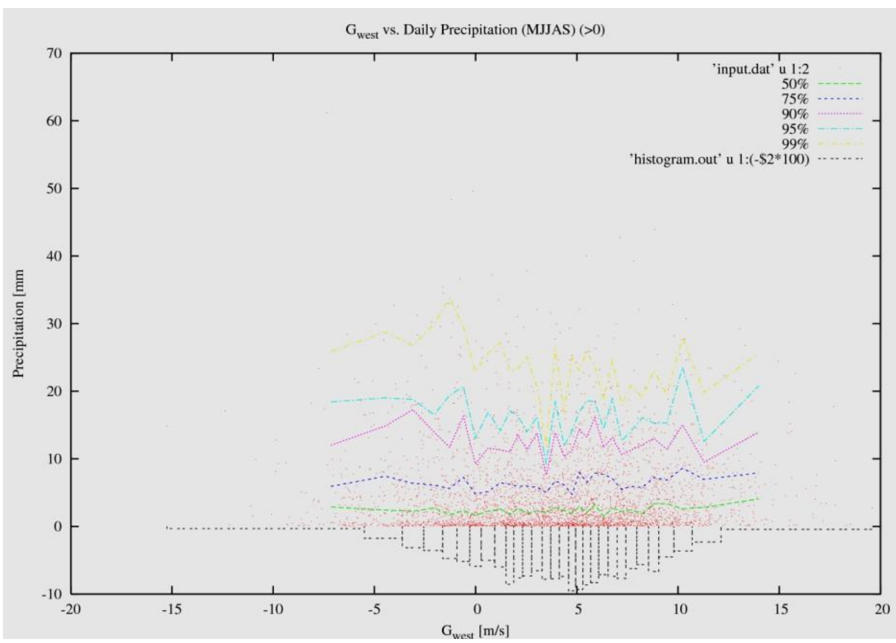

Figure 7. G-west vs. daily precipitation for summer months (May until and including September)

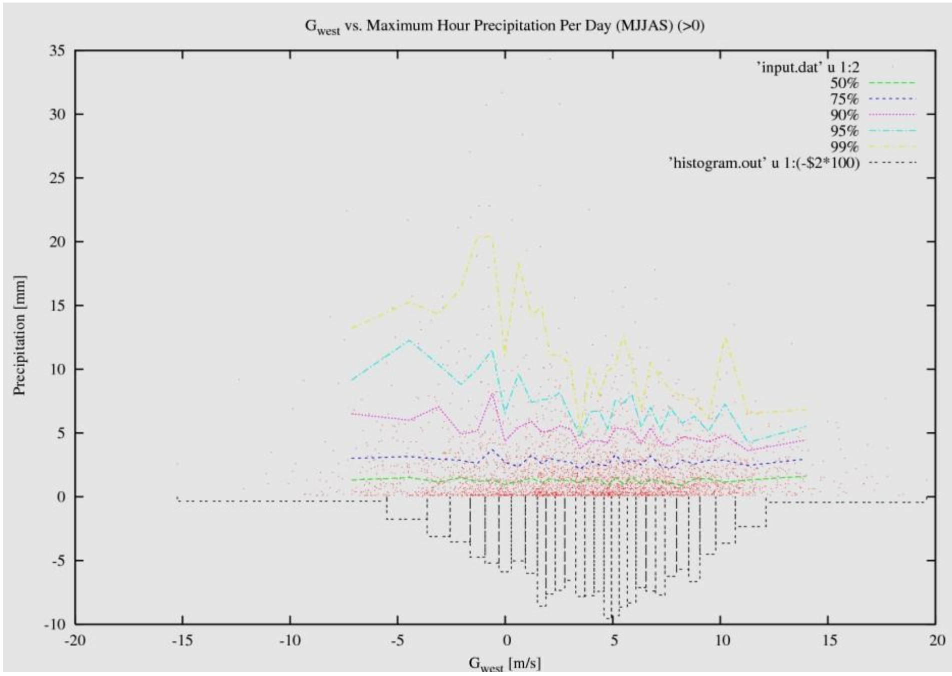

Figure 8. G-west vs. maximum hourly precipitation per day for summer months (May until and including September)

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 Figures 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.
Figure 9 is a plot of the relation between daily and maximum hourly precipitation in relation to maximum daily temperature plotted in Figures 5 and 6. The thin-dashed line is the 95% ratio. This was constructed by dividing the 95% percentile line for daily precipitation (Figure 5) by the 95% percentile line for hourly precipitation (Figure 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 relation with maximum daily temperature and therefore a different relation between daily and hourly precipitation. The linear equation for the bold- dashed line in Figure 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,

$$y_{99} = -0.18x_{99} + 5.78$$

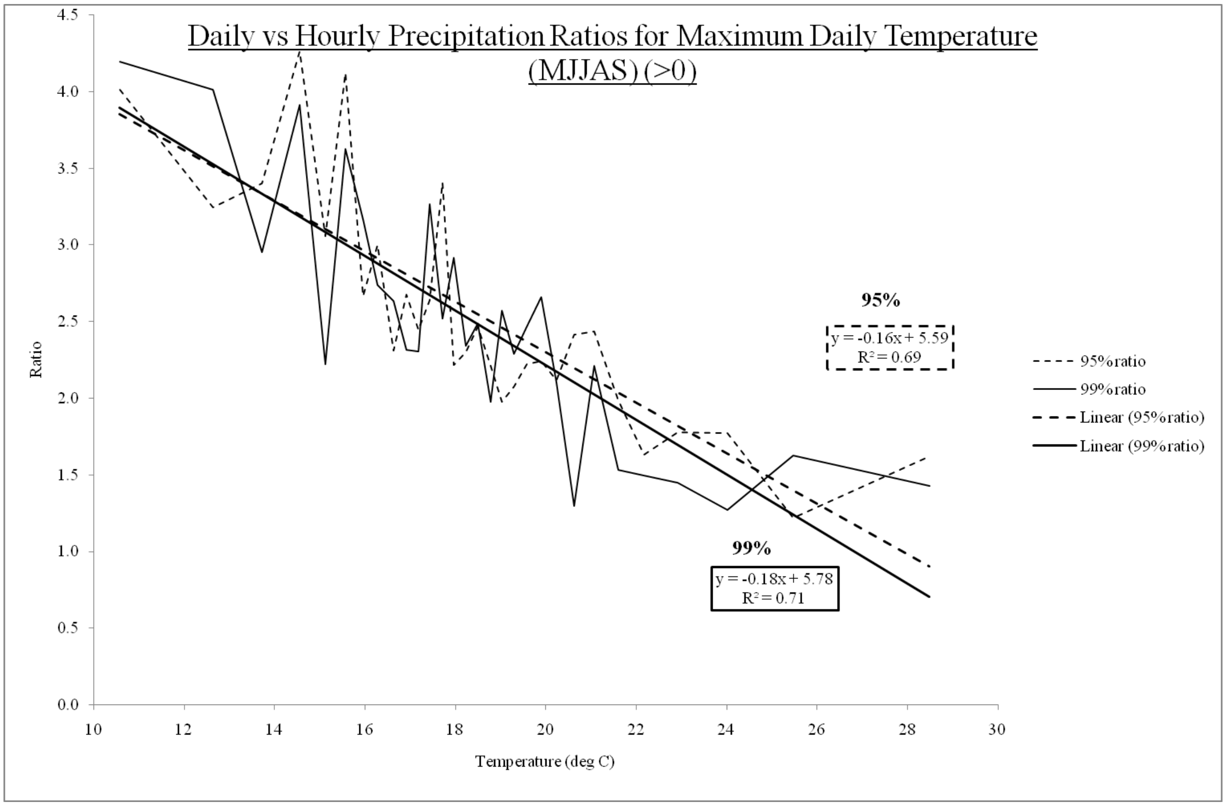

Figure 9. Daily/maximum hourly precipitation ratios in relation to maximum daily temperature for summer months (May-September). The bold-dashed line is the regression value of 0.69. The solid line is the regression value of 0.71

Figure 10 is a similar representation as shown in Figure 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 = G-west in m/s
y=ratio of daily to hourly precipitation

The same was done for the 99% percentile line ratio (solid line);

$$y_{99} = 0.08x_{99} + 1.92$$

Figures 9 and 10 show that the ratios of extreme daily to hourly precipitation for temperature and G-west which 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'06 climate scenarios using projected daily precipitation, G-West, and maximum daily temperature.

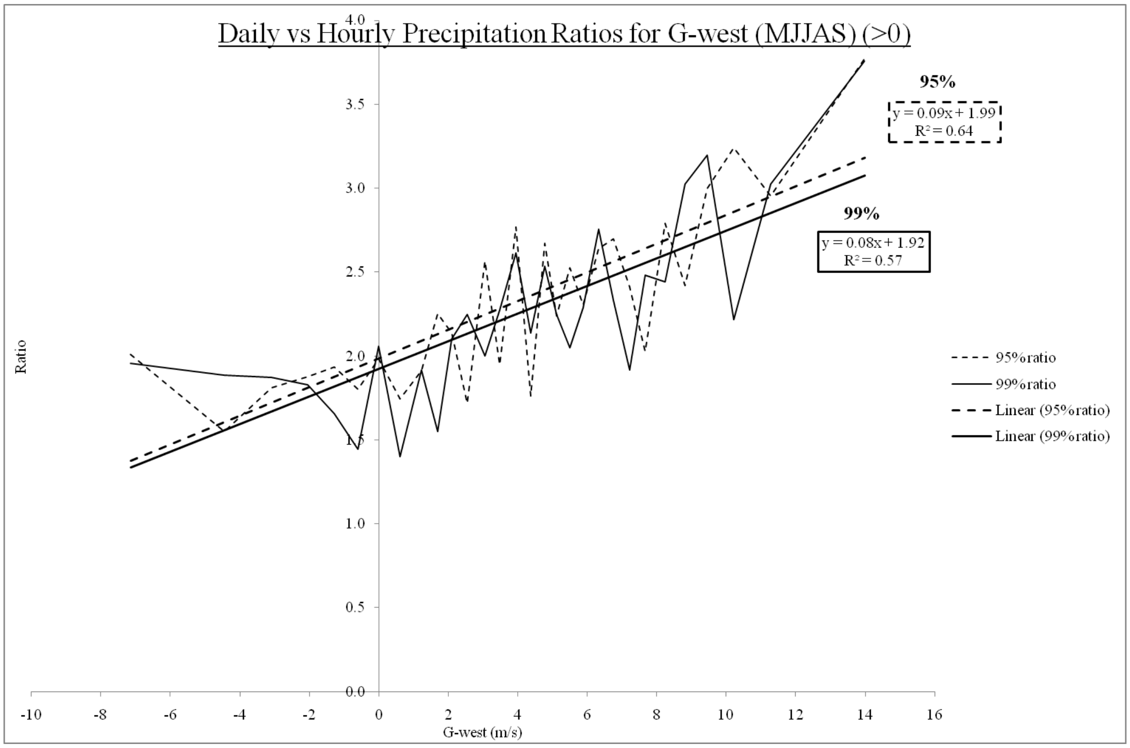

Figure 10. Daily/maximum hourly precipitation ratios in relation to G-west for summer months (May-September). The bold-dashed line is the regression value of 0.64. The solid line is the regression value of 0.57

CONCLUSIONS AND RECOMMENDATIONS

Based on the KNMI'06 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 thispaper

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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IMPACT OF BRASSWARE UTENSILS INDUSTRY ON THE ENVIRONMENT, CONSTANTINE, NORTH-EAST OF ALGERIA

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Abstract: *The traditional industry of brassware utensils localised in Constantine, north-eastern of Algeria. This industry occupies the left bank of the Rummel Valley, a work based on the transformation of copper in sheets into utilitarian or simply decorative items, using chemicals harmful to the environment discharged directly either into the sewerage network or run off on the surface to Oued Rummel, a solid and liquid sample was carried out in order todose the degree of pollution of possible heavy metals. The results of analyses show a high percentage of heavy metal pollutants in solid and liquid samples show a Cu level that varies from 2mg/l to 3 mg/l, chromium Cr reaches 1.07 mg/l, Nickel Ni 0.81 mg/l, Lead Pb 0.13 mg/l, Cadmium Cd 1.1 and Silver Ag 0.21 mg/l .Rates that exceed all standards, Algerian, WHO, AFNOR. The lack of long-term treatment of these discharges will cause pollution of metal elements harmful to groundwater tables and cause a degradation of water resources exploited for irrigation north of the city of Constantine and which partially flow into the Beni Haroun dam that supplies the major cities of northeastern Algeria.*

Keywords: *Traditional industry, copper, impact, heavy metals, pollution, Constantine.*

INTRODUCTION

For a long time, man's interest has been to satisfy his ever-increasing needs in terms of daily life. He has therefore turned to industry, including traditional industry, such as the copper industry (brassware), which dates back to the Middle Ages and focuses a large Turkish inspiration [4]. This traditional copper industry is renowned in Middle Eastern countries such as Syria and the Maghreb in Algeria and Morocco. In Algeria, copper manufacturers are concentrated in the Casbah, Algeria and Bardo Constantine [4], which finances the Algerian East with copper vessels (among the local products, the Mahbès, the Cafatira, the Kirouana, the M'rach and El Kettara) [4]. Despite its success in this area that has experienced great demand in the market recently, it has forgotten one, which is the effect of materials and chemicals used [3], this manufacturing process or process during the refining of copper after the completion of manufacturing that thrown into the water system or directly on the ground, which constitutes a degree of toxicity to the environment and man in the first place [7,5]. In order to help reduce pollution, we conducted a study on copper workers in the city of Bardo in Constantine to know the source and location of liquid and solid polluted discharges, and study their effects on the environment and man. And try to develop solutions and preventive measures to reduce pollution in this city.

Figure 15. Location of the studied area in Constantine’s city).

MATERIALS AND METHODS

For our study, we conducted field studies on the site of Bardo "Constantine", located between latitudes (36°22' and 36°21' North) and longitudes (6°37' and 6°36' East) [1]. Where we collected ten liquid and solid samples at different locations on the left bank of Oued el-Rummel next to the giant bridge "Salah Bey" Bardo site. The coordinates of the sampling points are recorded in a notebook. For solid samples we took by a manual auger and put it in numbered freezer bags and liquid samples were placed in glass bottles 500 ml, then place all samples in coolers with cold blocks. The scientific treatment of solid and liquid samples is done at the research laboratory of the Faculty of Science and Universe University Mentouri Constantine. Where we dried the soil samples in an oven at a temperature of 450 ° C for 24 hours [2 ,8], then we crushed and sieved them, then we carried out The acid attack, and filtering the samples and analysing them as well as the five water samples by atomic absorption spectrometry.

RESULTS AND DISCUSSION

Atomic absorption spectrometry analyses were made for the water samples by the protocol of Rodier [8], to determine the concentration of heavy metals in the five samples. Figure 2 represents the concentration (mg/l) of the elements (Fr, Cu, Cr, Zn, Ni, Cn, Sr, Pb, Cd, As and Ag)

Iron varies between 0.01mg/l and 1.1mg/l the highest value recorded on the basin of the coppersmith's shop and which contain all the chemicals. Copper varies between 0.002mg/l and 2.1mg/l the highest value recorded on the basin of the brassware that exceeded. Chromium varies between 0.87mg/l and 1.07mg/l where we recorded the highest value in the basin of the dinanderie and the upstream of Oued Rummel which is considered as the place of discharge of liquid discharges.

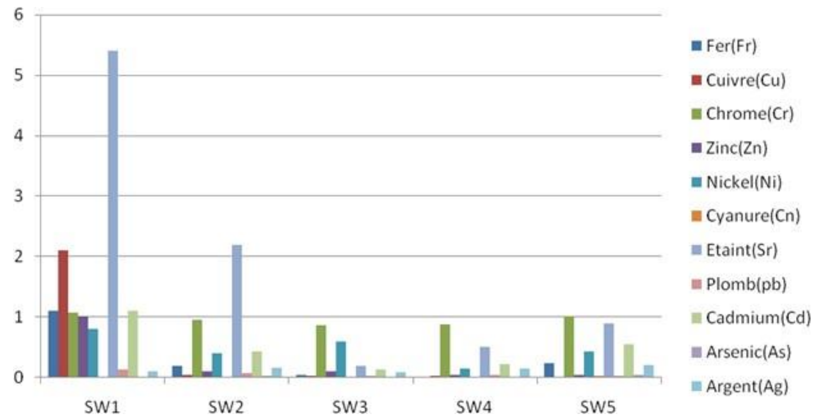

Figure 2: the concentration (mg/l) of heavy metals in the five water samples.

SW1: water sample from the basin of the dinanderie, SW2: sample water from the downstream of Oued Rummel
SW3: sample of spring water on the side of the Oued, SW4: sample water of Bardo sewerage network
SW5: sample water from upstream of Oued Rummel

Zinc ranged between 0.04mg/l and 1.01mg/l, the highest value recorded in the basin of the dinanderie. Nickel varied between 0.15mg/l and 0.81mg/l where we recorded high values in all the samples and exceeded the norms because nickel baths are used in the rinsing stage in *the coppersmith's shop [7,3]*. Cyanide varied between 0.001mg/l and 0.02mg/l and did not exceed the standards. Etait varies between 0.2mg/l and 5.4mg/l the highest value recorded on the basin of the copper mill. Etait is not a guide value in the standards: not very toxic. The lead varied between 0.03mg/l and 0.13 where we recorded high values in all the samples because there is a workshop to repair the car radiators with lead in the brassware of Bardo. Cadmium varies between 0.13mg/l and 1.1mg/l where we recorded high values in all samples. Arsenic varies between 0.01mg/l and 0.045mg/l the highest values recorded on the upstream, downstream of Oued Rummel and spring water. Silver the highest values recorded on the upstream, the downstream of Oued Rummel, and the basin of the dinanderie and the water of the sewerage network of Bardo. The Cu, Cr, Ni, Pb, Cd, As and Ag exceed the Algerian standards and the WHO standards (Table 1), on the other hand Zn and Cn do not exceed the standards (Table 1). Atomic absorption spectrometry analyses were performed on the soil samples using the Rodier [8] protocol, to determine the concentration of heavy metals in the five samples. Figure 3 represents the concentration (mg/l) of the elements (Fr, Cu, Cr, Zn, Ni,Cn, Sr, Pb, Cd, As and Ag)

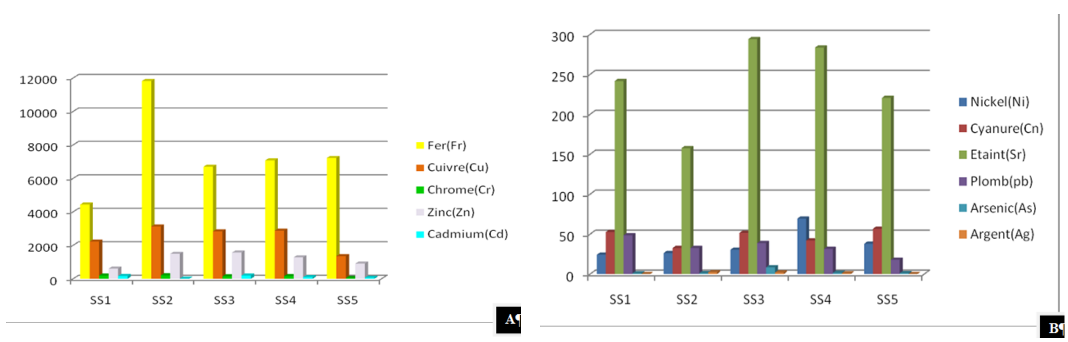

Figure 3. The concentration (mg/l) of heavy metals in the five soil samples. A/concentration of elements (Fr, Cu, Cr, Zn, Cd).B/concentration of elements (Ni, Cn, Sr, Pb, As, Ag)

ES1: soil sample from the entrance of Bardo Garden, ES2: soil sample from downstream of Rummel Oued
ES3: soil sample next to Salah Bey bridge, ES4: soil sample from upstream of Oued Rummel
ES5: soil sample next to waste water drains of Bardo

Iron varies between 4440mg/kg and 11825mg/kg the highest value recorded downstream of Oued Rummel. Copper varies between 1355mg/kg and 3125mg/kg where we recorded high values in all the samples 30 times the norm of AFNOR because in the process of cutting copper, the copper particles fall directly to the ground.

Chromium varies between 53.55mg/kg and 210mg/kg where we recorded high values in all samples .Zinc varies between 610mg/kg and 1570mg/kg the highest value recorded at the upstream of Oued Rummel .Nickel varies between 24.15mg/kg and 69. 3mg/kg the highest value recorded in the upstream of Oued Rummel .cadmium varies between 10.5mg/kg and 199.5mg/l where we recorded high values in all samples.(fig3) .Cu, Cr, Zn, Ni, Cd and Pb exceed the norms of AFNOR in all samples.(Table1)

Table 1: Standards of heavy metals in water and soil [6,9]

Heavy metals	Zn	Fr	Cu	Cr	Ni	Cn	Pb	Cd	Ag	Ar
Les normes algériennes (mg/l)	5	0.02	2	0.05	0.07	0.07	0.01	0.03	0.1	0.01
Les normes d'OMS (mg/l)	3	/	2	0.05	/	0.07	0.01	0.03	0.05	0.01
Les normes d'AFNOR (mg/kg)	300		100	30	50	/	100	10	/	/

CONCLUSIONS AND RECOMMENDATIONS

The current situation of the copper smelter Bardo "Constantine" is remarkable, because, metal pollutants found with high concentrations of Cu, Cr, Ni, Pb, Cd, As and Ag in the water that is discharged into Oued Rummel which is used for irrigation in some areas, and discharges into the dam Beni Haroun,it constitutes a threat to the environment and human health [10]. The industrial discharges have a polluting effect on the groundwater and contribute to the degradation of water resources in the region, we recorded high values of Cr, Ni, Cd, Pd in the spring water. We found very high values of Cu, Cr, Zn, Ni, Cd and Pb in the soil. For this reason, the Ministry of Environment and the State must find solutions to reduce pollution, whether by sensitising workers at the coppersmith's shop not to throw directly the liquid or solid discharges into the soil or watercourses and the need to install a filtration station and control the liquid discharges.

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A NOVEL-TYPE ANALYTICAL SOLUTION OF THE PROBLEM OF SIMULTANEOUS CONVECTION AND MULTI COMPONENT DIFFUSION PROCESS THROUGH POROUS MEDIA

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Abstract: *A novel-type analytical solution is proposed for simultaneous convection-diffusion processes taking place through porous media. It is shown, that the Riccati-type ordinary differential equation, frequently applied at modelling of such processes, may be interpreted in a more general manner, as it has been done. For simultaneous convection and diffusion of multi-component, chemically interacting materials, a completely new modelling type approach is proposed and described in the present work. Then, the integration factor function method is applied, and completely novel-type formulae are derived for solving of the adequate types of the Riccati’s ordinary differential equation. Finally, the new analytical results are compared to the earlier analytical solutions and their relevance for accurate future modelling of such types of drying processes is also discussed concisely.*

Keywords *Fractional-order derivatives, Percolative-fractal processes, Riccati-type ordinary differentialequations, Simultaneous convection and diffusion*

INTRODUCTION

It is known, that in the contemporary theories of coupled transport phenomena through porous media methods of both non-equilibrium thermodynamics [1] and many ones from the confident, well-established results of the contemporary theories of critical phenomena relevant for percolative systems [2],[3],[4] should simultaneously be taken into account. Although many of these methods have also been applied in the contemporary modelling and simulation of drying processes, there are further possibilities for their common new applications, to which our work is devoted, too.

The mathematical modelling of convection-diffusion processes is of importance from the points of view of both fundamental research and solving of engineering problems, whose complexity is frequently manifested by the nonlinear character of the ordinary differential equations (ODEs) and partial differential equations (PDEs) to be solved during the modelling procedure. The basic PDE for the convection-diffusion problems is [5]:

The mathematical modelling of convection-diffusion processes is of importance from the points of view of both fundamental researches and solving of engineering problems, whose complexity is frequently manifested by the nonlinear character of the ordinary differential equations (ODEs) and partial differential equations (PDEs) to be solved during the modelling procedure. The basic PDE for the convection-diffusion problems is [5]:

$$\frac{\partial c}{\partial t}-\nabla\left(D(c)\nabla c\right)+\frac{dK}{dc}\cdot\frac{\partial c}{\partial z}=0, \tag{1}$$

where c(r,t) denotes the concentration distribution function to be determined, D(c,T) is the (usually:) thermodynamically state-dependent diffusion coefficient, K(c) is the concentration-dependent hydraulic conductivity coefficient and z-axis corresponds to the direction of the gravitational acceleration. The general solution of the basic problem for a large class of convection - type transport processes through porous media can be suitably explained in the following finite sum form [6],[7]:

$$\begin{gathered} c(\zeta)=a_0+\sum_{i=1}^{q}\left(a_i\cdot\omega^i+b_i\cdot\omega^{-i}\right), \\ a_0, a_i, b_i=\text{const.},\left(1\le i\le q\right), q\in\mathbb{N} \end{gathered} \tag{2}$$

and it is explained by use of D'Alembert-type independent variables ζ instead of simple spatial coordinates. (This variable is defined as $\zeta := x - v\cdot t$, with a constant value "v" of the convection flow velocity). The physical meaning of the formula (2) is, that it gives analytical solution of the basic convection-diffusion equation (1) in the form of multiple travelling waves. It is a very important for the solution formula (2), that some very different types of effects (e.g. dispersion, dissipation and nonlinearities of various types of origin), which all may change forms of the multiple wave forms being discussed have to be balanced out. Furthermore, the functions of the separate modes entering the general solution (2), must obey the following Riccati-type ODE:

$$\frac{d\omega}{d\zeta}=\omega^2+k, \tag{3}$$

with "k" as a parameter depending on the "actual experimental conditions" [6]. The solutions of this basic convection-diffusion problem may be even of solitonic type. For our present study, it is of crucial importance, that we are always faced with applications of the Riccati's ODE. In order to realize our modelling work, we specify the eq. (3) as follows:

$$\begin{gathered} \omega'=\omega^2+k\rightarrow\omega'=\omega^2+\sum_m a_m(p)\,\zeta^m, \\ \left(\omega'\equiv\frac{d\omega}{d\zeta}\right) \end{gathered} \tag{4}$$

i.e. the constant coefficient "k" originally used in [6] has been replaced here by a series $\sum_m a_m(p)\cdot\zeta^m$, where the series expansion coefficients are assumed to be of stochastic character, due to the genuine percolative-fractal character of the dried bulk porous material to be observed at mesoscopic level.

MATERIALS AND METHODS

Following the general modelling concept described previously, in the present section we will justify concisely the most essential mathematical features of the modelling methods to be applied, following mainly the technique discussed in detail in our own earlier study [7]. Accordingly, as an essential new feature of technique initiated by us (which is nevertheless of very simplifying character), we would like to point out here, that firstly, the following reduced form of (4) will be applied:

$$\frac{d\omega}{d\zeta} - \omega^2 - a_n(p) \cdot \zeta^n = 0, \tag{5}$$

i.e. only the "dominant convective term" has been selected in the ODE (4), characterized by the expression $a_n(p) \cdot \zeta^n$. Then, after linearizing this last ODE (5), we got a second-order ODE expressed by

$$\frac{d^2\omega}{d\zeta^2} - a_n(p) \cdot \zeta^n \cdot \omega(\zeta) = 0. \tag{6}$$

The solution of this types of ODEs can be expressed in a closed form by use of Bessel-functions of the first-, and second kind, respectively, as (for the sake of generality, the dependent variable change notation $\omega(\zeta) \mapsto y(\zeta)$ has also been applied here):

$$\begin{aligned} y(\zeta) &= C_1\sqrt{\zeta} \cdot J_{\frac{1}{n+2}}\left(\frac{2\sqrt{-a_n(p)} \cdot \zeta^{\frac{n}{2}+1}}{n+2}\right) + \\ &+ C_2\sqrt{\zeta} \cdot N_{\frac{1}{n+2}}\left(\frac{2\sqrt{-a_n(p)}\zeta^{\frac{n}{2}+1}}{n+2}\right), \\ & C_1, C_2 = \text{const.}, \end{aligned} \tag{7}$$

i.e. the final result is explained by Bessel-functions, which are of different kind, but of the same order (1/(n+2)). The graphical representation of this solution function is given (in relative units) on the next figure.

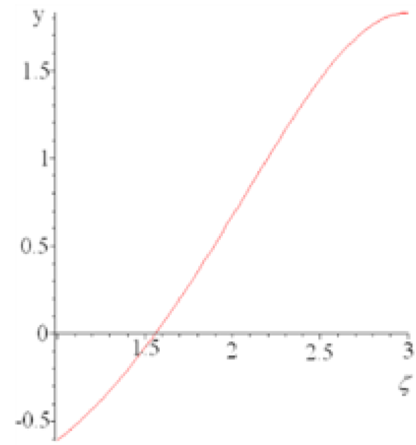

Figure (1) Graphical presentation of solution of the ODE (5) after linearization

Then, by taking into account the genuine very dissipative character of different types of convection-diffusion processes through porous media ranging from sub-, to superdiffusion type [8-9], a further, physically justified modification of the above proposed general solution must also be mentioned here. Namely, at a complete treatment of dispersion phenomena, the basic solution of the simultaneous convection-diffusion-type transfer processes through porous media in form of travelling waves, supplementary time-dependent factor functions imposed on each mode from (2), and ensuring decaying character of the amplitudes of such waves must also be taken into account [10].

Although the solution (7) represents a refined variant of the direct "tanh-function type solution" proposed initially by Fan, the method (explained essentially by the ODEs (4) and (5)) leading to it, will be improved in a slightly different way.

Namely, despite of the fact, that we have obtained solution of the problem we are investigating in a closed, analytical form, it is necessary to extend the calculation method applied, in order to open possibility for including further terms (in the sense of the eq. (4)) beyond the "dominant term" into the general modelling procedure we are developing, i.e. by

$$\frac{d^2\omega}{d\zeta^2} - a_n(p)\cdot\zeta^n\cdot\omega(\zeta) = a_r(p)\cdot\zeta^r. \tag{8}$$

Therefore, having solved the "basic homogeneous problem" (6), we may directly apply the well-known basic general formula (based on the classical Lagrange's method of variation of constants) for solution of the relevant inhomogeneous second-order ODE (6), and by this way (using the MAPLE computer algebra system [11]) we have also derived the following general solution formula:

$$
\begin{aligned}
\omega(\zeta) &= C_1\sqrt{\zeta}\cdot J_{\frac{1}{n+2}}(\xi)+C_2\sqrt{\zeta}\cdot N_{\frac{1}{n+2}}(\xi)+\\
&+\zeta^{\frac{1}{2}}\cdot J_{\frac{1}{n+2}}(\xi)\times\int\frac{(-1)\cdot a_r(p)\cdot\zeta^r\cdot N_{\frac{1}{n+2}}(\xi)d\zeta}{J_{\frac{1}{n+2}}(\xi)\left[\zeta^{\frac{1}{2}}N_{\frac{1}{n+2}}(\xi)\right]'-N_{\frac{1}{n+2}}(\xi)\left[\zeta^{\frac{1}{2}}J_{\frac{1}{n+2}}(\xi)\right]'}\\
&+\zeta^{\frac{1}{2}}\cdot N_{\frac{1}{n+2}}(\xi)\times\int\frac{a_r(p)\cdot\zeta^r\cdot J_{\frac{1}{n+2}}(\xi)d\zeta}{J_{\frac{1}{n+2}}(\xi)\left[\zeta^{\frac{1}{2}}N_{\frac{1}{2}}(\xi)\right]'-N_{\frac{1}{n+2}}(\xi)\left[\zeta^{\frac{1}{2}}J(\xi)\right]'},
\end{aligned}
\tag{9}
$$

where again, the independent variable defined by $\xi:=\dfrac{2\sqrt{-a_n(p)}}{(n+2)\cdot\zeta^{-\left(\frac{n}{2}+1\right)}}$ has been introduced and applied.

Then, the whole procedure applied here may be continued (and therefore: algorithmized in a suitable manner) by using gradually further terms from (4), having « less-dominant » character compared to the previously included ones.

One concrete explicit solution form corresponding to the subdiffusion limit situation ([1],[2]) is the following one. Accordingly, by direct use of the MAPLE computer algebra system, we arrive at (the exact meaning all of the coefficients in it, is also specified in the basic reference works [1],[2] we have mentioned):

$$
\begin{aligned}
&\frac{A^2(3-q)(q-2)}{B\cdot\left(A^2\right)^{1/(q-2)}}\cdot c_{SubDiff}(x,t)=\\
&=-3\cdot t^{-1/q}\cdot F\left(\left[\frac{1}{2},-\frac{1}{q-2}\right],\left[\frac{3}{2}\right],\frac{t^{-2/q}\cdot x^2}{A^2}\right)A^2q^2+\\
&+2\cdot t^{-3/2}x^2q\cdot F\left(\left[\frac{q-3}{q-2},\frac{3}{2}\right],\left[\frac{5}{2}\right],\frac{t^{-2/q}\cdot x^2}{A^2}\right)+\\
&+6v\cdot t^{\frac{q-3}{q}}xq\cdot F\left(\left[\frac{3-q}{2},\frac{q-3}{q-2}\right],\left[\frac{5-q}{2}\right],\frac{t^{-2/q}\cdot x^2}{A^2}\right)\\
&+15\cdot t^{-1/q}\cdot F\left(\left[\frac{1}{2},-\frac{1}{q-2}\right],\left[\frac{3}{2}\right],\frac{t^{-2/q}\cdot x^2}{A^2}\right)A^2q+\\
&-6\cdot t^{-3/q}x^2\cdot F\left(\left[\frac{q-3}{q-2},\frac{3}{2}\right],\left[\frac{5}{2}\right],\frac{t^{-2/q}\cdot x^2}{A^2}\right)+\\
&-18\cdot t^{-1/q}\cdot F\left(\left[\frac{1}{2},-\frac{1}{q-2}\right],\left[\frac{3}{2}\right],\frac{t^{-2/q}\cdot x^2}{A^2}\right).
\end{aligned}
$$

RESULTS AND DISCUSSION

The spreading out of the basic solution curve (i. e. dispersion) in the form of travelling waves can be assigned to the convection-diffusion equation, which is in the present study applied by stochastic change of the dominant convective term figuring in it. This procedure may also be directly generalized to the case of simultaneous convection and diffusion of several components, and the well-known Lagrangian representation of continuum mechanics has proven to be suitable from this point of view. Having discussed the essential basic general features of the simultaneous convection-diffusion processes taking place through porous media, we came to position for applying of the Riccati's ordinary differential equation in a novel manner, which method is suitable for modelling of this basic problem of drying processes under very different types of outer conditions. This modelling result, as well as another recent one [12], emanating from an attempt of introducing of the most essential thermodynamic features of the anomalous diffusion-type transfer processes (which represent a macroscopic manifestation of the genuine percolative-fractal character of the porous materials to be dried at mesoscopic level) into the recent drying theoretical formalisms.

CONCLUSIONS

In the present study a novel-type general method has been described for modelling of simultaneous convection-diffusion processes taking place in bulk porous media. The relevance of the Riccati-type ordinary differential equation is accepted as a crucial mathematical background necessary for modelling of such types of transport processes. According to this novel-type algorithm for accurate modelling of the simultaneous convection-diffusion processes through bulk porous media, the possible problems appearing because of the inclusion of more than the first dominant convective term into the linearized Riccati's ordinary differential equation is also eliminated.

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IMMOBILIZATION AND CHARACTERIZATION OF WATER-INSOLUBLE FE COMPLEXES AS MOLECULAR CATALYSTS FOR WATER OXIDATION

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Abstract: *The apparent difference between the expanding consumption of fossil fuels and chemicals and the limited amount of resources has motivated many researchers to seek solutions for maintaining the sustainability of our community. Artificial photosynthesis (AP), which utilizes sunlight to produce high-value chemicals, including H_2 from abundant resources, is regarded as the most encouraging and viable method. Modern AP systems necessitate in the first place to develop inexpensive, highly active, and stable catalysts for hydrogen production (Hydrogen Evolving Reaction, HER) and water oxidation (Oxygen Evolving Reaction, OER), both are a crucial challenge. However, prior to implementing any artificial systems on water-splitting catalysts that generate oxygen from water without extreme driving potentials are demanded. Many recent studies concentrate on molecular systems based on the highly abundant first-row transition metals (TMs) proper as water oxidation catalysts (WOCs) due to their structural versatility, transparent catalytic mechanisms, and ultimate atomic efficiency concerning catalytic centers. Herein, we report Fe-based compounds among these TMs as efficient electrocatalysts for OER. In this context, we studied the electrochemical behaviour of water-insoluble Fe complexes in homogeneous water/organic mixtures to reveal their intrinsic molecular properties. The water-insolubility of the selected Fe complexes allowed for simple immobilization methods (dip-coating and drop-casting) on model semiconductors. Ultimately, electrodeposition has been explored to reduce to a minimum amount of the complex required for long-term operando stability. The consequence of these studies is that water-insolubility presents a viable strategy for designing new molecular catalyst/(photo)anode hybrids.*

Keywords: *Artificial photosynthesis; water oxidation; molecular precursor; iron complex; immobilization; Electrodeposition*

INTRODUCTION

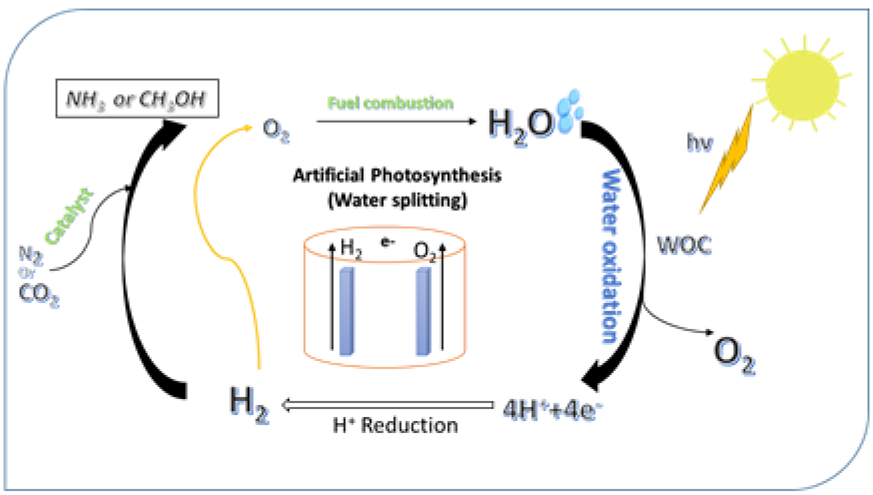
Fossil fuels are essential to match our daily energy consumption demands due to their ready availability, suitable energy density, and ease of handling, storage, and distribution [1]. The combustion of fossil fuels has fundamental adverse effects on the global climate, which is acknowledged as the primary contributor to global warming. Increasing carbon dioxide (CO_2) emissions to the atmosphere from various fuel types and immoderate emissions of exhaust gases have constituted a severe problem in many countries, affecting human health [2], [3]. Therefore, a clean, abundant, sustainable, and safe energy source is the real challenge for establishing an economy in continuous development. Artificial photosynthesis (AP), aiming to catch the sunlight, has the potential of producing clean, sustainable, and large-scale energy resources through water splitting and generating hydrogen gas as a renewable chemical fuel [4]. Water splitting by using AP attracted distinguished attention from researchers, and it is considered the most encouraging method for producing hydrogen (H_2) as fuel and oxygen (O_2) as a side-product [5]. Hydrogen gas is a potential fuel for the future because of its suitable energy density, carbon-free combustion (or use in fuel cells) that is important to protect our community.

Considering the model below (Scheme 1, Eqs. 1-3), splitting two water molecules to produce H_2 as a clean energy carrier (Eq. 1) results from two coupled half-reactions. The first half-reaction, the Oxygen Evolving Reaction (OER) (Eq. 2), is generally considered the overall system's bottleneck due to its sluggish kinetics that results from the complicated transfer of four electrons and four protons. The second half-reaction that demands much lower kinetic overpotential is the reduction of the protons to molecularH_2 using the released electrons (Eq. 3) [6].

$$2H_2O_{(l)} \rightarrow O_{2(g)} + 2H_{2(g)} \quad (1)$$

$$2H_2O_{(l)} \rightarrow O_{2(g)} + 4e^- + 4H^+_{(aq)};\ E^o = +1.23\ V\ vs\ NHE\ (2)$$

$$2H^+_{(aq)} + 4e^- \rightarrow H_{2(g)};\ E^o = 0\ V\ vs\ NHE\ (3)$$



Scheme 1. The general concept of artificial photosynthesis

Water oxidation catalysts (WOC) are intended to improve the OER's efficiency, thus aiding solar-to-chemical energy conversion as in the artificial photosynthesis concept [7]. The fundamental challenge is the rational design and development of catalysts for each reaction and creating a device proficient at completing the whole water splitting process. Efforts have resulted in promising findings by applying different first-row transition metal-based electrocatalysts that can help develop catalysts suitable forindustrial and practical applications to replace noble metal-based materials.

Recently, extensive efforts have been made to develop efficient WOCs composed of more abundant metals, such as manganese [7], [8], iron [9],[11], cobalt [12], [13], nickel [14], [15], and copper [16], [17] that have received significant attention. Iron earned distinguished attention among these metals since thisis the 4th most abundant element on Earth and an environmentally friendly metal. Molecular catalysts are promising compounds for water oxidation due to their well-defined active site structures and ease of mechanistic investigation [18]. As a recent example, mono- and binuclear iron corroles successfully immobilized in Nafion films were published to act as efficient electrochemical WOCs [19]. Fe^{III}-TAML (TAML = tetraamido macrocyclic ligands) complexes immobilized on carbon black/Nafion carbon-based electrodes have been published as effective electrocatalysts; their performance strongly depends on the ligand structure [20]. However, simple immobilization of molecular catalysts on the surface of electrodes is still a great challenge for many compounds. Consequently, we concentrated on molecular complexes that seemed suitable for simple grafting, and the selected Fe-based compounds have been tested as immobilized electrocatalysts for OER. In this perspective, we summarize our results on the electrochemical characterization of water-insoluble Fe complexes with (**a**) non-symmetric, readily available bidentate ligands, i.e., 2-(2'- pyridyl)benzimidazole (PBI) in $[Fe(PBI)_3](OTf)_2$ (**1**, OTf- = trifluoromethyl sulfonate anion), 2-(2'- pyridyl)benzoxazole (PBO) in [Fe(PBO)2(OTf)2] (**2**) [21],and (**b**) pincer ligands like in the $[Fe^{III}Cl_2$(tia-BAI)] complex (**3**, where tia-BAI$^-$ = 1,3-*bis*(2'-thiazolylimino)isoindolinate(−)) [22](Fig. 1). Importantly, we discuss some simple immobilization methods (dip-coating and drop-casting, Fig. 2, method A-C) on model semiconductors.

We demonstrated with the $[Fe^{III}Cl_2$(btia-BAI)] complex (**4**, btia-BAI− = 1,3-bis(2'-benzothiazolylimino)isoindolinate (−)) [23] the effectiveness of electrodeposition (ED) (Fig. 2 , method D) to fabricate catalytically active layers helped by the controlled solubility of complex 4 in the obligate solvent mixtures. Ultimately, electrodeposition proved to be suitable for reducing the complex's amount to a minimum needed for the long-term stability of the produced catalytic layer. The critical result of these comparisons is that water-insolubility offers a viable strategy for designing new molecular catalyst/(photo)anode hybrids.

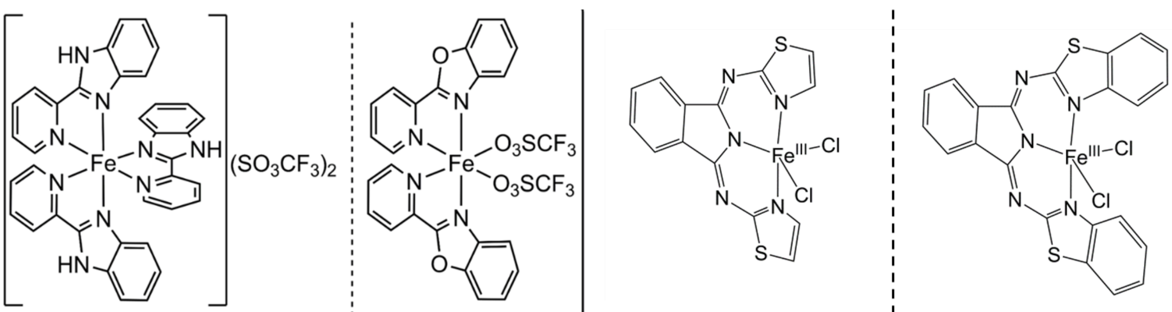


Figure 1. Molecular structure of the precursor Fe complexes 1-4 utilized in OER electrocatalysis

MATERIALS AND METHODS

The used solvents: methanol, ethanol, acetone, and dichloromethane (DCM) were HPLC grade, purchased from commercial sources, and used without further purification. These solvents were used in synthesis or electrolytes for nonaqueous electrochemical experiments. Tetrabutylammonium perchlorate (TBAP) was purchased from commercial sources and used without further purification. For complex synthesis, the $FeCl_3{\cdot}6H_2O$ and $Fe(CF_3SO_3)_2$ were purchased from Sigma-Aldrich and Strem Chemicals, respectively. Nafion polymer (a commonly used support for molecular electrocatalysts) was purchased from Sigma-Aldrich as a methanolic solution.

Ligands and complexes

The ligand 2-(2′-pyridyl)benzimidazole (PBI) was purchased from Sigma-Aldrich, while 2-(2′-pyridyl)benzoxazole (PBO) was synthesized following literature procedure [21]. The ligands 1,3–*bis*(2′–thiazolyl), iminoisoindoline (tia-BAIH), and 1,3-*bis*(2'-benzothiazolylimino)isoindoline (btia-BAIH) were synthesized according to known procedures [22]. The complexes 1-4 were synthesized and re-crystallized according to published procedures [21], [22].

Electrodes and semiconductor substrates

For heterogeneous electrochemistry and catalysis (using the immobilized complexes), indium tin oxide-coated glass slides (ITO, ~100 nm thickness) were purchased from PGO GmbH, Germany, or Ossila Ltd., Great Britain. Fluorine-doped tin oxide (FTO), which can be applied for long periods of OER electrocatalysts, was purchased from Ossila Ltd. Platinum coil (Pt) was used as an auxiliary electrode. The reference electrode was Ag/AgCl (3 M KCl) for aqueous experiments.

Electrocatalytic investigations/ Heterogeneous electrocatalysis

Standard electrochemical techniques were applied to characterize the immobilized complexes, including LSV, EIS, and CA. Low surface roughness FTO (20×15 mm, 600 nm thickness, 6-9 $Wð^{-1}$, 34.8 nm RMS) and ITO (20×15 mm, 100 nm thickness, 20 $Wð^{-1}$, 1.8 nm RMS) coated glass slides of uniform size were used as standard model electrodes, which were modified with thin films of the complexes as described in the followings. These modified electrodes were set as a working electrode in a three-electrode setup (Pt aux. and Ag/AgCl ref.) in a small cell, and the electrochemical behavior was compared to that of the unmodified ITO or FTO under the same conditions. ITO or FTO coated glass slides were cleaned with ethanol in an ultrasonic bath for 20 min, then rinsed with deionized water and dried with dry N_2 gas. All experiments were conducted in 0.2 M borate buffer at pH 8.2(1) for better comparison.

Deposition of the complexes on semiconductor (ITO, or FTO)

Different procedures (dip-coating, drop-casting, and electrodeposition) were applied to immobilize the complexes on a semiconductor surface. These were used to fabricate active catalytic layers of the complexes on the surface of ITO, or FTO [23]–[25]. Herein, we list all methods used, as shown in Fig. 2 (methods A-D). Methods (A-C) include drop-casting (DC) and dip-coating (DIP) with/no Nafion, whereasmethod D shows the electrodeposition (ED) method.

METHODS

Drop-casting (DC): the same procedure in the method (A) was used for complexes **1** and **2** dissolved in methanol in 6 mM concentration. As shown in Fig. 1, small portions of the solutions (50–150 μL) were evenly layered onto ITO using a micro-syringe. For these two complexes, methanol was evaporated at room temperature and, after that, dried for 30 min using an infrared lamp to provide evenly distributed catalyst films (Figure 3) [23].

The same procedure was repeated with Nafion and complex 1 in methanol to prepare complex/Nafion/ITO composite films, but no significant difference was observed compared to the complex/ITO sample [23]. Method (C) was followed to produce Nafion/substrate electrode for reference [25].

This procedure was used for complex 3, dissolved in methanol in 3 mM concentration. Small aliquots (50–200 μL) were evenly layered onto ITO using a micro-syringe. The solvent was evaporated, and the solid was dried by infrared heating for 30 min (Figure 3) [24].

Dip-coating (DIP): method (B) was used for complex 1 was dissolved in methanol with or without adding Nafion (5 wt% in water/methanol) to reach a final concentration of 0 or 0.4 wt% for Nafion and 0.4–6.0 mM for the complex. With complex **2** (0.4–10.0 mM), the concentration of Nafion was varied between 0 and 0.8 wt% to obtain different composite films. The ITO pieces were dipped into the coating solutions for 1 min, then kept at room temperature for 30 min, finally heated for 30 min at 90–110°C [23]. A similar procedure could be applied for complex **3** [25].

Electrodeposition (ED): We developed method (D) due to the poor solubility of **4** in methanol. The deposition was performed using a three-electrode configuration, containing FTO or ITO, Pt, and Ag^+/Ag (0.01 M $AgNO_3$, 0.1 M TBAP/MeCN), as working, counter and reference electrodes, respectively. The solution consisted of 0.8 mM of complex **3**, or **4** in DCM, and a mixture of 500 μL acetone and 54 μL MilliQ water. ED was conducted by CV at 100 mV/s, turning potentials of −0.4 V and 1.7 V *vs* Fc^+/Fc, for

a total of 20 cycles. The surface concentration of the deposited complex was determined from the current peak integral after the final cycle by presuming a $1e^-$ Fe(III)/Fe(II) transition ($z = Q/F$). The electrodes could be dried at room temperature after rinse [25].
All electrolysis experiments were carried out in 0.2 M borate buffer (pH ~ 8.3) for control potential electrolysis by (CPE) using a three-electrode configuration, containing ITO, or FTO, Pt, and Ag/AgCl as working electrode, counter, and reference electrodes, respectively.

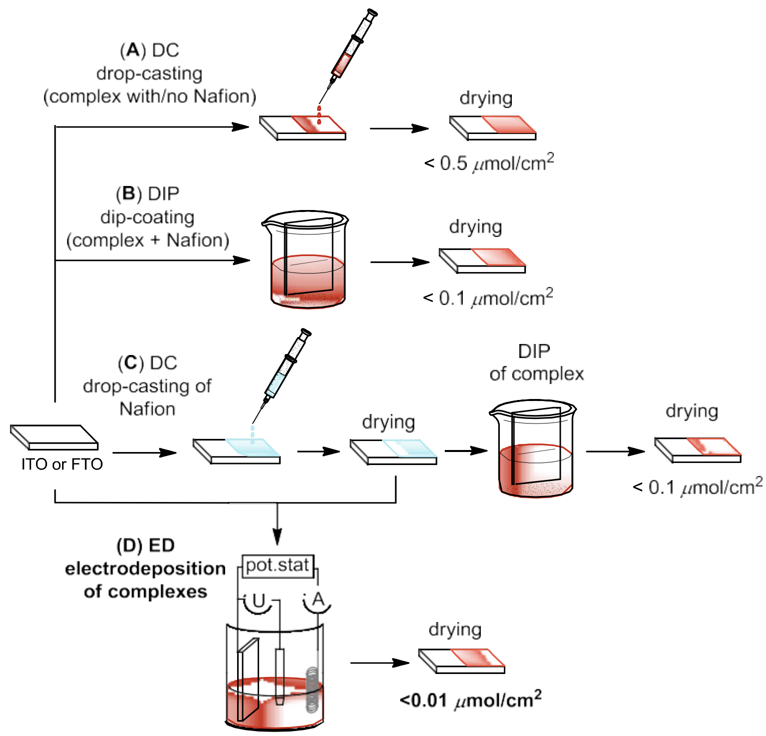


Figure 2. Schematic presentation of the different deposition methods [25]

Figure 3. Typical drop-casted samples of complexes **1**, **2,** and **3** on the ITO slides, applied in improved electrocatalysis to generate O_2 [23], [24].

RESULTS AND DISCUSSION

The simplest way of immobilizing molecular catalysts is to drop-cast the compounds onto electrode surfaces and dry the so formed thin films. These compounds are all water-insoluble due to the chosen ancillary ligands. However, suppose no further supporting additive is applied. In that case, the necessary but sufficient requirement is the water-insolubility and hydrophobic binding of the molecules to the surface, as proven by the successful deposition of the active molecular catalysts **1**, **2**, and **3** (see Fig. 3). We hypothesized that hydrophobic interactions would keep the surface-deposited complexes on the ITO electrode in an aqueous buffer during electrolysis.

As deposited onto the ITO working electrode, the catalyst layers were allowed to oxidize water to oxygen electrochemically under an applied potential of 1.4 V (vs. Ag/AgCl, pH 8.3). Following 2 hours of reaction time, we found that simple atomic level modification in the heterocyclic ancillary ligands causes drastic changes in the catalytic behavior. While catalyst **1** displayed long-term electrocatalysis to produce O_2 without remarkable decomposition of the catalysts layer on the ITO electrode, complex **2** underwent rapid in situ decomposition. The procedure was also applied to complex **3** (Fig. 3), which showed a 94% Faradaic efficiency after 4 hours of electrolysis in borate buffer at 8.3 pH comparable to that found for complex **1**. Note that complex **3** displayed Fe ion loss from the surface, causing its deactivation, while the surface modified with complex **1** showed enrichment in Fe that can be associated with a change in metal- to-PBI ligand ratio.

Method (B) created a thin layer of the complexes through simultaneous drying and heating to 120°C. Dip-coated ITO slides were possible to fabricate with complexes **1-3**, with and without the addition of Nafion (as support to see if long-term stability of the film in electrolysis is affected or not by this commonly used carrier additive). The modified electrodes were compared to plain ITO in borate buffer at pH 8.3. We found that Nafion had no detectable effect on the catalytic performance; thus, we could conclude that the hydrophobic interactions supplied by the ancillary ligands are indeed sufficient to warrant long-term stability for the system. In this respect, the choice of the ligand is the determinant factor.

The question remained, how can the surface-adsorbed complexes become active as a catalyst at the molecular level, despite their coordination sites being occupied by organic donor groups. It has been known for a long that water oxidation requires the binding of a minimum of one H_2O molecule to the catalytic center, which is the metal ion in the complex in our case. We presumed that ligand exchange reaction as experimentally observed in water/organic mixtures would also occur at the solid-liquid interface upon contact of the film-coated ITO with the aqueous phase, enabling the molecular systems to show catalytic activity [23], [24]. Indeed, surface composition analysis supported this hypothesis since thetotal absence of chloride could be concluded in the case of complex **3** during our detailed investigations. This means that chloride ligands exchange with water molecules upon contact with aqueous buffer, thus allowing for efficient catalysis, but the ancillary ligands, as shown in Fig. 1, remain coordinated and tune the catalytic capabilities.

In method (C) (see Fig. 2), the drop-casting was carried out using Nafion as support, and after that, the ITO pieces were immersed in a solution containing the complexes. However, adding Nafion did not result any notable effectiveness in OER.

Methods (A-C) were unsuited to fabricate catalytically active layers of complex **4**; as mentioned before, it has poor solubility in the obligate solvent. On the other hand, electrodeposition (see Fig. 2) was the proper selection to afford layers with better charge transfer properties and stability. This method was applied for complexes **3** and **4** that clearly showed a more satisfying performance. Table 1 summarizes all electrolysis performance data for complexes **1-4**. When applicable, ED is the most atom-efficient method that yields complex ad-layers with the highest activity in OER catalysis; therefore, further investigation is justified.

Table 1. Summary of the data of three immobilization methods onto ITO and FTO electrodes.*

complex	Electrode	method	j (μAcm^{-2})	E vs (Ag/Ag$^+$)	TON	TOF (s^{-1})	Faraday eff. (%)
1	ITO	DIP	107	1.4	n.d.	n.d.	n.d.
2**		DIP	36	1.4	n.d.	n.d.	n.d.
1	ITO	DC	533	1.4	73	0.012	98
2**		DC	800	1.4	n.d.	n.d.	n.d.
3		DC	612	1.4	228	0.014	94
3	FTO	ED	900	1.5	n.d.	n.d.	n.d.
4		ED	1200	1.5	5000	0.4	83

*not determined due to low or declining activity on the timescale of the experiment

**Complex 2 decomposes during electrolysis (it is not a molecular catalyst)

CONCLUSIONS AND RECOMMENDATIONS

Water splitting is a promising strategy to produce H_2 as a green fuel. In the overall process, the water oxidation reaction to produce O_2 at the anode (OER) is the most challenging task. This reaction produces electrons and protons for the reduction reaction generating H_2 at the cathode (HER). Efficient water splitting operated by solar energy can be accomplished by immobilizing a catalyst onto an electrode to achieve an efficiently catalyzed OER. Substantial variations of the ligand can adjust the catalytic activity of molecular complexes, but these ligands can influence the surface affinity, too, and allow scalable and straightforward immobilization of the catalysts on model semiconductors. The activity of the immobilized electrocatalysts based on essential parameters such as overpotential, stability, Faradic efficiency, and turnover frequency can be related to the molecular properties. Herein, we summarized and compared three scalable and straightforward methods (drop-casting, dip-coating, and electrodeposition) to immobilize the complexes onto ITO, FTO and investigated the activity and stability by extended electrolysis tests. The results showed that all three methods could be suitable for fabricating modified (and activated) electrodes for OER, but electrodeposition is the most atom efficient among those, easily yielding the most active ad- layers. The long-term stability of the **4**/FTO modified electrode is remarkable and, to our knowledge, barely matched by any other known Fe complex catalyst; therefore, this research direction is very promising in the utilization of first-row transition metal complexes for better OER performance.

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ASSESSMENT OF THE RISK MANAGEMENT FOR VARIOUS TYPES OF DISASTERS: IMPACT AND SUSTAINABILITY

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***Abstract**: Disaster management and crisis action planning play a primary role in disaster avoidance, mitigation response, and recovery. According to the research, effective disaster management is largely dependent on the efforts of emergency response organizations. There are disaster risk management problems concerning the communication process, the development of coordination, and the exercise of authority. This paper will overview and asset the risk management for various types of disasters which are classified into five main parts: Geophysical, Hydrological, Climatological, Meteorological, and Biological. Biological disasters are two types in origin namely, Calamities which are produced in crops by certain animals, and pandemics which are caused by the spread of infectious diseases among large numbers of people, and this kind of crisis creates new risks that needed to be identified. The investigation in this research will identify the risk concept that comes from natural disasters and prepare the plans and set priorities to respond effectively where and when needed, by implementing the risk assessment. However, the similarities are significant concerning the health, social, economic, and environmental aspects of all types of disasters, COVID-19 pandemic was the complete opposite from an environmental and social point of view i.e., but highly affected the death rate and urban health.*

***Keywords**: Crisis management, Pandemics, Risk management, Disaster impacts, sustainability.*

INTRODUCTION

A hazard is a potential threat to people, property, livelihoods, or ecosystems as well as damage or destruction to facilities and environmental resources. It is described as "the risk of a natural or human-caused physical event resulting in death, injury, sickness, or other health consequences, as well as destruction and loss to property, infrastructure, and livelihoods" [1]. A hazard is a dangerous occurrence that leaves a huge number of people dead or severely damaged property in its wake. Depending on where and how people live, a natural disaster may or may not turn into a catastrophe. Dangoures events do not pose a threat or cause disasters in places devoid of human habitation [2]. Natural disasters have direct deep impacts on the affected regions that they utterly destroy and cause physical and psychological harm for individuals and communities, along with loss of human life and property, when natural disasters occur they disrupt the daily lives, and the socio-economic activities for a certain period of time [3]. This study intends to give planners a quick overview of disaster management and the damaging effects of hazard occurrences, as well as their implications for long-term sustainability. and also shows how scientists can contribute in rescue operations and preparedness by using lessons learned from previous disasters to aid in forecasting in order to prepare for, and enhance

societal adaptability to, upcoming disasters' environmental and associated health impacts. A disaster is a result of the combination of hazard, vulnerability, and insufficient measures that lead to eliminating the chances of rescue and affecting vulnerable populations and causes catastrophes and damages, Figure 1 below shows illustrate the relationship between hazard and vulnerability [4].
A natural hazard is an unforeseeable and/or uncontrollable natural phenomenon of extraordinary intensity that poses damage to life, properties, and the environment. A hazard is a possible source of danger or a circumstance that might result in loss. It's also known as a possible or current situation that might destroy lives or threaten property and the environment (Middelmann, 2007) also the hazard is an unexpected threatto humans and/or their property (Mayhew, 1997). These definitions show that hazards involve social, technological, and political dimensions in addition to environmental ones. Such hazards include; Geophysical, Hydrological, Climatological, Meteorological, and Biological disasters. The term vulnerability means being oversensitive to damage or injury, however, concerning natural disasters it is the situation and characteristics of a person or group that influence their capacity to resist and recover [5].

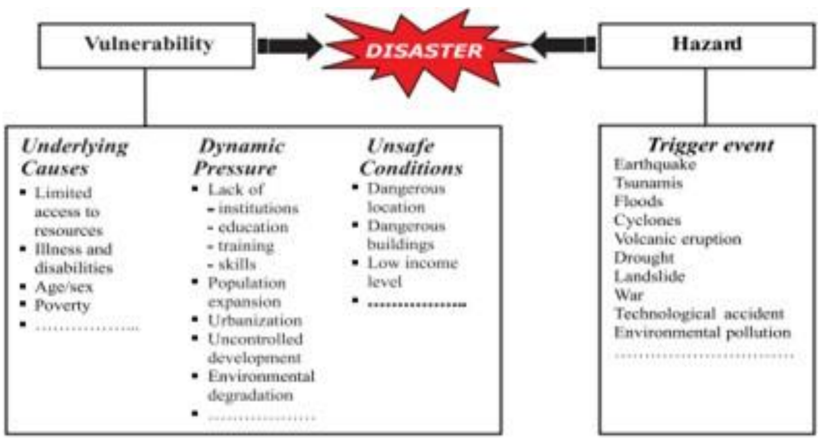

Figure 1. The relationship between hazards and vulnerability[4].

The United Nations Office for Disaster Risk Reduction DRR, specify the natural disaster as "the disasters with either short period and affect relatively small areas like earthquakes or disasters that occur slowly and affect large areas like Droughts" [6]. According to the International Federation of Red Cross & Red CrescentIFRC, Societies "Natural disasters are phenomena that occur naturally triggered by quick or gradual start catastrophes that have direct repercussions on human health and subsequent impacts bringing more death andsuffering,". [7]. As disasters become major threats to human life and the global economy, governments and international organizations must cooperate to enhance risk management globally and regionally, and raise awareness among people that disasters of all kinds, whether natural or human-made, must be dealt with professionally and consciously, and that the responsibility rests with individuals and institutions together in order to reduce disasters and improve the ability to mitigate them. the natural or human-caused disasters can be classified as follows [8]:1. **Geological disasters**; Earthquakes, Volcano Activity, Landslides, Sinkholes, Tsunami.

2. **Hydrological disasters**; Avalanche, Flood.
3. **Climatological;** Heatwaves and cold waves, Extreme Temperatures, Drought, Wildfires.
4. **Meteorological**; Cyclones, Storm Surge Waves.
5. **Biological disasters**; Plagues - Calamities produced in crops by certain animals, pandemics which are caused by infectious diseases between many people such as; Coronavirus / COVID-19 [6].

DISASTER CRISES MANAGEMENT AND CRISIS ACTION PLANNING

The information systems framework for Disaster Management DM first main objective is to reduce disaster losses and conserve developmental gains by many methods; Policy and planning decisions for disaster

preparedness and mitigation. preparing Hazard mapping and Vulnerability Assessment. Database of disaster history of pattern and trend analysis. Database of the disaster management plan, Awareness & training materials, Inventory of legal, techno legal, administrative, and institutional framework. the second main objective is the Quick emergency response and recovery by using the material and human response resources database. Besides, the Database of critical facilities, Infrastructure, and lifelines. As well as the database of trained human resources and finally with the Demographic information GIS-based information system [9].
In calamity counteraction, moderation, reaction, and recuperation, Information and Communication Technologies (ICTs) assume a critical base. Simultaneously, government organizations and other philanthropic entertainers partaking in dynamic and salvage tasks require a great deal of exact and opportune data. Four standards can be depicted in ICTs for Calamity The board: multi-risk, multi-staged, multi- innovation, and multi-partner [10]. Figure 2 below shows the main Phases of Disaster Management.

Figure 2. Phases of Disaster Management [11]

The communication process and information flow

The primary role of emergency organizations in disaster management is to carry out the activities of emergency responders. This includes the coordination of various agencies and the exercise of authority. Although disaster planning can help prevent disasters, it can also serve as a guide for handling the various aspects of crisis management. One of the most critical factors that can affect the success of disaster management is the communication process. There are various problems that prevent emergency organizations from effectively communicating with the public[12].
Organizational issues related to information flow can be seen in at least five main types of organizational behavior:

a. intra-organizational.
b. Inter-organizational.
c. From organizations to the public.
d. From the public to the organizations.
e. Inside structures of organizations.

The discussion which follows examines both the real information flow problem of the organizations in community disasters and mythological beliefs. It indicates how false assumptions about organizational behavior can undermine, and thus invalidate disaster preparedness planning and requires tactical management of specific difficulties [12]. Figure 3 explains the Risk management cycle.

Figure 3. Risk management cycle [13]

Information Flow Between Organizations

Under normal conditions, officials from various organizations will often chat informally, as they are accustomed to conversing with one another as friends and acquaintances. When tragedy occurs, however, official connections with previously unknown authority within organizations with whom there were no prior ties are frequently required. It's not uncommon for organizations to make contact with groups who were beforehand unknown to them before the crisis. As a result, establishing and supporting a formal communication flow between officials who are unfamiliar with others in outside organizations may be difficult [14].

In the Intra organizational Information Flow, all organizations must communicate consistently and internally exchange data with their group members under ordinary conditions. The communication scheme is developed to process and exchange relatively predetermined types and quantities of information. Though, during a disaster, the team members who are using the communication system will often increase significantly [15]. This can be done in part by internal staffing changes undertaken by the organization to meet the demands of the crisis situation. E.g., double shifts may be used, or volunteers may be incorporated into the workforce. Frequently, the current communication system cannot accommodate the volume of data necessary to these additional system users.

Normally, communications are routed through specific channels. The flow of information in non-crisis conditions follows the standard organizational line of command. As a result, system user information requirements, data exchange circumstances, and information and data flow from top to bottom (and vice versa) are all relatively well defined [15]. When the additional demands upon the internal communication system surpass its capability, this results in 'overload,' the net result of which causes either results in the loss of communication or system failure or delay of information to, from, and between staff members [16].

Nonetheless, conveying information throughout the organization becomes more difficult during a calamity. It is not uncommon, for example, for numerous people to fill a job that was previously only held by one person; officials to take on non-routine duties, or officials to be reassigned to serve in temporary emergency positions within the organization. These and other circumstances might lead to situations where standard communication methods are insufficient to ensure that all important information reaches individuals who need to be informed about organizational actions.[17].

Information Flow From Administrations to the General Public

In disasters situation, organizations may have to pass on information to citizens in general, but this is often done rather poorly. Typically, these effects result from the organization's failure to recognize that knowledge that is crucial to organizational staff is not fundamentally valuable to threatened individuals. Officials might collect extensive information on a flood or a chemical threat, for example. The organization will next release an official statement of instruction to the general public based on this information, which will exclude the details of its conclusions and other pertinent information [18].

THE IMPACT OF DISASTERS

Earthquakes, volcanic eruptions, floods, and drought are examples of uncontrolled events that have an influence on the environment in which we live. Toxins are often produced from disasters into the ecosystem via loops that move between air, land, and water, eventually burying themselves in lakes or deep ocean deposits. Wildfires, floods, volcanic eruptions, tsunamis, and earthquakes, on the other hand, can release these elements in great quantities and quickly. Methyl mercury, a very poisonous type of mercury present in aquatic settings, , can be emitted to the atmosphere as a result of geothermal activity. Mercury vapor affects the neurological, digestive, and immunological systems, as well as the lungs and kidneys, and maybe lethal if breathed. Because of the polluted toxic air, eight hundred persons die each hour, i.e. thirteen persons per minute. The Asia-Pacific area has a share of millions of these deaths. The UN Office for Disaster Risk Reduction's Global Assessment Report on Disaster Risk Reduction, 2019 revealed how hazards including air pollution, illnesses, droughts, and climate change connect and feed on each other, accelerating their negative health and environmental issues. Humans and assets are becoming vulnerable to a wide range of crises, in previously unknown locations and at unknown levels. Heatwaves combined with dry conditions can cause catastrophic wildfires that contribute significantly to air pollution which plays a role in the production of greenhouse gas (GHG) emissions, particulate matter, and other components, so, the heatwaves consider the most serious environmental hazard after global warming [19]. Negative impacts change the lives of individuals, families, communities, cities, and states, mostly can affect the economy of the entire country. The carrying capacity of the impact of the disaster has a great relationship with the level of preparedness, flexibility, and adaptation. However, recently it has been noticed that disasters are increasing in severity, especially human-made disasters, now the need to be prepared for a world full of unexpected shocks has become clearer than ever due to the acceleration that has been taken place in many countries all around the world, the industrial revolutions, technological, and biological activities, have given disasters new characteristics causing rapidly spread all over the world and increased the impact of disasters globally and in all levels [20].

a- Social (Individual And Community Impact)

One of the most serious issues that arise during and after tragic events is health problems, and in cases where mobility, transportation capabilities, and infrastructure are affected survivors of natural disasters may be cut off from rescue and urgent medical assistance. In addition, standing water, as in hurricanes and floods, can be a source of bacteria and microorganisms that can spread illness. Not to mention that survivors of any tragedy may suffer from mental health issues such as post-traumatic stress disorder [21].

Disasters can have immediate effects on human health, such as injuries, deaths, and disease outbreaks, as well as long-term effects such as noncommunicable illnesses, psychological morbidity, and impairments. Damage to health facilities and disruptions to health services typically impede the health sector's ability to respond to these consequences. The impact is often felt physically, and psychologically at the individual level. Natural disasters result in property damage, financial loss, death, illness, and deterioration of physical and mental health. In developing countries, the effects have a greater impact, sometimes leading not only to a shortage of resources, but also to the loss of security and safety, and massive human migrations. Because of the discharge of hazardous chemicals, flames, and explosions, a 'Natech' (natural-hazard-triggered technology) event can compound the impact of a natural catastrophe on the environment and human health.

Risk managers have just recently begun to investigate the causes and effects of such catastrophes, while there may be preventative and preparedness measures as well as response and recovery strategies in place to address the risks posed by technology and natural disasters, these are seldom coordinated. Furthermore, thereis a scarcity of risk analysis and planning methodologies and tools; as a result, it is critical to design strategies that include the potential of dealing with all of them at the same time [22].

b- Economic Impact

Infrastructure damage is the most urgent destructive problem of natural disasters, the damage of the public and private infrastructure can cost a lot, and not all communities are prepared to support post-disaster recovery. Additionally, many landowners lack property insurance or the financial resources to rebuild, and certain natural catastrophes are not covered by insurance; this means that people may lose all of their fixed and unfixed assets with no recourse. Natural catastrophes can have long-term negative impacts in addition to the acute loss of life and infrastructure devastation. Usually, after crises, the incident will last for years throughout the areas and the surrounding. For example, due to one of the disasters that occurred in New Orleans, more than 200,000 houses have been demolished and more than 70% of citizens have beendisplaced. For that, a massive amount of aids should be allocated as a kind of help for the cities and surrounding areas to revive the economy and have a reasonable recovery to re-construct the infrastructure [22].

c- Environment Impact

Disasters strike has varying degrees all across the world, many disasters are known to be quick, whereas others, such as drought and climate change, are long-term, and can occur globally at varying frequencies and magnitudes. Various disasters have the potential to change the natural environment, for example, the cyclones that occurred in Myanmar in 2008, or the wildfires that spread in California through the years are examples of how areas of land can be dramatically damaged the whole ecosystem just from a single disaster event. Estimates of sea-level rise due to melting glaciers is an important subject to debate for how to manage global climate change and its natural consequences since tidal waves threaten whole islands and several coastal settlements. Furthermore, the fast desalination of salty seas is a major concern, it has the potential to deprive the globe of edible fish and coral reefs.
Air pollution is one of the negative environmental factors that cannot be controlled, here are five ways in which disasters, natural or industrial, can either cause or exacerbate due to air damage:-

1- disasters in cities result in many technical problems, i.e, factories, and industries sites can bedamaged, resulting in the discharge of toxic or harmful compounds, such as the 2011 nuclear accident at the Fukushima Nuclear Power Plant in Japan, when the tsunami cut the power that provide cooling to three reactors,.
2- Natural disasters make it easier for dangerous materials to be released, i.e, when the stored gasoline inside large tanks destroyed by fire or chemicals burns up, it affects a vast region and a lot of people.
3- Increased discharge of accumulated pollutants, such as when Mt Mayon in the Philippines exploded on January 13, 2018, spewing a 2500 meter-high cloud of grey vapor and ash.
4- The floodwaters for a long time will still be full of microorganisms and bacteria this can cause lung damage, asthma, allergies, and the hypersensitivity pneumonitis becomes worse due to dust mites, pollutants, and germs left behind after a flood.
5- Droughts are more likely to cause sandstorms. A strong sandstorm blanketed Khartoum in March 2018, causing officials to postpone flights and close schools in the capital and surrounding communities.

Many nations rely on a variety of infrastructure facilities to reach sustainable development, such as highways, electric grids, ports, telecommunications networks, factories, and so on, in order to carry out socio-economic activities, any failure of these systems might result in severe impacts, and to avoid such losses, systems must be flexible and able to sustain and operate efficiently without large interruption, as well as recover swiftly with minimal cost [23].

d- The impact of human disasters as a compound of natural and man-made disasters: (The impact of the pandemic COVID 19)

A disaster of this kind causes severe destroy for livelihoods, economic catastrophe and can damage people's life for a long time. An epidemic is defined as "either an unexpected increase in the number of cases of a contagious diseases that already occurs in the region or country involved or the presence of an illness originally absent from a territory", according to the University of Louvain's Centre for Research on the Epidemiology of Disasters (CRED), the definition is used in public health to describe when a disease attacks a bigger number of individuals than predicted. [24].

The COVID 19 is highly contagious and has been linked to a high incidence of deaths. Direct contact or close proximity to infected persons is the major and the mobility of people has rapidly increased the spread the illnesses, pandemics have a direct and indirect influence on public health and people's livelihoods, and they can result in losses in manufacturing, jobs, trading, tourist, public and private transportation, education sectors, and many others. Additional expenditures must be incurred by the afflicted country to deal with the emergency, isolate, quarantine, and provide the right treatment for patients is an additional burden, especiallyin low-income countries. However, there are obvious impacts in the short and medium-term that will cause permanent damages, in the near term, more quarantine places are needed since the number of injured has much more exceeded the capacity of hospitals and health centers in some countries, as well as other side effects as a result of the increase in acute respiratory diseases and other diseases caused by the disaster, in themedium term, the living conditions become hard due to the pandemic and may extend for a while as a direct result of the increased vulnerability, health, and poor living conditions among individuals, and on societies as a result of the deterioration and disruption of the infrastructure and failure in basic services [25].Such disasters have health, social and economic consequences because they introduce new types of risks that have never been familiar before, It not only leads to deaths due to the rapid spread of the disease that has never been witnessed before, but also negatively affect the safety and security of people, as well as reduce normal living standards due to many hidden costs or economic consequences. Part of this paper will identify the risk principle that will arise from pandemics, prepare plans, and set priorities to respond effectively where and when needed, by implementing risk assessment, threats, vulnerabilities, and impacts to reach the bestscenario that will control the pandemic, and finally, the study in this research will address the question that everyone is concerned about: will conditions return to the way they were before the crisis. Although there aresignificant similarities in terms of the sustainability aspects of all types of disasters, the COVID-19 pandemicwas somehow the opposite from an environmental and social point of view, i.e. the priority here has been changed, the psychological and social impact are two further consequences on the population besides health. Where previously in disasters, social engagement was a necessary requirement to bring people together and assist family members, relatives, friends, and workmates, but nowadays for their and your own safety and sake, it is better to be away and contact remotely as much as possible. Disasters affect the population both directly and indirectly. It is useful to keep a separate record of people who lost their jobs as a result of the destruction of the company where they worked, as well as laborers who lose income, as this may provide an early significant warning and assess the direct and indirect effects on the population and for each sector. Private property damage is often classified and documented in the housing sector, whereas production damage and losses are included in evaluations of the impact on productive sectors. Although the loss of lifeis considered a permanent cost to society that cannot be replaced or recovered, the most well-known effect on catastrophe victims is an effect on their living levels. Disasters also posed a danger to people's securityand confidence, as well as the loss of houses and belongings, lowering regular living standards, in addition tothe psychological suffering, and social changes, the depression of individuals who do not get enough support, indirect costs are among the unquantifiable effects on the population., such damages might have severe short- and long-term consequences. A recent Lancet Psychiatry paper (Xiang et al. 2020) recommendsfor early consideration to mental health in the face of the COVID19 pandemic, especially mental health evaluation, counseling, and treatments, based on previous pandemics experiences. Now the need for psychiatric treatments is increasing all over the world this is making scientists turn to digital psychiatry includes unique capabilities and resources, such as artificial intelligence, computer-assisted mental health services, and a variety of many other modern technologies, which can support internationally. For a more efficient and effective system and in order to reduce psychological stress, initiatives have been established for remote communication and harnessing modern technology and electronic transformation and linking the psychological treatment process with machine learning, including virtual reality, and AI, one of these initiatives is a Croatian initiative that supported by the European Union [26].

CONCLUSION

The paper reviews the main objectives and principles of the information systems framework for disaster management, as well as, the communication process and information flow; information flow between organizations, and information flow from administrations to the general public. Moreover, how the negative impacts can change the lives of in the cities. The carrying capacity of a disaster's impact has a strong link to sustainability, and it has recently been observed that disasters caused by industrial revolutions, technological advancements, and biological activities are becoming more severe, particularly those that are the result of human actions, behaviors, and decisions that become part of global environmental change processes. The negative consequences of such crises pose new social, economic, and environmental risks. The negative consequences of such crises pose new social, economic, and environmental risks, improving technology will improve risk management and reduce vulnerability. Healthy systems can aid post-disaster resilience, enhance health, and may also reduce the frequency and severity of risks, as well as the provision of preventive protection services.

RECOMMENDATIONS

Recommend researching and accumulating crisis management states from prior civilizations in all areas of life, including religious, political, international, and individual. An examination of what has been done in a crisis situation since then may find little has changed. We should also mention that crisis management has gotten more observable in recent years. Different approaches to world crisis management can be used, and we propose a historical, ethical, and sociological approach and framework that will include all perspectives of crisis management, including ethics, leadership, and communication. It is critically needed by the world.

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RICHNESS IN POLYMETALLIC MINERALISATION Fe, Pb, Zn, Ba AND HYDROTHERMAL SPRING OF MOUNT M'CID AICHA, TELLIAN ATLAS, NORTH-EAST OF ALGERIA

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Abstract: *The massif of M'cid Aïcha is located in Tellian Atlas in the north-eastern of Algeria. This mountain chain is made up extrusions of Triassic gypsiferous formations and Jurassic carbonate, which contain polymetallic mineralization (Zn, Fe, Pb, Cu and Ba) and hydrothermal spring. The region is affected at the north by magmatic events. The structure is a set of anticlines and synclines of E-W direction delimited at the north and south by longitudinal faults; it is also affected by transverse meridian faults rich by a mineralisation. The hydrothermal spring localized in the intersection of the main tectonic accidents. The formation characterises a shallow sea environment. TheM'cid Aïcha deposit was once mined for their zinc ore in the form of calamine. However, the rare gitological work carried out on these two gites has described polymetallic mineralisation with Fe, Pb, Zn, Cu, Ba expressed as sulphides(galena, sphalerite, pyrite, covellite and gray copper), oxides and hydroxides (haematite, goethite and limonite), sulphate (baryte) and carbonates (cerusite, malachite and azurite). This concentration shows a form of clusters,pockets, veins and lenses of very modest dimensions.*

Keywords: *M'cid Aïcha, Lias, mineralization, polymetallic, carbonate, Hydrothermal*

INTRODUCTION

The northeastern of Algeria is characterised by the great existence of polymetallic mineralisation due to the great propagation of carbonate massifs. The massif of M'cid Aïcha is one of these massifs which conceals polymetallic mineralisation in Zn, Pb, Fe, Ba. It is part of a group of massifs that also contains polymetallic mineralisation like the massifs of Sidi Marouf, Tissimiran (Kef Boulahmam), Kef Dardja and the sector of Boudjoudoun. All these massifs are located in a regional geological context that is a key to understanding the events that built this portion of the alpine chain of northern Algeria or the Maghrebian chain. On the geological level, [1] gave the first study of M'cid Aïcha and Kef Sema in which he pointed out the presence of the Lias in the M'cid Aïcha massifs. This study was followed by several geological and structural studies such as [2, 3, 4, 5 and 6] where the last gave a good lithostratigraphic and structural description of the M'cid Aïcha massif. On the mining level, the M'cid Aïcha deposit was exploited during the period from 1910 to 1914 by the "Société anonyme des mines et fonderies de zinc de la Vieille-Montagne". During this period,
this company extracted 3374 tons of ore in the form of pockets of calamine with 40/55% zinc after

calcination [7]. In 1975 the geological engineer C. Popescu of SONAREM (National Society of Research and Mining) describes mainly the iron ore mineralisation and specifies the outcrop areas, the morphologies of the mineralised bodies and their relations with the tectonics. The petrographic and mineralogical aspects of the mineralisation and their Jurassic host of M'cid Aïcha are described by [8 and 9]. In these pages we try to make a synthesis on the previous works in order to highlight the mineralisation of the M'cid Aïcha and it is through the most recent gitological works.

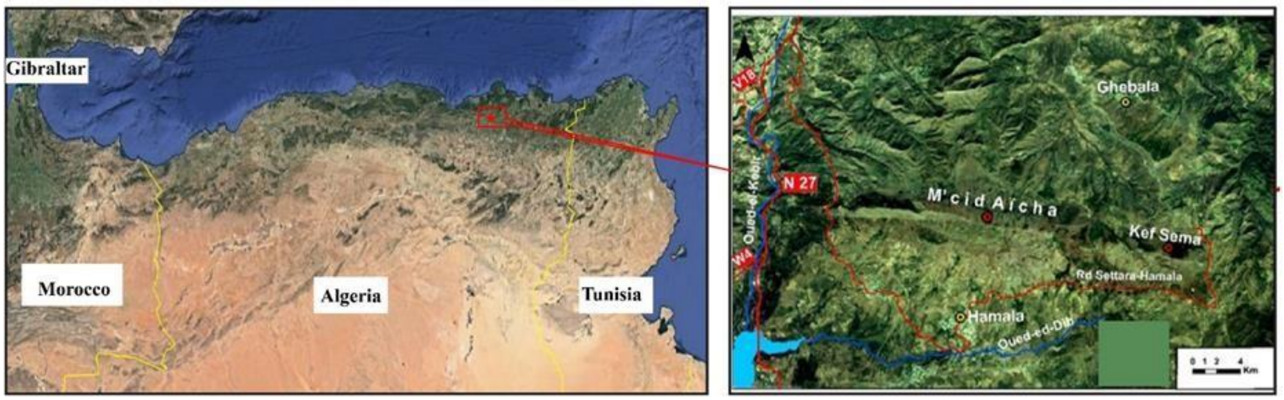

Figure 16. location of the massif of M'cid Aïcha

MATERIALS AND METHODS

Of all the other massifs of the numidic chain, the only massif of M'cid Aïcha which has not yet been well studied from a gitological point of view. However, due to the circumstances in which this work was carried out, the initial objectives were revised. Thus, given the impossibility of carrying out field and laboratory work, this characterisation was based much more on the work already carried out on the M'cid Aïcha massif. Unfortunately, these are not numerous. We have therefore called upon the old works of [5 and 6] which are monographs of a regional nature and more recent works carried out within the framework of university theses [8 and 9].

RESULTS AND DISCUSSION

Petrographic description of the carbonate rocks of M'cid Aïcha

Using the works of [5 and 6] we can subdivide the carbonate strata of M'cid Aïcha into three members, while from the works of [8 and 9] we can distinguish some petrographic aspects of these rocks.

1. The lower set

The lower set mainly forms the west side of M'cid Aïcha with an average thickness of about one hundred metres. It is essentially constituted by compact dolomitic rocks of greyish to brownish colour affected by cracks filled by iron oxides attributed to the Sinumerian. Microscopically, this facies shows greyish rhombohedral crystals with white patches. Microscopic cracks filled by iron oxides. These cracks intersect the crystals of the dolomites and this shows that the processes of fissuring and mineralisation are posterior to the genesis of the dolomite [6, 8] and 9] (Figure1 [1 and 2]).

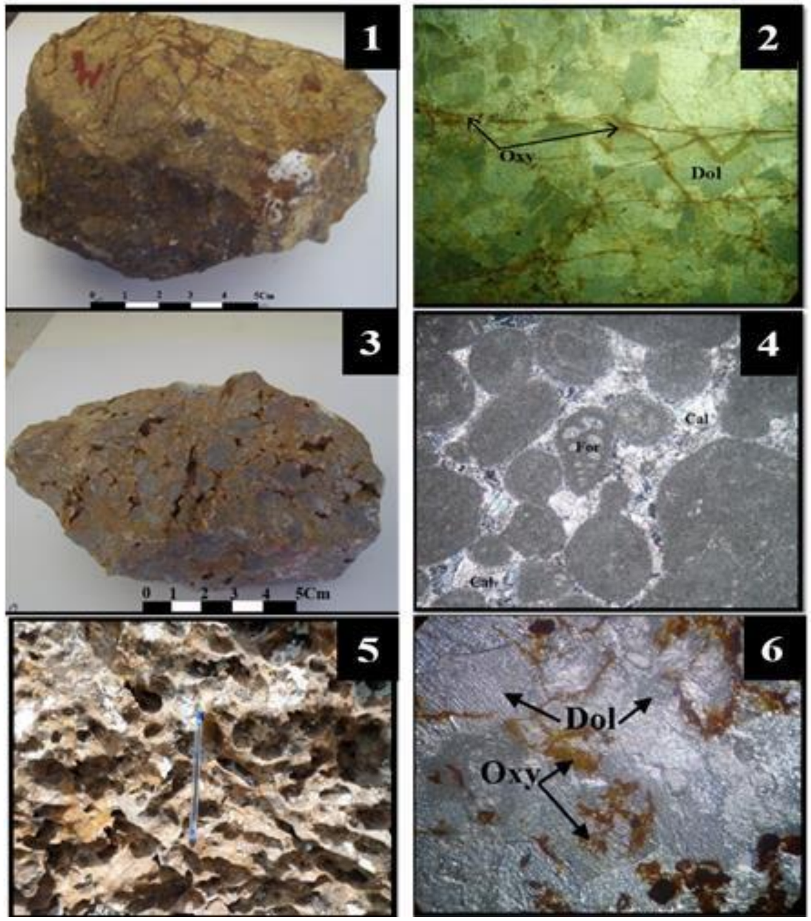

Figure 2. Macroscopic and microscopic appearance of carbonated rocks of M'cid Aïcha.
1/ Dolomitic limestone with cracks filled with iron oxides. 2/ Medium-grained dolomite. 3/ Brecciated limestone invasion of karsts and voids by a combination of iron oxide and calcite. 4/ Grainstone with foraminifera. 5/ Limestone bank surface showing karst cavities. 6/ Medium-grained dolomite with cracks filled with iron oxides (according to [8 and 9]).

2. The middle set

The middle set shows the largest part of the M'cid Aïcha massif, its thickness reaches up to 300m. They are attributed to the Lower Lias-Pliensbachian [6]. It consists by brecciated limestones and bedded limestones of Lower Lias-Pliensbachian age. The brecciated limestones are generally greyish brown, porous, cavernous and fractured and the fractures are often filled by calcite. They show microscopically grainstone-like textures containing pellets and rare foraminiferal tests set by crystalline sparite [6, 8] and 9] (Figure1 [3and 4]).

3. The upper set

It consit by a sublithographic limestones with marly intercalations that become more and more numerous towards the top of this unit. The thickness of this limb reaches up to 120 m. It is made up of sublithographic limestones with marly intercalations that become more and more numerous towards the top of this unit. The thickness of this limb reaches up to 120 m. All these facies are of Domero-Toarecian age. This limb is characterised by outcrops in the form of an elongated E-W "blade" at the level of the ridges in the M'cid Aïcha massif. The limestones are greyish in color and present specific dissolution surfaces and karstic cavities of variable size. Microscopically these limestones are of grainstone type. They contain foraminifera, fragments of lamellibranches, various indeterminable bioclasts and oolites set by a crystalline sparite. They often show dense microfracturing filled by calcite and iron oxides [6, 8] and 9] (Figure1 [5and 6]).

Mineralization

Two types of mineralisation exist at M'cid Aïcha: an iron mineralisation and a polymetallic mineralisation with Zn, Pb, Cu and Ba.

1. Iron mineralisation

Fifteen outcrops were identified by [10] in the northern edge of the M'cid Aïcha massif but only seven (07) were briefly described (Table 1). The seven outcrops have a vein morphology characterised by openings from 0.5 to 15 m and extensions between 15 and 100 m and controlled by the NNW-SSE and NNE-SSW transverse faults. Other iron mineralisation is found in the western part of M'cid Aïcha takes the lenticular form with dimensions among from 0.5 and 1.5 m and also the form in clusters present metric dimensions (5 to 15 m) (table 1). In the case of vein morphology and cavity filling the relationship between the ore and the host is regular while in the case of lenticular and cluster morphology this relationship is irregular. It is constituted by iron oxides and hydroxides (hematite, goethite and limonite). The hematite presents itself witha steel grey colour more rarely with reddish colors and shows a sub-metallic luster with a massive texture. Goethite is often blackish in color and has a massive concretionary or mamelonitic texture (fig.3 [1 and 3]). Limonites are mixtures of iron hydroxides that appear yellowish in color and are characterised by a very fine-grained granular texture. Under the microscope, hematite shows greyish-white tones with a medium reflectivity and a clear anisotropy in greenish-grey hues. It often shows frequent reddish internal reflections. Goethite appears with grey-blue tones and shows a clear anisotropy in bluish tones [8 and 9] (Figure 3 [2and 4]).

2. Polymetallic mineralization

The M'cid Aïcha massif contains polymetallic mineralisation, especially zinciferous in the form of calamines with related metals (Pb, Cu, Ba). This deposit, located in the eastern part of the massif seems to be formed by two lenses of smithsonite hosted in the liasic limestones. This mineralisation consists mainly of sulphides (galena, sphalerite and copper), sulphates (barite) and carbonates (azurite and malachite). All of these minerals have a massive texture. Galena, sphalerite and barite are often associated with each other. Galena isgrey to metallic luster with a tabular texture, sphalerite has apparently not been observed macroscopically, barite is yellowish-white with tabular crystals. The copper is often altered and give greenish malachite and bluish azurite (fig.4 [1 and 2]). Microscopically, galena occurs with whitish tones and always showstriangular pullouts, sphalerite often appears as large xenomorphic to automorphic patches and shows dark grey tones with low reflectivity, coppers occur as sub- automorphic to xenomorphic patches of greyish-whitecolor with medium luster [8 and 9] (Figure 4 [2and 4]).

Table 1. Nature and dimensions of iron occurrences of M'cid Aïcha massif (according to [10])

Occurrence	Nature	Dimension	Direction	Dipping
01	Limonitised limestone	50 x 10 = 500 m^2	N140E	60SW
04	Limonitised limestone	10 x (~4) = ~ 40 m^2	N10E	70ESE
10	Iron hydroxide dotted with nests and veins of calcite and barite	50 x 3 = 150 m^2	N180E	80W
11	Limonitised limestone and nests of iron hydroxide and barite.	150 x 100 = 15000 m^2	N180E	85W
12	Limonite, goethite and nests of barite and calcite	50 x 10 = 500 m^2	N165E	80ENE
14	Cavernous limestone Limonitised	100 x 5 = 500 m^2	?	?
15	Limonitized limestone with nests of Limonite	50 x 15 = 750 m^2	N80E	70S

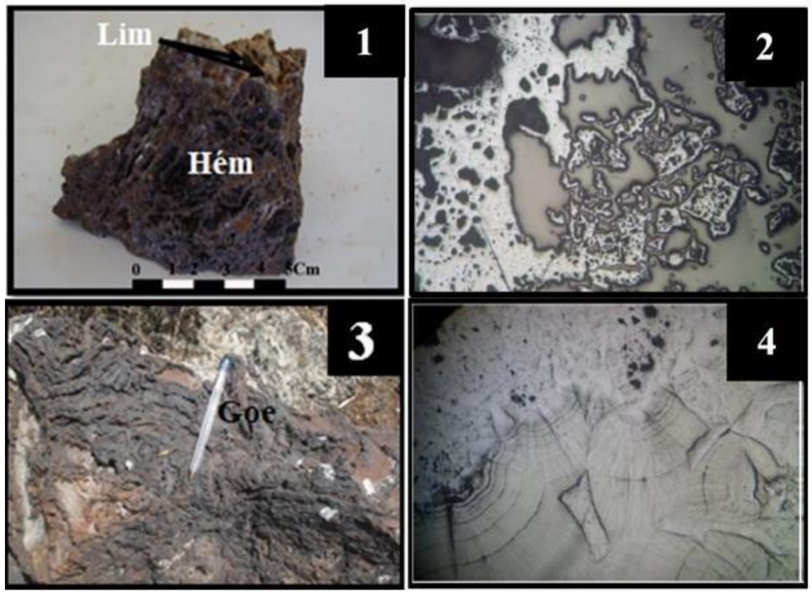

Figure 3. Macroscopic and microscopic appearance of iron mineralisation: (Hém) Hematite; (Goe) Goethite; (Lim) Limonite (Acording to [8]and [9]).

Comparison between the mineralization of M'cid Aïcha and the mineralizations of other massifs of the Numidic chain

In the western massifs of the Numidic chain of M'cid Aïcha massif contains various Fe, Zn, Pb, Cu and Ba mineralizations. Iron oxide and hydroxide iron mineralisation sometimes occupy alone the mineralised sites, it may also contain barite and are sometimes associated with base metal mineralisation (Zn, Pb).

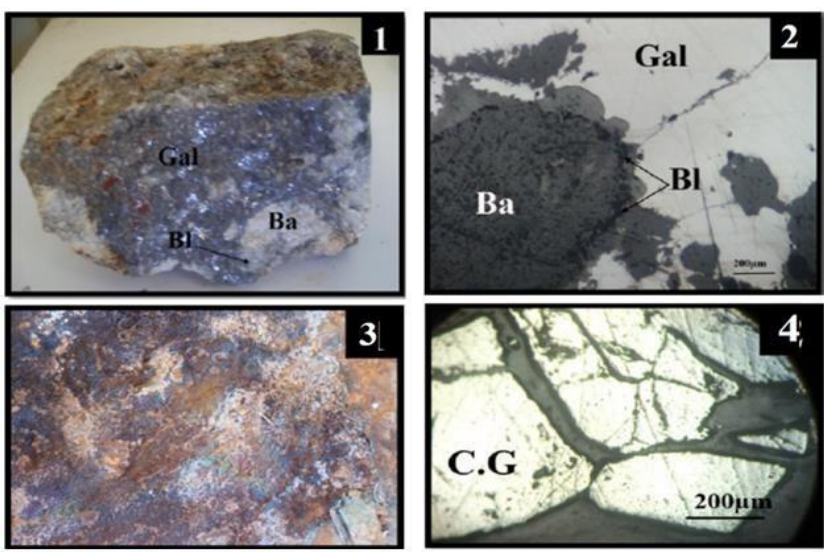

Figure 4. Macroscopic and microscopic appearance of polymetalic mineralisation. (Gal) Galena; (Bl) Sphalerite; (Ba) Barite; (C.G) Copper (Acording to [8]and [9]).

The cases of their spatial individualization allow to integrate them in a paragenesis independent of the other mineralizations. The massif of M'cid Aïcha and Kef Sema have a great variety of mineralizations compared to the other massifs of the Numidic chain. The Sidi Marouf massif contains only iron mineralisation with some trace of grey copper [11, 12, 13, 14, 15 and 16].

Tissimiran massif contains iron mineralisation with grey copper mineralisation [14, 17]. The Kef Darja massif contains only copper-barytic mineralisation [14, 18]. The mineralisation of M'cid Aïcha is hosted in carbonate rocks of the Lower Lias, as is the case in all the massifs of the Numidian chain [8, 9, 15 and 16].

These carbonate rocks range from Sinumerian to DomeroToarcian [6]. The iron mineralisation existed in the massif of Kef Sema, Tissimiran and Sidi Marouf. It has a lenticular morphology, lenticular and in clusters in the massif of M'cid Aïcha and Kef Sema [8, 9 and 10]. In Tissimiran it comes only in vein or in clusters [10, 14 and 17]. In the massif of Sidi Marouf, it is in the form of clusters, veins or nests [10, 12, 14, 15 and 16]. The iron mineralisation is more numerous and of greater size in the Sidi Marouf massif than in the other massifs [10]. It is always represented by oxides and hydroxides (hematite, goethite and limonite). The Plombo-Zinciferous mineralisation is found only in the massif of M'cid Aïcha and Kef Sema.

CONCLUSIONS AND RECOMMENDATIONS

The massif of M’cid Aicha consists by three carbonate liasic sets from the Sinumerian to Domero-Toarcian. This massif also contains iron occurrences in the form of oxides and hydroxides. It has the same morphologies and textures in all the massifs. The iron mineralisation is controlled by transverse faults. Iron paragenesis is individual and prior to polymetallic paragenesis. The polymetallic mineralisation is composed of sulphides (galena and sphalerite and grey copper) with barite. All these minerals come in massive texture. Lead and zinc mineralisation is found only in the massif of M'cid Aïcha and Kef Sema.

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IMPACT OF WASTE ON THE ENVIRONMENT STUDY OF POLLUTANTS STATISTIC AND SOLUTIONS: CITY OF CONSTANTINE, NORTH-EAST OF ALGERIA

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Abstract: *Daily human activity poses many problems for the environment because of the waste it leaves, the study conducted on solid and liquid household waste located in the city of Constantine, Northeastern Algeria. Regardless of a manufacturer or consumer, especially in the absence of dissuasive laws for such abuses. A solid and liquid sampling was carried out on the waters and sediments of the main wadi Rhummelwhich crosses the city of Constantine from the South to the North, the hydrochemical results show an increase in the rate of heavy polluting metals from upstream to downstream, Pb 0.15 mg/l, Cr 1 mg/l, Ni 0.80 mg/l. These metals are also revealed by X-ray diffractometric analyses. The spread of heavy metals in water poses a major threat to people's lives, requiring a quick and effective solution. The statistical analysis showed in El-Khroub and Ali Mendjli the two main municipalities are the most waste-producing district, while Ben Badis comes in last place. In 2019, total waste received at the Technical burying center of Bougharb 32623.37m^3 and 1533.62 T/month for inert waste where it receives about 700 tons of waste. The daily discharge and treatment of this waste in the Technical burying center of Bougharb lead to many nuisances for the environment. This wide dispersion of waste represents a major threat to citizens and requires strict decisions and a rapid solution to stop and eliminate these pollutants.*

Key words: *Waste, CET, pollution, Environment, wadi Rhumel.*

INTRODUCTION

Our planet is dying, day by day this planet is dying because of human waste. Different types of wastes are spreading terribly in the world due to unconscious behavior of people, whether they are consumers or manufacturers. Waste constitutes a major direct or indirect threat to human life and living beings. Algeria, like the rest of the countries in the world, suffers a lot from pollution due to the indiscriminate dumping of waste and the lack of awareness, especially in the big cities. The pollution makes a major threat to all living organisms without exception. In last years, Algeria has experienced a significant increase in population and factories, which has a negative impact on the environment, especially with the lack of awareness and the lack of waste disposal centers. Several studies have been done on the risk of pollution where many works have proven that when pollution is important, the number of species decreases as well as their recovery rate as in [1, 2 and 3]. Using of remote sensing by using high and medium resolution images and GIS [4] and statistical PCA analysis [5] help in the analysis of water pollution. In order to contribute to the fight against pollution, the aims of this work are to establish a study on the waste that is collected in the city of Constantine to know the source of some heavy metals' pollutant, type and causes of propagation of this waste, study its consequences on the environment and society in this city.

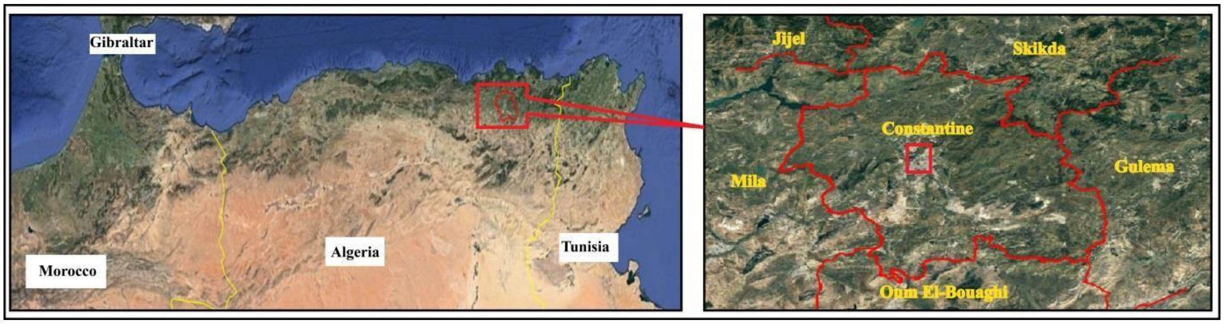

Figure 117. Location of the studied area in Constantine city (google earth 2020).

MATERIALS AND METHODS

This study, conduct field studies where we made a complete census of the waste of the city of Constantine years 2019 received at the level of the technical cent of burial of Boughareb where we took solid and liquid samples on the discharge of Wadi Rhumel. Where it passes on the downstream points until the upstream of which one passes by SETP El Hama, El Mania, club of lawyers towards Ain Smara. For solid samples numbered plastic bags were used and then placed in the bags and sealed. Liquid samples are placed in 4 plastic bottles 1500 ml. The treatment of the solid samples is done at the level of the laboratory of physical and chemical research of the University of Mentouri Brothers where these samples are studied by the DRX. The analysis of the liquid samples is done at the level of hydrogeological laboratories of the faculty of earth science where the physical-chemical analyses were done with the volumetric method.

STATISTICAL ANALYSIS AND GRAPHICAL PRESENTATION

During the year 2019, the technical landfill cent received two types of waste: inert waste from the landfill of Ali Mendjli where the average value of this waste reached 1087.44 T/day and 32623.37 m^3/month. The month of February recorded the highest value of this type of waste with a total of 66110.35 m^3, while July came last with a total of 18454.5 m^3 (Fig.2 A). The second type of waste received in the technical landfill cent is the household waste where the average value of this waste was 51.12 T/day and 1533.62 T /month. The highest value of this type of waste recorded in the month of March while the lowest value recorded in the month of June (Fig.2 B). During the year 2019, the commune of El-Khroub recorded the highest valueof dumped waste with an average of 58358.9 T followed by the commune of Constantine with an average value of 42820.75 T, while the commune of Ibn Badis came at the last place with an average value of2677.5 T (Fig.2 C)

RESULTS AND DISCUSSION

Physical-Chemical Analyses

Chemical analyses were carried out according to Algerian standards of temperature, conductivity and concentration of chemical elements in the water. From these analyses we notice that the temperature is about 13.7-13.9°. The conductivity varies between 1748µS/cm and 1882µS/cm where the highest values recorded on the on the wadi Rhumel due to a high amount of dissolved salts coming from the domestic discharges of the agglomeration of Ain Smara. In all cases the temperature and conductivity do not exceed the standards.

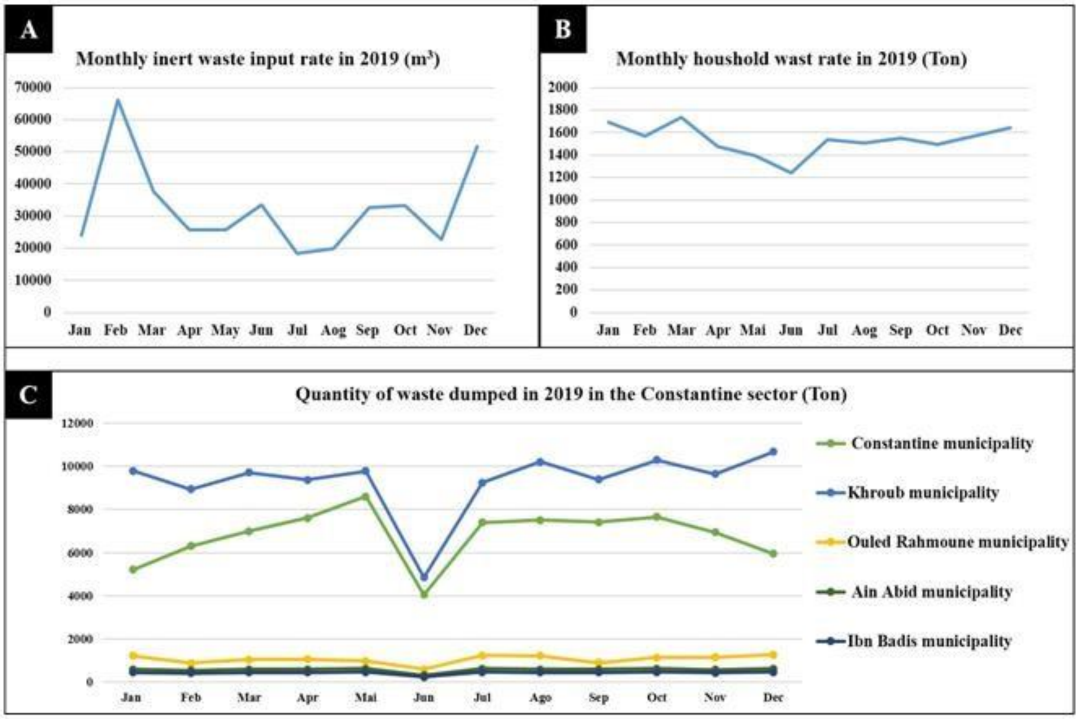

Figure 2. type and quantity of waste in 2019 in the city of Constantin. A/ Monthly inert input rate in 2019 (m^3); B/ Monthly household waste rate in 2019 (Tone); C/ Quantity of waste dumped in 2019 in the Constantin sector (Tone).

The values of calcium (Ca^{2+}) are between 144.28 mg/l and 165.13 mg/l, these values do not exceed the standards. The source of calcium is mainly the carbonate rocks; it also comes from the gypsum contained in the clayey rocks. The magnesium (Mg^{2+}) values do not exceed 63.18 mg/l, these values are the result of the dissolution of dolomites and gypsiferous soils by water. The water in the study area is very hard, with total hardness values ranging from 55°F to 64.4°F. The values of sodium (Na^{+}) are between 110.7 mg/l and 140.76 mg/l, sodium ions are the result of the alteration of silicate minerals in clays or of industrial and domestic wastewater discharges. Chlorides (Cl^{-}) have several sources: alteration of silicate minerals, evaporation or from chemical fertilizers and industrial discharges. The values of sodium (Na^{+}) are between 110.7 mg/l and 140.76 mg/l, sodium ions are the result of the alteration of silicate minerals in clays or of industrial and domestic wastewater discharges. Chlorides (Cl^{-}) have several sources: alteration of silicate minerals, evaporation or from chemical fertilizers and industrial discharges. The values of chlorides are between 184.6 mg/l and 202.35 mg/l. Sulphate (SO_4^{-2}) comes from the alteration of evaporitic rocks, organic matter or chemical fertilizers and industrial waste. Its values vary between 288 mg/l and 404 mg/l. Bicarbonate is found in carbonate soils. For the waters of our study area, the concentrations of bicarbonate range from 297.68 mg/l and 353.8 mg/l. The metallic elements Zinc (Zn) and Copper (Cu) are found in trace amounts where the high value does not exceed 0.9 mg/l for Zn and 0.7 mg/l for copper (Table 1). the hydrochemical results show an increase in the rate of heavy polluting metals from upstream to downstream, Pb 0.15 mg/l, Cr 1 mg/l, Ni 0.80 mg/l The results show a strong values of previous elements except bicarbonate are recorded at the level of the lawyer's club which is downstream of the agglomeration of Ain Smara. From these results, it is concluded that the high proportion of these elements is due to the industrial discharges of Ain Smara. We also note from the calculation of the content of Wadi Rhumel water in biodegradable organic matter that these waters are too polluted where the origin of this pollution can be domestic and industrial since it is downstream of the agglomerations.

Table 1. Results of physical-chemical analyses

		STEP El Hama	El Mania	Towards Ain Smara	Lawyer's club
Temperature °C		13.8	13.7	13.9	13.9
Conductivity µS/cm		1778	1748	1884	1882
Total hardness me/l		11.28	11	12.8	12.88
Ca^{2+}	me/l	7.21	7.41	7.53	8.25
	mg/l	144.2	148.2	150.6	165
Mg^{2+}	me/l	4.06	3.58	5.26	4.62
	mg/l	48.78	43.2	63.18	55.84
Na^{+}	me/l	6.12	5.98	4.79	6.12
	mg/l	140.76	137.54	110.07	140.53
HCO^{-3}	me/l	5.8	5.24	4.9	4.88
	mg/l	353.8	319.64	298.9	297.68
SO^{-2}	me/l	6	6.54	7.25	8.41
	mg/l	288	314	350	404
Cl^{-}	me/l	5.6	5.2	5.4	5.7
	mg/l	198.8	184.6	195.7	202.35
Zn	mg/l	0.07	0.07	0.08	0.09
Cu	mg/l	0.006	0.006	0.006	0.007
DBO_5	cm	10	20	15	10
Pb	mg/l	0.1	0.15	0.08	0.09
Cr	mg/l	0.9	1.0	0.8	0.85
Ni	mg/l	0.70	0.80	0.65	0.70

esults of XRD Analyses

Five representative samples were subjected to XRD, the analyses of these were carried out in the laboratories; Mentouri Brothers University. These five samples were analyzed by using XRD and the diffractogrammes specters. The analyis was done by a software Match 3 (evaluation version) which is used to determine the x-origin that puts the values of each peak and is represented by a value of 2θ. After the various calculations of the important lines in each spectrum, these are stripped using ASTM (American Society for Testing Minerals) files, using the list of minerals encountered in evaporitic deposits. The X-ray results confirmed that the samples taken on the edges of Wadi Rhumel downstream to upstream contained large amounts of quartz and calcite, and also confirmed the deposition of pollutants, which are heavy metals, on the soil of Wadi Rhumel which is represented by Chromium, Zinc, Lead, Arsenic and copper. (Figure 3)

The presence of some metals with low concentration like Zinc and copper does not mean they are is a sign of pollution [10, 11]. These concentrations are the result of urban effluents [12]. As for the water of Oued Rhumel, the of these high concentrations of heavy metals is the industrial discharges of Ain Smara.

CONCLUSIONS AND RECOMMENDATIONS

The current situation in the city of Constantine requires efforts from everyone to reduce the spread of waste where waste is terribly widespread in Constantine. The proportion of waste increases in the denselypopulated areas where the commune of El-Khroub and Constantine is recorded the highest values of waste. Temperature, conductivity and chemical elements (Ca^{2+}, Mg^{2+}, Na^{+} CL^{-}; HCO^{-3} and SO4-2) have highvalues especially in the Lawyers' Club due to industrial discharges from Ain Smara. The metallic elements (Zn and Cu) are found in traces. The analyses of the samples by XRD confirmed the pollution of the waters of Wadi Rhumel where the values of quartz and calcite are very high. These analyses also showed high proportions of many heavy metals (Zinc, Lead, Chromium, and Arsenic). For this reason, the state must develop quick solutions to reduce the spread of waste by establishing strict laws, recruiting all means and raising awareness to fight against this pollution. The solid waste can be eliminated by recycling it. The discharges of Ain Smara must be filtered in order to remove or decrease the concentration of elements.

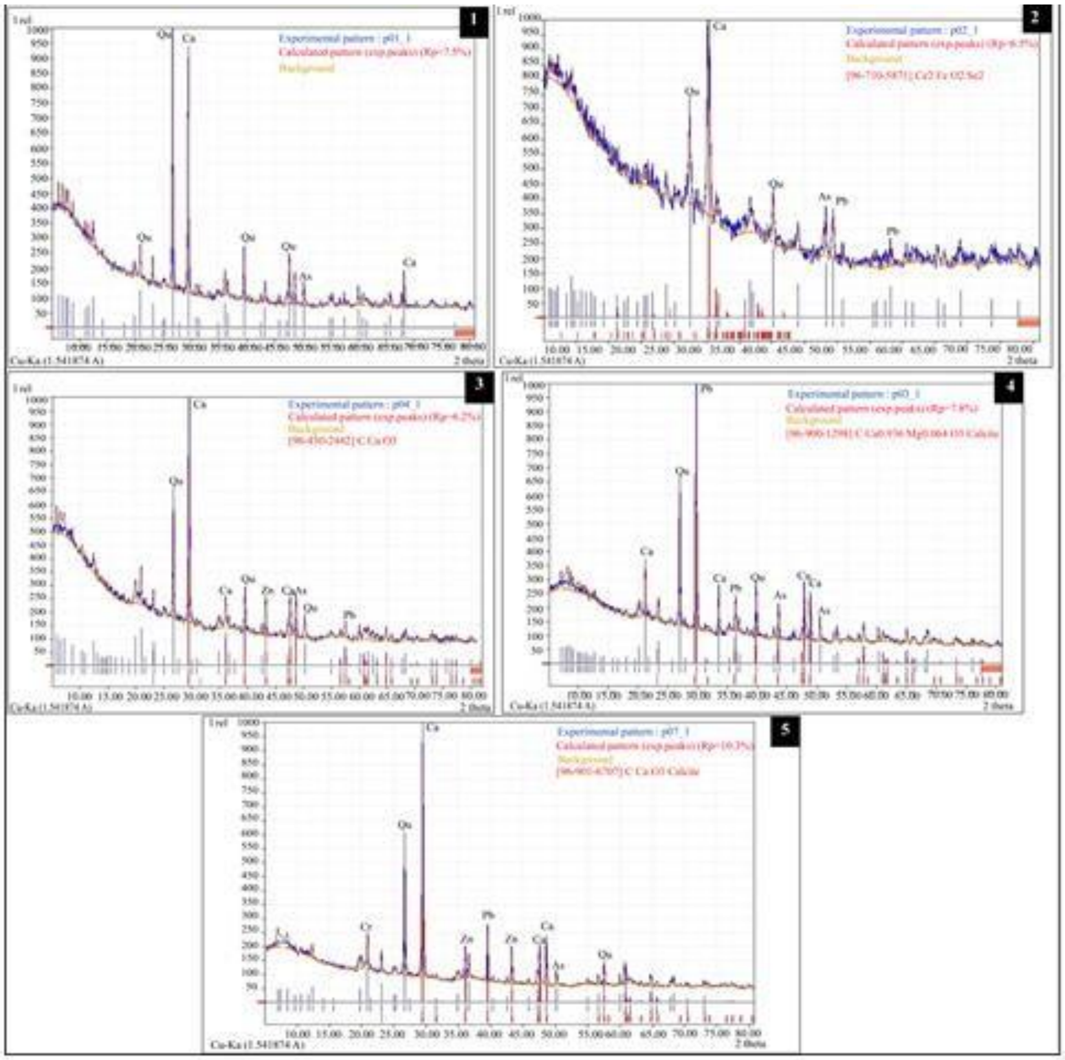

Figure 3. DRX spectra of samples taken from Owed Rhumel. 1/ samples of STEP el Hamma; 2/ samples of El Mania; 3/ samples from lawyers' club; 5/ samples of Ain Smara; 5/ samples of Lixivia. (Qu) quartz; (Ca) calcite; (Zn) Zinc; (Pb) Lead; (Cr) Chromium; (As) Arsenic; (Cu) Copper

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EFFECT OF ADDING POTASSIUM HUMATE AT DIFFERENT LEVELS OF MOISTURE TENSION IN SOME PHYSICAL PROPERTIES OF SOIL AND IN GROWTH OF ZEA MAIZE

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Abstract: The need to determine the ideal moisture tension for maize growth is significant, because the plant's response to water is more related to moisture tension compared to any other single factor and studying the effect of theinteraction with the optimal level of potassium humate, considering it a rapid organic intervention that improves the physical and hydrodynamic properties of the soil and increases the nutrients use efficiency Accordingly, A pot experiment was conducted on a clay silty soil to study the effect of different levels of potassium humate (POWHUMUS WSG 85) (0.6-1.8-3.6 kg/d) at different levels of moisture tension (400-600-800 millibar) on the physical properties of clay silty soil growing maize. The results show that soil bulk density was significantly decreased at 400 millibar in all levels of potassium humate added by 0.05-0.1-0.17 g/cm^3 respectively. Increasing moisture tension to 600 and 800 millibar and not receiving humate, bulk density decreased by 0.08 -0.13 g/cm^3 compared to the moisture tension 400 millibar treatment. The experimental constants (a) and (b) in $\psi=a\theta^b$ increased as the level of humate addition was increased at all levels of moisture tension. Moreover, leaf area of maize plant at the same moisture tension increases with the increase of humate addition reaching the highest value of 2476 cm^2 at 600 millibar and 1.8 kg/d. This study suggests that potassium humate has the potential to increase, nutrient uptake by improving soil physical properties. However, it recommends the application of this material for corn at the rate of 1.8 kg/d on a clay silty soil.

Keywords: *Available water; bulk density; clay soil; Potassium humate; moisture tension; moisture content; Zea*

INTRODUCTION

Physical and water properties of the soil occupy an important place in the overall agricultural operations aimed to improve soil fertility and productivity, and the physical properties related to soil productivity can be divided into two parts**:**
1) Directly related to plant development (water, oxygen, soil resistance to penetration, heat)
2) Indirectly related (texture, porosity, structure, bulk density) [1].
In this context, organic matter plays the main role in improving the physical and fertility properties of the soil. The addition of organic matter to the soil relieves the most of problems associated with dry areas, and results in a good soil structure, which facilitates agricultural operations, and improves the transport of nutrients and water for crops [2], organic matter application (from various sources) improves soil porosity, soil moisture, and reduces soil compaction [3] In addition, Soil structure also affects the transfer of fluids, gases, and heat, as well as physical processes such as seepage and aeration [4]. However، Plant growth and development do not occur unless the soil is adequately aerated [5]. The effects of organic manure on physical properties vary depending on the type and quantity of used materials and according to the type of

soil and its management [6]. Humic compounds constitute 50-80% of soil organic carbon [7] and humic acids are among the most prevalent organic compounds on Earth, as they are found not only in soil but in cow dung, sewage, compost, algae, brown coal (lignite) and other miscellaneous sediments [8]. They are compounds that are resistant to microbial degradation due to their complex and highly random structure [9] and it has high ability to form complexes with soil minerals 10]. It acts as a cushion and interface between the nutrients in the soil and the plants' roots, as these substances increase the growth of plants directly and indirectly. Plants can absorb elements faster from humic substances such as nitrogen, phosphorous, potassium, calcium and magnesium, or encourage changes in the availability of these elements in the soil, which increases soil productivity from the crop yield of the cultivated plant [11]. Humic compounds improve structure stability at low addition rates; therefore, it has better performance than animal manure [12]. According to Tahir et al. [13], adding 1 kg of humic acids (HA) has a benefit equivalent to 1 ton of manure (for example, cow dung), which needs a long time to dehumidify. The improvement in soil structureresulting from the addition of humic materials, including humic acids, affects the movement of water and airthrough the soil, and thus the ability of the soil to maintain life and perform its other vital functions. As it well-known it impacts the interactions between soil and atmosphere within multiple temporal and spatial scales [14].

The main problem in dryland soils management is the low availability of soil moisture so that the soil is no longer able to support the growth and productivity of crops [15]. Studies have shown the advantages of using moisture tension in soil moisture management [16], which allows determining the moisture content to be maintained for a particular crop in soils with different physical properties. Rawls and others [17] found that the relationship between moisture tension and organic carbon content was affected by soil texture and this effect is greater at moisture tension -kpa33, where the percentage of available water increased by an average of 22% when adding 10 kg/dunum of potassium humate 18].The plant is directly affected by the moisture tension in the soil, according to the prevailing climatic conditions affecting evapotranspiration, as the actual evapotranspiration decreases with the increase in moisture tension, and the water deficit appearsin the plant (Ibrahim and Barakat, 2013) [19].

The relationship between soil structure, moisture tension and evapotranspiration in the soil has great importance, especially for drought-sensitive crops with high water needs, including maize [20]. In any case, water requirements in crops, including corn, differ according to the stage of growth, maize requires less water in the early and late stages of growth, while the peak water requirement is during a period of two weeks before and after the expulsion of the flowering inflorescence [21]. Rivera-Hemandez and others [22] have shown that the appropriate moisture tension for sweet maize is about 30 kpa.

On the other hand, the proportion of these materials in the soil decreases with the passage of time due to the prevailing climatic conditions and the intensive investment of the soil [23]. Furthermore, studies recommend a careful and sustainable use of organic matter sources. For this reason, it was thought to use potassium humate, because it constitutes the largest part of the organic matter in the soil and provides an easy source to use and transport due to its application in very small quantities. It has proven its worth in improving the soil and reducing the impact of drought on plants [24]

In addition to provide a suitable medium for nutrients absorption within the soil-roots-plant system, and compensating the deficiency and deterioration of the soil. In contrast, moisture tension and soil moisture content play a prominent role in improving the efficiency of using organic materials through its effect on the structure stability through wetting and drying cycles, and thus affecting the absorption of water andnutrients. To confirm the uncertainty regarding the best application rate of potassium humate to the soil and the role of moisture tension, the current study was conducted using different rates of humate (from very low to very high) at gradual levels of moisture tension (above the permanent wilting point) on the growth of maize plant. However. This study would shed some light on the effect of potassium humate application rates at different levels of moisture tension on the physical and hydrodynamic properties of soil, and their effect on the growth of maize plant. Moreover, determination the hydrodynamical constants of the studied soil at different levels of potassium humate and moisture tension.

MATERIALS AND METHODS

Experiment materials

Soil: The soil was collected from the Scientific Research Center (Stkhers) from the topsoil (10 cm), which is a transferred clay soil.

Table 1. Main physical and chemical characteristics of clay silty soil

Analysis	Result	Used method
(0.002 < mm) clay)%(	45.79%	pipette (Bernharat,1967) [25]
(0.002–-0.05 mm) silt)%(	50.61%	
(0.05– 2 mm) sand)%(	3.6%	
Soil type	clay silty	German texture triangle (TGL,1985) [26]
Organic matter	0.72%	Wet Digestion, Ryan et al)2003([27]
Calcium carbonate	39.5%	Calibration Ryan et al)2003(
Effective lime	15 %	Doreno, Ryan et al)2003(
Cation exchange capacity	35.6 me/100g soil	Sodium acetate Ryan et al)2003(
Field capacity % volume	35	Membrane pressure device (Eijkelkamp Agrisearch Equipment 6987 ZG Giesbeek)
wilting point % volume	22	
True density	2.6	The pycnometer (Ibrahim and Barakat, 2013)
Inorganic nitrogen	24 ppm	Keldahl, Ryan et al)2003(
Available phosphor	12 ppm	Olsen, Ryan et al)2003(
Available potassium	422 ppm	Ammonium Acetate Ryan et al)2003(
pH	7.53	

Plant material: American yellow corn cultivar F1 Taxon hybrid.

Potasium humate: available under the trade name POWHUMUS WSG 85 was used, which consists of 65% organic matter, of which 80-85% potassium humate, 10-12% potassium oxide K_2O, 1% organic nitrogen, and 1% iron, according to the manufacturer on the packaging cover.

Determination of moisture tension levels in soil

The following moisture tension levels (ψ) are set using a hygrometer LUTRON –PMS-714 :

20. Ψ1 :at 400 milli bar (90% of field capacity)
21. Ψ2: at 600 milli bar (85% of field capacity)
22. Ψ3: at 800 milli bar (78% of field capacity)

Where the device is calibrated at different levels of moisture and moisture tension and the equation was as follows:

$$Y=1.1736x-11.872 \quad y: \text{ device's reading, } x: \text{ moisture content} \qquad R^2=0.9986$$

The moisture content was calculated by the device's reading and the amount of water to be added to the pot was calculated to raise the moisture to reach the level corresponding to the appropriate moisture tension (Figure 1).

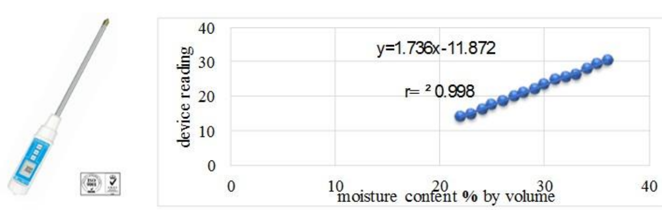

Figure 1. Calibration curve for hygrometer

The device is placed vertically within the soil, taking into account complete contact with the soil at a depth of 10 cm, to determine the soil moisture after knowing the reading of the device. After that, the amount of water to be added to reach the required moisture tension was calculated according to the following equation:

$$\Delta H2O = (\frac{M2+100}{M1+100} - 1) . Mm$$ (Ibrahim and Barakat, 2013)

ΔH_2O: The amount of water to be added to raise soil moisture from one specific moisture to another required one

$M2$: required moisture $M1$:current moisture Mm: Soil weight with current moisture

Experiment design

The Experiment design included studying the effect of 4 rates of potassium humate (0-0.6-1.8-3.6 kg/dunum), and three levels of moisture tension (400-600-800 millibars) and thus there were 12 treatments, four treatments of humate at each level of moisture tension, and each treatment has three replicates, according to the following Table 2.:

Table 2. The treatments

Moisture tension level (Milli bar)	Potassium humate rate kg/dunum	Replicates
400	M0 = 0	X 3 = **36** pots
600	x M1 = 0.6	
800	M2 =1.8	
	M3 =3.6	

Humate application was after dissolving it with irrigation water. The application rates were distributed in two batches:
First: 50% of the application rate a month before planting
Second :50% of the application rate after month and a half of planting
The allocated amount for each pot was calculated based on the weight of the soil in 1 dunum at a depth of 10 cm after knowing the bulk density of the soil as follows:
MS=$\delta d. 1000. B. F$
MS: Totally dry soil weight for 1 dunum at a depth of 10 cm ،
δd : bulk density 1000: conversion number B: depth (m.) F: area
Thus, the weight of the soil per square meter can be calculated as follows
0.8*1000*0.1*1000 =80000 kg/d/10 cm depth=80 kg/m2
Thus, humate treatments at the studied moisture tension treatments in 6 kg soil pots are as follows:
M0 pots have not received any humate
M1 (0.6 kg humate/d) pots received 0.045 g of humates distributed in two batches
M2 (1.8 kg humate/d) pots received 0.135 g of humates distributed in two batches
M3 (3.6 kg humate/d) pots received 0.27 g of humates distributed in two batches

Experiment preparation for cultivation

In the experiment, pots with a capacity of 8 kg, a diameter of 23 cm and a depth of 23.5 cm were used, so that the surface area was 0.0415 cm 2 and 6 kg of completely dry soil was placed in each pot. Phosphorous and potassium fertilizers were added in the full fertilizing dose after mixing with the soil, calculated according to the fertilizer formula: 40_80_120 (Roqaia et al., 2005) [28]
Each pot received 0.723 g/pot potassium sulfate and 2.98 g/pot triple superphosphate. Pots were distributed to the experiment square according to the randomized complete block method. They were watered with normal water until they reached the field capacity and left for a month until planting time .The planting was done by placing corn seeds at a depth of 2-2.5 cm on 26/7/2017 at a rate of 5 seeds per pot, where the first nitrogen fertilization dose was added in the form of urea 46% N (one third of the quantity at a rate of 0.65 g/pot) from the basic amount of 1.95 g /pot

Germination began after a week and was completed after 11 days, and germination percentage was 85%, and it was separated into 3 plants in the pot. After about half a month of germination, a plant was left in each pot.

Experiment Care

The second nitrogen fertilizer dose was carried out (Urea 0.65 g/pot after 15 days of planting) and the third dose (Urea 0.65 g/pot when the male inflorescence began to be expelled) and irrigation operations were carried out periodically. And that According to the needs of the moisture tension treatments under study, using ordinary water (sourced from the Tishreen 16 Dam).

Harvest Procedures

It was harvested 63 days after planting (the appearance of silk on the cones), where the growth parameters were recorded by cutting the plants from the soil level and the following measurements were taken**:**

Leaf area (Sakalova,1997) [29]

S = L.W.N.0.6

S: plant's leaf area cm^2 L: maximum leaf length W: maximum leaf diameter

N **:**leaves number Correction 0.6: coefficient for leaf area

After harvesting, samples of undamaged structure were taken using metal cylinders from all treatments with three replicates from each treatment to determine**:**

1**-** Bulk density**.**

2 **-**Available water:

We can determine the size of pores with a diameter of (0.2-10) μm as they contain the water available to the plant and play an important role in the transport and storage processes in the soil profile and play a prominent role in delaying the emergence of water deficit periods in plants during drought periods, which were identified in the membrane pressure device according to the law:

Pm=4σW/d (Ibrahim and Barakat, 2013)

σw: surface tension of water, d: pore diameter After that, the size of pores containing the available water (0.2-10) μm is determined:

PV% (0.2-10) μm=Wvol.pF2.5-Wvol.pF4.2

WvolPF2.5 the volumetric moisture at the end of the applicable pressure equivalent to the moisture tension pF2.5

WvolPF4.2 the volumetric moisture at the end of the applicable pressure equivalent to the moisture tension pF4.2.

Soil moisture characteristic curves by pressure membrane at (pF=1.8-2.5-3-3.5-4-4.2)

Soil moisture characteristic curves show the relationship between moisture tension (i.e., water holding force) and volumetric moisture in the soil. Soil moisture characteristic curves were determined using a membrane pressure device by applying increasing pressures starting from the pressure (pF1.8 - pF2 - pF2.5- pF3 -pF3.5 - pF4.2) using soil cylinders with a height of 4 cm, where the moisture content is calculated at different moisture tension levels and the corresponding averages of moisture are determined and these values are processed by computer The relationship between ψ and θ was of the form: $\psi=a\theta^b$(Gardner et al.,1970) [30] .After determining the moisture content at different levels of pressure, the following relationships are reached at all levels of potassium humate addition and moisture tension levels .

Saturated hydraulic conductivity:

Saturated hydraulic conductivity is considered one of the most important hydraulic properties of soil which is the ratio of flow to hydraulic stress gradient. This parameter is greatly affected by the size of the total porosity, especially the size of the pores with a diameter greater than 10 microns, and the degree of straightness of these pores (Suleiman and Ritchie,2001) [31]. It is also affected by the carbon content in the soil (Wang et al.,2009) [32].

Determining this parameter is very difficult due to the manifold of the pore system in the soil in addition to the variations in the shape and length of the tubes, where the amount of water flowing in the soil section is proportional to the fourth power of the pore radius described in the relationship:

$$q=\pi r^{(4)} (\Delta P/8\eta L)$$

L: Pore length (cm) r: Pore radius (cm), ΔP: height (H1-H2)*g*δw δw: water density g/cm^3 g:earth's gravitational acceleration cm/sec^2
(H1-H2): hydraulic height η:g/cm*sec water viscosity ,q: the amount of water flowing (cm^3/sec)
Thus, a small increase in the diameter of the pores is accompanied by a large exponential increase in the amount of water flowing, which is important to know the radii of the poresinvolved in the transfer processes. Sohnberg (1965) [33] determined Laboratory conductivity coefficient based on Darcy's law: Kf=q/Grad φH
q: the amount of water flowing through the soil section (m/d), Grad Φ: hydraulic gradient. Where the measurements were carried out for all samples at one hydraulic gradient and in the case of continuous flow). Also, samples of damaged structure were cut out to calculate the structure stability that were determined by the immersion method (Hartge and Horn, 1991) [34]. The average change in diameter of the secondary particles before and after immersion in water is determined according to the following equation:

$$\Delta GM = \frac{\sum ni.di - \sum na.di}{\sum ni} \text{(Hartge and Horn, 1991)}$$

ni: the weight of dry granules with diameter of di before wet sieving
na: the weight of completely dry grains with diameter of di after wet sieving
∑ ni: Weight the completely dry soil before wet sieving.

RESULTS AND DISCUSSION

The effect of potassium humate and moisture tension on bulk density

Bulk density is one of the most important physical properties of soil and it is a compound physicalcharacteristic through which it is possible to give ideas of water and air movement in the soil profile (Kunze and Petelkau, 1980) [35], which will have a reflection on plant growth and productivity (Petelkau, 1984)[36].
The table below gives a breakdown of soil's bulk density values under the effect of potassium humate and moisture tension. Overall, it can be seen that bulk density values decreased gradually with the increase in application rates of humates under all applicable moisture tension levels in the soil and the same figure was witnessed when moisture tension rose. Starting at 1.15 g/cm^3 bulk density value in the control treatment (400 milli bar, without humate), bulk density dropped significantly by (0.05 g/cm^3, 0.1 g/cm^3,0.17 g/cm^3) respectively. With the increments in application rates of potassium humate. Similarly, under both 600 millibar and 800 milli bar moisture tension, bulk density declined with the highest amendment of potassium humate (3.6 kg/dunum) by (0.1 g/cm^3) and (0.07 g/cm^3) compared to control (without humate). However, in treatments without adding potassium humate, moisturetension has a crystal-clear effect on reducing bulk density, this figure was by 0.13 g/cm^3 under 800 milli bar comparedto 400 milli bar moisture tension. This is due to the wetting and drying cycles of the soil, which positively affected the soil structure.

Table 3. Soil bulk density changes with humate levels and moisture tension

	M0	M1	M2	M3	$LSD_{0.05}$
Ψ1 400 milli bar	1.15	1.1	1.05	0.98	0.046
Ψ2 600 milli bar	1.07	1.04	1.02	0.97	0.05
Ψ3 800 milli bar	1.02	0.99	0.96	0.95	0.026
$LSD_{0.05}$	0.035	0.024	0.042	0.05	

These results are consistent with Mousa (2017) [37] which indicated a decrease in the bulk density with a steady increase in the application rate of potassium humate, and long and short-term studies indicate a remarkable linear relationship between the decrease in bulk density and the increase in organic carbon in the soil, which may be attributed to the additions of extracted humic acids (Bresson et al., 2001) [38].

Effect of potassium humate and moisture tension on the available water pore size (0.2-10 µm) in soil
Table (4) illustrates changes in pores size holding available water in soil under different levels of potassium humate and moisture tension. In general, the highest moisture tension distinguished with the highest values of pores size (0.2-10 µm) whatever potassium humate rate was. At 400 milli bar, pores size (0.2-10 µm) rises with the increasing of potassium humate rate under the same moisture tension until the first significant difference appeared by (5.47%) under 3.6 kg/dunum potassium humate application. In contrast, 600 mill bar moisture tension showed significant differences at (1.8 and 3.6 kg/dunum) by 2.75% and 5.32% respectively while the highest moisture tension started to response significantly at the first amendment rate by (2.9%, 3.98%,5.14%) respectively. Available water increases by 10.2% when humate is added by 250 g/dunum (Abdel-Razek,2011) [39]. Cristensen (1996) [40] clarified that potassium humate application for soil postponed plants wilt by6-9 days. This was explained on the basis of organic carbon ability to modify water adsorption sites on clay minerals.

Table 4. The pores size containing available water in soil under different rates of potassium humate and moisture tension

Pores size (0.2-10µm)	Application rate	Moisture tension
11.88	M0	Ψ1 400 milli bar
14.09	M1	
14.01	M2	
17.35	M3	
12.75	M0	Ψ2 600 milli bar
14.72	M1	
15.50	M2	
18.07	M3	
12.99	M0	Ψ3 800 milli bar
15.89	M1	
16.97	M2	
18.13	M3	
2.46	$LSD_{0.05}$	

The effect of potassium humate and moisture tension in Soil moisture characteristic curves and the empirical constants

Table 5. Soil moisture characteristic curves equations and empirical and selection coefficients constants

selection coefficients	Equation	treatment	Empirical coefficients	
			a	b
Ψ1M0	$\Psi=0.00088.\theta^{-11.1288}$	r2=0.96	0.00088	11.1288-
Ψ1M1	$\Psi=0.109.\theta^{-6.788}$	r2=0.74	0.109	6.788-
Ψ1M2	$\Psi=0.0458.\theta^{-8.028}$	$r^2=0.97$	0.0458	8.028-
Ψ1M3	$\Psi=0.13.\theta^{-7.119}$	$r^2=0.96$	0.13	7.119-
Ψ2M0	$\Psi=0.00916.\theta^{-8.994}$	$r^2=0.97$	0.00916	8.994-
Ψ2M1	$\Psi=0.0369.\theta^{-8.164}$	$r^2=0.98$	0.0369	8.164-
Ψ2M2	$\Psi=0.1016.\theta^{-7.141}$	$r^2=0.98$	0.1016	7.141-
Ψ2M3	$\Psi=0.719.\theta^{-6.09}$	$r^2=0.98$	0.719	6.09-
Ψ3M0	$\Psi=0.028.\theta^{-8.227}$	$r^2=0.96$	0.028	8.227-
Ψ3M1	$\Psi=0.213\theta^{-6.851}$	$r^2=0.99$	0.213	6.851-
Ψ3M2	$\Psi=0.206\theta^{-6.793}$	$r^2=0.98$	0.206	6.793-
Ψ3M3	$\Psi=0.371\ \theta^{-6.441}$	$r^2=0.97$	0.371	6.441-

Ψ :moisture tension (water column cm) ، θ :moisture content as part from one, Soil moisture characteristic curves were also illustrated according to graphic lines as shown in Figures (2-3-4).

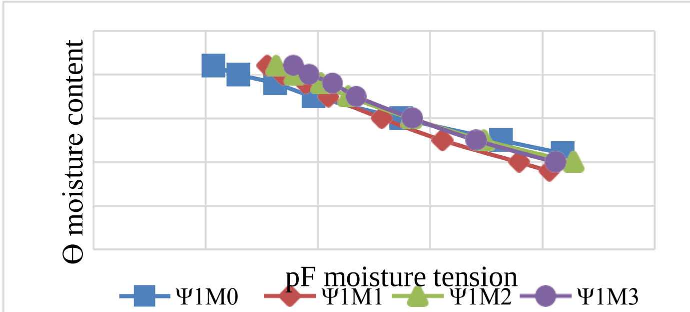

Figure 2. Soil moisture characteristic curves under different levels of potassium humate and moisture tension 400 milli bar

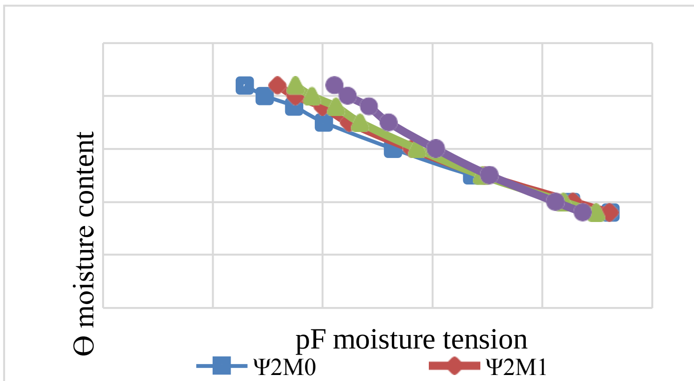

Figure 3. Soil moisture characteristic curves under different levels of potassium humate and moisture tension 600 milli b

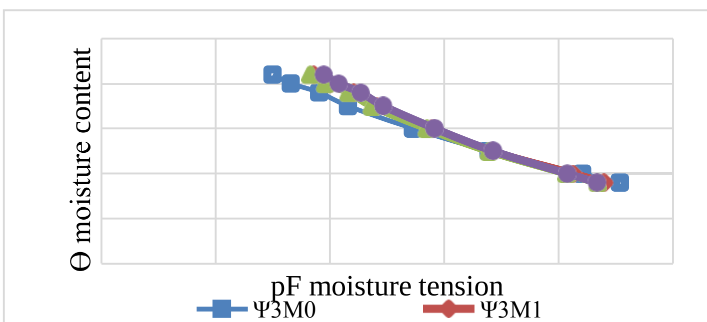

Figure 4. Soil moisture characteristic curves under different levels of potassium humate and moisture tension 800 milli bar

The soil's moisture content decreases with the increase of the moisture tension in all the studied treatments. It is also noted that with the increase in the potassium humate application rate at the same moisture tension, the moisture content in the soil increases as the humate increases the water holding capacity of the soil (Mackowiak et al., 2001) [41]. This rise is greater at low moisture tension levels. In conclusion, this indicates an increase in the soil's efficiency in water-holding capacity, especially the part called available

water table (5).
Equations in Table (5) indicate that empirical constants of soil (a) and (b) rise with the increase in the potassium humate application rate and the increase in moisture tension and this has a significant and positive effect during the movement of water by capillary action to the root system area. Usually, the water moving towards the surface of the roots is loaded with nutrients by the Darcy flow mechanism, which will positively reflect on the growth and productivity of the plant. (Mengle and Kirkby, 2001) [42]. The capillary channels also form the water column towards the surface of the roots, which forms a medium for the diffusion of the lowest concentration nutrients in the soil, and both mechanisms together increase the volume of the soil from which the plant benefits in absorbing nutrients (Marschner, 1995) [43].

Effect of potassium humate and moisture tension on saturated hydraulic conductivity
The table below states saturated hydraulic conductivity variations due to the application of humate and moisture tension in different levels. Overall, the saturated hydraulic conductivity coefficient was more affected by the humate application rate than by the moisture tension level.
Diving into more detalis, the first significant difference appeared at the moisture tension 400 milli bar for the (M3=3.6 kg/d) treatment with a high addition rate by (2.71 m/d) The high moisture tension 800 millibars took the same behavior until the first significant difference appeared by (4.17 m/d) at the same application rate of humate (3.6 kg/d) compared to the two treatments without adding humate. It is also noted that at the same application rate of the humate, the moisture tension did not have a significant effect on the saturated hydraulic conductivity. This may be due to the fact that the humate affected the distribution of the porous system in the soil in favor of intermediate pores over air pores that play a key role on the saturated hydraulic conductivity.
The use of potassium humate in the soil as an organic source led to improve the physical condition of the soil by improving the stability of the overall structure of the soil and reducing soil compaction, which leads to a decrease in the bulk density and an increase in soil porosity, and ultimately improving water infiltration (Zeleke et al., 2004) [44],which is reflected on the saturated conductivity, which increases with the increase in the potassium humate application rate(Ijaz et al.,2015) [45] .We can say that the positive effect of humate is due to the increase in the stability of the structure and not to the increase in the size of the air pores.

Table 6 :Saturated hydraulic conductivity (m/day) under the influence of different levels of humate and moisture tension

Application rate / Moisture tension	M0	M1	M2	M3	$LSD_{0.05}$
Ψ1 400 milli bar	3.91	4.85	4.65	6.62	1.82
Ψ2 600 milli bar	5.05	3.57	4.64	6.9	2.08
Ψ3 800 milli bar	4.25	5.23	5.31	8.42	1.99
$LSD_{0.05}$	2.7	2.56	1.47	2.28	

Effect of potassium humate and moisture tension on aggregates stability
Soil structure affects the water and air movement through the soil, which greatly affects the ability of the soil to sustain life and perform its other vital functions. Soil structure and high stability are important to improve soil fertility, increase agricultural productivity, and reduce erosion. Structure stability is a reflection of soil building because it depends on the balance of physical, chemical and biological factors (Brevik et al., 2015) [46]. The table below represents aggregate stability variations after the application of potassium humate and moisture tension in different levels.
In general, the structure stability was similar in its linear improvement for all levels of moisture with the gradual increase in the rates of humate application, as well as with the increase of moisture tension at the same rate of humate amendment.
It was found that structure stability gradually increased at the same moisture tension with an increase in the rate of humate application at all levels of moisture, which reached a peak of (1.35). at the amendment rate of

3.6 kg humate/d and a moisture tension (800 millibar) while at the same rate of humate amendment, the stability rises with the increase in moisture tension in treatments that received humate. Previous research also mentioned that the higher aggregates stability values were reached at the moisture tension values are 1000 cm water column (Alderfer and Merkle, 1942) [47]. And it is close to our moisture tension (800 millibars), perhaps this is due to the effect of wetting and drying cycles on the soil, as the soil whose moisture remains for a long time close to the field capacity (400 millibars) is affected negatively comparedto the soil that is exposed to wetting and drying at a moisture tension greater than 400 mbar (Hartge and Horn, 1991), although the aggregates stability remained within the medium range 1.2-4.5.
In this regard, organic matter contributes to stability by reducing wetting by increasing the hydrophobicity of the complexes (Caron et al., 1996) [48], and stability occurs as a result of the formation of complexes between humates and clay that protect the soil from the effects of dispersal [18]. The high specific surface has a high affinity for adsorption of humic compounds, thus stabilizing aggregations (Caravaca et al., 1999) [49]. Piccolo et al. [18] recorded increments ranging from 40% to 120% in the structure stability of a number of dry and semi-dry soils in the Mediterranean basin at low application rates for humate 0.1-0.05 g humate/kg soil.

Table 7. Aggregate stability (mm) under the influence of different levels of humate and moisture tension

	M0	M1	M2	M3
Ψ1 400 milli bar	2.59	2.29	2.22	2.14
Ψ2 600 milli bar	2.05	2.14	1.86	1.76
Ψ3 800 milli bar	2.08	1.95	1.85	1.35

Effect of potassium humate and moisture tension on the leaf area (cm^2)
The leaf area plays an important role in light interception, which has a significant impact on growth, respiration, and dry matter accumulation processes. Table (8) shows the leaf area of corn plants after 63 days of cultivation under the effect of different levels of potassium humate and moisture tension. Overall, Corn leaf area differed in its response to potassium humate and moisture tension. In addition, it shows that the leafarea increases at the same moisture tension with the increase in the humate rate addition, whereas, leaf area diminished significantly at the same application rate with an increase in moisture tension to (800 millibars) at the control treatment that did not receive humate and at the high addition rate when compared to the low tension (400 millibars).
To be more specific, at 400 millibars the first significant response to moisture tension was at the high rate of addition (M3=3.6 kg humate/dunum) while at 600 millibars the significant response to moisture tension started from the first rate of potassium humate, and continued until the highest rate of application reaching a summit of (2476 cm^2) at (M2=1.8 kg/d). This seems consistent with Gomaa et al. (2014) [50] who found that plants that received an application rate of 1.4 kg humate/dunum had the highest indicators of vegetative growth such as leaf area and plant height.
However, the increase in the growth properties of humate treatments may be due to the improvement in the absorption of major elements such as nitrogen, phosphorous and sulfur, as well as the case for microelements (Fe, Mn, Cu, Zn) (Chen et al., 1999) [51].
In the same vein, the response to humate continued with an increase in moisture tension to 800 millibars until the highest added rate of 3.6 kg/dunum. At 800 millibars, the leaf area was less than at 400 and 600 millibars, and this may be due to water stress in the soil that led to the decrease in the leaf area.
This variation in the response to humates depending on moisture tension appears to be related to the texture of Celtic clay soils, which are able to retain good amounts of available water with an increase in moisture tension.

Table 8. Leaf area cm^2 after 63 days of cultivation

	M0	M1	M2	M3	$LSD_{0.05}$
Ψ1 400 milli bar	1677.8	1888.6	1632	2165.8	142.2
Ψ2 600 milli bar	1724.0	2158.6	2476.0	2051.1	205.5
Ψ3 800 milli bar	1055.1	1716.2	1639.8	1731.6	164.4
$LSD_{0.05}$	168.4	196.1	161.3	207.6	

CONCLUSIONS AND RECOMMENDATIONS

1. The results show that the soil's bulk density at all moisture tension levels decreased significantly with the increase of humate application rate in all treatments compared to the treatment without adding potassium humate
2. The available water percentage in the soil at the application rate of 3.6 kg humate / dunum increased by 5.47-5.32-5.14%, respectively, at the moisture tension levels (400-600-800 millibars) compared to the treatments for the same moisture tension and without the addition of humate.
3. The study showed that the empirical constants (a), (b) increase with the increase in the humateapplication rate at all levels of moisture tension.
4. The addition of potassium humate led to an increase in the leaf area with an increase in the application rate at the same moisture tension

Based on that, we recommend the following:

1. Conducting the study on other types of soils to find out the appropriate level of potassium humate in improving the physical properties of the soil.
2. Recommend the use of organic fertilizer (Humate) at a rate of 1.8 kg/dunum for maize plants on clay silty soil .

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EDUCATION TO SUPPORT THE DEVELOPMENT OF A CIRCULAR ECONOMY APPROACH

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Abstract: *Global environmental problems, wasteful over-consumption with the increasing volume of waste, growing and increasingly dangerous effects of pollutants released to the environment, depletion of raw material resources, all call attention that it's no longer enough to just talk about sustainability, but we need to act. It requires first of all a change in the approach to the economy and a turnaround to replace the linear management systems still widely used today with a waste-free system. The product of today is the raw material of the future. The implementation of circular economy requires long-term thinking covering the entire life cycle of products from the initial moment of design. It requires well-informed decision-makers who have all the competencies that help to validate the mechanism of natural ecosystems' operations in today's economic systems. Development of skills and abilities expects a change of attitude ineducation. Through education, such knowledge and values must be conveyed, skills and abilities essential for the realization of a sustainable society and economy must be developed, primarily the responsibility and ethical behaviourtowards the environment. This is supported by Environmental Pedagogy as an integrated, independent science and educational strategy for project teaching. The study presents an educational strategy that is also effective in developing the competencies needed to implement a circular economic approach.*

Keywords: *circular economy, competences, project education, sustainable development*

INTRODUCTION

In the concept definition of sustainable development, the Brundtland Commission stated in its report 'Our Common Future' (1987), that the economy can only grow by preserving the environment. However, the unresolved environmental problems of the past years call attention to the fact that the **need for economic growth has overridden the conservation of natural resources, making it increasingly** urgent to reinterpret the environmental dimension and thus the viability of a sustainable economy and society. Recognition of this fact prompts professionals around the world to take action and find ways to use raw materials and energy resources that are both environmentally and economically sustainable. It requires anew approach, especially in the economy. Instead of the linear economic model that typically works today,it is necessary to create a new material management and business model based on an exhaustive, finite number of resources. Main ambassador and supporter of this new economic model is the Ellen MacArthur Foundation, which, by introducing the concept of circular farming, aimed to create an economic model in which the value of products, materials and resources used in the economy was preserved and maintained foras long as possible, minimization is the main goal. [1] The circular economy no longer wants to lose (dispose as waste), but to preserve as much as possible the work and energy invested in materials and products during the production and economic processes (Figure1).

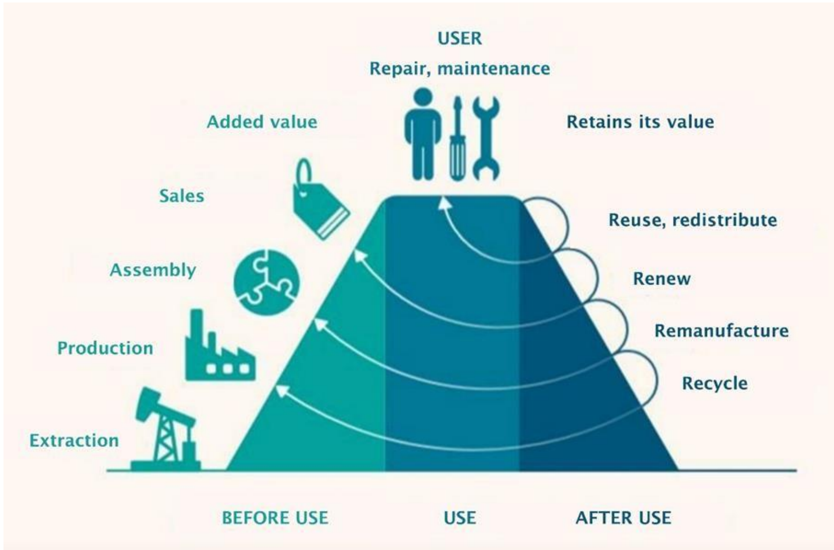

Figure (1) Flow of material in a sustainable world [2]

Definition Chapter in the Regulation 'Establishing a framework for the promotion of sustainable investment' of the European Parliament and Council defines the concept of circular economy as follows [3]:".. to preserve and maintain the value of the products, materials and resources for as long as possible andto minimize the generation of waste, including the application of waste hierarchy set out in Article 4 of Directive 2008/98 / EC of the European Parliament and of the Council".

Achieving this goal requires competencies like responsibility for the environment, creative and problem-solving thinking, interoperability, ability to innovate and, last but not least, environmental management approach. These competencies and their associated abilities, skills and attitudes are needed to achieve the main goal of keeping the value of the products and raw materials used for the longest time, minimizing waste generation and resource use, and creating new value by reusing end-of-life products. Necessary knowledge and development of competencies are the tasks of an educational process, where the main goal isnot to view development as a purely economic process or ecological threat, but as a series of rational and moral decisions. Sustainable development requires active, knowledgeable individuals and attentive, well- informed decision-makers, who can take the right steps the handle the complex, interrelated economic,social and environmental issues that arise in human society. The effectiveness of education for sustainable development can therefore be measured by the extent to which it changes people's attitudes and behaviour, both individually and in relation to their collective role and civic responsibilities. [4]

CIRCULAR ECONOMY

Nature itself provides a good example of a circular economy. No waste is generated in natural processes, as all by-products and end products are starting points of something. The ecosystem uses the energy of the Sun to keep the materials flowing through it at different speeds in a continuous cycle. This natural process can provide the basis for a sustainable economy, and this basic idea is reflected in the circular economy theory introduced by the European Union in 2015. [5] Circular economic theory aims to achieve a system in which there is no waste and the products of today are the raw materials of the future. Its primary goal is to validate the mechanisms of natural ecosystems in the economic systems of our time. [6]

In the linear economic model used today, products are produced from natural resources and primary raw materials, which become waste after use. Leaving the system, the available - non-renewable - natural resources are constantly decreasing. (Figure2)

Figure (2) Linear economic model [7]

In the circular economy, on the other hand, the products are returned to the production in the same or processed form. This may be a known process, as selective waste collection or recycling has already appeared in economic processes. However, experience shows that they are not solutions for waste management on their own: due to wear-and- tier of the materials and the limited reuse opportunities. Circular economy complements and creates a closed material process by counting what the product will become once the user discards it during product design. (Fig.3) shows the implementation of a closed recycling cycle in the textile industry in which resources are not consumed but used.

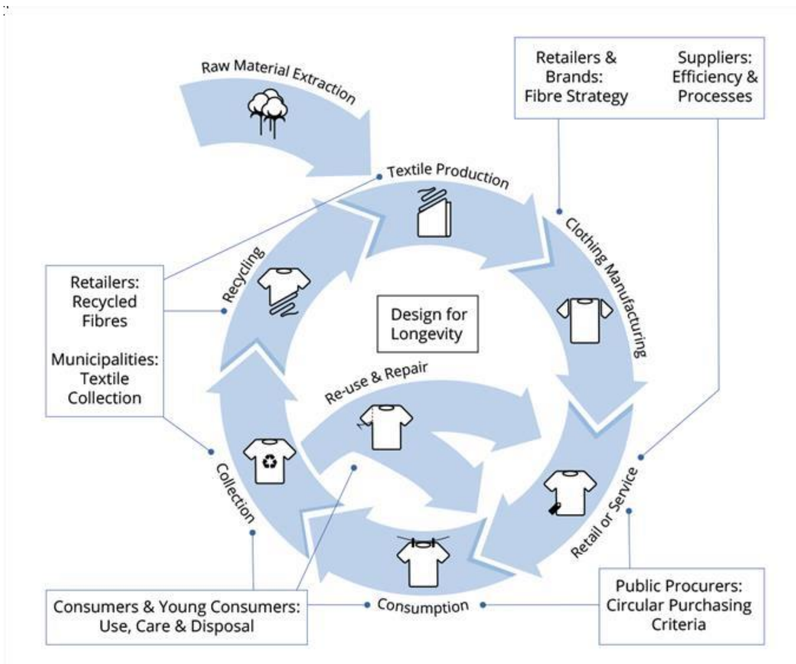

Figure (3) The circular textile and clothing model [8]

Circular economy is one of the possible and practical solutions for sustainable development, as it creates an economic system that minimizes waste, emissions, and energy losses. [9] The main goal is to keep the value of the products and raw materials used for as long as possible, to minimize the level of waste generation and resource use, and to keep resources still in the end-of-life products in the economy, creating added value through re-use. Jobs for society can be created, and consumers will have access to more durable, innovative products that, in addition to saving money, will improve the quality of life.
Circular economy rethinks the path of products from product design through production to consumption, providing an answer to what the product will become once the user discards it. With minimal or zero waste and resource utilization, it recycles the products it produces at the end of its life cycle, ensuring the longest possible product life, benefiting both the economy and nature. [10] There are the three key pillars to operate the model [11]:

1. “Preserve”: Appreciate and preserve the value of materials and products, favouring renewable energy

and raw materials, and preserve natural capital by using waste as a resource.

2. “Innovate”: Make optimal use of resources by keeping materials and products in the circular process. Through smart product design and innovation, develop business models (e.g. collaborative economy, an economic and social system that provides collective access to goods, services, data and knowledge; renovation, redistribution, further utilization to provide a kind of added value; return logistics, digitalization) which encourage operators responsible for production or marketing to give the product concerned as long a useful life as possible.
3. “Close the loop”: Improve the efficiency of the system by recycling, repairing, and re-using materials and products that turned into waste, to create new value after the end of their life cycle. System efficiency can be increased by identifying negative externalities and by minimizing them through life-cycle planning.

Closed-loop and thus design of the entire life cycle assume longer-term thinking; build on individuals with a wide range of knowledge and attentive, well-informed decision-makers, who can take the right steps to address the complex, interrelated economic, social, and environmental issues human society is facing. Lack of these is probably the reasons, why we have not achieved the desired result since the concept ofsustainability emerged. Solving the problem is not a task of a single discipline, or individual international ornational organizations, but a joint, complex assignment of different disciplines, a process that requires national and international consensus and action. The effectiveness of education for sustainable development can therefore be measured by the extent to which it changes people's attitudes and behavior, both individually and in relation to their collective role and civic responsibilities.

EDUCATION TO SUPPORT THE DEVELOPMENT OF A CIRCULAR ECONOMIC APPROACH

In its new action plan for a circular economy for a cleaner and more competitive Europe, the European Economic and Social Committee sets out the expectations for education as follows:"*Through education, capacity building and greater responsibility, more emphasis needs to be placed on spreading a 'circular culture' to encourage people to adapt and change their daily habits*." [12]

An effective method of this can be the self-regulation based project education, where the foundation of the learning process comes from experience and the sharing of good examples.

The priority objectives of circular economy projects are the following 13]:

- to master and understand the basic concepts of the circular economy.
- to understand the limited availability of resources.
- to develop the capacity to use the business model of the circular economy.
- to identify the needs of companies in relation to the circular economy.
- to develop the systems approach and problem-solving capability.
- to get to know the management tools related to the circular economy.
- to identify technological, economic opportunities and barriers and find the best solution.
- to ensure the possibility of developing competencies by applying appropriate teaching methods.

It is expected that at the start of the project, participants have a basic knowledge of the circular economy and are familiar with the principles. It can be measured with the concept map in the first session. If participants don’t have the theoretical knowledge required starting a project, it can be provided as part of an introductory session or via an online course. In the further phases of the project, newer and newer knowledge can be gathered based on experiences during practical activities

Primary condition for launching a project is the involvement of an external partner - small, medium and large company, association, municipality, community, or even an individual - who provides a real-life problem, as there can be no project without a problem. The most important aspect of the project work is to satisfy a real need, which motivates the participating students to do the work and thus gain experience and learning. Not always will the solution be revolutionary, but it is not an expectation, it can be a survey, study,analysis, testing, development, innovation, or even a dissertation, doctoral research, or service. The partner monitors the entire project process, available for consultation, and -it is important- evaluates the finished product. Partner is expected to share its expertise with project participants, to provide information on an ongoing basis, to provide ideas, to observe, to supplement, but not to give ready-made answers and to make a decision on behalf of the group. You can express a critical opinion, but rather encourage, understand, and evaluate students' ideas.

The project schedule "Fig.4" is compiled by the project manager to help planning and conducting the project. The first step in the schedule is to provide resources: involve students in the project, provide locations, and provide necessary equipment, labs, and other resources. The project leader is contacted by theexternal partner; they jointly formulate the project task and agree on the evaluation criteria. The project task must be specific, clear; it can refer to e.g. resource efficiency testing or recycling, or product life cycle extension, product renewable, risk analysis, etc. A good task sets simple, clear goals, makes room for innovation, and requires development of different skills. In connection with the task, the project manager may ask other experts and teaching colleagues from other fields to cooperate. The next step is to raise students' interest in solving a problem. If the project takes place within a lecture or practical course of a certain subject, the participation of students is given, but if it is run as a separate course, information is needed to attract students to take the course and the project task. It is very helpful to present short summaries of previous projects, as well as project evaluations and possible awards. Rewarding, recognizing, or possibly employing a student at a company can be much more motivating than just the credit value of the course.

An important task is to keep in touch with the project groups, to discuss the reports of partial results, experiences gained so far, to which the external partner can also be invited. At the beginning of the project, it is necessary to define the evaluation criteria, share them with the participants and agree on the conditions for closing the project. Equally important to agree on the form of the expected results, e.g. the partner expects a solution or product or analysis, etc.

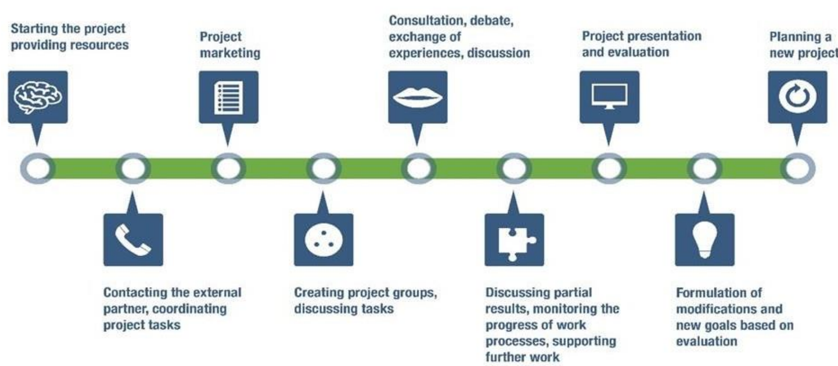

Figure (4) Project schedule [13]

Project groups are created to solve specific tasks, students can either freely choose a task and group, or the project manager assigned participants for each group. The groups always elect a team leader, who constantly monitors the group's activity, and activity effectiveness, ensures that the project is progressing as planned and, if necessary, motivates the group for further work, liaises with the project leader and the external partner. An equal division of labour should be targeted within the group, the sub-tasks should be chosen freely by the members of the group based on their intrinsic motivation and interest, striving for a clear division of roles. The work of the team leader and the group can be supported by higher grade senior students as tutors, who have already gained experience in project work.

Closing the project and presenting the results achieved is an important moment in the project work and differs from traditional pedagogical evaluations. Complexity of the project determines the complexity of evaluation, which must take into account the work of the whole group, the products, their quality and the learning process leading up to it, from the formulation of the problem to the solution. It is necessary to consider the learning processes that have taken place in terms of the growth of professional subject and metacognitive knowledge systems. The work should be evaluated from social relations and from the individuals' perspective, how much cooperation, helpfulness in the group has been developed during the work, and how the students were able to integrate into the group, if they had conflicts and how they resolved them, how much they could count on others, how and how much they learned during the project. These points can be assessed mainly by the project leader teacher, based on continuous observation and student self-assessment. Comments on this should be discussed with the students in the group sessions to help them develop and succeed in their further work. However, the main aspect of the evaluation is whenthe group evaluates their own and the other group's work, thus practicing opinion-making and decision- making. Each project team presents to the professional jury of invited guests (teaching colleagues, external partner and guests invited by them), the work done and the products. The evaluation can be assisted by a pre-developed specific evaluation and scoring system. The evaluation of the partner plays an important role in the further work and learning process. In particular, this should show how forward-looking the idea is, whether it takes into account the circular economy, whether it fits into national and international strategies, whether it can be financed, whether it is profitable, whether it is competitive, whether it is in line with principles of sustainable development, etc.

Achieving the goal of project teaching is facilitated by several pedagogical methods; they are primarily based on individual work and group cooperation, such as discussion, concept map, presentation, explanation, illustration, research, study, observation, experiment, analysis, field research, case study, impact assessment, group work. Due to these, in addition to the knowledge and skills of the students, their abilities and skills are also developing. This way, education in a project aimed at solving a real problem becomes suitable for developing and disseminating a broader approach to the circular economy.

CONCLUSION

Higher education has major responsibility in achieving the goals of sustainable development, since it is where the professionals, economic, technical, and political decision-makers and leaders playing a key rolein shaping the society of the future graduate. Their view of the world, its systematic operation, connections, and causal relations is the basis for their future decisions taking into account principles of sustainability. There is a need for pedagogical methods that help to develop practical implementation of sustainability and the circular economic approach by developing necessary competencies.

One of the most effective ways to do this is to break away from traditional teaching methods by a learning process motivated by experiential learning, practical activity, and solving a real problem, the method of which is the project teaching. The project can be adjusted to the level of skills of the students studying at specific level of education. Its scope, timing and product can always be changed flexibly according to the goal set, it can be run as an independent course or even within the framework of a specific subject. Its effectiveness in terms of both the acquired knowledge and competencies is proved by several results, so it isan indispensable educational method for achieving sustainable development.

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THE HYDROGEN IS HOPE AND REALITY

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Abstract: *This paper deals with green hydrogen production, conversion and end uses. Nowadays global energy consumption was increased increasingly due to the growing the population and standards of living style. Moreover, with increasing the global warming and environmental pollution, the development of renewable energy sources was becoming more essential. Hydrogen is one of the most promising clean and sustainable energy carriers and emits only water as a by-product without any carbon emissions. Hydrogen (H_2) is the simplest first chemical element of the periodic table. Hydrogen is the most abundant element in the universe, accounting for approx. 75% is hydrogen, but it occurs only in bound form in its compounds, from which hydrogen can only be produced by investing a large amountof energy (in the case of water decomposition it is 286 kJ/mol). On Earth, hydrogen only occurs naturally in compounds formed with other elements including in oxygen to form water (H_2O) and carbon to form hydrocarbons which are found in fossil fuels such as natural gas (predominately methane (CH_4)), coal and petroleum. Electrolysis isthe process of using electricity to split water into hydrogen and oxygen. This reaction takes place in a unit called an electrolyser. A fuel cell utilizes the chemical energy of hydrogen and oxygen to generate electricity without combustionor pollution. Fuel cell is not a new technology. Major industrial nations must look to a range of options to reduce theircarbon emissions and meet their various environmental targets. Of the many emerging solutions, hydrogen will have a significant part to play in our sustainable future as an efficient and clean energy carrier that can be utilised in new applications but also integrated into existing industrial processes in place of fossil fuels. The green hydrogen revolutionhas started, and we hope it will not be stopped.*

Keywords: *electrolysis, fuel cell, green energy, hydrogen, sustainable future.*

INTRODUCTION

Nowadays, the CO_2 emissions from the combustion of fossil fuels are 50 Gton/year, which is on average about 6 tons/person/year. CO_2 emissions exceed the amount bound by vegetation, the concentration of accumulating CO_2 greenhouse gases in the Earth's environment (atmosphere, seas) is increasing, which is the cause of climate change and warming (Figure 1).
Within the energy sources, the form of electrical energy is of paramount importance, and the electrical network allows excellent accessibility of the electrical network enables convenient, versatile use. Electricity must be available at all times according to consumption needs.
Figure (2) shows that the future energy supply will be dominated by electricity.

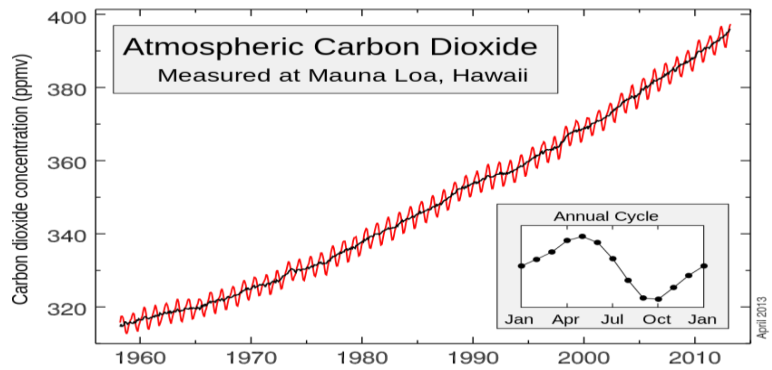

Figure 1. Greenhouse gases in the Earth's environment

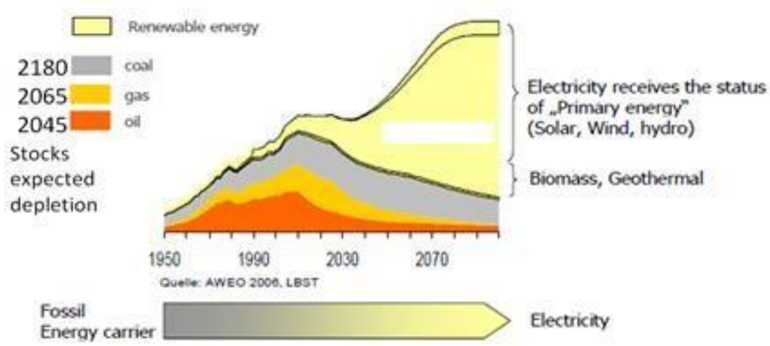

Figure 2. Future energy supply will be dominated by electricity

Reducing warming despite the steady increase in energy demand - the reduction of fossil fuels, which are still predominant in energy consumption – CO_2 emissions can be reduced by rapidly increasing renewable energies.

Hydrogen electrolysis by renewable electricity

Wind and solar capacity will increase rapidly (60 -80 GW/year) and renewable electricity costs will decrease. Figure (3) shows the global average cost of wind and solar technologies.

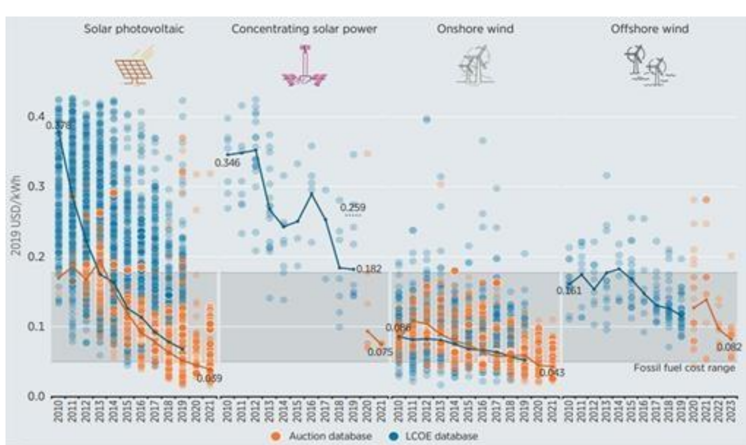

Figure 3. Global average cost of wind and solar energies

However, renewable electricity sources (water, wind, solar) are seasonal, time of day, weather dependent, so energy storage is a big challenge for the future. The developers also see opportunities in channeling surplus power into electrolyser plants. Overproduction of renewable electricity can be partially solved by rapidly expanding lithium-ion batteries and the decomposition of hydrogen by electrolysis. Thanks to the intensive development of batteries, the cost of specific storage energy has been reduced (Figure 4).

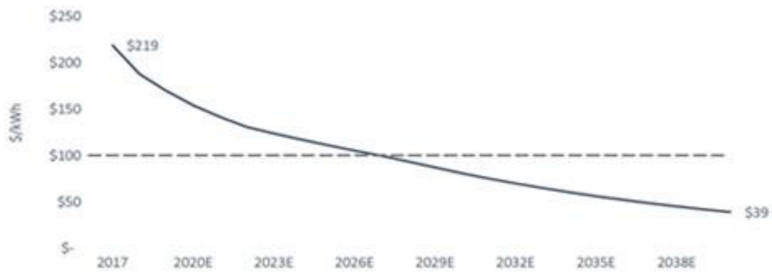

Figure 4. Battery pack price forecast from 2017 ($/kWh)

Electrolysers avoid carbon emissions by using electricity to split water into hydrogen and oxygen. Here is how a very simple electrolyser makes hydrogen gas from water (Figure 5).

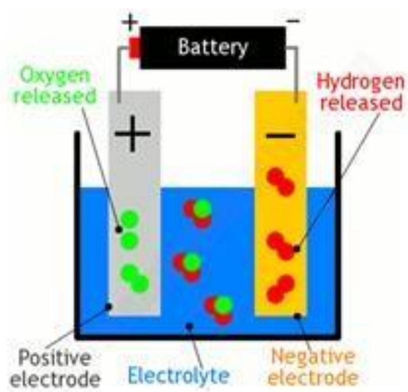

Figure 5. Working method of the electrolyser

Electrolysers avoid carbon emissions by using electricity to split water into hydrogen and oxygen. The cost of renewable hydrogen remains higher than hydrogen produced from gas renewable hydrogen costs, but falling wind and solar costs are closing the gap [2].

Hydrogen

Hydrogen can be compressed and held under very high pressures, or liquefied and held at cryogenic temperatures (Figure 6). Compression and cryogenic refrigeration increase H_2 energy density per unit of volume, but both are energy-intensive operations, and the vessels for both must be made of materials that can withstand high pressure and prevent hydrogen loss via permeation.

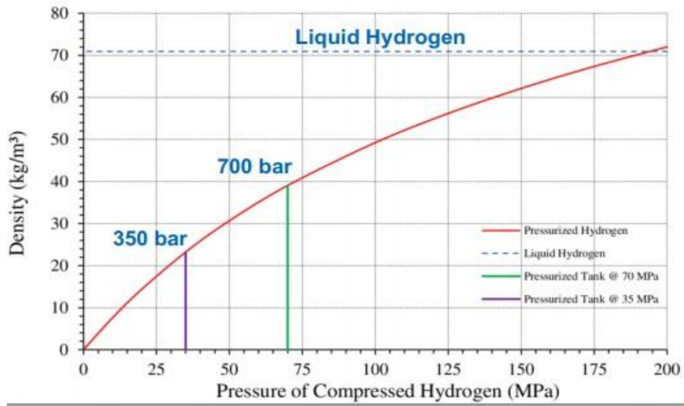

Figure (6) Hydrogen can be compressed under high pressures

The resulting robust containers do not "package" well in commercial trucks, let alone on passenger cars. Further, the cryogenic option requires continuous energy input to keep hydrogen at -253 °C. In the world of ground transportation, it's impractical for any use other than large-scale H_2 storage at vehicle refueling stations.
A third option would be quite welcome in automotive circles. It's technically possible to store hydrogen in a solid state at, notably, room temperature and normal atmospheric pressure. The method involves absorption or adsorption of hydrogen into certain metal halides. This method, however, is fraught with challenges and remains commercially impractical.
For the present, auto OEMs are focusing on compressed hydrogen gas, which currently offer the best cost vs. benefit ratio and the fewest practical barriers to implementation.
A fuel cell harnesses the chemical energy of hydrogen and oxygen to generate electricity without combustion or pollution (Fig. 7). Fuel cell technology is not new; NASA has used fuel cells for many years to provide power for space shuttles' electrical systems [1].

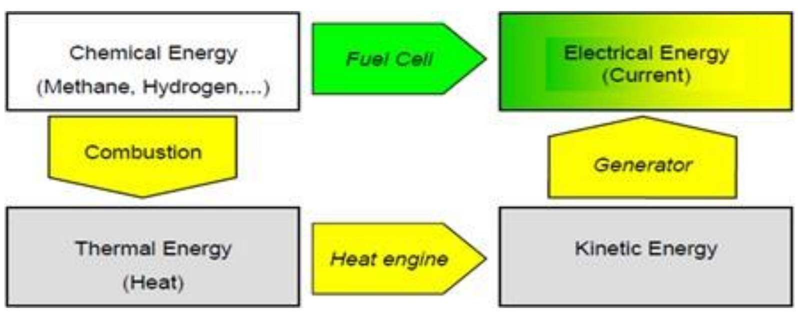

Figure 7. Fuel cell basics

Think of fuel cells as batteries that never run flat. Instead of slowly depleting the chemicals inside them (as normal batteries do), fuel cells run on a steady supply of hydrogen and keep making electricity for as long as there is fuel in the tank.

Hydrogen powered vehicles, fuel-cell

Most cars on the road today use an internal-combustion engine to burn petroleum-based fuel, generate heat, and push pistons up and down to drive the transmission and the wheels. Stricter regulations for CO_2 emissions (now 95 g CO_2 /km) require the development of new propulsion methods. There are really just two ways to power a modern car. Electric cars work an entirely different way. Instead of an engine, they rely on batteries that feed electric power to electric motors that drive the wheels directly. Hybrid cars have both internal-combustion engines and electric motors and switch between the two to suit the driving conditions (Figure 8).

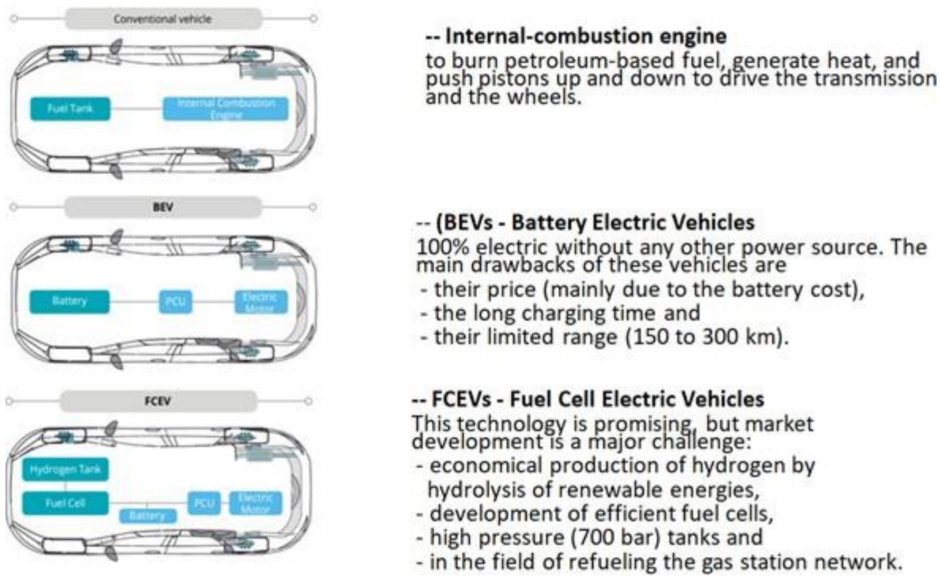

Figure (8) Propulsion system of vehicles

In the near future, the transition from a coal-based economy to hydrogen, the vehicle may also be powered by fuel cells. The type of fuel cell typically used in automobiles is a Proton Exchange Membrane (PEM), also called a Polymer Electrolyte Membrane fuel cell [2]. Working method of the PEM fuel cell can be seenin the Figure (9).

Fuel cells are a bit like a cross between an internal-combustion engine and battery power. Like an internal-combustion engine, they make power by using fuel from a tank (though the fuel is pressurized hydrogen gas rather than gasoline or diesel). But, unlike an engine, a fuel cell does not burn the hydrogen. Instead, it is fused chemically with oxygen from the air to make water. In the process, which resembles what happens in a battery, electricity is released and this is used to power an electric motor (or motors) that can drive a vehicle. The only waste product is the water, and that is so pure you can drink it!

Think of fuel cells as batteries that never run flat. Instead of slowly depleting the chemicals inside them (as normal batteries do), fuel cells run on a steady supply of hydrogen and keep making electricity for as long as there is fuel in the tank.

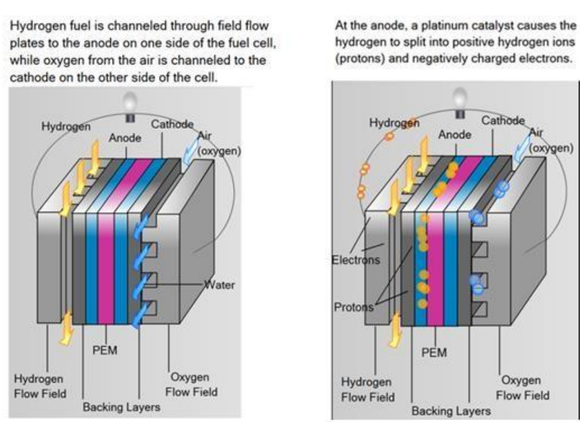

Figure 9. PEM fuel cells working method

What happens in a fuel cell is called an electrochemical reaction. It is a chemical reaction, because it involves two chemicals joining together, but it is an electrical reaction too because electricity is produced asthe reaction runs its course. Figure (10) shows schematic diagram of hydrogen drive [3].

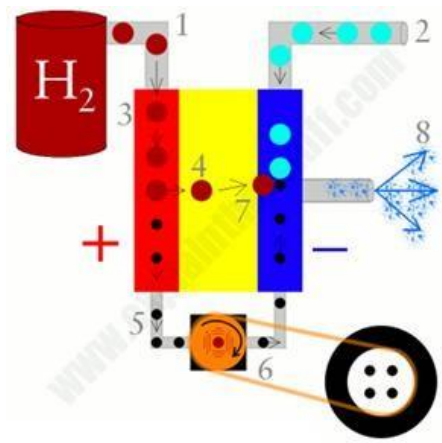

Figure (10) Schematic diagram of hydrogen drive

A fuel cell has three key parts similar to those in a battery. It has a positively charged terminal (shown here in red), a negatively charged terminal (blue), and a separating chemical called an electrolyte in between the two (yellow) keeping them apart.

This type of fuel cell is called a PEM (different people say this stands for polymer exchange membrane or proton exchange membrane because it involves an exchange of protons across a polymer membrane). It will keep running for as long as there are supplies of hydrogen and oxygen. Since there is always plenty of oxygen in the air, the only limiting factor is how much hydrogen there is in the tank [3].

Compressed gas tanks

The CHG (CHG - Compressed Hydrogen Gas) tanks and electrode substrates with mass production of FCVs expected to begin around 2021 and onward, Toray Group foresees accelerating growth in demand for extra-high pressure tanks suited to hydrogen fuel refilling. The hydrogen is highly flammable and transparent, this a growth business field where products for pressure vessel applications great business possibility challenge. The weight of the high pressure hydrogen tank is a crucial feature for vehicles, which is why Type IV (CFRP) tanks have been developed. The plastic (PA) lining inside is reinforced with carbonpatch spots spread on the dome part and then reinforced with carbon filament winding. The internationally reputed builders all agree on a pressure of 700 bar with a volume of 60 liters of hydrogen for about 2.5 kg ofhydrogen (Figue 11). Manufacturing technology is being developed to increase the hydrogen / tank weight ratio (2.5: 44 ~ 0.057) [1].

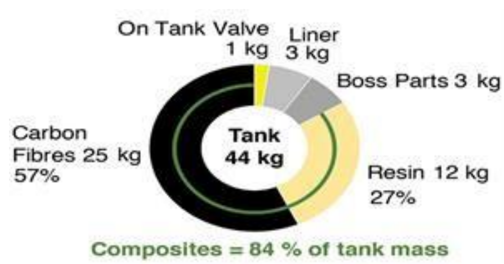

Figure 11. Mass distribution for a 60-litre tank

High-pressure CFRP-reinforced tanks for hydrogen-powered vehicles are key in the near future, carbon fiber can expect great market growth (Figure 12).

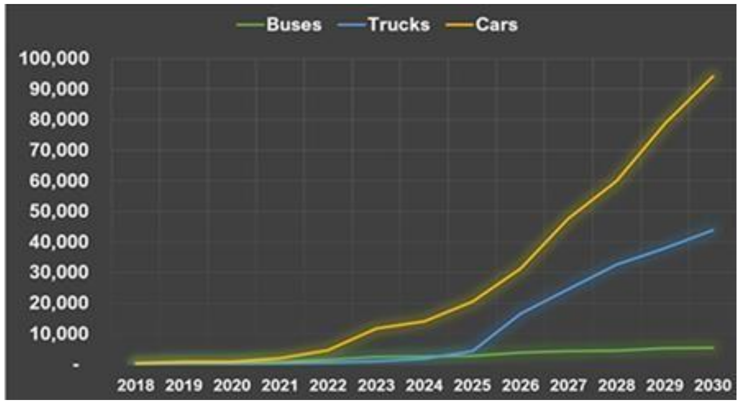

Figure 12. Projected carbon fibre usage (metric tons) in Type IV 700-bar compressed hydrogen tanks for the highest production volume fuel cell vehicles (FCV)

Application of hydrogen drive

The practical introduction of hydrogen propulsion on cars, buses, trucks, trains, ships and airplanes is all promising. In the case of airplanes, the use as a fuel in the liquefied state, cooled to -253 ^oC, is also being investigated. For a hydrogen economy, hydrogen refueling stations will be needed to provide fuel for vehicles. This could easily be done by retrofitting existing fuel stations. Some of these are located awayfrom urban centers or outside populated areas. On-site wind-powered water electrolysis is a potential solution. The advantage is cost allocation, due to integration of systems with current infrastructures and effective use of energy.

The expected prevalence of hydrogen-powered vehicles by the end of the decade is shown in the table. The Table (1) shows that these 2030 projections are conservative, for example, less than1% of current car production will be FCV in 2030 [3].

Table 1. Projection of the car production [3]

	2030 FCEV Projection	2020 Vechicle Production	% of Current Production
Buses	17,633	270,000	6.5
HD Trucks	42,380	4,100,000	1.0
Cars	754,585	92,000,000	0.8

CONCLUSIONS

Hydrogen propulsion can look forward to a bright future in the coming decades due to decarbonization, continuous electricity supply, high growth in renewable energy and electricity storage. As green electricity gets cheaper in the future, low cost green hydrogen is coming. In parallel, as with solar and wind, the cost of hydrogen production is falling exponentially, as system sizes and production volumes grow, while performance improves. Technical conditions for the use of hydrogen in the new energy carrier and storage: economical production, storage and use of hydrogen from renewable energy (wind, solar) (fuel cell). The technology is technically feasible, and its economy today is still expensive compared to fossil fuels.

The development and application of new structural materials (CFRP) (wind vane structure, CHG tanks, hydrogen cell GDL-Gas Diffusor Leir carbon fiber porous structure materials in fuel cells are absolutely necessary for the success of energy developments. It is planned in Europe to accelerate renewable hydrogen development, targeting the deployment of 6 GW of renewable hydrogen electrolysers by 2024 and 40 GW by 2030 [3].

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INFLUENCES OF MICROBIAL ACTIVITIES IN THE INSECTICIDES TREATED SOIL

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Abstract: *Globally, the consumption of nitrogen (N) fertilizer- is significantly increased day after day. The biological N_2-fixation is the main source of N input in agricultural soil. However, international emphasis on environmentally sustainable development with the use of renewable resources is likely to focus attention on the potential role of biological N_2-fixation in supplying N for agriculture. Several environmental conditions arelimiting factors to the growth and activity of the N_2-fixing root nodule rhizobia. One of the most important and potentially limiting factors to biological N_2 fixation is the use of pesticides including the insecticides. The objective of the study is to investigate the adverse effect of insecticides on N_2-fixing rhizobia. Experiments were conducted to study the impact of seven insecticides [Anthio 33 EC (Formotion (33%), Sevin 85 WP (Carbaryl (85%), Rogor L-40(Dimethoate (40%), Thiodan 50 WP (Endosulfan (50%), Phosphotion (Malathion (50%), Lannate 20 L (Methomyl (200 g/l), Pirimor 50 DP (Pirimicarb (50%)] on the growth of seven strains of N_2-fixing root-nodule rhizobia (four strains belonging to Rhizobium leguminosarum, one strain belonging to R. phaseoli, one strain belonging to R. trifolii and one strain belonging to R. loti) in vitro by measuring optical density. The rhizobial strains were grownin yeast extract mannitol broth medium treated each with different concentrations (0, 0.1, 1, 10, and 100 mg/litre ofactive ingredient) of each insecticide and incubated for 48 hours in microfermentor at 28°C The results illustrated that Phosphotion and Sevin had an adverse effect on the growth of the investigated rhizobial strains, whereas Thiodan was safe to these rhizobial strains. Whereas the strain Lóbab Z of R. leguminosarum was the most tolerantand R. trifolii Lo133/64 was the most sensitive one among the tested strains. The adverse effects of insecticides on rhizobia were observed at concentrations not normally expected to occur under field conditions. For further task, itis required to investigate the adverse effects of these insecticides on nodulation and N2-fixation capacity of specifichost plants with their rhizobia in pot and field experiments as well as other vital microbial processes in a wide range of soils.*

Keywords*. insecticides, N_2-fixing root-nodule rhizobia, in vitro, adverse effect*

INTRODUCTION

A tremendous amount of anthropogenic nitrogen (N) fertilizer has been applied to agricultural lands to sustain crop production all over the world. However, inappropriate N management applications have causednumerous ecological and environmental problems. Rather than anthropogenic nitrogen fertilizer, biological nitrogen fixation is more emphasized on supplying N for agriculture.
The main problem of using pesticides including insecticides is that the amount of applied pesticides which actually reaches the target organism is about 0.1 % and the rest usually ends up contaminating the soil ecosystem. [1] Invention of pesticides and insecticides has also promoted crop production by controlling the pests effectively which has also had negative impacts on environment due to its xenobiotics characteristics.

The negative impact of these chemicals on the soil environment and their processes has received more attention and has been described by many researchers. [2] Recent studies show that the applied pesticides may harm the natural microorganisms, disrupt soil ecosystem, and which eventually may affect human health by entering in the food chain. Soil has its beneficial microorganisms and their associated biotransformations. Soil microorganisms have the ability to perform biochemical transformations of different elements like nitrogen (N), phosphorus (P), sulfur (S), and carbon (C). Pesticides and insecticides may directly or indirectly has an effect on the important biochemical reactions such as mineralization of organic matter, N_2-fixation, nitrification, denitrification, and ammonification by activating/deactivating specific soil microorganisms and/or enzymes. [3,4] The fact that information on possible effects of pesticides on all biochemical processes is sparse proves that it deserves more emphasis from the researchers. The activity of the N_2-fixing root nodule rhizobia is limited by many factors such as increased use of pesticides and insecticides and even sewage sludge application. [5] The legume–rhizobia symbiosis has distinctive role in agriculture and it results in huge quantities of N_2-fixation throughout the world and any adverse effect on rhizobia results in decreased rates of biological nitrogen fixation. By infecting the roots of legumes, rhizobia bacteria can form nodules where N_2 fixation occurs. [6] Some pesticides can be detrimental to nitrogen fixing bacteria. It slows down the nitrogen fixation process in bacteria and reduces the bacterium's respiration rate which later prevents its positive effects. [7]

Insecticides

The term pesticide covers a wide range of compounds including insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators and others. [4] Pesticides and Insecticides are interchangeably used together which brings out a quite confusion within the community. To be specific, insecticide is just one type of pesticide, specifically for insects and it differs from pesticide by its formulation, chemical, organic and toxicity differences. Formulation is how these chemicals are used against certain pests. For example, the insecticide is effective at controlling insects in the larval or state of development. How the chemicals are derived and the toxicity level of the end product differs a lot due to their intended uses, targeted organisms and etc. This study has chosen seven different insecticides.

Formothion (Anthio 33 EC)

Formothion is a systemic and contact insecticide used for controlling spider mites, aphids, psyllids, mealy bugs, fruit flies and others. Formothion appears as viscous yellow oil or a crystalline mass. This insecticide is classified moderately toxic or listed in II toxicity class of U.S. EPA. However, oral and dermal ways of GHS hazard statement; it is considered as acute toxic compound. [8] It is available as an emulsifiable concentrate and an ultra-low volume spray. Formothion affects normal nervous system function because it is a cholinesterase inhibitor as well as organophosphate compound.

Carbaryl (Sewin 85 WP)

Carbaryl is an insecticide used on a variety of crops. Carbaryl is the first carbamate insecticide which was introduced in 1956, and more of it has been used throughout the world than all other carbamates combined. [9] These insecticides are either used as dusts or sprays. Carbamate pesticides are derived from carbamic acid and similarly kill insects as organophosphate insecticides. They are effective insecticides under their ability to inhibit acetylcholinesterase in the nervous system [10]. Acute (short-term) and chronic (long-term) occupational exposure of humans to carbaryl has perceived to be a source of cholinesterase inhibition. EPA has classified carbaryl as a Group D, not classifiable as to human carcinogenicity. General symptoms caused by extended low-level exposure to carbaryl are headaches, memory loss, muscle weakness, and cramps, and anorexia.

Dimethoate (Rogor L-40)

Dimethoate is a commonly used organophosphate insecticide. It was patented and introduced in the 1950s by American Cyanamid. Like other organophosphates, dimethoate is an acetylcholinesterase inhibitor which immobilizes cholinesterase, an enzyme necessary for central nervous system function. It works both by contact and through ingestion which means absorbance and distribution through the plant tissues are fast and is degraded relatively rapidly. Dimethoate appears as a white crystalline solid, with a camphor-like odor, white to grayish crystals for technical product. This material is a contact and systemic organophosphate insecticide effective against a broad range of insects and mites when applied on a wide range of crops. [11]

Endosulfan (Thiodan 50 WP)
Since the 1950s, endosulfan is one kind of organochlorine pesticide commonly used in agriculture to control a wide range of pests for crops, including cotton, rice, sorghum, and soy. [12] It causes worldwide concerns due to its environmentally persistent and semivolatile characters. Endosulfan can particularly accumulate in organism and cause neurotoxicity. [13] Endosulfan works as an endocrine disruption which also makes it become a controversial chemical in the market. Threat to human health and to the environment from this chemical is quite huge, thus the global ban of this chemical was negotiated under the name of Stockholm Convention in April 2011. [14]

Malathion (Phospotion)
Malathion is an insecticide that does not occur naturally. Pure malathion is a colorless liquid, and technical-grade malathion, which contains >90% malathion and impurities in a solvent, is a brownish-yellow liquid that smells like garlic. [15] Malathion is a synthetic phosphorous compound and cholinesterase inhibitorthat is strictly used as a topical pediculicide which is used to kill lice. [15] Malathion acts on the nervous system of the lice by irreversibly restraining the activity of cholinesterase enzyme. It eventually leads to the head lice's death.

Methomyl (Lannate 20L)
It is used as a nematocide, and an insecticide on vegetables, tobacco, cotton, alfalfa, soy beans, and corn. [16] Methomyl is classified as Restricted Use Pesticide (RUP) by the Environmental Protection Agency because of its high acute toxicity to humans. [17] Methomyl is a white crystalline solid with slight sulfurous smell. It was first introduced in 1966 as a broad-spectrum insecticide because it is pretty effective in two ways [17]. First of all, it kills the target insects upon direct contact as in a way of contact insecticide. Secondly, it is a systemic insecticide by causing systemic poisoning in target insects in a way that being transported throughout the pests which feed on treated plants. Methomyl is considered as a carbamate chemical by impeding cholinesterase, essential nervous system enzyme without being harmful to the plant.
[16] Toxicity of this chemical is quite high and is potential poisonous for humans. If ingestion or absorption happens, it is highly toxic, in case of inhalation it is considered moderate. [17]

Pirimicarb (Pirimor 50DP)
Pirimicarb is an insecticide for aphid control in a wide range of crops. *Aphids consists* has various types including woolly aphid, green peach aphid, and the cabbage aphid. The applications of this chemical are also wide starting from wheat, fruit, vegetables, to cotton, and tobacco. It was reported in 1969 and first marketed in 1970. It belongs to the carbamate substance group. [18]

Rhizobia strains
A group of bacteria which forms root nodules of leguminous plant roots among the soil bacteria is called Rhizobia. General characteristics of this group would be aerobic, gram-negative belonging to a class of Alphaproteobacteria. [19] Rhizobia are considered as plant growth promoting rhizobacteria in symbiosis with legumes. Rhizobial species belong to several genera such as: *Rhizobium, Mesorhizobium,Bradyrhizobium, Ensifer, Allorhizobium, Azorhizobium, Neorhizobium and Pararhizobium* and can exist as free-living soil saprophytes or as N_2-fixing endosymbionts of legume host plants roots that creating the root-nodules of host legumes or in close association with the plant roots [19].
Symbiotic relationship between host plants and rhizobia depends on the presence of nodulation (Nod) genes which are not always found in the species. Rhizobial strains are often located on plasmids, mobile genetic elements. Thus, rhizobial communities in the environment consist of both free-living cells lacking symbiotic

genes (Nod). Nod can replicate consistently in soil but does not form root nodules. [20]

Rhizobium leguminosarum

Rhizobium leguminosarum bv *trifolii* is a soil bacterium that creates a N_2-fixing symbiosis with clovers (*Trifolium* spp.). These plants belong to legumes (*Fabaceae*) and it makes up for 18000 species which are economically and industrially important plants. These species are the source of food, and biofuels. [21] The distinctive ability of rhizobia is to enter into a symbiosis with legumes. It eventually forms the special organs, called nodules, on host plant roots. [21] Inside nodules, rhizobial cells modify into bacteroids that convert atmospheric dinitrogen to ammonia, a compound that can be used by the plant [22]. Symbiosis plays an important role in many ecosystems, annually yielding 200 million tons of nitrogen, which is closer to the amount of artificial nitrogen fertilizers [23]. Lastly, from this group, 4 strains of *R. leguminosarum* were selected for this experiment to be investigated for the effects of insecticides.

MATERIALS AND METHODS

Insecticides

Seven types of insecticides (Table 2) which work effectively against a broad range of insects and mites when applied on a wide range of crops were used to determine of its adverse effects on microorganisms, rhizobia strains.

Table 2. Detailed data on inoculated insecticides [24]

Insecticide (commercial name)	Active Ingredients	Active Ingredients	Molecular Formula
Anthio 33 EC	Formothion	33%	C6H12NO4PS2
Sevin 85 WP	Carbaryl	85%	C12H11NO2
Rogor L-40	Dimethoate	40%	C5H12NO3PS2
Thiodan 50WP	Endosulfan	50%	C9H6Cl6O3S
Phosphotion	Malathion	50%	C10H19O6PS2
Lannate 20L	Methomyl	200g/L	C5H10N2O2S
Pirimor 50DP	Pirimicarb	50%	C11H18N4O2

Rhizobial Strains

Seven strains of N_2-fixing root-nodule rhizobil strainsa were used in the following investigations. Four strains of *R. leguminosarum,* one originated from Libya (HB-3841^{str+} streptomycin resistant mutant) strain, two Hungarian strains (Lóbab Z and Bükköny 75/4), and English strain (E1012) and three Hungarian strains (Feryol 1/4, Ló 133/64, Baltacim-3) belonging to *R. phaseoli, R. trifolii, R. loti* respectively as shownin Table 2.

Table 3.Detailed data on tested *Rhizobium* strains

Rhizobium strain	Laboratory code	Host plant	Origin
R, Leguminosarum	HB-3841^{str+}	*Vicia faba*	Libya
	E 1012		England
	Lóbab Z		Hungary
	Bükköny 75/4		Hungary
R. phaseoli	Feryol 1/4	*Phaseolus vulgaris*	Hungary
R. trifolii	Ló 133/64	*Trifolium pratense*	Hungary
R. loti	Baltacim-3	*Onobrychis viciifolia*	Hungary

Methods

An *in vitro* experiment was carried out to evaluate the response of four *R. leguminosarum* strains and each strain of *R. phaseoli*, *R. trifolii*, *R. loti* originated from different soil types to 7 insecticides using microfermentor technique. The microfermentor technique was carried out as following: Insecticides were applied at four concentrations (0.0, 0.1, 1.0, 10, and 100 mg/l).

These range of concentrations was tested in 5 ml yeast extract mannitol (YEM) broth medium inoculated with 125 µl bacterial suspension of cell density (10^6 CFU/ml). Sterilized, defined yeast mannitol broth medium contains the following ingredients in 1 litre of distilled water: yeast extract 1 g, mannitol 10 g. The growth was measured at 550 nm from a shaken culture using a Sanyo-Gallenkamp SP50 spectrophotometer

U.K after 48 hours incubation in rotary shaker (150 rpm) at 28°C. The results were presented as relative growth rate of control tubes.The results from this study provide critical baseline information for further examinations to optimize the growth of these root nodule fixing bacteria.

RESULTS AND DISCUSSION

From Figure 1, it can be concluded that growth of Lóbab Z and E1012 from England strains was higher than the rest of strains. Ló 133/64 is sensitive towards the toxicity of Phosphotion.

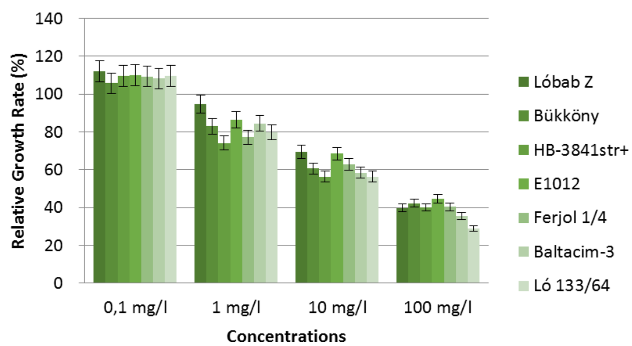

Figure 18. Effect of Phosphotion on relative growth of different rhizobial strains

Figure 2 shows that the strain Lóbab Z has higher tolerance against Sewin 85 WP insecticide, and Ló 133/64 was the sensitive one. Overall, there are gaps between the growths of each strain on each concentrations, it indicates that sewin 85 wp had a adverse effect on root-nodule bacteria.

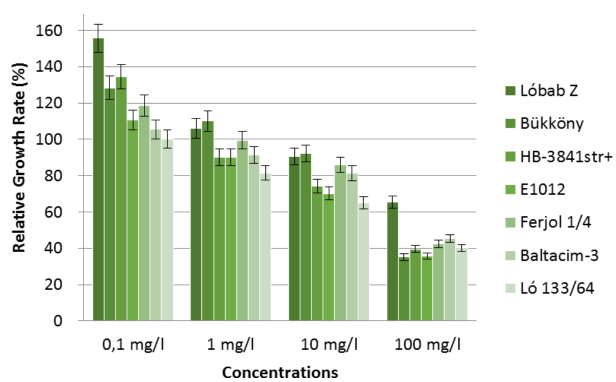

Figure 19.Effect of Sevin 85 WP on relative growth of different rhizobial strains

In Figure 3, there were some odd result from Rogor L-40 that shows HB-3841 str^+ has showed a higher growth at 10 mg/l of concentration than the rest of them and the growth decreased dramatically at 100mg/l of concentration. The tolerant strain was Lóbab Z and the sensitive strain was Baltacim-3.

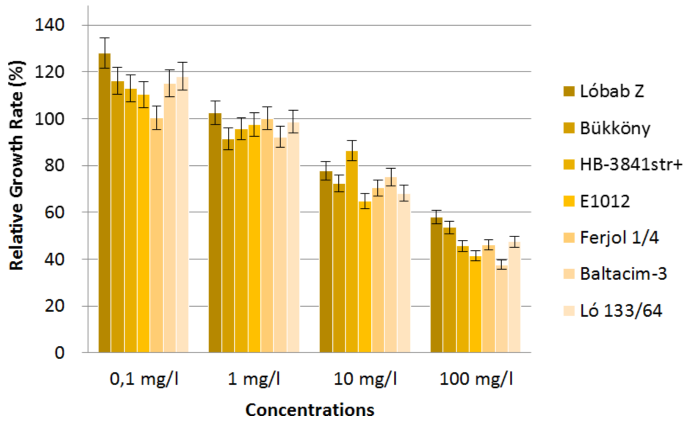

Figure 20.Effect of ROGOR L-40 on relative growth of different rhizobial strains

In Figure 4, it was found that Bükköny 75/4 had a highest growth at almost all concentration levels of Anthio 33 EC insecticides. Baltacim-3 and Ló 133/64 strains could not show high growth.

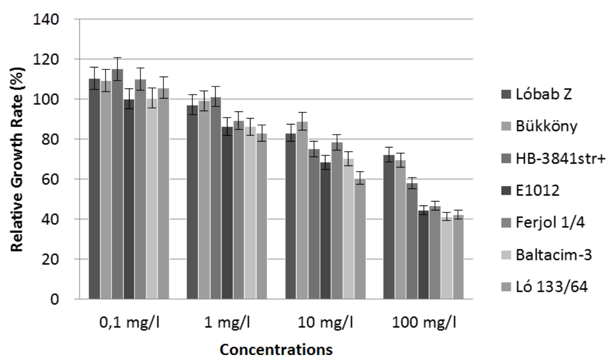

Figure 21.Effect of Anthio 33 EC on relative growth of different rhizobial strains

Regarding to the effect of Lannate 20L, Figure 5 illustrates that Baltacim-3 belonging to *R. loti* showed the lowest growth; while Bükköny 75/4 and Lóbab Z strains had shown relative high growth.

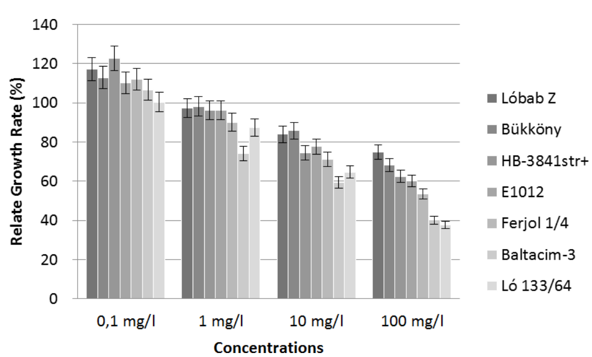

Figure 22.Effect of Lannate 20L on relative growth of different rhizobial strains

Figure 6 shows that Piriimor 50DP insecticide did not have adverse effect on E1012 and Lóbab Z strains. However, Ló 133/64 is the most sensitive one towards this insecticide as well.

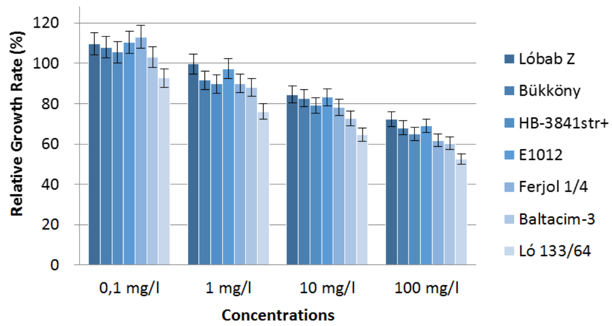

Figure 23.Effect of Piriimor 50 DP on relative growth of different Rhizobium strains

Figure 7 shows the effect of Thiodon insecticides on the different strains. Bükköny and Ferjol 1/4 showed bigger growth while this insecticide was harmful for strains Ló 133/64, E1012, Baltacim 3

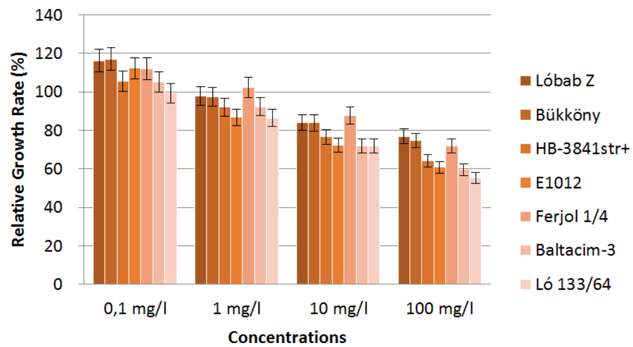

Figure 24. Effect of Thiodon 50 WP on relative growth of different rhizobial strains

Figure 8 summarizes the average growth of all rhizobial strains by each insecticidal effect, Phosphotion and Sevin 85 WP had an adverse effect on all strains. To contrast, Thiodon 50 WP, Piriimor 50 DP were safer to use. To summarize from the tolerance of strains, Ló 133/64, Baltacim-3 were sensitive to almost every . In comparison, Lóbab Z was the most tolerant and showed growth in this experiment, Bükköny 75/4 and Ferjol 1/4 were the following.

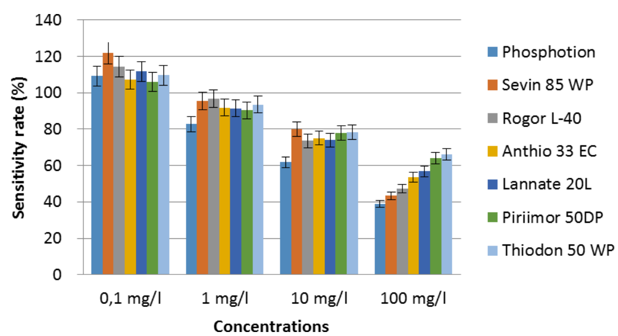

Figure 25. Comparison of effects of each insecticide on average growth of all strains

These results provided a partial explanation of the compatibility of *Rhizobium* strains and insecticides under laboratory conditions. As mentioned earlier, any adverse effect on legume-rhizobia symbiosis results in reduced rates of biological N_2-fixation which counts and contributes more than artificial N supply.

Therefore, the research with definite results and comparison to show how insecticides and pesticides affect these beneficial bacteria and its N_2-fixation process by decreasing the bacterial respiration rate should be carried out in the future.

CONCLUSION AND RECOMMENDATION

This study was designed to evaluate the effects of seven insecticides in vitro on the growth rate of seven rhizobial strains of N_2-fixing root-nodule. From this study, it can be concluded that the results obtained under *in vitro* experiment show the sensitivity of the studied *Rhizobium* strains was as described in the literature. It was found that the fungicides had similar effects on the investigated four *Rhizobium* strains. Itis concluded that *Rhizobium* strains vary in their sensitivity to the insecticides. The degree of growth inhibition at each concentration of insecticides tested shows the similar trends. The Lóbab Z strain (isolated from Hungarian soil) proved to be broad-tolerant (the most tolerant) to most of the insecticides investigated,Bükköny 75/4 (Hungarian) and HB 3841$^+$ (Libyan) strains were the following tolerant strains. Strain E1012 (of English origin) was relative sensitive strain which depended on the toxicity of insecticides. Thus, it can be said that insecticides react differently with the strains depending on their toxicity and concentration. It was found that Thiodon 50 WP, Piriimor 50 DP were the least toxic, compared with Phosphotion, Sevin 85 WP being the most toxic. Rogor L-40, Anthio 33 E, Lannate 20 L have moderately influenced strain survival and reproduction. More investigations should be carried out using different techniques and other species of symbiotic N_2-fixing bacteria. What other factors affect the strain tolerance towards any kind of pesticides and how insecticides specially affect N_2-fixing bacteria should be studied more in order to understand the relationship between the genes and symbiotic genes.

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LITHIUM AND HEAVY METAL CONCENTRATION ANALYSIS IN SAJÓ VALLEY

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Abstract *The Sajó valley was a blooming industrial area 20-25 years ago, but in the early 1990s most of the factories closed down, but relatively little attention was paid to the pollution left behind. The Green Action Association carried out a comprehensive monitoring of the Sajó Valley in the early 1990s. This gave us the idea to carry out our work, as significant heavy metal and lithium pollution was found in the areas surveyed. It is very likely that this was mainly caused by heavy industry from the 19th century until the 1980s. Our aim was to investigate how the lithium and heavy metal contamination might be found in some of the areas studied by the association more than 20 years later. Six areas were selected as study sites for the soil samples, between Ónod and Muhi (3 areas) and near Tiszaszederkény and Tiszagyulaháza (3 additional areas). Our soil samples were collected from the floodplains of the Sajó, Hernád and Tisza rivers at a depth of 0-40 cm. After proper storage, we started the analysis by preparing and digesting the samples.The pH-value and dry matter content of the sieved (2 mm) samples were determined. Digestion of the finely sieved samples (0.45 mm) with nitric acid using a Milestone 1200mega microwave digestion system allowed the samples to be analyzed with an "ATI UNICAM 939 AAS" atomic absorption spectrometer for seven elements: cadmium, copper, zinc, lead, manganese, iron and lithium. The results of the measurements were converted to mg/kg dry matter. The results obtained showed that there are still areas where some elements, such as Cd, are contaminated above the limit values (Joint Decree 6/2009 (IV. 14.) of the Ministry of Agriculture, Forestry, Environment and Water Management). The measured pH values are slightly alkaline and slightly acidic, which means that the contaminants are immobile in the soil. Statistical evaluation was performed by use of the three-factor random block analysis variance method using SPSS 14.0 for Windows software package. After performing analysis of variance, it was shown that the heavy metal content of soil samples was significantly related to the sampling location. Based on the data obtained in our work, we propose to carry out a study of similar magnitude to the monitoring carried out in the 1990s and to clean up the contaminated soils*

Keywords: *Lithium, Heavy metals, Heavy Industry, Soil contamination*

INTRODUCTION

We often hear: protecting the environment is also protecting future generations [1]. But to imagine, influence and shape the future without knowledge of the present is a futile attempt. It is therefore not surprising that the collection of data on the state of the environment is as old as the birth of environmental protection [2].
Nowadays, as pollution becomes more widespread, more and more are being said about potentially toxic substances and more and more attention is being paid to the hazards associated with heavy metals. Industrial installations in favorable geographical locations and mineral-rich areas have been producing and releasing pollutants into the immediate environment in an uncontrolled manner for centuries. Scientific research and new technological tools are increasingly enabling us to assess and evaluate these pollutants [3].

In this paper, we focus on the heavy metal and lithium pollutions concentrated in the Sajó valley over decades by the heavy industry of Borsod-Abaúj-Zemplén county. The Sajó valley was a flourishing industrial region 20-25 years ago, but in the early 1990s most of the plants were closed down. But the soil contamination left behind has hardly been dealt with.

The heavy industry is a part of the industry. Basically, it produces those type of products, which are not necessary for everyday consumption, but also durable ones, and produce other products, which are necessary to produce machines. Low labor demand and substantial energy, raw materials and capital requirements are characterized. The „heavy" word refers to the weight of the final product (mechanical engineering) and complexity of the production of (chemical industry) as well [4].

The North Hungarian Chemical Company in Sajóbábony was started in the late 1940s. Until the 1950s, the factory produced mainly military products and explosives, and later pharmaceutical and pesticide active ingredients, chemical raw materials and polyurethane foams [5].

In 1965, the production of active battery masses was started, the only technology of the factory that determined the cadmium contamination of the Sajó and even the Tisza.

According to a 1974 study, 13 tons of cadmium were being discharged into the Sajó every year during that period.

Most of the cadmium that entered the river settled out and became embedded in the bottom sediment, which was mobilized by the tidal waves and spread the contaminated sediment in the lower stretches of the river.

The polluting part of the plant was closed down in 1998, but the cadmium deposited in the Bábony stream and in the factory's sewage system continues to pollute the Sajó.

The Ózd steelworks produced pig iron, steel and rolled products. The company's effluent was discharged into the river Sajó via the Hagony stream, causing significant heavy metal pollution. The Borsodnádasd sheet metal factory had a history of almost 130 years before its closure, where it was mainly engaged in the production and metal coatings. The company's waste water was not treated until 1975, when it was discharged into the Hódos stream and from there via the Hangony stream into the Sajó. Construction of the factory began in the 1950s, formerly known as Borsod Chemical Combine [6].

Until the 1970s, the factory's plants discharged their effluents untreated into the Sajó river due to a lack of environmental controls. The company came to the center of attention mainly because of the small amount of mercury discharged during the production of large quantities of chlorine gas and caustic soda, and the chlor-alkali electrolysis plants which caused significant pollution over the years. Some 850 tons of mercury were removed from the three plants in the period 1963-1989, from which mercury-containing effluents were discharged untreated into the River Sajó until the late 1970s. According to WHO/UNDP/OVH Water Quality Protection Project studies, approximately 1.7 tons of mercury were discharged into the river with these effluents in 1974. The plant started operations in 1960. It mainly discharged pollutants, which have been significantly reduced by the environmental protection measures introduced in the meantime.

According to the available data, the heavy metal pollution of Tisza Chemical Group [7] is not noteworthy.

The plant started operations in 1960. It mainly emitted pollutants, which have been significantly reduced by the environmental protection measures introduced in the meantime. According to available data, Tisza Chemical Group's heavy metal pollution is not important. Iron metallurgical plant which from 1989 operated under the name DIMAG RT [8].

After its privatization in 1991, it was split into 30 different legal entities, after which the plants went bankrupt and then merged under a government decision as another name (DNM Ltd.). The company's wastewater, which also contains heavy metals, is discharged into the Sajó river via the Sinava stream.

4 December Wire Works was a steelwork producing high-strength steel wire and stranded steel wireproducts. As a result of this production technology, the process effluents, surface preparation sludges were largely contaminated with zinc, lead, iron and to a lesser extent chromium, nickel and cadmium. Prior to 1987, the effluents were discharged into the Sajó after minimal treatment and neutralization. During this period, the company was the most significant heavy metal polluter of the Sajó.

Heavy metal contamination [9] in the Sajó Valley was brought to our attention by the Green Action Association [10] when the so-called "mercury scandal" broke out on 23 August 1990, and in December 1990**,** the association drew up a program to investigate heavy metal contamination in the area. A map of the contamination in the area was completed in 1992, and has been available to us ever since, providing a good

basis for examining the topicality of the issue.
Our aim was to assess the concentration of some heavy metals (Zn, Mn, Fe, Cu, Pb, Cd) and lithium in the soil of part of the area. Our work was divided into two main areas, the floodplain of the Hernád and Sajó rivers between Ónod and Muhi and the floodplain of the Sajó and Tisza rivers between Tiszagyulaháza and Tiszaszederkény.

MATERIALS AND METHODS

Soil sampling principle

Sampling is the collection of a sufficient number of samples from a typical soil section or from individual levels or layers of soil for laboratory analysis. Soils vary in their horizontal and depth extent even over small areas. This means, that it is not possible to classify a large area on the basis of the results obtained by point sampling and analysis. A basic rule for the selection of sampling sites when investigating soils is that they should be representative of the soil or area for which the results are to be used [11].

Sampling of linear emission areas

Sampling is the collection of a sufficient number of samples from a typical soil section or from individual levels or layers of soil for laboratory analysis. Soils vary in their horizontal and depth extent even over small areas. This means, that it is not possible to classify a large area on the basis of the results obtained by point sampling and analysis. A basic rule for the selection of sampling sites when investigating soils is that they should be representative of the soil or area for which the results are to be used [11].

Sampling of linear emission areas

For the heavy metal analysis of floodplain sediments, the standard MSZ 21470-1:1998 was used. According to the standard methods, the "banded sampling system" (Figure 1) was used for sampling. According to the standard, rectangular sampling grids should be established at 5, 10, 20, 50 m distances from linear pollutant sources. The intersection of the diagonals of a given rectangle best represents that rectangle, so this is where we took our soil samples on both sides of the rivers.

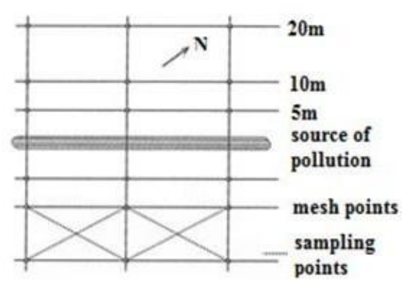


Figure 1. Band sampling system [12]

Other small area sampling

After the sampling units have been selected, the soil grid should be drawn on a sketch. A minimum of 4-6 sampling units is recommended, so that 8-12 average samples can be obtained. The average samples are obtained by taking 20 to 20 right and left transects along the diagonals of the quadrilaterals for surface sampling [12].

Field sampling

Our samples were collected in two transects in the Sajó valley in Borsod-Abaúj-Zemplén county in northern Hungary. Firstly, in the area bounded by Ónod - Muhi - Sajóhídvég, approximately 14 km as the crow flies from Miskolc. Within this, 3 smaller areas were identified (Figure 2). The River Sajó (area 1), River Hernád (area 2), River Sajó after the Hernád inlet (area 3). It was designed using the Google Earth program:

Figure 2. Sampling areas (areas 1 to 3)

The sampling grid we constructed is a stretched rectangular grid with grid points spaced 5, 10, 20, and 50 m from the river on either side of the river. The distance between adjacent mesh points is 30 m (Figure 1.).
The sampling points are red marked, and their GPS coordinates were read using the Google Earth program (Figure 2. and 3.). Soil samples were taken at the sampling points with the sampler at a depth of 0-40 cm. The excavated soil was placed into a plastic bucket and a 1 kg average sample was taken according to the standard and placed in a labelled plastic bag. The bagged soil samples were kept in a cool place until laboratory work.

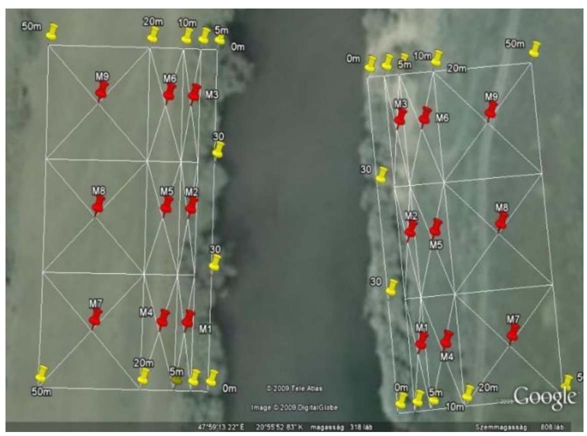


Figure 3. Sampling grid in Google Earth

Preparation of soil samples
The collected soil samples were cleaned from stones, plant parts and roots and poured into plastic containers and dried in the laboratory for one week at room temperature. The resulting "air-dry" soil samples were pulverized in a pestle and mortar and sieved through a sieve with a 2 mm mesh to obtain a sample of approximately 150 grams. The resulting sample was further sieved through a 0,2 mm sieve. Samples of around 50 grams were placed in small paper bags, numbered and stored in cardboard boxes.
Then, approximately 5 g of the soil sieved through a 0.2 mm sieve was weighed into weighing bottles for the determination of the absolute dry matter content according to standard MSz-08-0205-1978. The samples were dried in a drying oven at 105 ^{o}C to constant weight.
The % dry matter content of the soil samples was calculated according to the following formula: $n=(v/b)*100$
Where: n= dry matter %, v=mass of the soil dried at 105 ^{o}C (g), b=mass of air-dried soil (g)

Measurement of soil pH
The measurement was performed according to the standard MSZ-08-0206/2-1978. [13] 6 grams of each air-dry soil sample was weighed on a dial balance and 15 ml of distilled water or 15 mL of 1 mL potassium chloride solution was added to the samples in the test tubes and the samples were mixed thoroughly. The

samples were left to stand for 12 hours in the cork-film sealed tubes and then measured with a Corning NE 1604 pp3 pH meter set to a so-called two-point calibration.

Digestion of soil samples with a Milestone 1200 mega microwave digestion device
Procedure for digestion: 0.5 g of soil was measured from the air-dry soil samples into Teflon bombs, then 5 ml of 65% nitric acid and 2 ml of 30% hydrogen peroxide were added. The samples were then allowed to stand for half an hour, and the bombs were sealed and placed in a Milestone 1200 mega in which the program according to Table 1 was set.

Table 1. Program of digestion

Number of steps	Requires time	Operation
1.	5 minutes	Digestion, 250 Watt
2.	2 minutes	Ventilation
3.	5 minutes	Digestion, 400 Watt
4.	5 minutes	Digestion, 250 Watt
5.	7 minutes	Digestion, 700 Watt
6.	5 minutes	Ventilation

After destroying, the samples were cooled in a water stream for half an hour and then opened in a gas mask in the open air. The liquid from the Teflon bombs was filtered through a funnel and 0.45 µm pore size filter paper into 25 mL flasks and filled to the mark with deionized water. After homogenization, the solutions were transferred to plastic containers and stored in the refrigerator until measurement.

Determination of the concentration of the elements under test using a UNICAM 939 atomic absorption spectrometer

Emission mode (to measure the concentration of lithium ions)
Flame photometry is a branch of emission spectroscopy where the sample is excited by the thermal energy of a flame at an appropriate temperature. It exploits the phenomenon that excitation of certain elements with low excitation energy is possible at hot flame temperatures.
The solution under test is injected into the flame in the form of an aerosol by means of high-pressure gas atomization. The temperature of the flame must be high enough to ensure the evaporation, atomic dissociation and excitation of the solid after the solvent has evaporated; temperatures of 2000-3000^{o}C. However, the flame temperature must not be so high that metal atoms with low ionization energy are highly ionized, because this will reduce the emission of the substance. The excited elements emit a characteristic linear or banded spectrum in the flame. Linear flame colors are produced by the excited atoms (e.g. alkali metals), while banded flame colors are produced by the molecules (e.g. alkaline earth oxides).
By spraying the solution under test into the flame at a constant velocity, the intensity of the wavelength emission characteristic of each element can be used to infer the concentration of the substances, as the emission depends on the number of atoms excited. If we know the relationship between emission and concentration, i.e., the credibility function, the concentration can be calculated from the measured emission [14]. In my measurements, I first prepared a series of calibration solutions containing the element to be measured, 4-5 depending on the element. In all cases, distilled water was used as the blank solution. After preparing these, the wavelength characteristic of lithium (Li: 670.8 nm) was set on the machine.

Atomic absorption mode (to measure the concentration of the heavy metal under test)
In the single light path setup, the light from the cathode lamp passes directly through the atomizing field and enters the detector after the monochromator. In this arrangement, the measurement starts by setting the initial light intensity I_o. During the measurement, the reduced light intensity I due to atomic absorption is compared to this initial value I_o. The absorbance measured in this way is can be calculated using the formula [15]:

$$A = \lg \frac{I_o}{I}$$

In our measurements, we first prepared a series of calibration solutions containing the element to be measured, 4-5 depending on the element. In all cases, double distilled water was used as the blank solution. After preparing these measurement procedures, we set the wavelength of the elements on the machine. Theseare Zn: 213.9 nm., Cd: 228.9 nm., Pb: 217.0 nm., Mn: 279.5 nm., Cu: 324.8 nm., Fe: 252.3 nm.

RESULTS AND DISCUSSION

We have divided the area into left (B) and right (J) sides according to the course of the rivers. The letter "M" was used to mark the samples. They are numbered from 1 to 9. According to the results of the pH measurements (Table 2.) of the soils, most of the samples are neutral, some of them are weakly acidic and some are weakly alkaline at the time of analysis. The measured pH values indicate that the mobilization of heavy metals is low.

Table 2. pH values (MSZ-08-0205:1978): [13] at the time of soil sampling, weakly alkaline and weakly acidic, therefore heavy metals were not mobile in the soil

	pH average	
	KCl	H_2O
max	7.61	7.805
min	5.66	6.315

The statistical analysis of the data is intended to answer the following question:

1. Does the concentration of the soil samples depend on the location of the sampling site along the river? (X factor)
2. Does the concentration of soil samples depend on the distance of the samples from the river (perpendicular to the river)? (Y factor)
3. Does the concentration of soil samples in the samples depend on their location parallel to the river (see sampling grid)? (Z factor)

The answers to these questions were sought using a three-factor random block design analysis of variance and the analysis was performed using the program "SPSS FOR WINDOWS 14.0" at P=5%. The factors of analysis of variance were as follows:

Factor X: twelve levels of the right and left bank of the Sajó, the right and left bank of the Hernád, the right and left bank of the section after the inflow of the Sajó Hernád, the right and left bank of the Tisza, the right and left bank of the section before the inflow of the Sajó into the Tisza, the right and left bank of the section of the Tisza where the Sajó has already flowed into the Tisza.

Y factor: three levels 5 m-10 m- 20 m

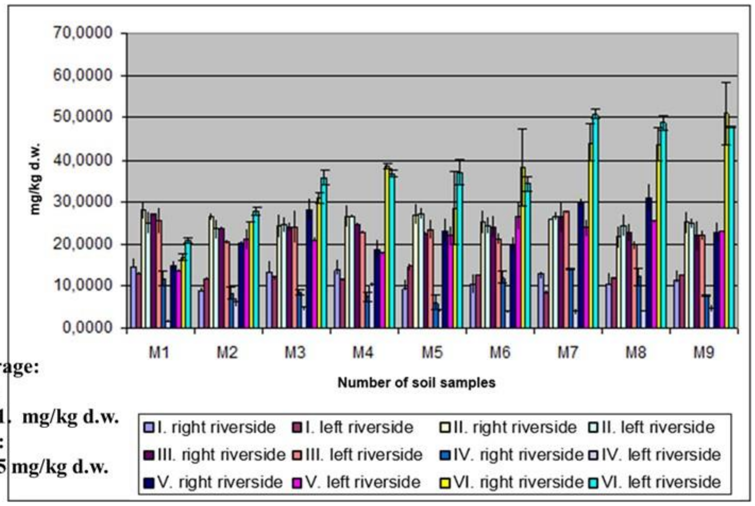
Z factor: three levels 0m-30 m-60 m

The values measured by the GA [15] in 1992 are not comparable with our results, as the average samples were formed differently (the GA [15] averaged samples taken at a depth of 0-60 cm), but they are indicative. Our analyses were carried out from average samples of soil samples taken to a depth of 0-40 cm.

Lithium concentration measures in soil samples

According to Figure 4. the average lithium content in Area I is 11.96 mg/kg of dry matter weight (hereinafter d.w.). There is no contamination limit for lithium in soils. The average lithium content of the samples taken from the right bank of the river is 11.71 mg/kg d.w. The average lithium content of the samples taken from the left bank of the river is 12.20 mg/kg d.w. The average lithium concentration in the GA [15] soil samples taken at Ónod was 10.62 mg/kg d.w. The average lithium content of the samples taken from the right bank ofthe river was 25.66 mg/kg d.w. The average lithium content of the samples taken from the left bank of the river was 25.28 mg/kg d.w.

The average lithium content of the samples from the right bank of the river is 24.20 mg/kg d.w. The average lithium content of the samples from the left bank of the river is 23.10 mg/kg d.w. The average lithium concentration of the ZAE soil samples taken at Muhi was 10.75 mg/kg d.w. The average lithium content of the samples taken from the right bank of the river was 9.84 mg/kg d.w. The average lithium content of the samples taken from the left bank of the river was 5.01 mg/kg d.w. The average lithium content of the samples taken from the right bank of the river is 23.24 mg/kg d.w. The average lithium content of thesamples taken from the left bank of the river is 21.71 mg/kg d.w. Average lithium content in Area VI: 36.56 mg/kg d.w. Average lithium content in samples from the right bank of the river: 35.32 mg/kg d.w. Average lithium content in samples from the left bank of the river: 37.80 mg/kg d.w.



Average:
GA:
11.41 mg/kg d.w.
Our:
11.95 mg/kg d.w.

Figure 4. Lithium concentration in the soil samples tested

Cadmium concentrations measured in soil samples

Figure 5. shows that the average cadmium content in Area I is 8.21 mg/kg d.w. The contamination limit for cadmium in soils is 1 mg/kg d.w. according to Joint Decree 6/2009 (IV. 14) [16] of the Ministry of Agriculture, Forestry, Environment and Water Management, which was exceeded in all (18) samples. The average cadmium content of the samples taken from the right bank of the river was 6.20 mg/kg d.w. The average cadmium contentof the samples taken from the left bank of the river was 10.21 mg/kg d.w. The average cadmium concentration of the GA [15] soil samples taken at Ónod was 6.21 mg/kg d.w.

The average cadmium content in Area II was 5.74 mg/kg S.A. All samples (18 samples) exceeded the contamination limit for cadmium in soils. The average cadmium content of the samples from the right bank of the river was 6.04 mg/kg S.A. The average cadmium content of the samples from the left bank of the river was 5.43 mg/kg S.A.

The average cadmium content in Area III was 0.95 mg/kg of soil d.w. The contamination limit for cadmium in soils was exceeded in 9 samples, mainly from the left bank. Samples from the right bank of the river had an average cadmium content of 0.24 mg/kg d.w. Several of the samples from the right bank were below the measurement threshold. Samples from the left bank of the river had an average cadmium content of 1.66 mg/kg d.w. The average cadmium concentration of the GA [15] soil samples taken at Muhi was 2.13 mg/kg d.w.

The average cadmium content in Area IV was 0.52 mg/kg d.w. The contamination limit for cadmium in soils was exceeded in 12 samples. Samples from the right bank of the river had an average cadmium content of 1.32 mg/kg d.w. Several of the right bank samples were below the measurement threshold. The average cadmium content of the samples from the left bank of the river was 1.84 mg/kg d.w. The average cadmium content in Area V was 1.97 mg/kg soil d.w. The contamination limit for cadmium in soils was exceeded in 16 samples. Samples from the right bank of the river had an average cadmium content of 1.64 mg/kg d.w. Several of the right bank samples were below the measurement threshold. The average cadmium content of the samples from the left bank of the river was 2.31 mg/kg d.w. All samples in Area VI were below the measurement limit.

Average:
GA:
8.21 mg/kg d.w.
Our:
6.21 mg/kg d.w.

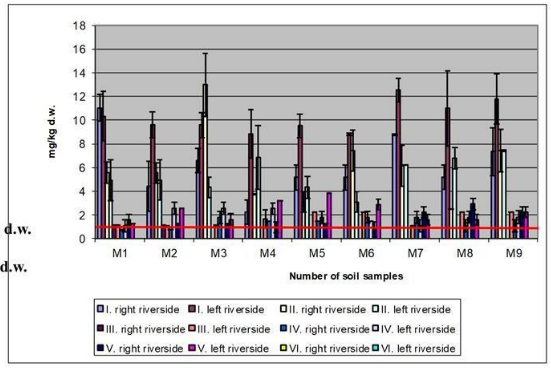


Figure 5. Cd concentration in soil samples

Zinc concentrations measured in soil samples

According to Figure 6. the average zinc content in Area I is 281.48 mg/kg d.w. The contamination limit for zinc in soils is 200 mg/kg d.w., which was exceeded in 12 samples, according to the joint decree 6/2009 (IV. 14) of the Ministry of Agriculture, Forestry, Environment and Water Management. The average zinc content of the samples taken from the right bank of the river was 296.97 mg/kg d.w. The average zinc content of the samples taken from the left bank of the river was 265.99 mg/kg d.w. The average zinc concentration of the ZAE soil samples taken at Ónod was 403.30 mg/kg d.w.

The average zinc content in Area II was 64.21 mg/kg d.w. No sample exceeded the contamination limit for zinc in soils. Samples from the right bank of the river had an average zinc content of 63.63 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 64.79 mg/kg d.w.

The average zinc content in Area III is 61.42 mg/kg d.w. of soil. Samples from the right bank of the river had an average zinc content of 60.21 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 62.63 mg/kg d.w. The ZAE soil samples taken at Muhi had an average zinc concentration of 90.00 mg/kg d.w.

The average zinc content in Area IV was 17.28 mg/kg d.w. No sample exceeded the contamination limit for zinc in soils. Samples from the right bank of the river had an average zinc content of 17.87 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 16.68 mg/kg d.w.

The average zinc content in Area V is 147.75 mg/kg d.w. The contamination limit for zinc in soils was exceeded in 2 samples. Samples from the right bank of the river had an average zinc content of 161.05 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 134.44 mg/kg d.w.

The average zinc content in Area VI was 197.12 mg/kg of soil d.w. The contamination limit for zinc in soils was exceeded in 9 samples. Samples from the right bank of the river had an average zinc content of 179.94 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 214.30 mg/kg d.w.

Average:
GA:
403 mg/kg d.w.
Our:
281 mg/kg d.w.

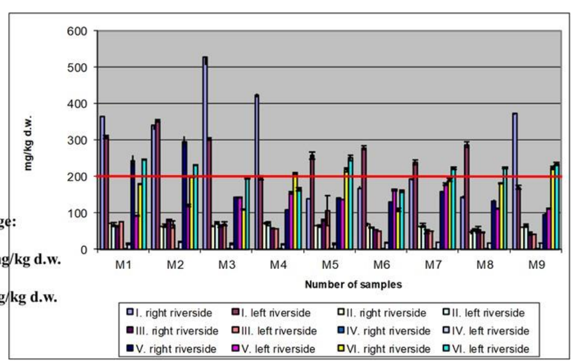


Figure 6. Zinc concentrations measured in the soil samples tested

Lead concentrations in soil samples

According to Figure 7, the average lead content in Area I is 45.71 mg/kg d.w. The contamination limit for lead in soils is 100 mg/kg d.w. according to the joint decree 6/2009 (IV. 14) of the Ministry of Agriculture, Forestry, Environment and Water Management, which was not exceeded by any sample. Samples from the right bank of the river had an average lead content of 36.95 mg/kg d.w. Samples from the left bank of the river had an average lead content of 54.47 mg/kg d.w.

The average lead concentration of the GA [15] soil samples taken at Ónod was 253.72 mg/kg d.w.

The average lead content in Area II was 65.84 mg/kg d.w. Only 1 sample exceeded the contamination limit for lead in soils. The average lead content of the samples from the right bank of the river was 79.23 mg/kg d.w. The average lead content of the samples from the left bank of the river was 52.44 mg/kg d.w.

The average lead content in Area III was 95.23 mg/kg d.w. The contamination limit for lead in soils was exceeded in all (9) samples from the right bank. Samples from the right bank of the river had an average lead content of 128.42 mg/kg d.w. Samples from the left bank of the river had an average lead content of 62.04 mg/kg d.w.

The GA [15] soil samples taken at Muhi had an average lead concentration of 35.85 mg/kg d.w.

The average lead content in Area IV was 48.89 mg/kg d.w. No sample exceeded the contamination limit for lead in soils. Samples from the right bank of the river had an average lead content of 73.05 mg/kg d.w. Samples from the left bank of the river had an average lead content of 24.73 mg/kg d.w.

The average lead content in Area V was 71.62 mg/kg d.w. The contamination limit for lead in soils was exceeded in 3 samples. Samples from the right bank of the river had an average lead content of 92.38 mg/kg d.w. Samples from the left bank of the river had an average lead content of 50.87 mg/kg d.w.

The average lead content in Area VI was 111.74 mg/kg d.w. The contamination limit for lead in soils was exceeded in 8 samples from the right bank. Samples from the right bank of the river had an average lead content of 151.31 mg/kg d.w. Samples from the left bank of the river had an average lead content of 72.17 mg/kg d.w.

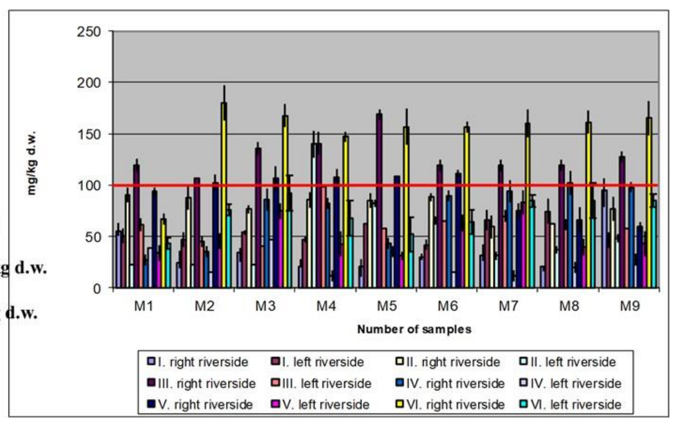


Figure 7. Lead concentration in soil samples tested

Manganese concentration in soil samples

According to Figure 8, the average manganese content in Area I is 584.66 mg/kg d.w. There is no contamination limit for manganese in soils. The average manganese content of the samples taken from the right bank of the river is 617.01 mg/kg d.w. The average manganese content of the samples taken from the left bank of the river is 552.31 mg/kg d.w. The average manganese concentration in the GA [15] soil samplestaken at Ónod was 1030.00 mg/kg d.w.

The average manganese content of the samples taken from the right bank of the river was 190.90 mg/kg d.w. The average manganese content of the samples taken from the left bank of the river was 194.36 mg/kg d.w. The average manganese content of the samples taken from the right bank of the river is 468.68 mg/kg d.w. The average manganese content of the samples taken from the left bank of the river is 479.49 mg/kg d.w.

The average manganese concentration of the GA [15] soil samples taken at Muhi was 1059.00 mg/kg d.w. The average manganese content of the samples taken from the right bank of the river was 602.42 mg/kg d.w. The average manganese content of the samples taken from the left bank of the river was 535.76 mg/kg d.w. The average manganese content of the samples taken from the right bank of the river was 447.58 mg/kg d.w. The average manganese content of the samples taken from the left bank of the river was 433.70 mg/kg d.w. The average manganese content of the samples from the right bank of the river was 714.28 mg/kg d.w. The average manganese content of the samples from the left bank of the river was 795.85 mg/kg d.w.

Iron concentration in soil tested

According to Figure 8, the average iron content of Area I is 12086.94 mg/kg d.w. There is no contamination limit for the iron content of soils. The average iron content of the samples taken from the right bank of the river is 12088.63 mg/kg d.w. The average iron content of the samples taken from the left bank of the river is 12085.25 mg/kg d.w.

The average iron content of the samples taken from the right bank of the river is 10299.61 mg/kg d.w. The average iron content of the samples taken from the left bank of the river is 10204.48 mg/kg d.w. The average iron content of the samples taken from the right bank of the river is 6219.72 mg/kg d.w.

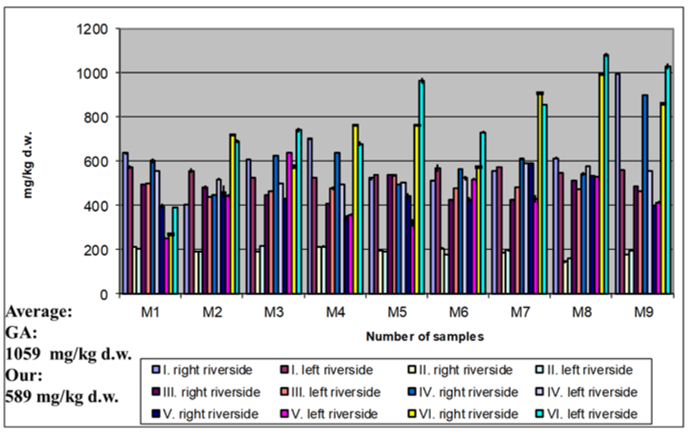


Figure 8. Manganese concentration in soil samples tested

Iron concentration in soil tested

According to Figure 9, the average iron content of Area I is 12086.94 mg/kg d.w. There is no contamination limit for the iron content of soils. The average iron content of the samples taken from the right bank of the river is 12088.63 mg/kg d.w. The average iron content of the samples taken from the left bank of the river is 12085.25 mg/kg d.w.

The average iron content of the samples taken from the right bank of the river is 10299.61 mg/kg d.w. The average iron content of the samples taken from the left bank of the river is 10204.48 mg/kg d.w.

The average iron content of the samples taken from the right bank of the river is 6219.72 mg/kg d.w.

The average iron content of the samples taken from the left bank of the river is 6091.66 mg/kg d.w. Average iron content in Area IV: 11806.23 mg/kg d.w. Average iron content in samples from the right bank of the river: 11757.91 mg/kg d.w. Average iron content in samples from the left bank of the river: 11854.55 mg/kg d.w.

Average iron content in Area V: 9696.70 mg/kg d.w. Average iron content in samples from the right bank of the river: 9283.40 mg/kg d.w. Average iron content in samples from the left bank of the river: 9490.05 mg/kg d.w.

Average iron content in Area VI 14901.93 mg/kg d.w. Average iron content in samples from the right bank of the river 14891.37 mg/kg d.w. Average iron content in samples from the left bank of the river 14912.50 mg/kg d.w.

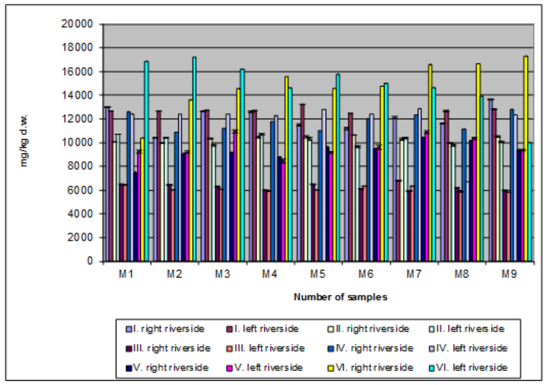


Figure 9. Iron concentration in tested soils

Zinc concentration in measured soil samples

According to Figure 10, the average zinc content in Area I is 281.48 mg/kg d.w. The contamination limit for zinc in soils is 200 mg/kg d.w., which was exceeded in 12 samples, according to the joint decree 6/2009 (IV. 14) of the Ministry of Agriculture, Forestry, Environment and Water Management [16]. The average zinc content of the samples taken from the right bank of the river was 296.97 mg/kg d.w. The average zinc content of the samples taken from the left bank of the river was 265.99 mg/kg d.w. The average zinc concentration of the GA [15] soil samples taken at Ónod was 403.30 mg/kg d.w.

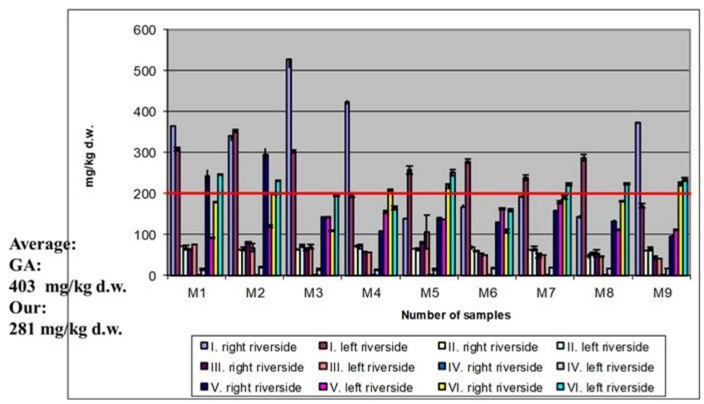


Figure 10. Zinc concentration in tested soil samples

The average zinc content in Area II was 64.21 mg/kg d.w. No sample exceeded the contamination limit for zinc in soils. Samples from the right bank of the river had an average zinc content of 63.63 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 64.79 mg/kg d.w.

The average zinc content in Area III is 61.42 mg/kg d.w. of soil. Samples from the right bank of the river had an average zinc content of 60.21 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 62.63 mg/kg d.w.

The GA [15] soil samples taken at Muhi had an average zinc concentration of 90.00 mg/kg d.w.

The average zinc content in Area IV was 17.28 mg/kg d.w. No sample exceeded the contamination limit for zinc in soils. Samples from the right bank of the river had an average zinc content of 17.87 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 16.68 mg/kg d.w.

The average zinc content in Area V is 147.75 mg/kg d.w. The contamination limit for zinc in soils was exceeded in 2 samples. Samples from the right bank of the river had an average zinc content of 161.05 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 134.44 mg/kg d.w.

The average zinc content in Area VI was 197.12 mg/kg of soil d.w. The contamination limit for zinc in soils was exceeded in 9 samples. Samples from the right bank of the river had an average zinc content of 179.94 mg/kg d.w. Samples from the left bank of the river had an average cadmium content of 214.30 mg/kg d.w.

The copper content in measured soil samples

According to Figure 11, the average copper content in Area I is 40.49 mg/kg d.w. The contamination limit for copper in soils is 75 mg/kg d.w. according to the joint decree 6/2009 (IV. 14) of the Ministry of Agriculture, Forestry, Environment and Water Management, which was not exceeded by any of the samples in this area. Samples from the right bank of the river had an average zinc content of 37.65 mg/kg d.w. Samples from the left bank of the river had an average zinc content of 43.33 mg/kg d.w.
The GA [15] soil samples taken at Ónod had an average copper concentration of 51.61 mg/kg d.w.
The average copper content in Area II was 39.66 mg/kg d.w. None of the samples exceeded the contamination limit for copper in soils. Samples from the right bank of the river had an average copper content of 39.44 mg/kg d.w. Samples from the left bank of the river had an average copper content of 39.88 mg/kg d.w.
The average copper content in Area III was 16.31 mg/kg d.w. None of the samples exceeded the contamination limit for copper in soils. Samples from the right bank of the river had an average copper content of 14.63 mg/kg d.w. Samples from the left bank of the river had an average zinc content of 17.99 mg/kg d.w.
The GA [15] soil samples taken at Muhi had an average copper concentration of 56.90 mg/kg d.w.
The average copper content in Area IV was 19.75 mg/kg d.w. No sample exceeded the contamination limit for copper in soils. Samples from the right bank of the river had an average copper content of 22.15 mg/kg d.w. Samples from the left bank of the river had an average zinc content of 17.38 mg/kg d.w.
The average copper content in Area V was 25.40 mg/kg d.w. No sample exceeded the contamination limit for copper in soils. Samples from the right bank of the river had an average copper content of 26.00 mg/kg d.w. Samples from the left bank of the river had an average zinc content of 24.79 mg/kg d.w.
The average copper content in Area VI was 60.57 mg/kg d.w. The contamination limit for copper in soils was exceeded in 4 samples. Samples from the right bank of the river had an average copper content of 52.14 mg/kg d.w. Samples from the left bank of the river had an average zinc content of 68.99 mg/kg d.w.

Average:
GA:
40 mg/kg d.w.
Our:
52 mg/kg d.w.

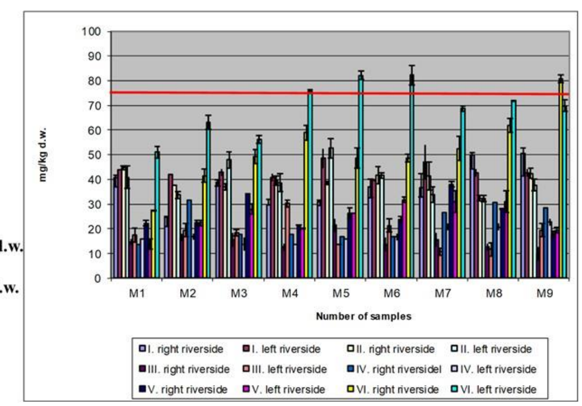


Figure 11. Copper concentration in soil samples

CONCLUSIONS AND RECOMMENDATIONS

The Green Action Association [15] carried out a comprehensive monitoring of the Sajó Valley in the early 1990s. This gave us the idea to carry out our work, as significant heavy metal and lithium pollution was found in the areas surveyed. It is very likely that this was mainly caused by heavy industry from the 19th century until the 1980s. Six areas were selected as the test sites for the soil samples, between Ónod and Muhi(3 areas) and near Tiszaszederkény and Tiszagyulaháza (3 additional areas). Our soil samples were collected from the floodplains of the Sajó, Hernád and Tisza rivers at a depth of 0-40 cm. The results obtained showed that there are still areas where some elements such as Cd, Zn, Pb, Cu are contaminated above the limit values(Joint Decree 6/2009 (IV. 14.) [16] of the Ministry of Agriculture, Forestry, Environment and WaterManagement). Due to the weakly alkaline and weakly acidic pH values measured, the contaminants are immobile in the soil.

In our floodplain soil samples from the six sample sites, the following four heavy metals (Cd, Zn, Cu, Pb) with contamination limits exceeded the contamination limit. We measured high concentrations of cadmiumin five areas (Areas I, II, III, IV, V), high concentrations of zinc in three areas (Areas I, V, VI), lead concentrations above the limit value in three areas (Areas II, III, VI) and copper concentrations above the limit value in one area (Area VI). As floodplain areas are often used for grazing and are close to arable land,the accumulation of heavy metals can pose a serious health risk, as these heavy metals can accumulate in plants and animals and can indirectly harm the human body. Before choosing the measures to reduce the heavy metal load described above, it is necessary to analyze samples of river sediment and sludge, because itcannot be excluded that during the past continuous pollution, large quantities of heavy metals have been deposited in the sediment, which could be reintroduced into the floodplain and further polluted by flooding. Statistical evaluation was performed by three-factor random block analysis of variance using SPSS 14.0 for Windows software package. After performing analysis of variance, it was shown that the heavy metal content of soil samples was significantly related to the sampling location. On the basis of the data obtained, we propose to carry out a study on a similar scale to the monitoring carried out in the 1990s and to clean up the contaminated soils.

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ENVIROMENTAL AND ECOLOGICAL IMPACTS OF ILLEGAL DUMPING

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Abstract: *My chosen topic is the environmental and ecological impacts of illegal dumping because today it is a very big problem in Hungary and around the world. During my research I studied the impacts done to the soil using Hungarian standards to determine soil quality. Within this, I used organic and inorganic chemical test methods such as e.g. analysis of heavy metals, detection of inorganic compounds or organic compounds by spectrophotometric methods. Soil pollution is a global problem that affects both humans and the wildlife around them. Contamination entering the soil can spread to other environmental elements, so its investigation is also important for human health. The results show that illegal dumping not only causes social problems, but also the impact of soil as an environmental element based on the performed studies. I established these results with the help of Hungarian and European Union regulations and pollution limit values. In conclusion, we can talk about the fact that in each casethe degree of pollution depends on the waste deposited and its amount, which is reflected in the ecological effects as well as in the measured results.*

Keywords: *Illegal, waste, pollution, soil, health, environment*

INTRODUCTION

General soil characteristics

The concept of soil, a conditionally renewable natural resource, which is also a basic means of agricultural production, forestry, a living medium of the Earth's solid surface, the most important characteristic of which is fertility [1] under Act CXXXIX of 2007, but in the ordinary sense the soil is the highest solid envelope on Earth. The soil is home to animals, people, and a place to grow plants. Its basic property is fertility, which means that it is able to supply the vegetation on it with enough nutrients and water at the right time. This allows for the production of primary biomass. Soil is involved in the natural cycle, both biologically and chemically. Because the energy and chemicals that come to the earth's surface appear in the cycle and either appear as an initial or intermediate or final destination in the soil, from which they canbe utilized in some way by the appropriate living organisms. Due to fertility, we can say that soil is a product of fertility. Examined from this point of view, the condition of the soil is authoritative and guidingthe ecology of the surface formed on it. With this in mind, it can be said that soil plays a multifaceted role globally. In part, it can be an indicator, a place of production, a habitat, but even the soil can be all of them. Furthermore, soil is a fundamental element with several functions, its function is the space of humanactivities and life, but it can be considered as a physical medium, a source of raw materials, but also as a medium with archival functions. In terms of physical medium, man can use soil as a "area" for construction. These include roads, houses, social facilities, and everything our built environment needs for
life. As a source of raw materials, the soil can be said to provide some of the raw materials for the

construction industry (sand, gravel, clay), but it also contains water, minerals, many types of oil, and also a deposit of raw materials. Its function as an archive is nothing more than the carrying of archaeological and paleontological information, which is essential for contemporary history in order to draw conclusions from the changes of the past regarding the development of our future.

Soil structure

In the extent of the soil, we can speak of two directions. Its horizontal extent is the part of the earth's surface that we can also see, as well as the vertical part, which is the depth direction of a given soil profile,which is the section that can be examined by moving towards the center of the earth. As they are built up by different soil formers at different depths of the soil, certain physicochemical properties will also change(spatial change). Another feature of soils is that their physical, chemical and morphological properties can change over time. Such as: temperature, which is a periodic change, a trend changes in a certain direction, such as: accumulation of organic matter. The change can be random, which is mostly man-made pollution.The duration of the change over time also varies, from a change of a few hours to a change of seasons. During soil surveys, monitoring surveys provide a complete picture of changes affecting the soil. Its Hungarian collection system is the TIM, the Soil Protection Information System, which records the measured data, which is public and can be retrieved. This is based on the 2007 CXXXIX. law, which covers arable land, land protection and soil protection. The core points of the TIM system are 865 points nationwide, we can find 183 of the measuring points in forestry, and we can also find a nice number of special measuring points, exactly 188 points. [2]

Chemical and physical properties of soil

Soil types appear in very varied forms on Earth. They may vary from continent to continent, but also from region to country. Terrain and weather conditions largely determine its quality and, consequently, the composition of the soil. In general, soils contain humus, minerals, water, gases, and, of course, organic matter. The quality and general characteristics of the soil can also be greatly influenced by the flora covering the soil. One of the most important chemical characteristics is the pH, which can be clearly seen in the figure shown here, what is typical in Hungary.

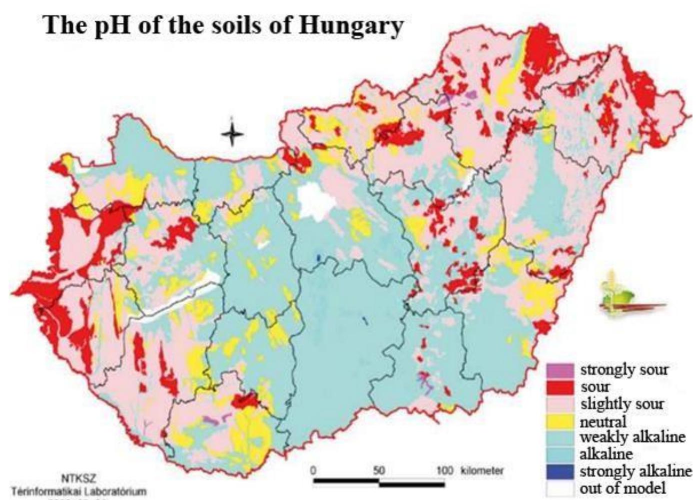

Figure 1. The pH of the soils of Hungary

In terms of its physical properties, it can be said to have a mechanical composition, a constraint, a structure, and its own water and air management.

Soil contamination

The following can be considered as the definition of soil pollution, the entry of foreign substances into the soil that reduce the fertility and quality of the soil, either directly or through air or water. Also, the combined effect of soil degradation caused by secondary contaminants formed during the transformation of the input materials causes the deterioration of soil quality and fertility, which can also be caused by human activity and natural processes. These processes usually have some physical, biological negative effect. Changes in the balance of physical and biological soils are accompanied by changes in soil ecology:

1. direct pollution → anthropogenic + local
2. with air / water → regional or global
3. lithosphere pollution (deeper)
4. contamination under the humus layer (in the case of lateral movement)

Using a different definition, it can be said that it is a process related to human activity, during which the physical, chemical and biological properties of the soil developed under natural conditions change significantly and in an unfavorable direction. Soil pollution impairs ecological soil functions (biomass production, filtering, balancing, transformation and storage role, habitat and genetic reserve).

Types of waste, production and consumption waste

One of the main problems with waste is that products with a minimum lifespan are produced from too many materials and by investing large amounts of energy. Due to the organization of the consumer society, rapidly consuming energy sources are available, in contrast, an increasing amount of waste is generated in developing and developed countries. Therefore, a more modern approach and assessment of waste will be given great emphasis in the coming period.

Today, human society is producing ever-increasing waste heaps. This entails pollution, but it is also a huge problem for today's social order. The biggest fact about waste that we have to declare is that the best waste is what we don't even produce. With this in mind, we need to take stock of the types of waste, at the level of production and use, as well as the technologies, ideologies associated with waste management, fashion trends today, and the effects of waste on the environment.

Groupings and quantities of waste

In terms of legal regulations, the definition used in Hungary today, but also internationally accepted, was formulated and applied in accordance with the amended European Community Directive 75/442 / EEC on Waste, which reads as follows: "the intention of all holders of waste and interest based on it". In addition, Section 3 (a) of the Waste Management Act provides the domestic definition, which includes the following: An object or substance falling within one of the categories set out in Annex I which the holder discards or intends or is required to discard. [3]

The production / use of waste and its disposal pathway must consider the chemical / physical / biological effects of the waste and, in this context, require legal and social measures covering a coordinated set of activities covering the whole life cycle of the waste. This includes the prevention of waste generation, the minimization or reduction of the amount of waste generated, and the application of one final solution, storage and disposal. In accordance with this, Act XLIII of 2000, which has a broad legal background applicable in Hungary, was born. Act on Waste Management. [4]

According to a 2016 figure, the amount of waste generated in the European Union is estimated at 2 and a half billion tons. A significant part of this comes from mining (~ 25.3%) and construction (~ 36.4%), but a huge amount is generated from household waste (~ 8.5%). [5]

MEASUREMENT RESULTS AND CONCLUSION

The results in the table above, which were considered to be above the limit value, were determined according to the points of the relevant annex of Joint Decree 6/2009 (IV. 14.) KvVm-EüM-FVM. [6]

Original sample identifier in the first soil sample: District X 1/1; simple name 1/1 sample exceeds the soil limits in several points. A III. These are marked with an asterisk in Annex. Among the general chemical parameters tested, the following metals exceeded the pollution limit values set out in the relevant Annex 1 points of Joint Decree 6/2009 (IV. 14.) KvVm-EüM-FVM [7].

Barium (Ba)

Barium is a naturally occurring element that can have the following physiological effects: high barium content is usually a toxic element measured in air and soil (which is the 14th most common in soil) from which it can be extracted by skin or by growing vegetation in the area toxic effects, which can lead to paralysis and, in severe cases, death. In general, the toxic element in areas containing hazardous waste is barium, which is miscible in water, so the compounds formed from it can leach from the soil into deeper water layers, which can further pollute the ecosystem as well as groundwater. [8]

$$Ba + 2H_2O \rightarrow Ba\ (OH)_2 + H_2$$

Exceeding the limit value of almost 10% can be measured in the examined soil sample. The limit value is 6/2009. (IV.14.) KvVM-EüM-FVM, in which Annex 1 deals with the pollution limit value by groups of substances, of which Annex 1 contains metals and semi-metals. The limit is given in mg / kg dry matter. The measured result is 273 mg / kg dry matter. The value of barium exceeding the limit value measured in the soil is probably due to the fact that the examined area (District X 1/1 sample - 0.15 m) of the illegally dumped waste had been ignited earlier. An area of 2 to 1-2 centimeters high ash covered the area, covering an area of almost 10-15 m2. During sampling, this ash portion did not come into contact with the soil sample as they were taken at a depth of 15–30 cm. It can therefore be concluded that barium, which belongs to the group of alkaline earth metals in the soil, is derived from illegally deposited waste incinerated there. Because barium is water-soluble, it could have been washed into the soil with the help of rainwater, causing pollution. From the results measured so far, it can be seen that it has entered and washed into the top layer of the soil.

Cadmium (Cd)

From a physiological point of view, in connection with the measured results, it can be said that it is an important moment during the research and exploration of contaminated soil. Cadmium can be said to be dangerous in several ways, as it can be enriched much more easily in the upper layers of the soil than other heavy metals. This is because it cannot leach out of the soil and makes it much easier to get into the food chain. It is important to mention that they are easily absorbed from the soil in plants, even without visible poisoning. [8] By incorporating essential zinc into the human body, it can have harmful effects that can damage the liver and the lungs when inhaled but can also lead to many cardiovascular problems.

One of the factors influencing cadmium uptake is pH, which in larger acidic soils other than the general pH 7 allows higher amounts to enter living organisms. [9] This is fully met in our case, as it is clear that at each sampling point, although the pH point falls within the “normal” pH range, the other points in the study area are strongly acidic pH areas. As the contaminated source is not entirely a point source, possible leaching is possible to the entire area covered by illegal waste. Like barium, cadmium pollution above the limit value can pose a serious threat to wildlife. Aware of these, it can be said that it can be concluded that cadmium, which belongs to the group of transition metals in the soil, comes from illegally deposited wasteincinerated there. Because cadmium is soluble in water, it could leach into the soil with the help of rainwater, causing contamination in the topsoil.

Zinc (Zn)

The average amount of zinc in the lithosphere is 80 mg kg-1 on average, while in Hungary it is 25-100 mg kg-1 [10]. In general, it can be found in the form of Zn2 +. The material balance of the soil in the case of zinc shows that more zinc enters the soil every year than the soil-dwelling vegetation can absorb or utilize. It can get into the soil mostly in connection with mining, metallurgy and the burning of fossil fuels, the latter burning the sheep into the soil by settling out of the float. Because zinc is an essential trace element, it is easily absorbed by wildlife, but in parallel it is one of the most dangerous heavy metals. The high value measured at the first soil sampling point is extremely important for soil remediation.

Copper (Cu)
Copper plays a particularly important role in plant nutrition and plant growth. As an essential element essential for proper life processes to take place, it is an activator of the respiratory chain, an activator and creator of many enzymes. The average total copper content of the soils is approx. 20 mg / kg, but this is the average of very different extremes. The mineral content of soil-forming rocks primarily determines the total copper content of soils, as in the case of Zn and Mg. depending on the rock type, the copper content varies, the highest amount is found in basic rocks (140 mg / kg), sedimentary rocks already contain less copper (57 mg / kg) and the smallest amount (30 mg / kg) in acidic rocks such as e.g. occurs in granite. The amount of microelements that can be taken up by plants is regulated primarily by the reaction state and pH of the soil, so any effect that directly or indirectly affects the pH of the soil also affects the uptake of microelements. The resulting deficiencies and the possible toxic effects are also strongly influenced by the microbiological processes that change with the effect of pH, the microbiological activity modifies the solubility and oxidation state of the microelements Mn, Zn, Cu, Al and Mo.

Lead (Pb)
Of the toxic heavy metals, lead is one of the oldest known occupational toxicants. It is used in many areas of the economy as a metal or in the form of its compounds. During exposure, it tends to accumulate in the human body and cause damage to health. The damage to health can be temporary or permanent, so it is important to control exposure
The average amount of lead (Pb) in the earth's crust is 15 mg kg^{-1}. The lead content of surface soils varies in the range of 3-189 mg kg^{-1}, the lead content of unpolluted agricultural soils is 10-67 mg kg^{-1}, with an average of 32 mg kg^{-1}. 80% of domestic soils have a lead content of less than 25 mg kg^{-1}, the same as the domestic background value [12]

CONCLUSIONS

However, the adverse effects of metals are significantly more complex in environmental compartments, as toxicity is determined by solubility, ionic strength, pH, and redox conditions. As a result, with changes in temperature, solubility, pH, and redox conditions, the metal compounds present can be transformed, and the most toxic form can appear at any time.
In biological systems, the concentration of metals can vary by several orders of magnitude relative to each other. Their presence in a certain concentration is necessary for healthy functioning. The so-calledessential metals below a certain concentration cause developmental disorders, which are Zn, Cr, Co, Mn, Mo, Sn, Cu and Fe.
In the case of soil contamination, the most important feature is remediation, and this is determined by the remediation target value. The value is defined as the remediation target value, which gives the maximum concentration of the pollutant in the environmental medium after remediation. This value must not only be achieved during remediation but must also be maintained in the long term. In addition to professional and technical issues, ethical and social aspects of the environment must be taken into account when determining concentration.
One of the most frequently used methods of cleaning up a polluted environmental element is boundary system remediation. The system is based on a table of specific pollutant concentration values, which prescribes limit values based on a uniform environmental policy for all environmental elements. During system-based remediation, the limit values in force in the contaminated area apply with binding effect to the target condition to be achieved.
Soil pollution can be caused by any anthropogenic, liquid, dissolved, or soluble foreign matter that enters the soil surface or directly into the soil. These contaminants move in the soil according to the laws of physical chemistry and also affect the ecosystem. The speed of movement is determined by several parameters. The most important of these are the chemical properties of the contaminant, persistence, solubility, gravity, pressure conditions, specific gravity differences, soil porosity / capillarity, soil sorption / retention capacity, redox conditions and soil solution pH. In addition to the parameters that determine the transport process, taking into account the effects of pollutants on soil and water, pollution prevention and

remediation offer a wide range of solutions in the field of environmental technology. The applied technological solutions may be unique, but the operational elements of the technology are similar.

Suggested solutions:

As the sampling shows the measured values over a given period, it is in any case necessary to re-examine the given soil samples at a later date. It is considered possible that III. The amount of impurities exceeding the limit values indicated in Annex I will also appear in deeper layers in spring, as the sampling took place in the early autumn after summer. In the case of higher precipitation, which could be said to be true for the last few days (until 2021.10.01-2021.11.05), the fact may arise that the pollution has entered the deeper layers. It cannot be ruled out that it will sooner or later reach the aquifers. Therefore, a soil damage in the area is suggested in this way.

The high PAH content measured in the contaminated soil area is partly due to the fact that it was taken next to an access road. It has been reported in several literature that the optimal air-fuel mass ratiorequired for perfect fuel combustion is 14.5 [11]. In the case of a different ratio, we can speak of imperfectcombustion, during which polyaromatic hydrocarbons, also known as combustion, can be formed.

A soil remediation procedure is recommended in the area, as the area is approximately 20 square meters and only the top 15cm in height was measurable, so soil replacement is recommended in the area. However, PAH pollution exceeding the limit value needs further investigation, as the amount of illegally disposed waste found in the area does not justify the pollution exceeding the limit value.

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BIOMONITORING OF LICHEN AS A BIOINDICATOR OF ATMOSPHERE QUALITY IN ULAANBAATAR, MONGOLIA

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Abstract: *The lichen species are an essential part of plant diversity and they are well-established indicators of air pollution. Lichen is used to indicate different levels of nitrogen pollution and as indicators of forest continuity*
City of Ulaanbaatar, the capital of Mongolia was initially designed for a half million residents. Due to intense rural-to-urban migration after transition to market driven economy, the population of the capital is nearly tripled, which resulted in huge area of informal settlements and elevated number of vehicles. Tents and small buildings in above settlements heated by conventional stoves by burning coal and wood, while the most vehicles on the road are imported second-hand cars. During last two decades, air quality of capital city Ulaanbaatar is considered as an emerging issue and above two are primary sources of outdoor air pollution. The most abundant air pollutants are nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and carbon monoxide (CO) which have disastrous effects on health when inhaled over prolonged periods of time. Due to the quantities of these pollutants would be far more abundant and thus cause the catastrophic effects to the air quality that is seen in Ulaanbaatar. Various techniques have been developed to monitor air quality, including biomonitoring using lichens. In this study, we monitored types of epiphytic lichens covering sensitive to air pollution fruticose type and relatively tolerant foliose type of lichens. Unlike air quality index, lichens clearly show negative impact of poor air quality on surrounding ecosystems. We examined lichens on Larix sibirica, themost abundant coniferous tree of the area. Both foliose and fruticose types of lichens are abundant in Larix sibirica dominated forests located to the northern areas of Ulaanbaatar. It indicates the area is free of pollution. In contrary, fruticose type lichens, especially representatives from the genera Usnea, Cladonia and Vulpicidia are absent in coniferous forest to the southern areas of Ulaanbaatar.

Keywords: *lichen species, Ulaanbaatar, Mongolia, air pollution, bi indicators*

INTRODUCTION

Lichens are mutualistic associations of a fungus and an algae or cyanobacteria. In nature, they occur on rocks, bare grounds, and trees, the latter known as epiphytic lichens. Due to their dependence on airborne nutrients, lichens are very sensitive to air pollution especially to sulfur dioxide. They do not bear defensive tissue, therefore quickly absorb, and accumulate sulfur dioxide in their tissue, which subsequently leads to a damage of chlorophyll in phycobiont algae so that photosynthesis is inhibited. Because of this sensitive characteristic, lichens are widely used as environmental indicators or bioindicators. Depending on their degree of tolerance, some species may present with certain concentration of pollutants, while all species mayvanish with extremely poor air quality. On this ground, lichens provide a relevant, sensitive, and measurable indicator for long-term monitoring (Das *et al*., 2013; Giordani, 2007).
One of the places where lichens could be used as bioindicator is city of Ulaanbaatar, the capital of Mongolia. The city is characterized by its high elevation (1350 meters above sea level), low precipitation (200-300

mm), and its location in a basin (Hauck, 2008). The city was initially designed for a half million residents. However, due to 1990s intense rural-to-urban migration, population of the capital was far more exceeded than its infrastructure capacity and ended up with informal settlements or huge ger areas (Figure 1). Since Ulaanbaatar is the coldest capital in the world with annual mean temperature of minus 3.7ºC (Hilbig et al., 2004), the major cause (c.a. 80%) of air pollution comes from coal burning stoves which are the sole way to heat ger homes under sub-zero temperatures. There are 130.5 thousand families in ger areas burn roughly 525 thousand metric tonnes of coals, 290 thousand cubic metres of firewood, and other combustible materials each year (http://agaar.mn/static/stove-distribution).
As a result, concentrations of the major pollutants far outreached the guideline values provided by World Health Organization (WHO). For example, on the coldest days of the year, daily average of $PM_{2.5}$ level reaches 687 μg/m^3, which is 27 times higher than the level WHO recommends as safe (https://www.unicef.org/mongolia/environment-air-pollution).

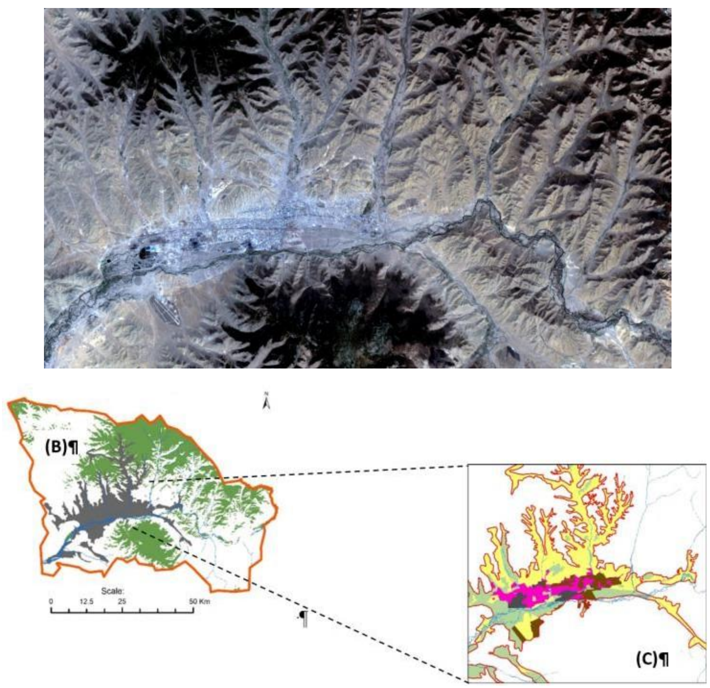


Figure 1. Map of the city of Ulaanbaatar
(A) Landsat image (https://landsat.visibleearth.nasa.gov); (B) Settlement areas of the city, where grey - settlement areas, green –forest areas, and blue – rivers; (C) Land use map as of 2010, where yellow – ger areas (Myagmartseren et al., 2018)

Similarly, sulphur dioxide, the major pollutant from coal burning reaches 170 μg/m^3, which is eight times higher than a national air quality standard. The second major source (10%) of air pollution is 340 thousand vehicles on the road and most of which are (79%) aged more than ten years and with substandard quality. Total of three thermal power plants are responsible for 6% of Ulaanbaatar air pollution, and the rest 4% is windblown dust (Davy et al., 2011).
Supporting reason for dense air pollution of Ulaanbaatar is its geographical location in a basin. The city is located along the Valley of Tuul River. Surrounding mountains reduce vertical and horizontal dispersion of air pollutants, especially during wintertime (Figure 1).

Objectives
Polluted air accumulates in the city area and shows number of negative impacts on human and ecosystem health. Air quality of capital city Ulaanbaatar is considered as an emerging issue and dozens of measures taken during the last two decades; however, no significant improvements have been achieved so far. Study

on lichens in relation with air quality started in mid 90s (Galsan et al., 1995; Enkhtuya, 1999) and further studies examined Ulaanbaatar air pollution effect on lichenous flora of surrounding ecosystems, biochemical and chemical analysis of lichens, bioindicator roles of local lichens and biodiversity of lichens (Ganbold et al., 2007; Hauck, 2008; Baljinnyam et al., 2009; Delgermaa et al., 2016).
In this study, I examined epiphytic lichens on *Larix sibirica*, the most abundant tree of the local forest at four sites close to Ulaanbaatar city. Two sites were chosen from Bogd Khan Mountain to the south and downwind of the city and two were from Chinggeltei Mountain to the north and upwind of the city.

Climate Change in Mongolia

Temperature: Very high rates of historical warming are reported in recent years. Average temperatures rose by average of 2.41°C between 1940 and 2017. It is mainly associated with reduced cold days and increase in hot summer days. During that time the maximum temperature has risen up to 2.6°C while the minimum has risen only up to 0.3° around the same time. According to the research the temperature trends can be different depending on the area, altitude and biome.

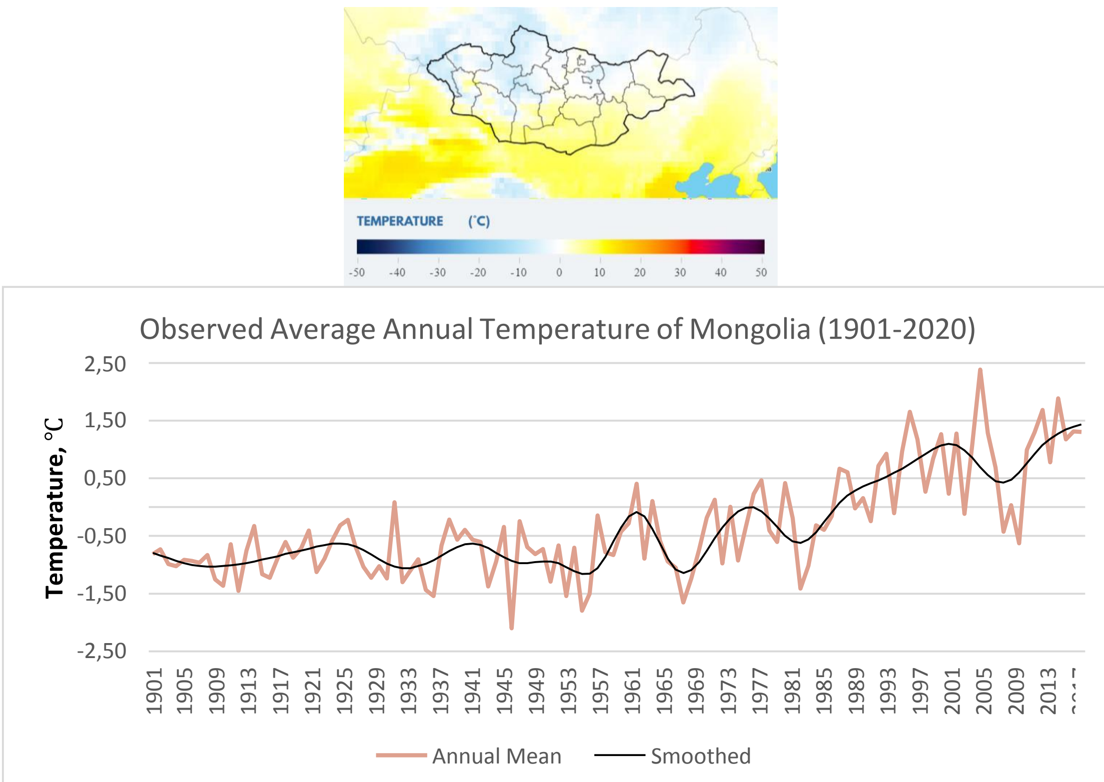


Figure 2. Observed Average Annual Temperature of Mongolia for 1901-2020 (https://1212.mn)

Presipitation: During the period of 1940 to 2017 it is reported a decline in average annual precipitation of 7% to the Mongolia’s Third National Communication. The central regions of the country have observed this decline in strong rainfalls over time. This supports the large increase in winter snowfall. Also during the time of 1971 until 2017 it is believed the number of consistent wet days and days with heavy precipitation have dropped. But, these claims have low statistical importance and should be negotiated carefully. Locals observation and knowledge have identified an increase in occurring thunderstorms and short high rainfall events

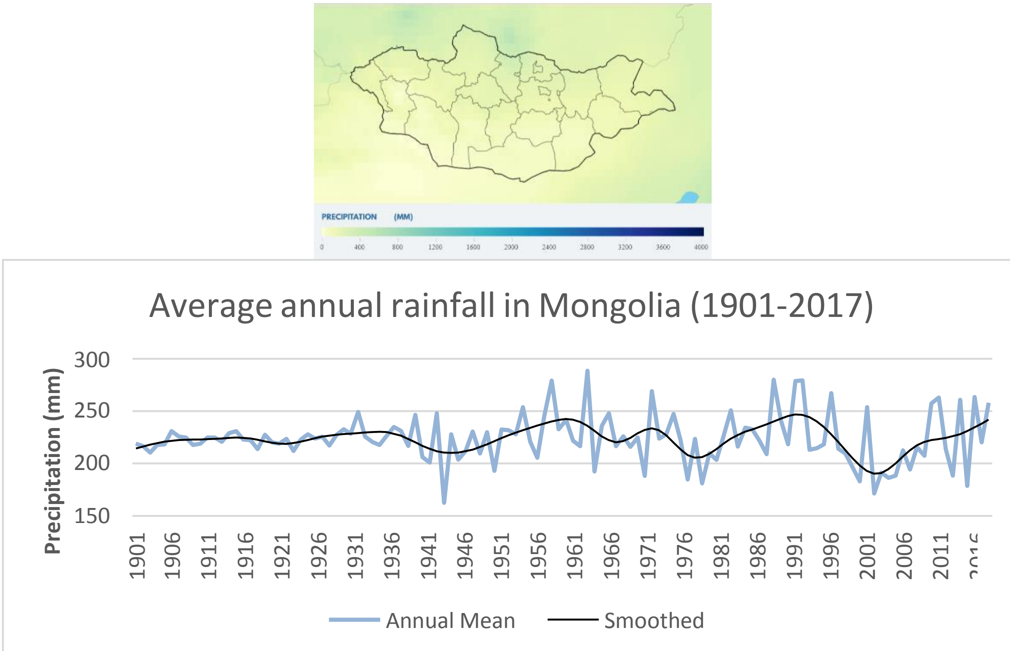


Figure 3. Observed Average Annual Rainfall of Mongolia for 1901-2020 (https://1212.mn)

Drought and Dust: Mongolia is affected by two types of droughts. Meteorological (associated with a difference of precipitation) and hydrological (associated with a difference in surface and subsurface water flow, originating mainly in the regions wide river basins.) Today, Mongolia is expected to have severe meteorological drought around 4%, according to standardized precipitation evaporation index (SPEI) of less than -2. In spite of that, Mongolia is prone to other complex forms of drought mainly due to its unique climate parameters. Dry and hot summers followed by cold winters that create a natural hazard named “Dzud”. The study also shows an increase in the frequency of both meteorological and pasture drought from 1965-2010. It is widely supported and confirmed by the local knowledge and observations, due to this in drier areas, frequency of dust storms has increased.

Air Pollution: Firstly, it should be stated that the air pollution is a top priority issue for the government, and its monitoring is very important for the public health. Until 2006, the capital city, Ulaanbaatar had four air quality monitoring stations and 15 mobile stations for controlling purposes. These four stations mainly located in the internal parts of the capital city only measured sulfur dioxide (SO2) and nitrogen oxides (NO_2) concentrations (Figure 4). The studies from the monitoring data indicates the rise in the SO_2 and NO_2 concentration during the year 2013-2015.
However, SO_2 pollution, which has sources similar to PM_{10}, authorizes a direct linkage to growing trend in coal use. Likewise, increasing vehicular population is one of the main causes for increased NO_2 levels, a primary precursor for ground-level ozone pollution and secondary contributor to $PM_{2.5}$ pollution (Guttikunda et al., 2013). It could be seen that the 4 stations and their capabilities were insufficient to cover a large area and conduct thorough air pollution related studies.

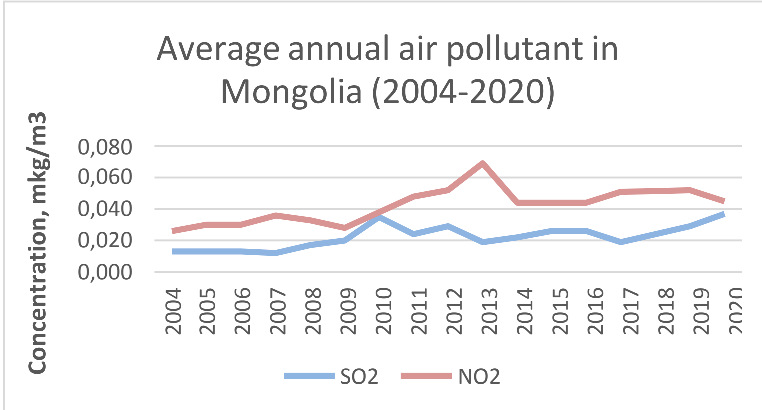


Figure 4. Concentration of SO_2 and NO_2

MATERIALS AND METHODS

Study sites

Total four sites were selected in this study. Site A and B located in Bogd Khan Mountain area which is to the south and downwind of the city. The Site A located at 1762 meters above sea level, where wind flows mostly from the west, rather not from the city. Site B was just 1.62 kilometers apart from Site A, however 298 meters below and located downwind the emission from Thermal Power Plant III. With this reason, the Site B was suspected as the most polluted site along with other three sites (Figure 5). Site C and D were from Chinggeltei Mountain to the northern side and mostly upwind of the city. The Site C was chosen because its location along the Selbe River. During winter, when air pollution reaches its highest peak, the polluted air fills up the valley and reaches Site C if wind flow is weak. That is why we suspect this site to expose to mild pollution. The last Site D was chosen because its distance from the source of pollution. All of the above four sites belonged to the same type of forest or coniferous forest where larch tree dominates (Figure 5). Details of the selected sites were given in Table 1.

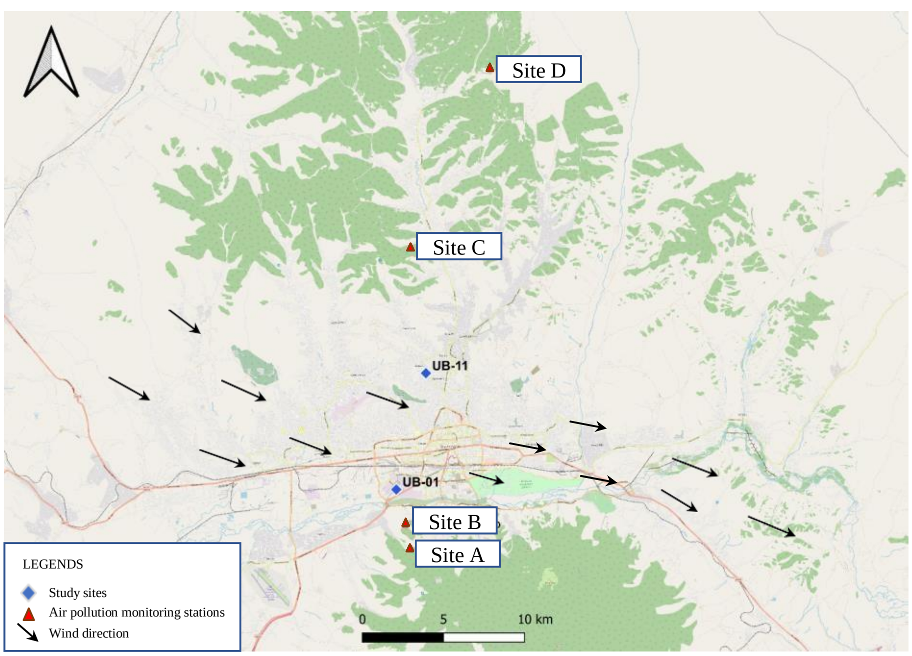


Figure 5. Location of the selected sites

Table 1. Details of the selected sites

Site of study	Bogd Khan Mountain (downwind the city)		Chinggeltei Mountain (upwind the city)	
	Zaisan	Khiimoriin ovoo	Yargait	Khandgait
	Site A	Site B	Site C	Site D
Latitude	47º86′26.2″N	47º87′61.5″N	48º02′93.9″N	48º12′71.2″N
Longitude	106º88′28.6″E	106º87′91.7″E	106º88′90.8″E	106º95′85.8″E
Altitude	1782 m	1464 m	1545 m	1731 m
Distance from city center by road or path	8.6 km	7.0 km	14.7 km	26.9 km
Forest type	Coniferous	Coniferous	Coniferous	Coniferous

Lichen sampling

Siberian larch *Larix sibirica* was used in this study because of its abundance and morphological characteristics of bark that is rough and suitable for lichen settling. Lichen colonies were collected with the help of forceps, placed in sample bags and transferred to a laboratory.

Identification of lichens

Lichen specimen was collected in polyethylene bags and transferred to a laboratory. The samples were air dried and identified using light microscopy with the help of chemical tests (Orange et al., 2010).

Total lichen coverage

Total fifteen individual larch trees, whose diameters ≥20 cm were selected at each site. Quantification of lichens was done by placing a lichen grid (20X20 cm) on the tree at 0-20 cm and 130-150 cm heights from ground level (Figure 7).

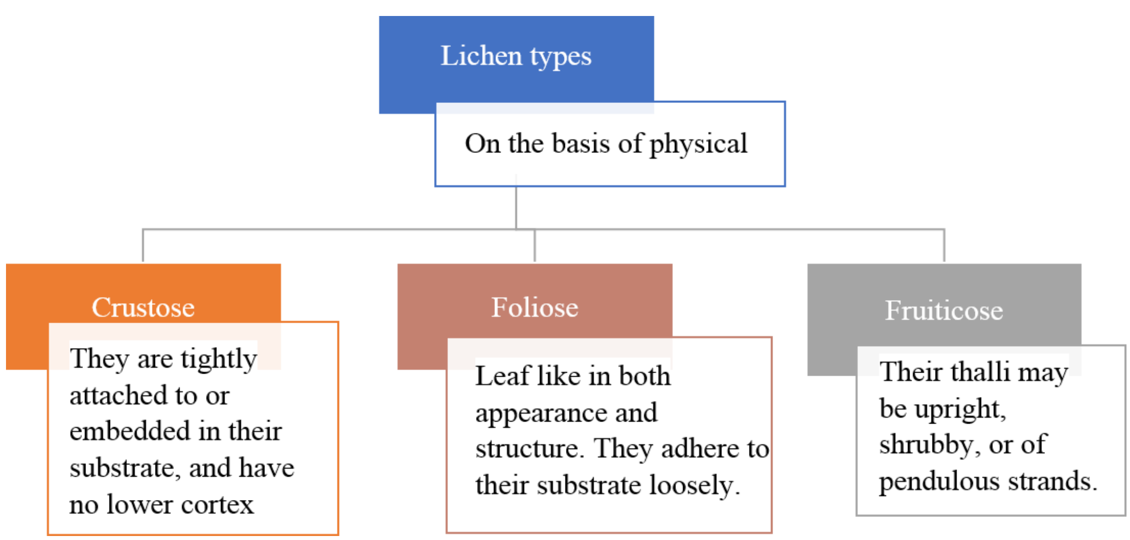


Figure 6. Lichen types

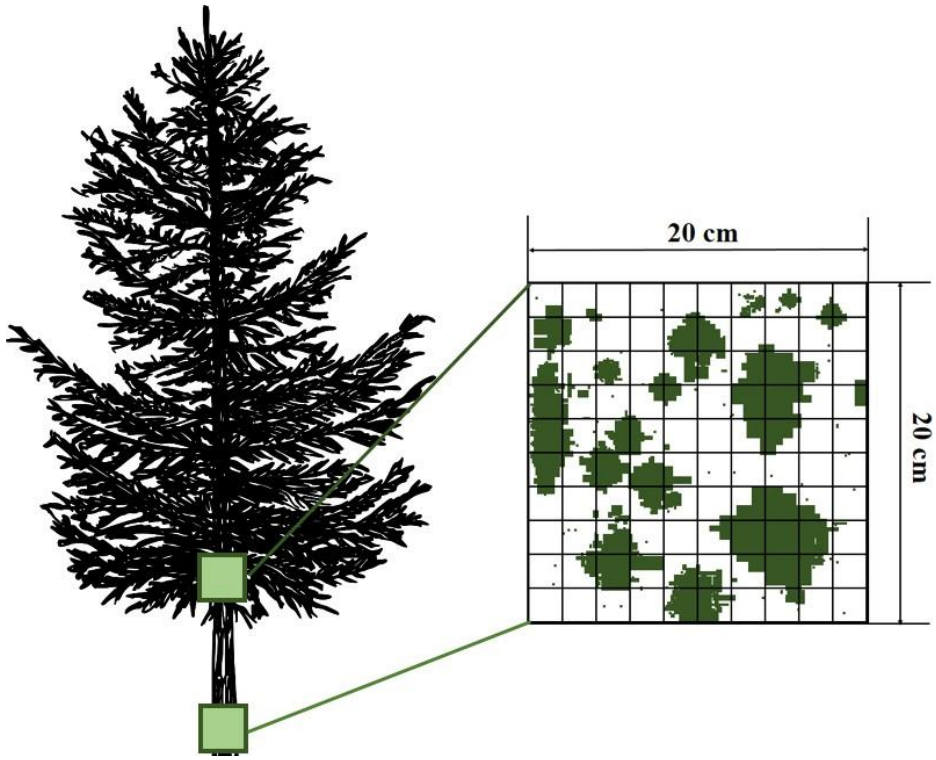


Figure 7. Lichen grid (20cm*20cm)

RESULTS AND DISCUSSIONS

Lichen diversity

Currently there are 225 species of lichen recorded in Bogd Khan Mountain (Enkhtuya, 2007). However, in this study, we recorded collectively 12 lichen species at the A and B sites selected from Bogd KhanMountain area (Table 2); 10 and 8 species from the Site A and B, respectively.

Most lichens observed from Bogd Khan Mountain belonged to foliose and crustose growth type which are relatively tolerant to air pollution. For example, according to Hawksworth, 1970, foliose type lichen *Hypogymnia physodes* could tolerate 70µg/m^3 mean winter SO_2 concentration and appear around the basis of the trees, but do not extend up the trunks.

In our study, mostly all sensitive species from fruticose type lichens were vanished and foliose type species - *Hypogymnia physodes, Flavopunctelia soredica and Parmelia sulcata* were observed as dominant lichens mostly around the basis of the trees. Especially, two tolerant species *Flavopunctelia soredica* and *Parmelia sulcata* comprised more than 90% of the total lichen coverage at the Site B.

From fruticose growth type, only one species - *Evernia mesomorpha* was observed in this area. To note, only one colony of *Evernia mesomorpha* was recorded among fifteen larch trees used at the Site B.

For the two sites C and D from Chinggeltei Mountain area, upwind the city, the most sensitive fruticose type lichen species were observed as abundant lichens (Table 2).

Well known bio-indicator species from a genus *Usnea*, which exist when mean winter sulfur dioxide concentration is below 40µg/m^3 only were observed at both Sites C and D. Furthermore, golden-colored foliose type lichen *Vulpicidia pinastri*, which is extremely sensitive to any type of air pollution was recorded at Site D. This result indicated an excellent air quality at this site.

We collected and identified total 22 species of lichens from Chinggeltei area; 15 and 22 species from the Site D and C, respectively. Some of the lichens were photographed and shown in Table 3.

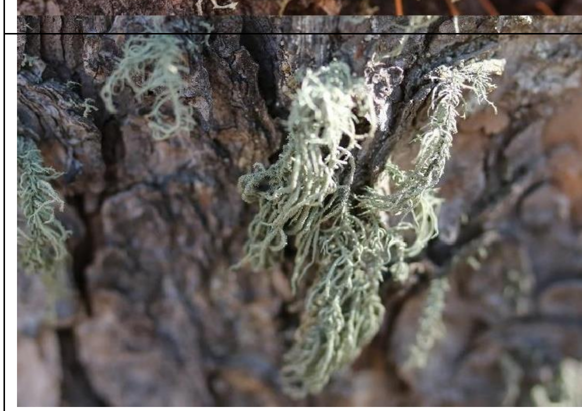
Table 2. Lichen species recorded at each study site

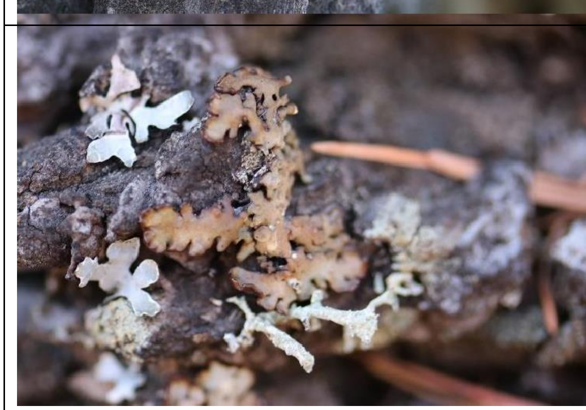
Species	Morphology	Bogd Khan Mountain		Chinggeltei Mountain	
		Site A	Site B	Site C	Site D
Cladonia coniocraea	Fruticose			+	+
Cladonia fimbriata	Fruticose			+	+
Evernia mesomorpha	Fruticose	+	+	+	+
Usnea fulvoreagens	Fruticose			+	+
Usnea hirta	Fruticose			+	+
Usnea lapponica	Fruticose				+
Usnea sp.	Fruticose				+
Flavopunctelia soredica	Foliose	+	+	+	+
Hypogymnia bitterii	Foliose	+		+	+
Hypogymnia physodes	Foliose	+	+	+	+
Melanelia exasperatula	Foliose	+			+
Melanelia olivacea	Foliose			+	+
Parmelia soredica	Foliose		+	+	+
Parmelia sulcata	Foliose	+	+	+	+
Vulpicidia pinastri	Foliose				+
Buellia sp.	Crustose			+	+
Lecanora piniperda	Crustose	+			+
Lecanora symmicta	Crustose			+	+
Lepraria sp	Crustose	+			+
Rinodina sp.	Crustose			+	+
Trapeliopsis flexuosa	Crustose	+	+	+	+
Trapeliopsis granulosa	Crustose		+		+
Hypocenomyce scalaris	Squamulose	+	+		
	Total	**10**	**8**	**15**	**22**

+ present

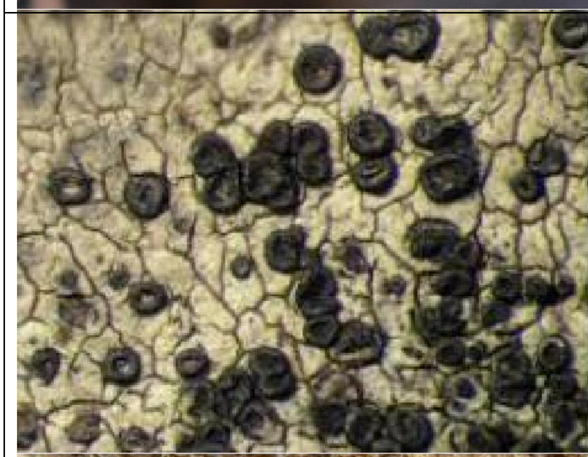
Table 3. Lichen species observed near Ulaanbaatar city

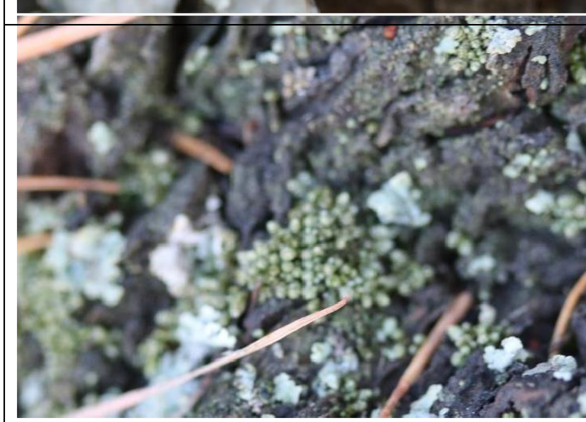
	Fruticose	*Cladonia coniocraea*

	Fruticose	*Cladonia fimbriata*
	Fruticose	*Evernia mesomorpha*
	Fruticose	*Usnea fulvoreagens*
	Fruticose	*Usnea hirta*

	Fruticose	*Usnea lapponica*
	Fruticose	*Usnea* sp.
	Foliose	*Flavopunctelia soredica*
	Foliose	*Hypogymnia bitterii*

	Foliose	*Hypogymnia physodes*
	Foliose	*Melanelia exasperatula*
	Foliose	*Melanelia olivacea*
	Foliose	*Parmelia soredica*

	Foliose	*Parmelia sulcata*
	Foliose	*Vulpicidia pinastri*
	Crustose	*Buellia* sp.
	Crustose	*Lecanora piniperda*

	Crustose	*Lecanora symmicta*
	Crustose	*Lepraria sp*
	Crustose	*Rinodina* sp.
	Crustose	*Trapeliopsis flexuosa*

	Crustose	*Trapeliopsis granulosa*
	Squamulose	*Hypocenomyce scalaris*

Total lichen coverage

Total lichen coverage at each sites were calculated on the basis of data obtained from fifteen trees. It means total sixty larch trees used in this study. And a column graph was plotted and shown in Figure 8. The highest lichen coverage was observed at Site A, both for 0-20 cm and 130-150 cm heights above ground level. Lowest coverage rate was observed at Site B, where emissions from Thermal Power Plant III sediment. A previous finding (Enkhtuya, 2007) proved that high amount of heavy metals were accumulated in tissue samples of the lichens at this site.

At the Site C and D, coverage difference between the heights from ground level is reduced. This result indicates that environmental condition at these sites is more favorable and lichen species extend to the trunk of the trees.

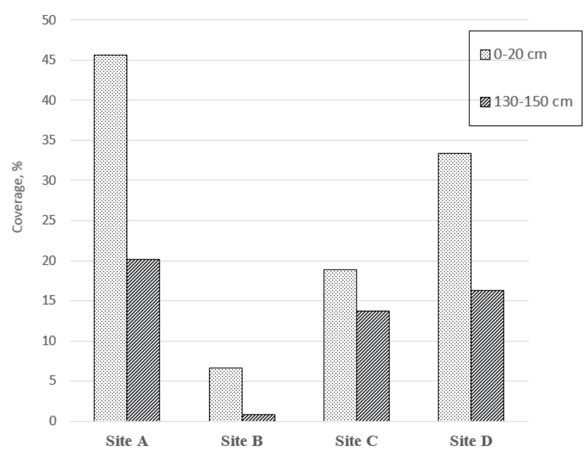


Figure 8. Total lichen coverage at the selected study sites

Figure 9: Lichen coverage in selected sites (0-20cm)

Figure 10: Lichen coverage in selected sites (130-150cm)

Lichens as bioindicator of air quality

Sulfur dioxide level in the air can be estimated qualitatively by studying the epiphytic lichens growing on trees (Hawksworth, 1970). In contrary, higher vascular plants and trees respond to air pollution at much slower rate (Muir et al., 1988). I observed lichen diversity within and outside of the city of Ulaanbaatar. All species of the trees and bushes near roads, parks and residential areas of Ulaanbaatar city do not bear any of the species of lichens. This result simply suggests a disastrous amount of air pollution that is mean winter sulfur dioxide concentration is around or exceeded 170μg/m^3. This finding also meets measurement results from the air quality monitoring stations.

Bogd Khan Mountain area, downwind of the city bear only lichen species tolerant to mild pollution, but size, color and morphology are already changed, and this result indicate plant stress under polluted conditions (Figure 11).

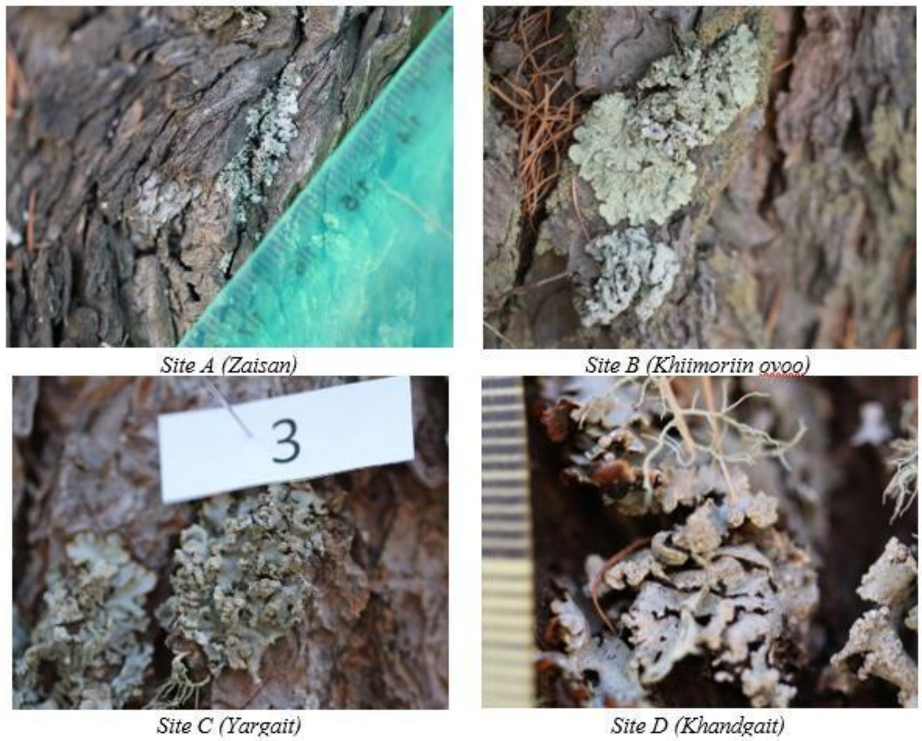


Figure 11: Morphological difference of *Hypogymnia physodes* in selected sites

CONCLUSION

In this study we observed clear change in lichen diversity downwind and upwind of the capital cityUlaanbaatar. The results suggest that polluted air generated from conventional stoves from ger areas transferred to the southern part of the city and show its negative impact to Bogd Khan Mountain ecosystems.Lichens are the first organisms respond to environmental pollution and warn us; but if such antropogenic false activity still remains for the future, many other important life forms may degrade in term of prolonged exposure time

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SMART-BUILT ENVIRONMENT: REVIEW

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Abstract: *The purpose of this review is to explain the intelligent built environment. And what are the motives for turning cities into smart cities? In addition, analysis of the aspects that must be made available to achieve this equation at an urban level, from people to infrastructure. In addition, the chapter provides a reference to the role of linking technological modernity in service management on urban scales and buildings (smart cities, smart buildings.*

Keywords:*. Smart city –Built environment- Smart City Features*

INTRODUCTION

Inhabited by over 7 billion people, our planet is in the midst of a massive ecosystem transition, climate change, tectonic plate movements, and biological evolution. Among these, climate change is one of the most critical issues affecting our planet and is largely attributable to human activities. Climate change brings with it adverse effects such as threats to biodiversity and ecosystems, risks to human health, rising sea levels due to the accelerated melting of glaciers and ice caps, increased water stress and decreased agricultural productivity.
These issues are driving many economies and cities around the world to focus on mitigating greenhouse emissions to counter climate change impacts. Cities account for the bulk of the world's greenhouse gas emissions and energy consumption. As cities in most nations are drivers of economic growth, urbanization is projected to continue to increase in the near future. This will, in turn, drive the depletion of non- renewable resources and add to carbon dioxide emissions. Innovation and digital technology must be leveraged to tackle rising urbanization and climate change issues to minimize energy consumption and improve the quality of life. To address urbanization challenges and ensure sustainability, innovation must be combined with energy, digital technology and information and communications technology. Sustainability encompasses not only the environment but also social equity and the economy. The globe iswitnessing a shift in economic power corridors, as China and India are considered to be the most powerfuleconomies to watch out for. These emerging economic giants need to take precautionary steps to avoid thedevastating effects of climate change.

What does the term "built environment" mean?

The term built environment is used when referring to those surroundings created

- for humans,
- by humans,
- to be used for human activity.
  Examples would include cities, buildings, urban spaces, walkways, roads, parks, etc.

Smart Environment

Smart Environment: Smart solutions for the environment consist of smart systems for managing environmental quality, irrigation, waste, photovoltaics, lighting, weather station and water supplies. Its objective is **to improve energy efficiency and the quality of the environment in cities**.

Smart Environments for Smart Cities: How do they work?

- Smart cities are a framework, predominantly made up of information and communication technologies (ICT), in which urban planning and sustainable development practices are developed and implemented to address the growing challenges of urbanization.
- IoT applications are fed back by an intelligent network of connected objects and machines that transmit data using wireless technology and the cloud.
- Supported by Big Data, smart cities use this data to implement measures that improve efficiency and the quality of life of the inhabitants.

Smart City Features

In the approach to the Smart Cities Mission, the objective is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions. The focus is on sustainable and inclusive development and the idea is to look at compact areas, create a replicable model which will act like a lighthouse to other aspiring cities. The Smart Cities Mission of the Government is a bold, new initiative. It is meant to set examples that can be replicated both within and outside the Smart City, catalyzing the creation of similar Smart Cities in various regions and parts of the country.

The core infrastructure elements in a Smart City would include - adequate water supply, assured electricity supply, sanitation, including solid waste management, efficient urban mobility and public transport, affordable housing, especially for the poor, robust IT connectivity and digitalization, good governance, especially e-Governance and citizen participation, sustainable environment, safety and security of citizens, particularly women, children and the elderly, and health and education. Some typical features of comprehensive development in Smart Cities are described below:

- Promoting mixed land use in area-based developments — planning for 'unplanned areas' containing a range of compatible activities and land uses close to one another in order to make land use more efficient. The States will enable some flexibility in land use and building bye-laws to adapt to change;
- Housing and inclusiveness — expand housing opportunities for all;
- Creating walkable localities — reduce congestion, air pollution and resource depletion, boost local economy, promote interactions and ensure security. The road network is created or refurbished not only for vehicles and public transport, but also for pedestrians and cyclists, and necessary administrative services are offered within walking or cycling distance;
- Preserving and developing open spaces — parks, playgrounds, and recreational spaces in order to enhance the quality of life of citizens, reduce the urban heat effects in Areas and generally promote eco-balance;
- Promoting a variety of transport options — Transit Oriented Development (TOD), public transport and last mile para-transport connectivity;
- Making governance citizen-friendly and cost effective — increasingly rely on online services to bring about accountability and transparency, especially using mobiles to reduce cost of services and providing services without having to go to municipal offices; form e-groups to listen to people and obtain feedback and use online monitoring of programs and activities with the aid of cyber tour of worksites;
- Giving an identity to the city — based on its main economic activity, such as local cuisine, health, education, arts and craft, culture, sports goods, furniture, hosiery, textile, dairy, etc;

Applying Smart Solutions to infrastructure and services in area-based development in order to make them better. For example, making Areas less vulnerable to disasters, using fewer resources, and providing cheaper services.

What are Smart Solutions

Before delving into the variety of environments that make up smart cities, we briefly explain what Smart solutions consist of, in charge of turning a city into a smart one.

These Smart solutions are intelligent services to measure and control the basic needs of a Smart City, through a modular and scalable system of connected management systems that facilitate the control and management of different areas of the city. In the case of **Nexus Smart Cit**, there are 4 main areas of solutions to implement:

1- **Smart Environment:** Smart solutions for the environment consist of smart systems for managing environmental quality, irrigation, waste, photovoltaics, lighting, weather station and water supplies. Its objective is to improve energy efficiency and the quality of the environment in cities.

2- **Smart Mobility:** Smart solutions for urban mobility consist of intelligent monitoring systems for pedestrians, bike lanes, parking spaces, charging stations, capacity control, traffic control and tourist saturation. Its objective is to reduce the noise of cities so that it can function normally.

3- **Smart Living:** Smart solutions for homes and everyday life consist of intelligent fire detection systems, video surveillance, air conditioning and management of sports facilities. Its objective is to improve the quality of life of citizens.

4- **Smart People:** Smart solutions for citizens consist of optimizing the services offered to them, taking into account that co-habitants are crucial to co-build a better city for all. These solutions include informational Mupis, citizen cards, citizen Apps, and social Wifi. Its objective is to enhance communication between the different parties.

APPROACH

Create solutions for the sustainable and smart design, renovation and repair construction, use, and maintenance of buildings, infrastructure, and cities.

Assist in the making of decisions and choices in urban planning that will benefit future generations.

These are the cornerstones of approach:

Developing new concepts and materials for sustainable new construction and renovation building. develop digital solutions for the entire life cycle of built environments from planning and construction to the use and demolition stages.

Construction of energy-efficient buildings and energy-positive residential areas without compromising on the comfort of the buildings and living environments.

Create development platforms for sustainable and smart urban solutions.

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CLIMATIC CHANGES AND NATURAL DISASTERS AFFECTING THE GLOBAL ENVIRONMENT

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Abstract: *Today, there is near universal consensus among the world's professions that human activity is causing climate change. The Intergovernmental Panel on Climate Change (IPCC) cautions that global greenhouse gas emissions should be cut in half by 2030 and reach net zero emissions by mid-century in order to avert the most catastrophic consequences climate change. Climate change in combination with other factors is putting at least one million plant and animal species at risk of extinction around the world. Changes in the global climate exacerbate climate hazards and amplify the risk of extreme weather disasters. Increases of air and water temperatures lead to rising sea levels, supercharged storms and higher wind speeds, more intense and prolonged droughts and wildfire seasons, heavier precipitation and flooding. The evidence is overwhelming and the results devastating: The number of climate-related disasters has tripled in the last 30 years. Between 2006 and 2016, the rate of global sea-level rise was 2.5 times faster than it was for almost all of the 20th century. More than 20 million people a year are forced from their homes by climate change. The United Nations Environment Program estimates that adapting to climate change and coping with damages will cost developing countries $140-300 billion per year by 2030. Extreme weather disasters affect all countries, rich and poor. But as we face a future with enhanced risks, it is critical to face the reality of those who bear the burden of our changing climate. For Oxfam, this is an issue of justice: those living in poverty are the hardest hit by climate change despite being the least responsible for the crisis. Climate change is forcing people from their homes, bringing poverty on top of poverty and increasing hunger. People in poorer countries are at least four times more likely to be displaced by extreme weather than people in rich countries. The world faces a race against time to reduce emissions and help the most vulnerablecope with climate impacts that are already being faced today and will escalate in the years ahead. It's time to act* now.

Keywords:*. climate change, extreme weather disasters, United Nations Environment Program*

INTRODUCTION

- The major public health organizations of the world have said that climate change is a critical public health problem.
- Climate change makes many existing diseases and conditions worse, but it may help introduce new pests and pathogens into new regions or communities.
- As the planet warms, oceans expand and the sea level rises, floods and droughts become more frequent and intense, and heat waves and hurricanes become more severe. (Figure 1)
- The most Climate change stresses our health care infrastructure and delivery systems.





Figure 1. Some of pictures of environmental changes due to climatic changes

Climate change is already damaging the health of the world's population and is set to have lifelong health consequences for future generations.

- We now know that man-made climate change is real and that it poses a great threat to the planet and its inhabitants.
- Current data suggest that we need to reduce greenhouse-gas emissions in developed countries by at least 80% by 2050 in order to have a chance of staying below an average temperature rise of over 2ºC.
- Factory farming is a major contributor to the climate change challenge, releasing vast volumes of greenhouse gases.
- It's not just CO_2 that's the problem: gases including CH_4 and NOx, produced in significant quantities, are released through various sources including animal waste and fertilizer use.
- Livestock farming produces 37% and 65% of our global CH_4 and NOx emissions respectively.
- Both gases are much more potent than CO_2 .
- Climate change is already harming food production and these impacts are projected to increase over time, with potentially devastating effects.
- Higher temperatures, for example, could place further stress on water-scarce regions and make it harder to rear animals and grow food crops.
- According to the Convention on Biological Diversity climate change may affect plant growth and production by promoting the spread of pests and diseases, increasing exposure to heat stress and encouraging soil erosion due to stronger winds.
- The climate crisis is one of the greatest threats to the health of humanity today, but the world has yet to see a response from governments that matches the unprecedented scale of the challenge facing the next generation
- The clinical, global health and research community needs to come together now and challenge our international leaders to protect the imminent threat to childhood and lifelong health.

Climatic Changes

- The climate is the normal weather in a specific area.
- When the normal temperature and the amount of rain in a specific area changes, there is a transition in the normal weather.
- This is climate change. Not only in specific areas climate change is observed, all over the world the consequences of climate change are felt.
- Global climate change is directly affects the main environmental components: water, air, weather, and ecosystems.
- Changes in precipitation, temperatures, and melting of ice caps are already occurred and will create new changes in the availability and quality of water and temperature.
- Health and Climate Change has found that, if carbon emissions and climate change continue at the current rate, a child born today will face a world on average 4˚C warmer by their 71st birthday, threatening their health at every stage of their lives.
- Health and Climate Change makes clear that climate change is taking a heavy toll on people's health, and the toll is heaviest on those who have contributed least to changing our planet's climate.
- For the world to meet its climate goals and protect the health of the next generation, the energy landscape will have to change drastically, and soon, the report warns.
- Nothing short of a 7.4% year-on-year cut in fossil CO_2 emissions from 2019 to 2050 will limit global warming to the more ambitious goal of 1.5°C.

Categories of Human Health

- the categories of human health consequences of global climate change such as
    1. asthma,
    2. respiratory allergies,
    3. air quality diseases,

4. cancer,
5. cardiovascular
6. Disease and stroke,
7. food-, water-borne,
8. vector-borne and
9. zoonotic diseases,
10. nutrition,
11. weather and heat-related morbidity and mortality,
12. human developmental impacts,
13. mental health and stress-related disorders,
14. neurological diseases and disorders,
15. Pesticides and chemical exposure
16. Food safety, distribution, and nutrition
17. Extreme weather event
18. Vulnerable populations, etc.

- Climate science has concluded that the rise in average temperatures will lead into more frequent and severe **acute hazards**, such as floods and heat waves, and the **intensifying of chronic hazards**, such as rising sea levels and drought.

By definition

- Climate risk is a term referring to risk assessment based on formal analysis on the consequences, likelihoods and responses to the effects of climate change and how societal constraints shape adaptation options.
- But what does this mean for finance?
- In close connection to live-ability and work-ability are the conditions of food systems.
- Every corner of the World has at some point experienced events that have led to difficulties in food production.
- This kind of situation developing in many areas simultaneously could prove to be devastating.
- Climate change is already shifting ecosystems and as the phenomenon continues, more of them are lost to unfavourable conditions.
- On the other hand a change can mean that even if conditions worsen somewhere, they might become favourable in someplace else.
- Extreme conditions put under strain the manmade physical assets such as buildings and infrastructure.
- Damage and destruction in this area is prone to have knock-on effects, such as disruption of certain services or an increase in the costs of some others.
- This can create distrust that in turn further shakes the foundations of the whole socioeconomic structure.
- Climate Change is arguably the greatest challenge facing mankind today.
- Every walk of life is affected and will become more so over time if serious action is not taken.
- Climate Change introduces great risk to every aspect of our world, and especially **Financial Risk in the banking sector**.

OVERVIEW OF THE POTENTIAL HEALTH IMPACTS OF CLIMATE CHANGE

Drivers of Health Issues

1. Population density
2. Urbanization
3. Public health infrastructure
4. Economic and technologic development
5. Environmental conditions

6. Populations at risk:
    1. Poor
    2. Children
    3. Increasing population of elderly residents
    4. Immunocompromised

Attention

- **Today, we need a global cooperation 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**.

Health Impacts of Floods (Figure 2)

- Immediate deaths and injuries
- Nonspecific increases in mortality
- Infectious diseases – leptospirosis, hepatitis, diarrheal, respiratory, and vector-borne diseases
- Exposure to toxic substances
- Mental health effects
- Increased demands on health systems

Figure 2. Impacts of Floods

HEALTH DATA TO DETERMINE THE CURRENT BURDEN OF CLIMATE-SENSITIVE DISEASES

Questions to be addressed

- What climate-sensitive diseases are important in the country or region?
- What is the current burden of these diseases?
- What factors other than climate should be considered?
- Water, sanitation, etc.
- Where are data available?
- Are health services able to satisfy current demands?

METHODS OF ASSESSING HUMAN HEALTH VULNERABILITY AND PUBLIC HEALTH ADAPTATION TO CLIMATE CHANGE

Methods for:

- Estimating the current distribution and burden of climate-sensitive diseases
- Estimating future health impacts attributable to climate change
- Identifying current and future adaptation options to reduce the burden of disease

Estimate Potential Future Health Impacts

- Requires using climate scenarios
- Can use top-down or bottom-up approaches
- Models can be complex spatial models or be based on a simple exposure-response relationship
- Should include projections of how other relevant factors may change
- Uncertainty must be addressed explicitly

Risk of Vector-Borne Diseases

- Four qualitative scenarios developed of changes in climate and in vector populations
    1. Vector not present
    2. Local distribution of vector
    3. Widespread distribution of vector
    4. Change from local to potentially regional distribution
- Expert judgment determined likely risk under each scenario for 5 vector-borne diseases

Estimating the Global Health Impacts of Climate Change

- What will be the total potential health impact caused by climate change (2020 to 2030)?
- How much of this could be avoided by reducing the risk factor (i.e. stabilizing greenhouse gas (GHG) emissions)?

Questions for Designing Adaptation Policies and Measures

- Adaptation to what?
- Is additional intervention needed?
- What are the future projections for the outcome? Who is vulnerable?
- On scale relevant for adaptation
- Who adapts? How does adaptation occur?
- When should interventions be implemented?
- How good or likely is the adaptation?

Current and Future Adaptation Options

- What is being done now to reduce the burden of disease? How effective are these policies and measures?
- What measures should begin to be implemented to increase the range of possible future interventions?
- When and where should new policies be implemented?
- Identify strengths and weaknesses, as well as threats and opportunities to implementation

Public Health Adaptation to Climate Change

- **Existing risks**
    - Modifying existing prevention strategies
    - Reinstitute effective prevention programs that have been neglected or abandoned
    - Apply win/win or no-regrets strategies
- **New risks**

Options for Adaptations to Reduce the Health Impacts of Climate Change (Table 1)

Health Outcome	Legislative	Technical	Educational-advisory	Cultural & Behavioral
Thermal stress	Building guidelines	Housing, public buildings, urban planning, air conditioning	Early warning systems	Clothing, siesta
Extreme weather events	Planning laws, economic incentives for building	Urban planning, storm shelters	Early warning systems	Use of storm shelters
Vector-borne diseases		Vector control, vaccination, impregnated bednets, sustainable surveillance, prevention & control programmes	Health education	Water storage practices
Water-borne diseases	Watershed protection laws, water quality regulation	Screening for pathogens, improved water treatment & sanitation	Boil water alerts	Washing hands and other behavior, use of pit latrines

CONCLUSIONS

- Climate change may already be causing a significant burden in developing countries
- Unmitigated climate change is likely to cause significant public health impacts out to 2030
    - Largest impacts from diarrhea, malnutrition, and vector-borne diseases
- Uncertainties include:
    - Uncertainties in projections
    - Effectiveness of interventions
    - Changes in nonclimatic factors

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WATER MANAGEMENT IN SELECTED EU MEMBER STATES IN 2010S

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***Abstract**: Study overviews main issues for agricultural water-use and wastewater conditions in Czechia, Hungary, Romania, Slovakia, Bulgaria, Slovenia, Portugal, Spain in 1998 -2017. Analysis can provide possibility to compare water management and water cleaning avoiding wastewater in countries. Water management connects with irrigation mostly on permanent cultivated agricultural areas. Analysis focuses on agricultural value added contributing to GDP growth, share of agricultural GVA produced by irrigated agriculture, total renewable water resources per capita, produced municipal wastewater, the agricultural water withdrawal as % of total renewable water resources mainly on total agricultural water managed area concerning qualified level of cultivated lands. **Motivation/Background**: Aim of analyses is to clear some correlations of several economic variables mentioned as features of selected countries. Global warming and longer drought period in EU-28 need for more successful water management to balance scarcity of water. **Method**: Study compares water management feature of Spain and Portugal with some EU member states in Central – East European based on SPSS statistical analyse. **Conclusions**: Innovation prosperity should be developed by more educated and skilled human power resources in agricultural production. Share of production based on irrigated land by cleaning water should increase in total agricultural value added.*

***Keywords:** Arable lands, Correlations, Gross value added, Irrigation, Permanent cultivated areas, Scarcity of water*

INTRODUCTION

Study overviews main issues for agricultural water-use and wastewater conditions in Czechia, Hungary, Romania, Slovakia, Bulgaria, Slovenia, Portugal, Spain in 1998 -2017. Analysis can provide possibility to compare water management and water cleaning avoiding wastewater in countries. Water management connects with irrigation mostly on permanent cultivated agricultural areas. Analysis focuses on agricultural value added contributing to GDP growth, share of agricultural GVA produced by irrigated agriculture, total renewable water resources per capita, produced municipal wastewater, the agricultural water withdrawal as share of total renewable water resources mainly on total agricultural water managed area concerning qualified level of cultivated lands. The main difficulties are continuously emerging, namely the longer and frequent drought period, which make also some more heavy irrigation possibility, which can result either less irrigated areas or less harvested crops from irrigated areas mostly in Slovakia, Hungary (FAO AQUASTAT, 2021). Additionally, the above-mentioned problem renewable water resources per capita, agricultural water managed area and share of agricultural GVA (gross value added) produced by irrigated agriculture also decreased in some countries, but produced waste water increased in some countries.

The hypotheses of the study:

1) Very strong correlations between human development index (HDI5) and produced municipal wastewater (PMunWasW8).

2) Strong correlations between arable land area (ArabLand1) and % of agricultural GVA produced by irrigated agriculture (IrAgrGVA6).

3) Strong correlations between human development index (HDI5) and the total renewable water resources per capita (ToReWaCap7).

Aim of analyses is to clear some correlations of several economic variables mentioned as features of selected countries. Global warming and longer drought period in EU-28 need for more successful water management to balance scarcity of water. In case of this research two main country-groups of EU member states were focused, namely Central-East European countries and two countries of the Mediterranean region, where Spain and Portugal have somehow mainly same measured areas or territories as territories of other six countries of another European region. Naturally the geographical and economic conditions are different between two main regions.

The typical measure of production management is productivity (Kryszak et al, 2021; see more in Mugera eat al, 2016). Palash and Bauer (2017) claim that a farm's profitability may be affected by land allocation to specific types of production. It is exact, but also, qualified level of the soils and their fertility can make influence on the profitability of the farms' production, therefore not only the land allocation determine the profitability of farms. Gloy and LaDue (2003), we assume that financial management decisions may further influence farm profitability (see more in Rogers eat al, 2002). Education and training of professional, technical staff and decision makers and others, including non-public organizations, on a wide range of subjects related to sustainable water management. b. Manpower build-up. Institutions to be staffed with qualified manpower (managers, engineers, technicians, social scientists) that should be adequately compensated (Chartzoulakisa – Bertaki, 2015).

Precision irrigation can be defined as an efficient collaboration and precise application of water to meet specific requirements of individual plants or management units and minimize related adverse environmental impacts. As a holistic coordinated performance, precision irrigation not only enables the emergence of more flexible and reactive operational systems, but also involves the optimal management and best operation of agricultural irrigation systems; therefore, it has been employed in response to the growing problem of water scarcity and the need for more effective irrigation management (Liang et al, 2020; Harmanny - Malek, 2019). Our opinion is that additionally the other inputs of agricultural production the *efficiency of the water management* can impact on the qualified level of the *production management*, and finally on the productivity. In this case the water management is based on the unified measure of the water used, which means that as less amount of water used leads to more yield of agricultural production on farm. Therefore, the drop irrigation system is more profitable. Because in tropical-sub-tropical areas the reining irrigation system leads to 70% of water used evaporates. Also, the efficiency of the water management can increaseby less price level of unified water used. The difficulty of farms is to obtain the water resource by highly level of price, which can increase the production cost and finally the level of farm gate price, which cannot make agricultural production be efficient and profitable. The farmers by the highly level of farm-gate price can loss their market share.

MATERIALS AND METHODS

Study compares water management feature of Spain and Portugal with some EU member states in Central – East European based on SPSS (Statistical package for social sciences) statistical analyse (Csallner, 2015; Sajtos-Mitev, 2007; SPSS Base 15.0 User's Guide, 2006). The statistical analyse can provide compare among researched countries based on their economic features and water-use conditions concerning the weather issues. The economic features and water-use conditions are covered by ten economic variables, namely these are as arable land area (ArabLand1), permanent crops area (PerCropAre2), percent of cultivated land irrigated [harvested crop] (CultIrLand3), agriculture, value added in percent of GDP (AVAtoGDP4), Human Development Index (HDI5), percent of agricultural GVA produced by irrigated

agriculture (IrAgrGVA6), total renewable water resources per capita (ToReWaCap7), produced municipal wastewater (PMunWasW8), agricultural water withdrawal as percent of total renewable water resources (AgWaWiRWR9) and also total agricultural water managed area (TAgWMA10). The data for analysing come from the FAO AQUASTAT, 2021 and Eurostat between 1998-2017.
Within the SPSS statistical analyse the Pearson correlations of economic variables, variance explained by principal components, the rotated component, cluster membership and the principal component analysis map of countries using components were used to overview the difference and their measures among researched countries based on their economic and water conditions. This statistical analyse helps to strengthen the hypotheses of the scientific research by cleaning the conclusions.

STATISTICAL ANALYSIS AND GRAPHICAL PRESENTATION

The SPSS statistical analyse includes some main statistical data bases, from which the proofing process can make possibility to obtain scientific results concerning water use and water management by irrigation conditions for agriculture accompanying with wastewater conditions in researched EU member states, namely Czechia, Hungary, Romania, Slovakia, Bulgaria, Slovenia, Portugal and Spain.

Table 1. Water use for agriculture and wastewater conditions in Czechia, Hungary, Romania, Slovakia, Bulgaria, Slovenia, Portugal, Spain from 1998 -2017 in percent based on hectare and m^3

Economic Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Czechia	-14	-40	28	-1	10	1	-4	-7	-2	-2
Hungary	-6	-2	-23	-1	7,7	-1	5	1	-1,2	10
Romania	-9	-14	40	-7	12,5	1,3	11	-80	1,1	-77
Slovakia	-5	-36	-76	1	10	-9,4	-1	-43	-1	-46
Bulgaria	-2	-35	-1	-5,7	11	-2	11	-12	-13	10,5
Slovenia	9,5	80	0,1	-1	6,6	0,1	-7	30	-0,3	-95
Portugal	-42	-1	13	-1	7	18	1	42	-2,7	-23
Spain	-5	-5	-1	-1	7	-1,3	-10	68	-4	-2

Source: Selected countries: Czechia, Hungary, Romania, Slovakia, Bulgaria, Slovenia, Portugal, Spain FAO AQUASTAT, 2021. http://www.fao.org/aquastat/en/databases/maindatabase/
Total areas of Czechia, Hungary, Slovakia, Romania, Bulgaria and Slovenia = 59 060 000 hectare
Total areas of Portugal, Spain = 59 817 000 hectare
For Period of **1998-2017, 1998-2002 = 100**

Table 2. Abbreviation of economic variables

Variable Abbreviation	Variable name	Period	Source/database
ArabLand1	Arable land area (1000 ha)	1998-2017	FAO AQUASTAT, 2021
PerCropAre2	Permanent crops area (1000 ha)	1998-2017	FAO AQUASTAT, 2021
CultIrLand3	% of cultivated land irrigated [harvested crop] (%)	1998-2017	FAO AQUASTAT, 2021
AVAtoGDP4	Agriculture, value added (% GDP) (%)	1998-2017	FAO AQUASTAT, 2021
HDI5	Human Development Index (HDI) [highest = 1] (-)	1998-2017	FAO AQUASTAT, 2021
IrAgrGVA6	% of agricultural GVA produced by irrigated agriculture (%)	1998-2017	FAO AQUASTAT, 2021
ToReWaCap7	Total renewable water resources per capita (m^3/inhab/year)	1998-2017	FAO AQUASTAT, 2021
PMunWasW8	Produced municipal wastewater (km^3/year or 10^9m3/year	1998-2017	FAO AQUASTAT, 2021
AgWaWiRW	Agricultural water withdrawal as % of total	1998-2017	FAO AQUASTAT, 2021

R9	renewable water resources (%)		
TAgWMA10	Total agricultural water managed area (1000 ha)	1998-2017	FAO AQUASTAT, 2021

Source: FAO AQUASTAT, 2021.

Table 3. Pearson correlations of economic variables

	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Correlation	,321	-,254	-,066	,099	**-,797**	-,115	-,158	-,086	-,265
PerCropAre2		,113	,162	**-,631**	,227	-,390	,420	,295	**-,606**
CultIrLand3			**-,615**	,171	**,561**	,158	,031	,015	-,080
AVAToGDP4				**-,690**	-,081	**-,649**	,463	,340	,183
HDI5					-,356	**,698**	**-,889**	-,127	-,060
IrAgrGVA6						,026	,397	,061	,003
ToReWaCap7							**-,686**	-,278	,091
PMunWasW8								-,206	,301
AgWaWiRWR9									**-,560**
TAgWMA10									1,000

Source: Owned calculations based on the basic statistical data of FAO AQUASTAT, 2021.

Value for the correlations among the economic variable is very strong between 0,800 -1,000 (as 80-100%), and strong between 0,500 -0,800 (as 50-80%) and weak less than 0,500 (50%). Minus for the economic variable means that the given variable has contradictive correlations with other positive variables. Negative economic variables decrease, but the positive variables increase in fields of their correlations. But negative economic variables within their own correlations can be either increasing or decreasing in cases of principal component analysis map of countries using components. In the Table 3 the most important correlations among economic variables are written in bold numbers. Negative variables are as follows: (-)HDI5, (-)ToReWaCap7, (-)TAgWMA10, (-)ArabLand1, (-)AVAToGDP4 (Table 3; Table 5; FAO AQUASTAT, 2021). HDI includes purchase power parity, standard of living; education level and health care.

The Table 4 shows the variance explained by principal components, which means in this study, that the four principal components cover 90,63% of the cumulative belonging to the initial eigenvalues. Therefore, this statistical analyse is proofed by 90,63% based on the four principal components. The Table 5 shows the rotated component matrix, which gives the overview for four components with their economic variables.The highest value of economic variable in its given line of the table determines that to which the given variable can be included into the component. The bold figures are included into one component in columnof each component. According to the Table 6, generally, researchers determine that how many clusters are used in this SPSS analyse. Often 5 clusters are used in SPSS statistical analyse, also, even one country can be one cluster, but this means that 8 clusters would be used in this study. In cases of 5 clusters the research can be more successful, because within a country group as a cluster, those countries can be classified into one cluster, of which economic features are somehow similar or closed to each-others.

Table 4. Variance explained by principal components

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Principal Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,490	34,903	34,903	3,245	32,446	32,446
2	2,306	23,058	57,961	1,980	19,802	52,248
3	2,033	20,334	78,295	1,977	19,767	72,015
4	1,264	12,641	**90,936**	1,892	18,921	90,936

Source: Owned calculations based on the basic statistical data of FAO AQUASTAT, 2021.

Table 5. Rotated Component Matrix[a]

	Component			
	1	2	3	4
HDI5	**-,956**	-,044	-,147	,166
PMunWasW8	**,932**	-,294	,169	,028
ToReWaCap7	**-,774**	-,175	,066	,323
PerCropAre2	**,682**	,534	-,248	,329
TAgWMA10	,013	**-,882**	,243	-,247
AgWaWiRWR9	,012	**,879**	,223	-,291
ArabLand1	,043	,096	**-,977**	,007
IrAgrGVA6	,300	,062	**,818**	,448
CultIrLand3	-,040	,074	,341	**,818**
AVAToGDP4	,552	,086	,114	**-,797**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 9 lterations.
Source: Owned calculations based on the basic statistical data of FAO AQUASTAT, 2021.
Negative variables: (-)HDI5, (-)ToReWaCap7, (-)TAgWMA10, (-)ArabLand1, (-)AVAToGDP4
Other variables: PerCropAre2, CultIrLand3, IrAgrGVA6, PMunWasW8, AgWaWiRWR9

Table 6. Cluster Membership

Case	5 Clusters	4 Clusters	3 Clusters	2 Clusters
1:Czechia	1	1	1	1
2:Hungary	1	1	1	1
3:Romania	2	2	2	2
4:Slovakia	1	1	1	1
5:Bulgaria	3	2	2	2
6:Slovenia	4	3	1	1
7:Portugal	5	4	3	1
8:Spain	1	1	1	1

Source: Owned calculations based on the basic statistical data of FAO AQUASTAT, 2021.
Based on the separating into five clusters based on the SPSS (Sajtos-Mitev, 2007).
Cluster-1: Czechia, Hungary, Slovakia, Spain; Cluster-2: Romania; Cluster-3: Bulgaria
Cluster-4: Slovenia; Cluster-5: Portugal

RESULTS AND DISCUSSION

According to the economic variables of selected countries the main issue is *to use renewable natural water resources by more efficiently.* There are very strong correlations between human development index (HDI5) and produced municipal wastewater (PMunWasW8) by minus 0,889 as 88,9% (Table 3, FAO AQUASTAT, 2021). The human development index consisting of three main elements, namely (1) purchase power parity, standard of living; (2) education level and (3) health care. From point of view of HDI the educational level can ensure such human experiences to help for decreasing the municipal waste water in different establishments, like towns, villages. Therefore, the contradictive correlations are between both sides are proofed. Also, the less produced municipal wastewater can contribute to increase the standard of living by cleaning natural resources to sustain adequate human health level. In case of the efficient water use means that the unite of water use accompanies with less produced wastewater.

In cases of eight EU member states in this study Romania has more favourable results in these fields, because Romania increased the HDI level by 12,5% by the highest level within these eight countries, while this country decreased produced municipal wastewater by 80%.

The second better conditions were in Slovakia, where the HDI increased by 10% and deceased the produced municipal wastewater by 43%. The most unfavourable conditions were in Spain, where the HDI increased only by 7%, but wastewater increased by 68%, while in Portugal HDI increased also by 7% as much as in Spain and wastewater increased by 42%, little less than in Spain. Also, Slovenia HDI increased by 6,6% and wastewater increased by 30% moderately increasing. In cases of Spain and Portugal the decrease of the produced municipal wastewater would have been more, because the water scarcity could be more than the other seven countries of this study.

In Hungary the conditions of HDI increase were somehow as much same as in Spain and Portugal by 7,7%, but the wastewater increased only by 1%, which cannot be seen as real increase. But also, in Hungary the transiting water resources abroad should have been saved more, because almost all of the water coming abroad go away from Hungary.

It can be declared that the most efficient water use can be realised by less produced municipal wastewater accompanying with increasing level of the HDI in cases of eight EU member states of this study for the period of 1998-2017.

The strong correlations are main issues in cases of correlations among the economic variables, which can show the better innovative production technologies in one country then the other one within researched countries. Contradictive strong correlations are between arable land area (ArabLand1) and share of agricultural gross value added (GVA) produced by irrigated agriculture (IrAgrGVA6) by 79,7%. The strong correlations are between human development index (HDI5) and the total renewable water resources per capita (ToReWaCap7) by 69,8%. There are strong correlations between the agriculture, value added in percent of GDP (AVAToGDP4) and Human Development Index (HDI5) by minus 69%. The total renewable water resources per capita (ToReWaCap7) and produced municipal wastewater (PMunWasW8) have strong correlations by minus 68,6%. The agriculture, value added in percent of GDP (AVAToGDP4) has strong correlations with the total renewable water resources per capita (ToReWaCap7) by minus 64,9%.Also, the permanent crops area PerCropAre2 are in strong correlations with Human Development Index (HDI5) by minus 63,1%. The share of cultivated land irrigated (harvested crop, CultIrLand3) has strong correlations with agriculture, value added in percent of GDP (AVAToGDP4) by minus 61,5%. While the permanent crops area (PerCropAre2) and total agricultural water managed area (TAgWMA10) are in strong correlation with each-others namely by minus 60,6%.

The share of cultivated land irrigated (harvested crop, CultIrLand3) and percent of agricultural GVA produced by irrigated agriculture (IrAgrGVA6) have reached strong correlations at the level of 56,1% for the researched period. The Table 3 also, shows how much strong correlations are between agricultural waterwithdrawal as percent of total renewable water resources (AgWaWiRWR9) and total agricultural water managed area (TAgWMA10), by minus 56% for period of 1998 and 2017.

From experiences of the above-mentioned strong correlations among economic variables it can be declared that the most efficient water use can be realised by less produced wastewater and increasing share of irrigated agriculture in gross agricultural gross value added even increasing the arable land or all cultivated areas by innovative developing irrigation system. The difficulty for the agricultural arable land increase, thathe innovative development mostly is missing. This difficulty can be followed in ceases of average results of selected eight EU member states. Naturally the lack of capital and less consumption of the fixed capital including irrigation system means somehow backwardness in this field. When the cropped areas are increasing, also the irrigation system should increase more than increasing rate of copped areas. The other difficulty that the self-financing power of farmers and agricultural companies is at low level to realise innovation development.

While the permanent crops area (PerCropAre2) decreases, the total agricultural water managed area (TAgWMA10) increases the strong correlation with each-others, because more withdrawal lands can be realised. In Slovenia the permanent crops area (PerCropAre2) has increased by 85%, but the total agricultural water managed area sharply decreased by 95%, in Czechia permanent crops area decreased by

40% and the total agricultural water managed area only little decreased by 2% for the researched period. Bulgaria has also considerable contradiction correlation between both of variables, crop area decreased by 35%, but the total agricultural water managed area increased by 10,5%. In case of Romania the position was the worst, because both of them decreased by 14% in case of crop area and by 77% in case of water managed area in the same period. This reason is that, in less areas the more innovative and advanced technology including the water management are used and consequently the yields and output of agricultural producers increases. Therefore, producers-farmers should decrease their permanent crop area in order that they do not exceed their quotas by increasing their yields. This is the reason is coming that the national yield quota cannot be exceeded by the rule of EU common agricultural policy. If the agricultural producers do not have well innovative and advanced techniques in their agricultural basic production by less yields per hectare, they can increase their permanent crop area within yields of their quotas given by national governments based on the common agricultural policy of the EU.

When the agricultural producers can have enough or *more purchase power (HDI5) for obtaining inputs* to invest into agricultural sector even for water management, the total renewable water resources per capita (ToReWaCap7). This also can be followed in the correlations both of variables. In Romania the HDI5 increased 12,5% as top level in this field and water resource per capita increased by 11%. Also, in Bulgaria both of them increased considerably by 11% in field of purchase power and by also 11% in field of water resource per capita. The human purchase power resource (HDI5) increased, while the share of the agricultural value added in GDP (AVAToGDP4) decreased. This can be explained that the *HDI5 as consumers increasingly purchased products of other economic sectors* and not considerably from agricultural sector. In Romania the HDI highly increased by 12,5% but sharply decreased by 7%, as toplevel within researched countries.

The other difficulty is that when the total renewable water resources per capita (ToReWaCap7) increase, by decreasing produced municipal wastewater (PMunWasW8). In Romania the water resources per capita by 11%, which could be resulted by decreasing municipal wastewater by 80%. The difficulty was in case of Spain, where the municipal wastewater increased by 68%, which led to decrease of water resources per capita by 10%. The cleaning system should develop in process of water use in fields either firm-company water uses or population water use. The law and regulation systems should strongly control water use of companies of different economic sectors even within the qualified demands for the production process concerning the water use.

But by the other side when the total renewable water resources per capita (ToReWaCap7) increases, often the agricultural value added in percent of GDP (AVAToGDP4) can decrease, because the more water use is realised in other economic sectors and not in agricultural one. In this case the water allocation was not successfully for interest of increasing agricultural production or the share of value added of other economic sectors in GPD by more water use could increase comparably to the agricultural value added in share of GDP. This means that the other economic sectors more developed than the agricultural sector by the more water use. In Romania water resources per capita increased by 11% and the agricultural value added in percent of GDP decreased by 7% as deepest level within researched countries. In Bulgaria water resources per capita also increased by 11% and the agricultural value added in percent of GDP decreased by 5,7% as the second deepest level within researched countries.

Also, when the permanent crops area (PerCropAre2) increased, this could be a reason, that number of farmers or employees (annual working unit) in agricultural sector withdrew from this sector, therefore, the Human Development Index (HDI5) decreased or little increased, which means that the mechanization and modernization in the agricultural sector could more substitute the considerable human resources in this sector. But when the permanent crops area (PerCropAre2) decreased and the Human Development Index (HDI5) increased, the land use could be separated into more small plots or farm-lands by increasing the number of annual working units or farmers. Also, this means that within a farm more children of farmers' families inherit lands, which resulted separation of the original plots. This can result less developed farm structure for the future. In Romania HDI5 increased by 12,5% as top level but the permanent crops area decreased 14%, in Czechia HDI5 increased by 10% but the permanent crops area decreased 40% as mostly deeply within researched countries. The other opposite example, in Slovenia HDI5 increased only by 6,6% as mostly deeply level but the permanent crops area sharply increased 80%, as top level in these countries.

Probably in Slovenia the land use and ownership concentration can be increasing, which can be explained by decreasing number of farmers, annual working units or landowners. In a fact only in Slovenia the permanent crops area has increased for the same period within researched countries. In cases of all other seven member states permanent crops area and arable land area decreased.
This part of the study shows measures of economic variables, as features according to eight EU member states of this research. General correlations among economic variables concerning the renewable natural resource water and water management including possible advanced irrigation system can demonstrate the *economic developing trends* of each EU member state. This economic developing trend focuses on the creating innovative irrigation system by *advanced using technologies* and water management. All of these developing aims need for *enough purchase power capacity* of farmers and agricultural producers, firms, companies or transnational corporations based on the structure of agro-business and vertically integrated product channel from land to table of consumers. Also, the increasing yields and outputs of producers are limited by the *quota system* in EU. This quota system would like to make *balance between market supply- demand sides* of the agricultural single market.

CONCLUSIONS AND RECOMMENDATIONS

The hypotheses of the study were proofed by the results and analyses. 1) Very strong correlations between human development index (HDI5) and produced municipal wastewater (PMunWasW8). 2) Strong correlations between arable land area (ArabLand1) and share of agricultural GVA produced by irrigated agriculture (IrAgrGVA6). 3) Strong correlations between human development index (HDI5) and the total renewable water resources per capita (ToReWaCap7). Solutions of the difficulties of these EU member states, that the innovation prosperity should be developed by more educated and skilled human power resources in agricultural production. Share of production based on irrigated land by cleaning water should increase in total agricultural value added. It is important to increase the subsidies for farmers for available water resources to irrigate in order to obtain increasing yield based on the efficient allocation of water resource accompanying with the possible international cooperation beyond borders.

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AIR QUALITY AND DISTRIBUTION OF LICHENS AS BIOMONITORS IN SOME SERBIAN TERRITORIES

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***Abstract**: This paper deals with using lichens as a bioindicators of the air quality. A bioindication and physical- chemical detection of air pollution in Zrenjanin has not been carried out. Over recent decades, air quality has become environmental problem worldwide due to industrial activities and road traffic. Atmospheric monitoring has been necessary to control air quality and reduce pollution sources. Air quality is a topic that attracts more and more attention especially with the problem of human health. Biomonitoring is based on the detection and monitoring of changes that occur on different levels of the biological organization for living organisms under the influence of air pollutants. It was noted that not all lichen species are equally likely to indicate different levels of air pollution. The assessment of lichen biodiversity was based on the calculation of lichenic abundance indices. This research work dealswith using lichens as a bioindicators of the air quality and it was conducted from various Serbia locations. Also, it is shown the relationship between the Serbian air qualities, and how lichens act as a bioindicator for the air quality, in some parts of Serbia such as in Sremska Mitrovica city, Fruska Gora mountine, Palic Lake and Silver Lake. The bioanalysis of the samples from investigated sites indicates the presence of different lichen taxa, which shows that these sites are rich in lichen species. Information about the air quality index of Zrenjanin city as an example of the Serbian cities which demonstrates the chemical pollutants, climate changes for example weather, wind and temperature This work also shows the distribution of the lichens which can be found in the investigated sites. The presence of lichen indicates that the air quality in these sites: Sremska Mitrovica city, Fruska Gora mountine, Palic Lake and Silver Lake is quite good. It was concluded that the presence of epiphytic lichens plays an important role in determining the air pollution in those sites. By the presence of these lichens, we have found that the most dominant lichen taxa were Rhizocarpon geographicum, Lecanora muralis, Lecanora muralis, Rhizocarpon geographicum,Xanthoria parietina and Xanthoria candelaria.*

***Keywords**: air quality; biomonitors; lichen biodiversity, Serbian locations*

INTRODUCTION

Over recent decades, air quality has become environmental problem worldwide due to industrial activities and road traffic. Atmospheric monitoring has been necessary to control air quality and reduce pollution sources [1]; [2]. The evolution of conventional measurement methods continues to advance the monitoring of air quality. A biomonitoring using living organism offers an interesting complementary tool to estimate the impact of atmospheric pollution [3].

The negative effects of air pollution on human health are well known [4]. On the basis of the available knowledge about the possible threats to air quality, there is a need to know the type and extent of the threat that has arisen [5]. The basis for improving air quality is detection and registration on time. This can be achieved by physico-chemical or biological monitoring [6].

A bioindication and physical-chemical investigation of air pollution in Zrenjanin has not been carried out. The air quality is getting worse all over the world. The presence and absence of lichens and different species around different pollution sources has been used for problems connected to air pollution. This type of investigation started in Serbia in last decade of 20th century [1], [7], [8].
Lichens are currently considered to be fungi that live in symbiosis with a photobiont, an autotrophic green alga (phycobiont), or cyanobacterium (cyanobiont) or, in some cases, both. The fungal partner (mycobiont) in most lichens (98%) belongs to Ascomycetes, and Zygomycetes and rare Basidiomycetes make up the remainder. The symbiotic relationship is often characterized as mutualistic, that is, both partners benefit. However, recent evidence suggests that, while the fungus is dependent on its autotrophic partner, the photobiont is often fully content to live alone [9]
Air pollution is one of the biggest and most important risk factors for health in the world. Worldwide approximately 7 million people died prematurely due to the pollution; within the European countries 400,000 people suffer a premature death. [10]
The substances that are affecting health the most are: nitrogen oxides (NO_2), sulphur oxides (SO_2), ozone and particulate matter with the latter – especially particulate matter below 2.5 microns ($PM_{2.5}$) – being of greatest concern, as these tiny particles penetrate deep into the lungs, affecting both the respiratory and vascular systems. Both extent and duration of the exposure influence health outcomes. The impact of air pollution on health is a big concern as research shows more connection between a number of serious diseases among various age groups and air pollution (e.g. diabetes, neurodevelopment, pre-term birth, low weight birth, etc.). According to the results of the air quality monitoring, Serbia is one of the most polluted countries in Europe and worldwide. Pollution in Serbia is in general, really high in past few years. Serbia's air pollution comes from a variety of sources, with Serbia's reliance on lignite and coal-fuelled power plants being a well-known cause of the energy sector in addition to burning solid fuels (such as coal and wood) to heat homes. Pollutant emissions from an aging transport fleet, industrial activities, landfills and emissions from agriculture make a significant contribution to this. The specific industrial sites that have been documented as causing air pollutants in Serbia include the petrochemical complex around the cities of Pančevo and NoviSad for example. The level of air pollution from different sources varies in different areas of Serbia. For example, in large urban areas such as Belgrade, Novi Sad and Niš, road traffic is a significant contributor to urban air pollution and increases. The emissions in Serbia are largely attributed to the country's relativelyold vehicle fleet, with an average car in the country estimated at 17 years. [11]

AIR QUALITY INDEX (AQI)

As in Table (1), the air quality index is used to report daily air quality. It is used to find information of how the air is polluted, or clean, also which health effects might be of a concern in that place. [12]

Table 1. Air Quality Index information

Air Quality Index (Aqi) Values	**Levels Of Health Concern**	**Colours**
AQI RANGE:	Air Quality Conditions	Symbolized By Colour:
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy For Sensitive Groups	Orange
151-200	Unhealthy	Red
201-300	Very Unhealthy	Purple
301-500	Hazardous	Maroon

As in Figures (1 and 2), based on IQAir's "2019 World Air Quality Report", which aggregated air quality data for over 4000 cities globally, Serbia ranked as the 32^{nd} most polluted country worldwide, of a list of 98 ranked countries for $PM_{2.5}$ pollution. [11] The country's annual average $PM_{2.5}$ concentration, when weighted by population, emerged as 23.3 μg/m^3, which represents a twofold exceedance of the World Health Organization (WHO)'s international guideline limit for $PM_{2.5}$ as 10 μg/m^3. [13]

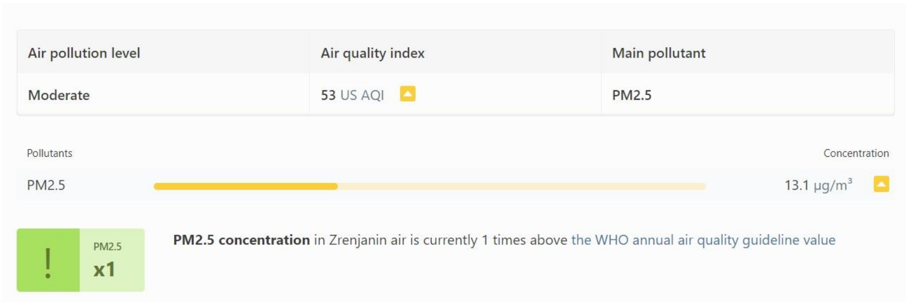


Figure 1. AQI Zrenjanin during the Summer (August 2021) [14]

Figure 2. AQI Zrenjanin (September 2021) [14]

In the Figures above, it is shown that the Air Quality Index (AQI), on first one in August 2021 (data found during the day), and on second report from the September 2021 (data found during the night). AQI values can be varied depending on the time of day.

Fine particulate matter ($PM_{2.5}$) is an air pollutant that may be a difficulty for popular health when its level in air is high. $PM_{2.5}$ is tiny particle with inside the air that reduces visibility and it is a reason for air to seem hazy while levels are increased. Outdoor $PM_{2.5}$ levels are maximum probable to be increased on days with very little or no wind or air mixing. The New York State Departments of Health (DOH) and Environmental Conservation (DEC) alert the general public through issuing a $PM_{2.5}$ Health Advisory whilst $PM_{2.5}$ concentrations in outdoor air are predicted to be dangerous for touchy groups.

There are outdoor and indoor sources of fine particles. Outside, fine particles in most cases come from car, truck, bus and off-road vehicle (e.g., construction equipment, snowmobile, locomotive) exhausts, different operations that contain the burning of fuels inclusive of wood, heating oil or coal and natural sources inclusive of wooded area and grass fires. Fine particles additionally form from the response of gases or droplets with inside the surroundings from sources inclusive of power plants. These chemical reactions can arise miles from the authentic supply of the emissions. Some indoor sources of fine particles are tobacco smoke, cooking (e.g., frying, sautéing, and broiling), burning candles or oil lamps, and operating fireplaces and fuel-burning space heaters (e.g., kerosene heaters). [15]

The higher the AQI the higher the air pollution and the higher level of concern for health. "For each pollutant the AQI value of 100 generally corresponds to an ambient air concentration that equals the level ofshort-term national ambient air quality standard for protection of public health. AQI values at or below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is unhealthy: at first for certain sensitive groups of people, as AQI values get higher. There are six categories ranging from good with little to no risks to hazardous with emergency conditions. [16]

Table 1, AQI Basics for Ozone and Particle Pollution [17]

Daily AQI Color	Levels of Concern	Values of Index	Description of Air Quality
Green	Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Yellow	Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Orange	Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Red	Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Purple	Very Unhealthy	201 to 300	Health alert: The risk of health effects is increased for everyone.
Maroon	Hazardous	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

Particles in the $PM_{2.5}$ size range are able to travel deeply into the respiratory tract, reaching the lungs. Exposure to fine particles can cause short-term health effects such as eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath. Exposure to fine particles can also affect lung function and worsen medical conditions such as asthma and heart disease. Scientific studies have linked increases in daily $PM_{2.5}$ exposure with increased respiratory and cardiovascular hospital admissions, emergency department visits and deaths. Studies also suggest that long term exposure to fine particulate matter may be associated with increased rates of chronic bronchitis, reduced lung function and increased mortality from lung cancer and heart disease. People with breathing and heart problems, children and the elderly may be particularly sensitive to $PM_{2.5}$ (Figure 3).

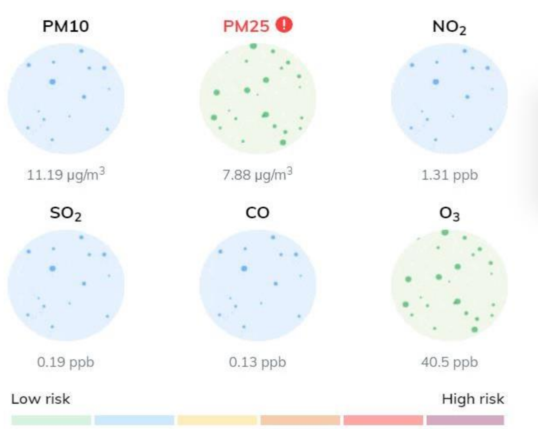


Figure 3. Chemical pollutants in Zrenjanin

AIR CHEMICAL POLLUTANTS IN SERBIA ESPECIALLY IN ZRENJENIN

AIR Pollutants:

Ozone (O_3): O_3 is a powerful oxidant and has many industrial and consumer applications related to oxidation. It can damage mucous and respiratory tissues in animals, and plants.

Particulate matters:
PM_{10}: Inhalable particles, with diameters that are generally 10 µm and smaller. These particles come in many sizes and shapes and can be made up of hundreds of different chemicals.
PM_{25}: Inhalable particles, with diameters that are generally 2.5 µm and smaller. Some are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires.
Carbon monoxide (CO): CO is a colourless, odourless gas that can be dangerous when inhaled in large amounts. Sources of CO are cars, trucks and other vehicles or machinery that burn fossil fuels.
Sulfur Dioxide (SO_2): SO_2 is one of a group of gases called sulfur oxides. The largest source of SO_2 in the atmosphere is the burning of fossil fuels by power plants and other industrial facilities.
Nitrogen dioxide (NO_2): NO_2 primarily gets in the air from the burning of fuel. NO_2 forms from emissions from cars, trucks and buses, power plants, and off-road equipment.'' [17]

CLIMATE CHANGES IN ZRENJANIN (IN LIMITED TIME)

Figure (4) shows those months with the largest precipitation are June, May, July with 209 mm precipitation. Most precipitation occurs in June with an average precipitation 83 mm. The annual amount of precipitation in Zrenjanin is 619 mm. The average annual temperature is 16°C in Zrenjanin. The warmest month of the year is July, with an average temperature: 28°C. January is the coldest month in Zrenjanin, with average temperature 2°C. The difference between the hottest month: July and the coldest month: January is: 26°C. The difference between the highest precipitation (June) and the lowest precipitation (February) is 48mm. The lowest temperature recorded (monthly average) was -10°C in February 1956 in Zrenjanin. The highest temperature recorded (monthly average) was 26°C in August 1992 in Zrenjanin. The year 2017 was the warmest in Zrenjanin, average temperature was: 14°C. 1956 was the coldest year (Figure 5), with average temperature was: 10°C. [18]

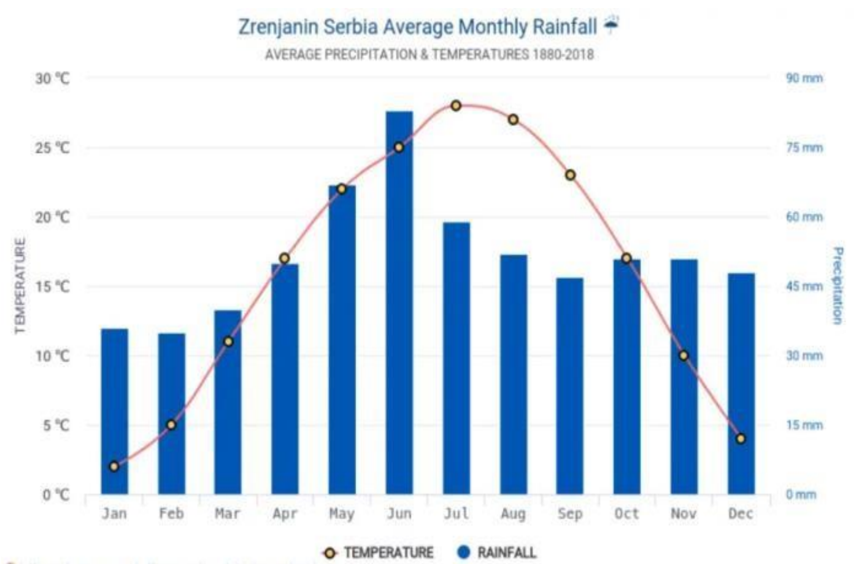


Figure 4. Climograph of monthly averages climate data
Temperature and precipitation in Zrenjanin, a basic climate data set 1880-2018 for Zrenjanin [18]

In Zrenjanin, in general, summers are warm, the winters are dry and cold, and during the year is usually partly cloudy. Over the year, the temperature was variants from 2°C to 28°C, and it rarely goes under -10°C and above 33°C [5].

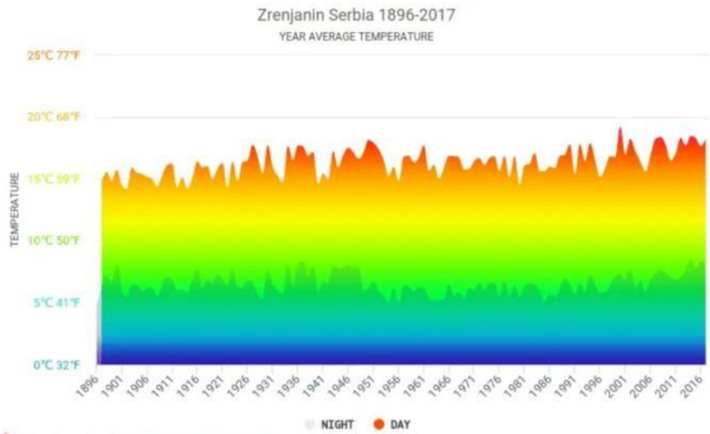


Figure 5. Average temperature in Zrenjanin over the years
Average Weather in Zrenjanin, Serbia Climatological information about changes of temperature over the years in Zrenjanin

Figures (6) and (7) illustrate the different climatic parameters such as temperature, relative humidity and wind as well as the $PM_{2.5}$ and PM_{10} at various times, August and September, respectively.

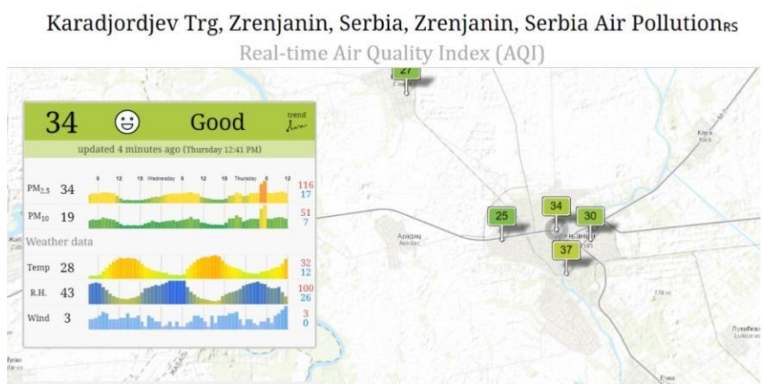


Figure 6. Data in Zrenjanin in Summer time (August)

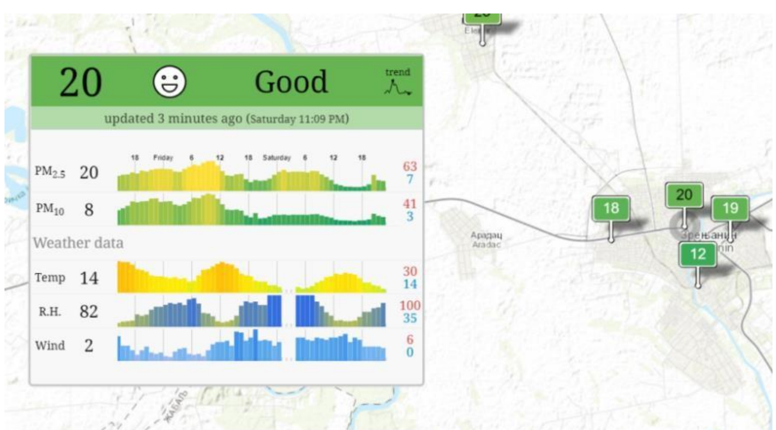


Figure 7. Data about Zrenjanin, in September [19]

Such a picture of the different air pollution levels in Zrenjanin is a logical consequence of air pollution and the mixed influence of microclimate, substrate and geo-physical features, as well as the distribution of "green" areas and objects. According to the qualitative and characterization of lichens, a qualitative assessment of lichen sensibility to air pollution has been made.

LICHENS AS AIR POLLUTION BIOMONITORS IN SERBIA

Biological monitoring is based on the detection and monitoring of changes that occur on different levels of the biological organization for living beings under the influence of pollutants [20]. Lichens are indicator organisms that have significant use in the bioindication of air quality. Not all lichen species are equally likely to indicate different levels of air pollution. Previously conducted studies have shown that certain species of lichens are sensitive to air pollutants in the atmosphere while other ones are resistant to them [21], [22].
Epiphytic lichens are defined as "permanent control systems" for estimating air pollution [23]. They are extremely sensitive to environmental changes because of their physiologies [24]. Lichens are the most used species in bioindication to detect and monitor air quality. The sensitivity of lichens is related to their biological characteristics due to the lack of cuticle and stomata which allows pollutants to penetrate the whole surface of the organism [1], [25]; [26]; [27]; [28].
Bioindication techniques have been established based on the composition of the lichenic flora [29], mainly the Shannon diversity index (H') [30], the lichen diversity value index (LDV) [31] and the atmospheric purity index (IAP) [32]. These indices are used to estimate air pollution levels that affect lichen diversity [25]; [28], [33]; [34], so that some environmental sources of pollution can be identified [3]; [35].
Loppi & Corsini [25] mentioned that lichen growth can be affected by different gaseous air pollutants such as: high sulfur dioxide concentration, carbon compounds in smoke, fluorides, car fumes (carbon monoxide, oxides of nitrogen, lead containing compounds, hydrocarbons) and dust, photochemical smog (ozone, peroxyacetyl nitrate, nitrogen oxides etc.), heavy metals (iron, lead, zinc, and copper), radioactive isotopes of metals (radionuclides), agricultural chemicals (such as pesticides, especially fungicides, and fertilizers).
Generally, it's thought-about that the most reasons for categorization of lichens as vulnerable organisms are disappearance and contamination of their environments primarily caused by humans, because of pollution of the atmosphere, industrialized agriculture, unfavourable biology practices and phylogeny alterations of huge habitat areas. All of those problems have led to the degradation of lichen habitats. In Serbia there are currently around 586 species of lichens. [10]
Lichenoflora in Vojvodina, including bank region of the River Tamiš and the Danube-Tisza-Danube Canal hydrosystem has been explored randomly [38], [39], [40], and more systematically within the study of former Yugoslavia lichen flora [41], [42], [43].
Lichens are used as an environmental biological indicator or the bioindicators for the pollution worldwide. In case that air is a lot polluted with for example SO_2, there won't be any presents of lichen, only the green algae can be found. Because of their sensitivity to SO_2 they can be considered, and used as a bioindicatorsof air quality and pollution. On the other hand, in case that air is clean, and air quality is good, lichens become abundant, which means that in absence of pollution, lichens are presence. If the lichens are smaller and less variety, environment in more polluted. Lichens are sensitive to atmospheric pollution because they get their nutrients and water from wet and dry atmospheric deposition. [44]
Based on the sizes of lichens, they can be classified in two groups: Microlichens and Macrolichens.

Microlichens: are really small, and not so easily defined because of impossibility of seeing their structure and physical characteristic with the naked eye.

Macrolichens: Because of their size, they can be easily defined and observed only with the naked eye.

Based on their growth forms lichens can be: Crustose, Folios and Fruticose, and on the basis of substrate on which they grow, they can be classified as: Corticoloua, Ramicolous, Legnicolous, Saxicolous, Musicolous, Terricolous, and Follicolous. Methods which can be used for identification of lichens are:

- Microscopic Approaches: Morphology, Anatomy
- Chemical Approaches: Colour spot test, TLC, HPTLC, HPLC
- Molecular Approaches: PCR genotyping and DNA Barcoding [45]

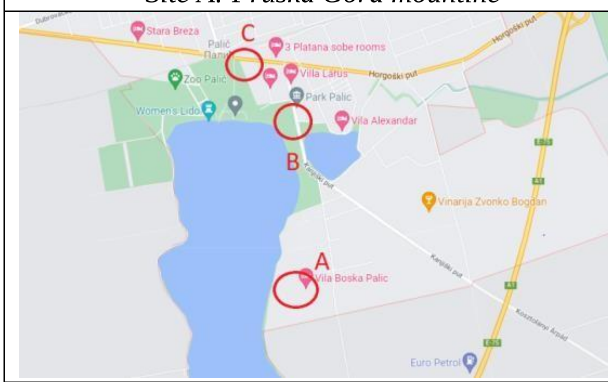
Many studies on air quality are based on testing of lichens, in which a large number of papers have described the air quality level in urban areas [46], [47], [48], [49], [50], [51], [52]. Degtjarenko et al. [53] suggested that lichen growth form, reproductive strategy, and tolerance to substrate pH could serve as potential tools for indicating the effects of dust pollution. The study conducted by Szwed et al. [54] showed a high level of lichen sensitivity to air quality changes created by anthropogenic impact. In different studies of biomonitoring of air quality, the degree of urbanization and traffic density are the basic causes of pollution in urban areas [55], [56]. Lichenological study in Serbia is still developing. Basic groundwork must be comprehended in order to meet the nation's needs and also to strive towards the biotechnology industry.

MATERIALS AND METHODS

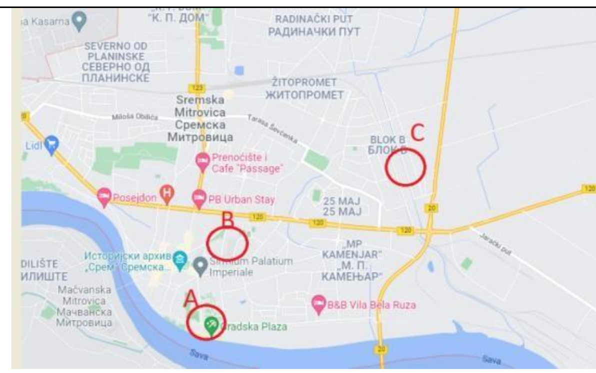
Sites of collecting samples: The lichen samples were collected from four different climatic and topological conditions sites: Site A: Fruska Gora mountine, Site B: Silver lake, Site C: Palic lake and Site D: Sremska Mitrovica city as shown in the Figure (8).

Site A: Fruska Gora mountine

Site B: Silver Lake



Site C: Palic Lake



Site D: Sremska Mitrovica city

Figure 8. The sites of lichen samples collections presented by red circles

Lichen samples in Sremska Mitrovica city, Fruska Gora mountine, Palic Lake and Silver Lake were collected from different trunk of various trees at different locations. The investigated sites are located in the urban part of Sremska Mitrovica, starting from the centre of town and close to Sava River (Figure 8).

RESULTS AND DISCUSSION

At four investigated sites, various lichen taxa from different genera were found. The most frequent and dominant as well as common taxa in these four sites of collections were *Rhizocarpon geographicum, Lecanora muralis, Lecanora muralis, Rhizocarpon geographicum, Xanthoria parietina and Xanthoria candelaria*.

The presence of lichens indicates that the air quality of the study sites (Sremska Mitrovica city, Fruska Gora mountine, Palic Lake and Silver Lake) which it illustrated a quite good. Also, it was concluded that the presence of epiphytic lichens plays an important role in determining the different degree in air quality. The following Figures (from 9 to 13) will demonstrate some common samples of collected lichens in the investigated sites.

SAMPLE COLLECTION OF LICHENS FROM FRUSKA GORA MOUNTINE SITE

Figure 9. Lichens in Fruska Gora mountine

SAMPLE COLLECTION OF LICHENS FROM SREMSKS MITROVICA TOWN SITE

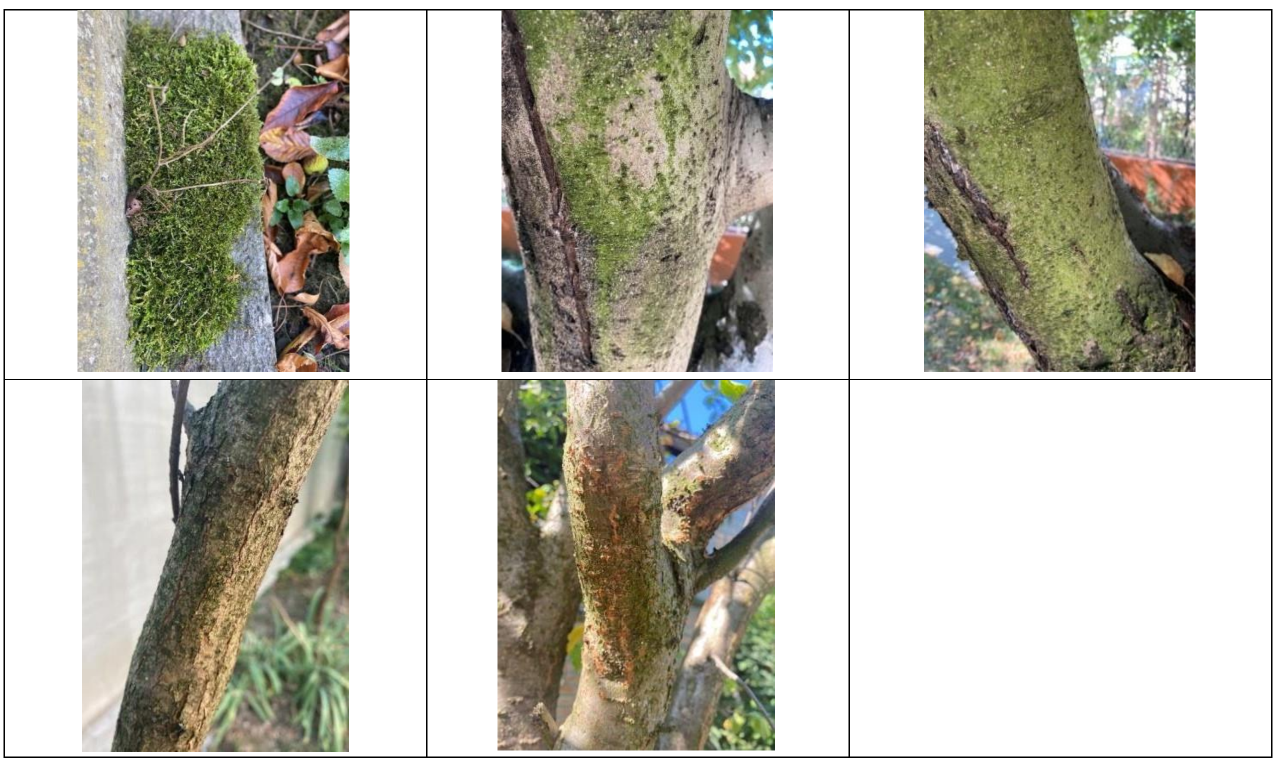


Figure 10. Lichen semples from Sremsks Mitrovica town

SAMPLE COLLECTION OF LICHENS FROM SAVA RIVER IN SREMSKA MITROVICA SITE

Figure 11. Lichens near Sava River in Sremska Mitrovica

SAMPLE COLLECTION OF LICHENS FROM PALIC LAKE SITE

Figure 12. Lichens close to Palic Lake

COLLECTION OF LICHENS FROM SILVER LAKE SITE

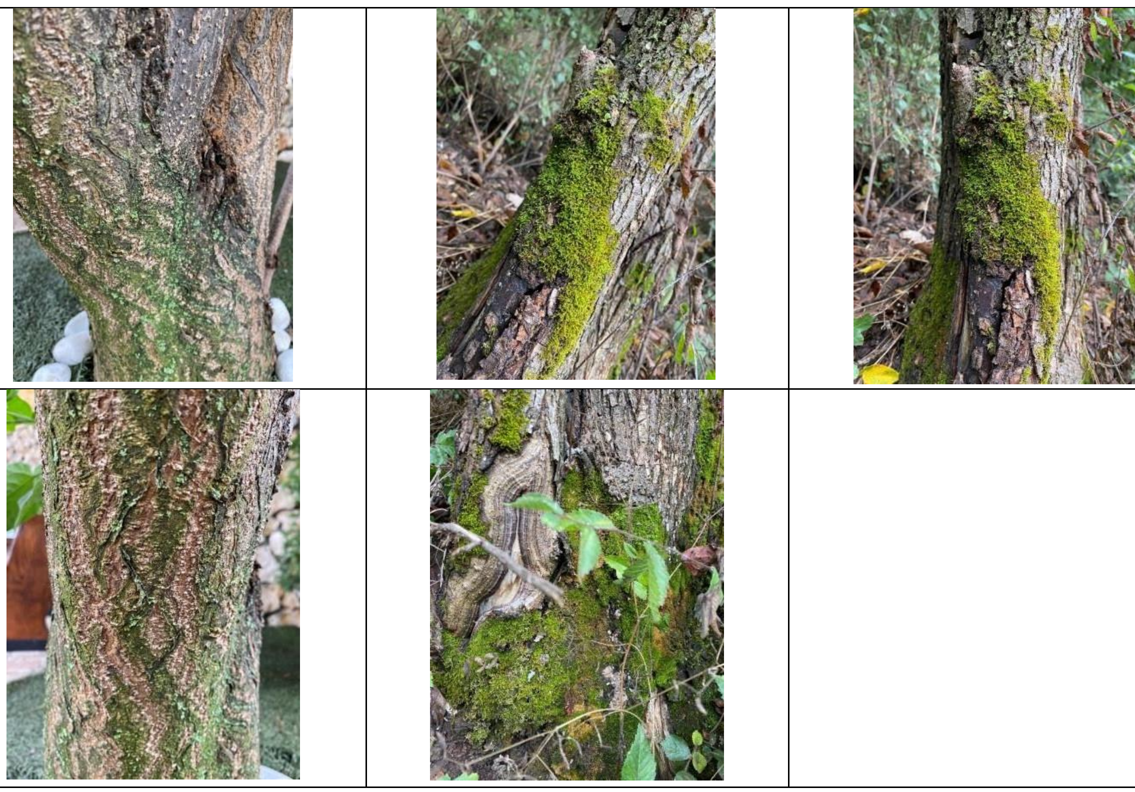


Figure 13. Lichens close to Silver Lake

Generally among the distribution of lichens throughout the four collected sites, the Site A: Fruska Gora mountine contained the highest amount of lichens. The distributions of lichens at the Site D: Sremska Mitrovica city were differentially found between the collected points. The C point showed the lowestlichens content than the other two points. A point was the site where the highest lichen population is found. Finally, it was found that the distribution of lichens at Site D: Sremska Mitrovica city was lower than in others sites. So, high ambient concentrations of pollutants have been associated by international epidemiological studies with various negative health impacts.

CONCLUSIONS

The areas from where lichens samples were collected are urban settlement and without much and large industry and traffic. A bioindication and physical-chemical investigation of air pollution in Zrenjanin has not been completed yet. At different investigated sites a lot of lichen taxa were collected from various genera. The most frequent lichen taxa are: *Rhizocarpon geographicum, Lecanora muralis, Lecanora muralis, Rhizocarpon geographicum, Xanthoria parietina and Xanthoria candelaria*. The presence of lichen indicates that the air quality in these sites (Sremska Mitrovica city, Fruska Gora mountine, Palic Lake and Silver Lake)is quite good. It was concluded that the presence of epiphytic lichens plays an important role in determining and distinguish between the air pollution at the different areas of collections. Finally, the need for further studies on lichens is suggested as a basis for their effective protection and conservation in relation with the climatic changes and air quality.

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INSTABILITY OF THE SLOPES LINKED TO A NEO-TECTONIC ACTIVITY, MAHOUNA, NORTH-EAST, ALGERIA.

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Abstract: *The Mahouna region located in northeastern Algeria, in a margin considered active; it constitutes a fragmented landscape, extremely varied, with a very complex substratum characterised by a tectonic heritage of severalgeological units. The sedimentary soil dates from the Permo-Triassic to the Plio-Quaternary. It is distinguished by a structural relief, young, active, due to its geodynamic evolution during the Upper Tertiary (convergence of the Africa- Eurasia plates). The instability of the slopes by the size and extent of the affected masses constitutes a serious threatand pose problems of development of this region. It is recommended on the one hand to discern the different revealersof recent tectonics; and on the other hand, the highlighting of the relationship between neo-tectonic activity and disorder whose main purpose is to improve the geological balance of a region that remains very little explored from themorpho-structural point of view. The multi-source mapping and analysis through the GIS, the deciphering of a mosaic of aerial photos, coupled with the field study, give us new results and show that the construction and the genesis of this relief is closely linked to the neo-tectonic activity, whose activation is confirmed by the disorder, dismemberment and quite significant deformation that affect both ancient and recent geological formations and the morphology of the region.*

Keywords: *Deformation, Instability of the slopes, Mahouna, Neo-tectonic, Structural relief, SIG.*

INTRODUCTION

The Mahouna or Ain Larbi region is part of North Eastern Algeria (Figure 1-a). It is located at longitudes: 7°19' and 7°41' East, and latitudes: 36°13' and 36°30' North. It extends from the town of Guelma in the north to the village of Ain Arbi (formerly called Gounod) in the south and is located between the following three main wadis: Oued Seybouse which penetrates the Guelma plain in the North, Oued Cherf in the South-West and Oued R'bibain the South-East (Figure.1-b). From a palaeogeographical point of view, these wadis correspond to a transition zone between the low valleys of the tell and the high plains region.
Due to its location in an area considered to be an active margin, with medium seismicity, it is also known for significant hydrothermal activity. There is a clear contrast in the geomorphological landscape (mountains, depressions, hills, etc.), with a variety of facies, reflecting the eventful geological and palaeogeographical history and active geodynamic evolution of the region from the end of the Miocene to the present day. Thus, the rugged and tormented relief presents numerous disorders. The instability of the slopes due to the size and extent of the masses affected is beginning to pose problems for the development of this region.
Despite its proximity to Guelma, the study area has remained poorly explored in morpho-structural detail. On the 1:50,000 geological map of the Mahouna [5], no faults have been mapped; whereas mapping and field observation

show that the rugged topography presents many discontinuities. Faced with the increasing lack of detailed and precise geological mapping information (e.g. geological boundaries), which constitutes a major handicap, one of the problems posed in the present work is, on the one hand, the establishment of the various indicators or indicators of recent tectonics and, on the other hand, the highlighting of the relationship between neo-activity and disorders (instability), the main purpose of which is to flesh out the geo-mapping of the region.

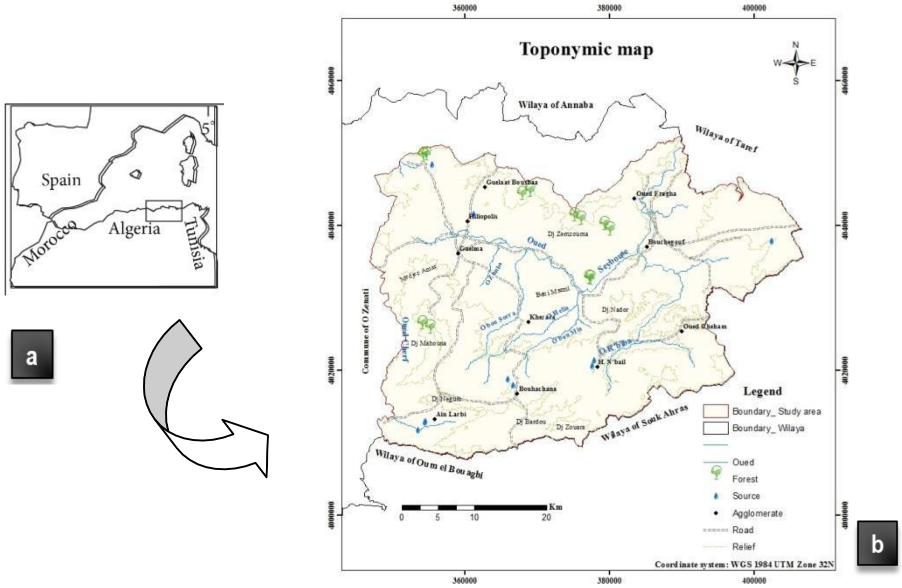


Figure 1. Mahouna or Ain Larbi region is part of North Eastern Algeria and Oued Cherf in the South-West and Oued R'biba in the South-East

MATERIALS AND METHODS

The methodology is based on:

1- Analysis and digital cartographic processing through GIS (hypsometric, hillshade and slope map..), the reading and interpretation are done on a geological background [1] to compare the particular structures and anomalies with the available geological data;

2- Draw a network of lineaments (any object appearing linear or more or less curved) from the general shape of the hydrographic network of the region using the Raskatov method [1] [3] and [13];

3- The deciphering of a mosaic of aerial photos;

4- The field study.

CONTEXTE GEOLOGIQUE

Geologically, the study area belongs to the Tellian Atlas which is part of the outer domain of the folded Alpine chain of North Africa. Overall, it appears that the region has a strong structural legacy, comprising several landslide sheets, according to J. M. Villa, these are probably the most spectacular landslide sheets known in North Africa [6]. These nappes have an extremely complicated structure of detail; they are generally distinguished by a stacking of pellicular units (Figure 2) with a complex geodynamic history.

The deposits that constitute the territory of this region range from the Permo-Triassic to the Quaternary:

- The Triassic formations are generally evaporites, poorly stratified, present in the study area in numerous outcrops, sometimes occupying large surfaces. The Triassic only outcrops in abnormal positions, either in the form of diapirs or injected along tectonic faults [10], whereas in the Nador N'bail's massif, it outcrops in a normal situation [5], as it occupies the bottom of an anticline;
- The marly and calcareous marl soils (Jurassic - Eocene) form the main part of the Sellaoua unit, they outcrop in the south-eastern corner of the study area, surmounted in places by Tellian series.

- A thick series of limestones, interspersed with marlstones of the Tellian unit sensu stricto, ranging from the Senonian to the Lutetian, located mainly in the centre of the study area.
- The Numidian complex (400 metres high) forms the main part of Jebel Mahouna, overlying the Tellian allochthonous series of the territory.
- The continental detrital, lacustrine and fluvial terrains of the Quaternary Mio-Plio (a thick series beginning with the travertines and ending with the alluvium) are widely developed in the region,covering the whole of the northern part (Guelma Basin), as well as the eastern end (Hammam N'bail's Basin).

From a lithological point of view, it is important to note the extreme complexity of the bedrock:
*Various rocks of different ages; *Stacking of units; *Direct and anomalous contact existing between both ancient and recent formations (Triassic terrains and travertine or tuffaceous formations of the Quaternary).

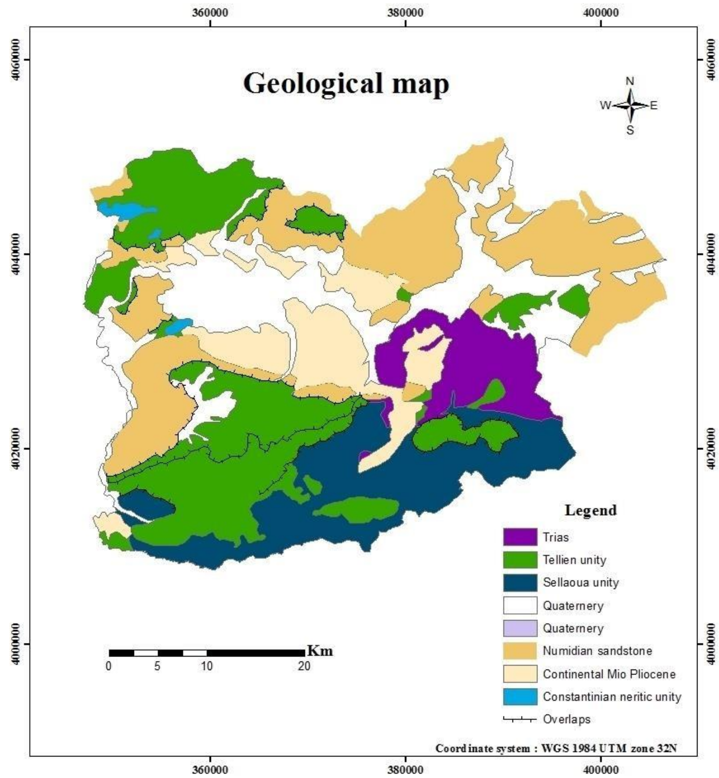


Figure 2. A strong structural legacy of studied region

OROGRAPHIE PARTICULARITIES

On the morpho-structural level, the DEM and the hypsometric analysis (Figures 3 and 4), which show a hierarchical relief by altitude classes, provide a wealth of information on the particularities of the orography of the area (rate of deformation and dismemberment). The reading and interpretation is done on a geological background [1] to compare the particular structures and anomalies with the available geological data;
The study area is made up of a large number of very small regions, each of which is distinguished from the others by more or less striking features.
The relief shows an extreme variety of landscapes. In (Figure 3), three regions can be distinguished by their physical characteristics (mountains, ranges and intra-mountainous depressions); the essential difference lies in altitude and shape. Between the highest peaks (1411 m), and the bottom of the Seybouse valley (90 m),the difference exceeds 1300 m.

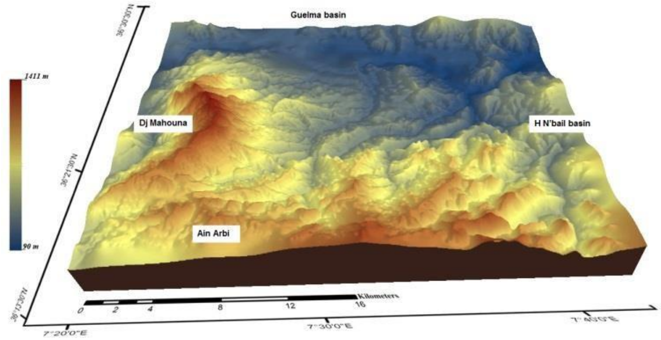


Figure 3. Three regions of the morpho-structural level

The reliefs all belong to the succession of several geological units; their physical differences result from the conjunction of their altitudes, their situations, their shapes, their lithological behaviours and undoubtedly to the persistent tectonic constraints which have a rather important role in the shaping of the relief in particular and the geomorphological evolution of the region in general.

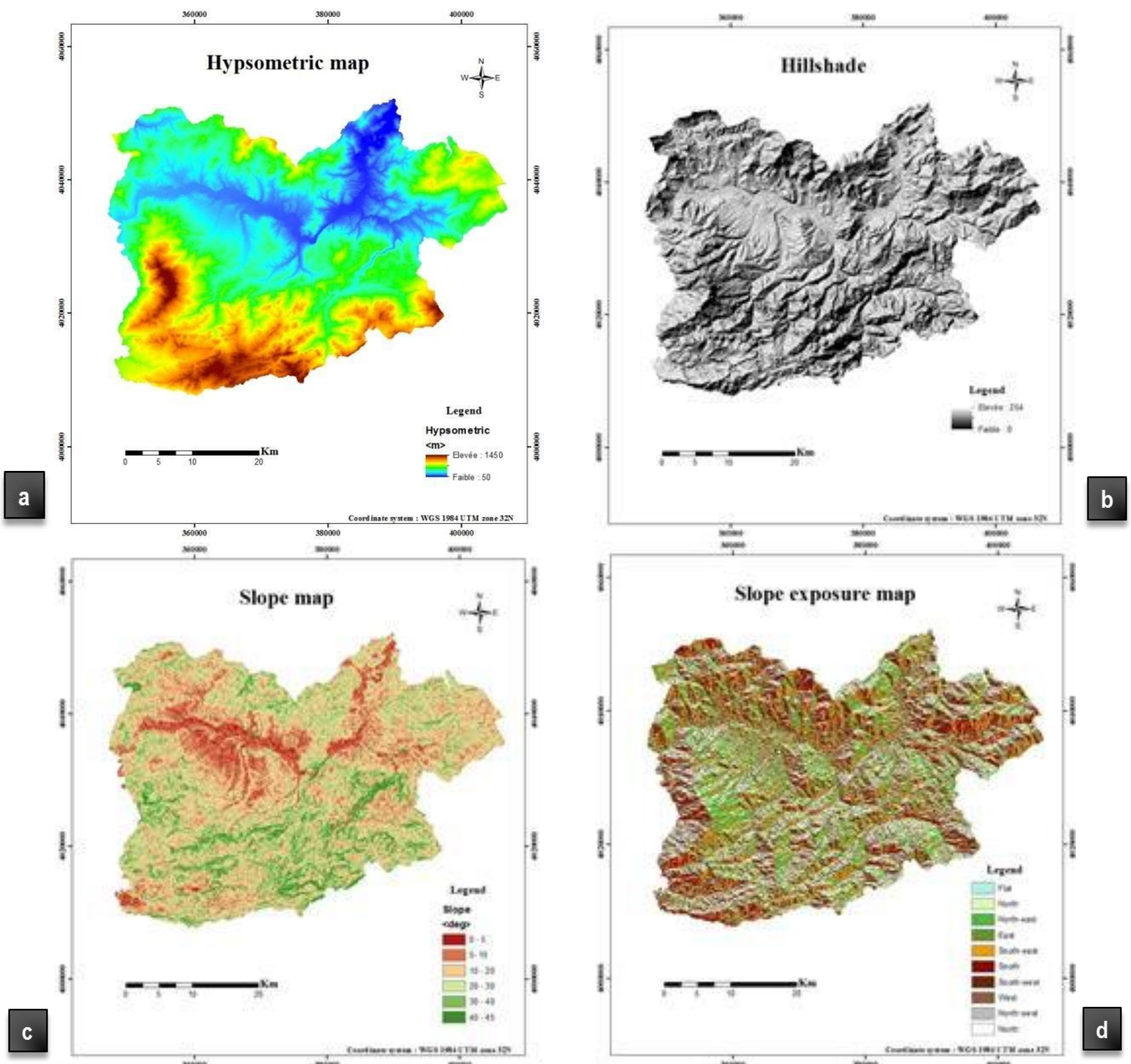


Figure 4. The hypsometric analysis

Due to its geographical situation, the Mahouna is a fragmented area, the nuance is quite clear between the northern part (low areas) and the southern part (high areas) which is composed of less monotonous units, surrounded by topographical and geological discontinuities;

High areas

To the north of the municipality of the study area, a vigorous massif, bearing the ancient name of the study area: La Mahouna; constitutes the dominant element of the whole territory, both from the point of view of altitude (1411 m) and of the surface area it occupies, it is curved in the shape of an arc, the convexity being turned towards the West; by its general North-South orientation seems to link in some way the Atlasic chain to the Numidic chain [5]. It is characterised by a dissymmetrical, dislocated and dismembered aspect. Indeed, its particular shape, its position and its relation with the Guelma basin in the North, make it interesting from a morpho-structural point of view (fig.4- a, b, c and d);

- A brutal flooding is observed in its northern termination, near the Medjaz Amar region. The passagefrom the mountain to the Guelma basin follows a significant slope (over 40°);
- The ridge line shows virgations and discontinuities;
- Linear scarps, orthogonal to the ridge direction, are numerous, possibly fault scarps, often with decaying kinematics;
- A piedmont of considerable dimensions stands out in the NNE part, inclined between the massif and the plain, developed for the most part on very thick detrital accumulation materials (Mollasse de Guelma), resulting from the erosion of the massif upstream. This can certainly be explained by the Plio-Quaternary surrection of the mountain as a result of the orogeny and therefore implies the intervention of an active structural control. Thus, the important fact to mention is the weight of the filling materials which still favours the subsidence of the basin to the north.

The Mahouna massif becomes narrower at its southern end, where we can note an oro-hydrographic lineament (Oued bou Zender), oriented roughly East-West, corresponding to a structural contact between the Numidian unit to the North and the Tellian Sensu-stricto unit to the South. It is likely that this lineament extends further eastwards in a NE-SW direction to limit the monoclinal reverses of the limestone.

An alternation of steep limestone and marl with a significant thickness of the Ypresian-Lutetian [5] favours the clearing of structural forms by differential erosion to form the ranges and reverses of the monoclines, but also active tectonics responsible for the construction of the latter; the most characteristic ones can be seen in the central part, at the level of the Khezara region and to the south of the Mahouna massif.

Even further west, the Nador-N'bail's anticline reaches 1108 m and appears as an anticline, centred on Koudiat en Guataya in a SW-NE direction. Most of it is made up of Triassic gypsiferous formations, except in a few places where Neogene terrain and fragments of Eocene limestone are hidden.

Morpho-structurally, this anticline has a particular morphology and a rather dissymmetrical aspect. While the south-eastern flank is more or less regular, the north-western flank, which is longer, is characterised by a significant dissection: It is subdivided by large erosion zones into several morpho-structural entities (mega-blocks): kef el Mouza, koudiat Eratba, kef lahraiche, kef Mourad...etc.; These mega-blocks are often deformed in the form of virgations at the level of their terminations;

The north-western limit corresponds to an oro-hydrographic lineament (oued Seybouse), characterised by a steep and rectilinear cliff in a NE-SW direction, as well as a large incision of Oued bou Mia (oued Melah in its upstream part) which limits the massif to the east, where the Triassic formations are intertwined; the tectonic nature of these lineaments is obvious.

Another interesting structure stands out between the sandstone massif of the Mahouna and that of the Nador N'bail's: the massif of the béni Marmi; a thick flyshoid series, clayey and sandstone, rests unconformably on the marls of the middle Eocene [5], culminating at more than 460 m and dominating the Guelma plain like a spur. This structure presents two directions: NE-SW then it becomes NNW-SSE in its extension towards the plain. This change of direction is explained by a series of gullies that run through it and have just dislocated the ridge line. It is bordered by a particular linearity of the Oued bou Sorra in its western part and limited by the Oued bou Mia from djebel Nador. Thus a flooding, a lowering of the ridge line and a slight virgation can be seen in the NNW end. This leads us to believe that the evolution of this structure is controlled by tectonics.

To the south, a mountainous group, represented by the massifs of the Sellaoua Unit, surmounted in places by the Tellian formations: the syncline of Dj Zouara (1292 m) whose summit line is intersected by a very important linear escarpment, exceeding 1500 metres in length, with an East-West direction, marking in our opinion the location of an important fault; the syncline of Dj Bardou (1261 m) with an Eocene core; Dj Zoubia (1173 m), Dj Neguib (1133 m), of triangular shape whose crest line forms an angle of 90° with two directions, NW-SE then abruptly, it becomes NE-SW and finally, Rous el Mzaïr (1081 m) presents a complexity of beds, with very varied facies, Large central depressions with low relief (up to 50 metres), dug into the black, bituminous marlstone formations of the Eocene, where we note the presence of two sub- parallel faults with vertical components, running NW-SE; All these massifs are asymmetrical, dislocated and present anomalous directions, except the last one (Rou el Mzaïr) which keeps the Atlasic direction (NE-SW).

Low areas

The Hammam N'bail's intra-mountainous basin constitutes a rather elongated ellipse whose major axis is oriented approximately SSW to NNE, it extends in a continuous way, over a length of approximately 15 kilometres and a width varying from 2 to 3 kilometres. It corresponds to a Miocene fluvio-lacustrine mega-sequence, containing polygenic conglomerates with carbonate pebbles [4].

To the north, the Neogene basin of Guelma corresponds to a wide open lenticular depression, about 25 kilometres long from west to east and varying in width from 3 to 10 kilometres. This wide valley, where the town of Guelma is located, is limited to the south by the northern end of the Mahouna massif and the much less important Bni Marmi massif, which is the last buttress of the Atlas chain [5]. Finally, it is closed to the South-East and to the East by the Nador-N'bail's massif. The Guelma basin is largely filled by evaporite deposits from the terminal Miocene, partially or totally covered by travertine deposits from the Pliocene and Quaternary. The ORGM (1984) is applied several geophysical methods in order to better define the structural arrangement of this basin. The results of the geophysical work revealed that the Guelma basin is divided into two blocks: a collapsed block and a raised block. These two blocks are separated by first order tectonic faults and present two general directions: an almost East-West direction and a North-West-South-East direction.

In summary, the structuring effects of a recent post-orogenic tectonics are well marked on the current relief pattern; to this effect, some anomalies have been drawn:

- Clear dissymmetry between the flanks of the djebels such as dj Mahouna, dj Zouara, Rous el Mzair, dj Nador... etc;
- Deformations, significant twists at the level of the ridge lines of the majority of the massifs;
- Some massifs are subdivided into several morpho-structural units by topographic and/or geological discontinuities;
- Detachment of mega-blocks and the presence of recent scree in the vicinity of the Mahouna sandstone massif and the limestone ranges;
- Kilometre-long scarps are probably fault lines;
- Linear incisions appeared on the irregular slopes under the effect of intense erosion;
- Rectilinear orographic limits could coincide with tectonic accidents such as the southern limit of Jebel Mahouna;
- Remarkable abrupt erosion.

HYDROGRAPHIE ANOMALIES

The hydrographic network is a component of the complex geomorphological system, which is very sensitive to exogenous variations, particularly climatic variations and active tectonic deformation [6]. The region is characterised by a continental Mediterranean climate; the average rainfall, which varies between 500 and 800 mm/year, is a very important climatic factor, conditioning the seasonal flow and directly influencing the watercourse regime. The study region belongs to the catchment area of the middle Seybouse (catchment area N°14): the Seybouse, which drains the Guelma basin to the north, is fed by an important independent

hydrographic network between the Atlas chain of the Tell to the south and the Numidian chain to the north [5].
The hydrographic analysis (Figure 5) shows that the watercourses represent a dense hydrographic network, of dendritic type with rather complex branches in certain parts. The watercourses do not follow a uniform direction and they have undergone disturbances and disorganisation manifested by meandering or sinuosities, and these are guided by the morpho-structures of the terrain crossed and reflecting the variety of heterogeneous geological formations from the point of view of facies.

Figure 5. The hydrographic analysis

The northern system: the Seybouse valley
The general aspect of the sinuous course of the Seybouse valley is E-W with two different and asymmetrical banks; At the level of the mouth of O bou Sorra in the Seybouse we notice a progressive change of the direction of the valley to the NW-SE until Koudiat bou kasrouba which obliges the valley to make adiversion towards the East, by crossing the gorges of Nador and by crossing several geological formations (the steep triassic formations of Nador, the liasic formations of koudiat bou Kasrouba and the more recent quaternary grounds), then suddenly, the direction of flow becomes NE-SW with a rectilinear and linear aspect, this perfect linearity, already mentioned above on the hypsometric map, corresponds indeed to an accident.
Thus, there are two distinct constrictions in the valley (fig. 6-c): the first (1) at the level of the Nador massif and Koudiat Bou Kasrouba and the second (2) at the level of Bni Marmi and the mega dejection cone of Jebel Zemzouma;

The southern system: the mountainous area
The southern part includes two sub-catchments: one in the south-west corresponding to the O. Cherf (which rises south of Guelma), and the other in the south-east, represented by the O. R'biba, whose upper course (the upstream part) is successively called O. Mellah and O. Zouara. These last streams flow in a particularly hilly region, at the bottom of wild, deep valleys with steep walls; between the two sub-basins, the secondary tributaries and the talwegs of the Seybouse valley have a different course and a bizarre appearance expressing the morphological complexity of the terrain; those coming from the north-eastern slope of Dj Mahouna have a NE-SW direction (O. Zimba), others coming from steep limestone ranges of the Tell atlasic chain, show several directions: (O.bou Sorra E- W, O.bou Mia N-S and O.Helia NE-SW), the latter, with altitudes varying from 150m to 800m, has undergone disturbances during its course and has changed its direction six times; and finally, O. Melah, descending from the Nador massif, with a flow following the E-W direction, but after its confluence with O. bou Mia, it abruptly takes the S-N direction. In fact, the structural directions that emerge are: the N-S and the E-W.
Sometimes we see semi-circular structures (the upstream part of Dj Nador) which are very interesting from a

morpho-structural point of view; however, we believe that these structures deserve further study, as this could shed light on the current tectonic evolution of the region and the sub-surface or even semi-deep structures; in fact, these structures can be associated with:

a. A network of stall systems;
b. Deep or semi deep intrusive structures;
c. A halokinetic phenomenon (diapirism).

Given the geological nature, structural heritage and hydrothermal activity of the region, all three possibilities have their place.

In addition, the application of the Raskatov decryption method (Figure 6-a).and detailed observations on the secondary oueds and their tributaries also reveal quite significant disturbances:

- Linear flows over hundreds of metres in some cases;
- Abrupt changes in their course due to the presence of accidents;
- Abandonment of beds (confirmed by aerial photographs);
- Abrupt stop of some streams before joining the main stream (Figure 6-b). This explains in most cases the permeability of the cover crossed (alluvial formations) added to the small quantity of running water (temporary tributaries);
- Perpendicularity (angularity) of oueds etc.
- Strangulations of the Seybouse valley (Figure 6- c);
- High hydrothermal activity and frequency of water sources.

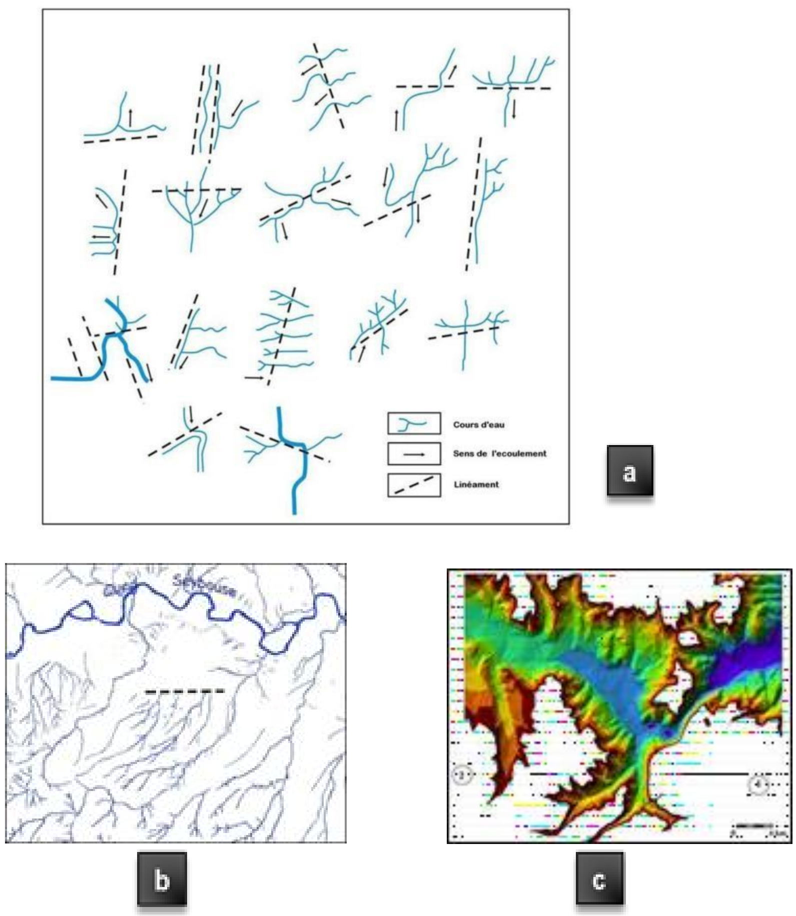


Figure 6. The geological nature, structural heritage and hydrothermal activity of the region

Thus, the important fact to note is that most of the watercourses are temporary and their regime is torrential and aggressive; Guelma, situated at an altitude of 290 metres, at the foot of the sandstone massifs, on a plain (essentially filled in by more than a hundred metres of terrigenous and powerful alluvial deposits from the Quaternary period, according to boreholes), is considered to be a superficial water table, and floods, torrential floods and gullies are the main facts each time it rains. These hazards constitute a major risk, where the torrential crisis will be doubly devastating, as the settlements will be affected not only by flooding, but also by torrent migration and embankments. If houses are located on the new course of the river, they will eventually be destroyed.
The susceptibility of the slopes to erosion varies according to the degree of fragility of the terrain (highly fractured Numidian sandstones, friable marl and limestone formations and Triassic terrain), the fracture rate of the terrain and the degree of slope.

SLOPE INSTABILITIES: Morphological manifestations

The disorder and the ground movements at the level of the study area are frequent and occupy important surfaces, they constitute true active morphological elements which have a dominating role in the evolution of the slopes, indeed, these movements are well controlled by factors of natural order: irregular climatic conditions, heterogeneous lithology, tormented and uneven topography but most often, they are closely related and in a direct way by the active structural context of the area (powerful regional tectonics).Moreover, these instabilities are beginning to cause problems and damage in urban areas and disruption of road traffic.

Here are some fairly common morphological features that have been identified (fig.7 and photos):

- **Mass movements**: in Jebel Mahouna, the hummocky slopes associated with gullying (slides, flows), recent or reactivated, are almost common. With variable volumes and thicknesses, on a steep slope, always higher than 45° (fig.4-c and d), along a breaking surface; To this effect, a typical example was drawn, the national road N°80 was several times damaged by the resumption of movements, thus, to takethe road of the wilaya N°123 connecting Guelma to Aïn Larbi, that is to say about forty kilometres, constitutes a real expedition because of the dilapidated state of the road due to landslides; Thus, the bare slopes are strongly dissected by gullying because of the fragility of the terrain (highly fractured sandstone, friable marl and calcareous formations or triassic argillo-gypseous terrain); Jebel Nador offerscurious examples of erosion of this kind where the claws of an intense gully form a fantastic landscape.
- **Rock instabilities and scree**: rock instabilities are a phenomenon that often forms the prelude to rock falls and landslides, sometimes considerable at the foot of the mountains; the most obvious are those affecting the limestone and marlstone ranges of the Bou Hachana region and represent a potential threat to property and people along National Road N° 80. The scree is strongly present at the foothills of the Oligocene sandstone ledges, and the Tellian limestone ranges could testify to previous tectonic activity;
- **Torrential incision**: numerous torrents flowing down from the sandstone massif constitute a recurrent factor of imbalance; it is well known that the steepness of the slopes exerts a decisive geodynamic influence; on the two slopes of dj Mahouna, the erosive force of the temporary and aggressive torrents is considerable, not only because of the violence of the displacement of their waters, but above all because of the materials of all sizes that they carry;
- **Solifluctions and blisters**: marly musty soils often have topographic flats, solifluosions, blisters, etc. on the surface.
- **Faults:** some of the Numidian sandstones or the limestone ranges are affected by a whole series of accidents (faults, breaks...) of variable directions;
- **Eluvial and colluvial formations**
- **Halokinetic phenomenon.**

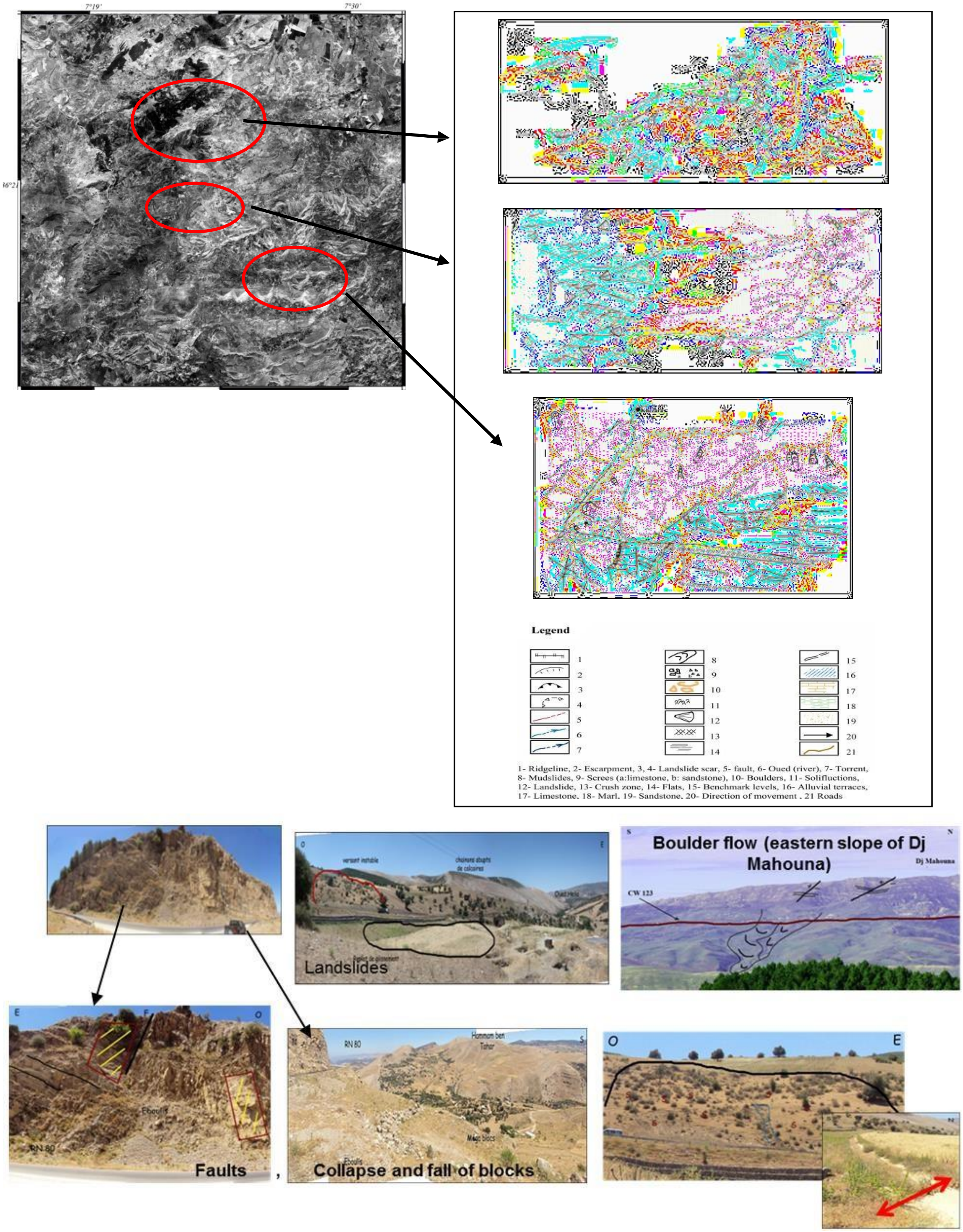
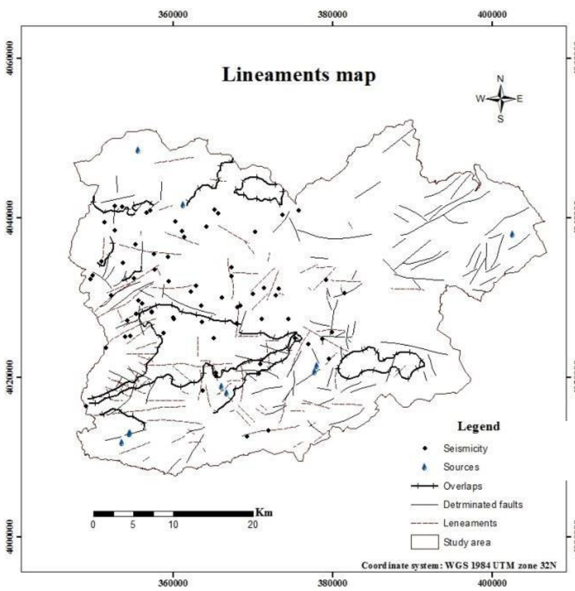


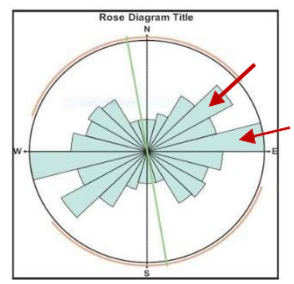
Figure 7. Mosaic of aerial photos of the entire southern part southern part of the study area

RESULTS AND DISCUSSION

More than one hundred oro-hydrographic lineaments (Figure 8) are reported from all the maps made but only the major lineaments are mapped on a toponymic background of the region; Three major directions emerge from the lineament map: NE-SW, NW-SE and N-S; Two structural directions: NE-SW and NW-SE are well marked on the hypsometry and hydrographic network by their alignment and influence the hydrographic system of the region.

The N-S directions are less visible. The typological analysis of the lineament map has revealed an uneven distribution of the tectonic fracture network. This is certainly explained by an uneven distribution of stresses and also by recently deposited materials covering a large area of the study area.





Rosette of lineaments directions

Figure 8.

Also, two typical examples have been drawn:

- Corridor N-S of Kef er Riah: at the level of this corridor, it is important to note: The existence of a hot source. A flap of triassic marl stretched and laminated, The presence of quaternary travertines in direct and abnormal contact with the previous formations. There is no doubt that these structures appear (without doubt) in favor of a fold-fault. These are convincing indications of the active nature of this sector and the reactivation of deep tectonic structures.
- Corridor E-W (eastern slope of Jebel Mahouna): the watershed of Dj Mahouna, provided by a corridor borrowed by an important fault (dexterous drop) of NE-SW direction, this fault draws in thelandscape by kilometer escarpments, affecting the Numidian sandstone of Oligocene; Indeed, severalsliding bodies (sinking-sliding) of large areas and different typologies, are manifested at the level of the NE slope of Mahouna, they are always close to rivers and streams; they are real active morphological structures that have a primary role in the evolution of the slope.

CONCLUSIONS AND RECOMMENDATIONS

The various results obtained from this work can be summarized as follows:

The morphological manifestations of an active deformation, affecting a structural relief, young are well marked at the level of the area of study; the oro- hydrographic irregularity (discontinuities, torsion, decoupling, escarpments of linear faults, the existence of thermal sources etc.), the slope instabilities and the deformation of an important sedimentary stock; certainly constitute one of the most manifest evidence.

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