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20–21 March 2025
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Editors

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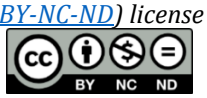

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CONTENT

PREFACE

Due to climate change, freshwater resources are becoming increasingly valuable and strategic worldwide. Due to the increased agricultural utilization of water resources, R&D&I activities related to water resource management, water quality, plant water requirements, environmental and ecological impacts require special attention. The specific tasks of agricultural water management include: serving environmentally, economically and socially sustainable agricultural and fish production with water and irrigation water; contributing to safe and environmentally friendly food production; effectively preventing and treating damages caused by excess water (waterlogging) and lack of water (drought); contributing to the quantitative and qualitative protection of multi-purpose surface and subsurface water resources; supporting the sustainable development of rural areas; and maintaining wetlands, landscapes and biodiversity.

The International Scientific Conference on Water (ISCW) is an annual multidisciplinary platform for international scientific discussions on all aspects of water. ISCW offers an excellent opportunity to exchange ideas, strengthen and create new academic networks, and foster dialogue between academia, public institutions, private sector, and civil society organizations. It addresses recent global and regional trends in water use.

The 8th ISCW covers the following main thematic areas:

- water management and climate change,
- water use in agriculture (irrigation, plant production, animal husbandry, fisheries and aquaculture),
- water use in food and drink industry,
- natural resources management and environmental protection,
- municipal water and wastewater management,
- rural development and water tourism,
- economy of water.

The 8th ISCW Abstract Book presents thematic summaries of the presentations and posters at the conference, providing an interesting and colorful palette of diverse water-related issues for all readers.

The Editors

SESSION: REGIONAL SCALE AND REMOTE SENSING

SUPPORTING WATER RESOURCE DECISION MAKING THROUGH LAND COVER MAPPING ON A REGIONAL LANDSCAPE

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Abstract

Managing water resources effectively is vital to ensure sustainable use and conservation of water in the face of climate change and increasing urbanization that intensifies pressures on hydrological systems. Accurate and real time- dynamic land cover mapping is crucial in the assessment, monitoring and mitigating the impacts of land use on hydrological systems. The existing traditional mapping methods are limited in providing the level of detail, accuracy and handling complex, heterogeneous landscapes needed for effective management of water resources. This research explores machine learning techniques specifically Random Forest (RF), Naive Bayes, and Gradient Tree Boosting (GTB) in combination with remote sensing using a portion of the Tisza-Körös Valley Irrigation System region (TIKEVIR) in Hungary as a case study site.

In this study, classifiers were evaluated over two reference cropping periods (2018 and 2022) to assess their ability to handle complex and non-linear classes in the land cover data consisting of water bodies, build up areas, Grasslands, mixed forests, Corn, Sunflower, Autumn wheat and other crops. Results indicated that Random Forest achieved an overall accuracy of 87% and a kappa coefficient of 0.83 in 2018, while GTB performed slightly lower with an accuracy of 81%. Naive Bayes showed the lowest performance with an accuracy of 61%. In 2022, Random Forest showed a slight decrease in performance (82% accuracy, kappa 0.78), while GTB improved, achieving an accuracy of 84% and a kappa coefficient of 0.80.

This study highlights the potential of machine learning classifiers, particularly Random Forest and Gradient Tree Boosting, in providing reliable land cover maps that can inform water management decisions. Despite small variations in the classification performance, these methods demonstrated their utility in mapping critical land cover features that are integral to understanding the land use activities taking place over space and time on a regional scale. Given this scalability and adaptability, these machine learning classifiers are valuable tools for supporting decision-making in sustainable water resource planning and environmental conservation, especially in areas with heterogeneous landscapes like the TIKEVIR.

Keywords: Regional Hydrology, Machine Learning, Land Cover Classification, Water Resource Management

Acknowledgements: This research was funded by the Széchenyi Plan Plus program under the RRF 2.3.1 21 2022 00008 project.

ANALYSIS OF INLAND EXCESS WATER DURABILITY USING SENTINEL SATELLITE IMAGES BASED ON INLAND EXCESS WATER FREQUENCY MAPS GENERATED BY CONVOLUTIONAL NEURAL NETWORKS

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Abstract

Extreme weather events are becoming more frequent due to climate change, increasing the risk of inland excess water in Hungary. Our study analyzed temporary water surface formation in a 30-hectare agricultural area in the Central Alföld region using Sentinel-1 and Sentinel-2 satellite images.

We applied convolutional neural networks to generate water frequency maps, achieving an F1-score of 0.71 for Sentinel-1 and 0.56 for Sentinel-2. Data gaps were filled using temporal interpolation. Results indicated that 3.08 hectares remained underwater for at least 58 days, with a maximum estimated water volume of 1,984 m^3 and an average depth of 6.4 cm.

Keywords: Sentinel-1, Sentinel-2, inland excess water, frequency map, durability, CNN

HYDROMORPHOLOGICAL ASSESSMENT AND DYNAMIC WATER BALANCE MODELING OF RESERVOIRS

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Abstract

The spatial and temporal variability of precipitation patterns, along with the increasing frequency of drought periods, presents significant challenges for water resource management, particularly in the Carpathian Basin. Sustainable reservoir operation requires a precise understanding of hydromorphological characteristics and continuous assessment of water balance components.

This study aims to develop a hydrodynamic model based on a bathymetric survey refined using remote sensing techniques, enabling dynamic analysis of reservoir water balance processes. The morphological survey of the Vezér Street Reservoir, located in Debrecen, Eastern Hungary, was conducted using an Apache 3 unmanned surface vehicle equipped with a monobeam sonar and a Stonex X120GO SLAM laser scanner. These measurements facilitated the generation of a high-resolution digital bathymetric model. The acquired data were integrated into a PowerSim-based temporal water balance model, incorporating precipitation, evaporation, and infiltration processes, and allowing for the simulation of various water replenishment strategies.

Results indicate that the total storage capacity of the reservoir is 39,213.59 m^3, with a maximum water surface area of 16,354.93 m^2. During the summer period, daily evaporation losses may reach 45,000.24 mm/day. The developed model provides a framework for evaluating different water level management strategies and determining the required water supplementation for optimal reservoir operation.

The applied methodology contributes to the rational allocation of water resources, improving reservoir management efficiency and supporting the development of sustainable water management strategies.

Keywords: water balance modeling, hydromorphology, remote sensing, PowerSim, water resource management, bathymetric surveying, reservoir operation.

Acknowledgements: The research presented in the article was carried out within the framework of the Széchenyi Plan Plus program with the support of the RRF 2.3.1 21 2022 00008 project.

ADVANCING AGRICULTURAL WATER REGIME USING SAR TECHNOLOGY: SOIL MOISTURE AND ET_C ESTIMATION FOR SUSTAINABLE CROP PRODUCTION

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Abstract

Agricultural water management is critical for achieving sustainable crop production and ensuring global food security. In this context, Synthetic Aperture Radar (SAR) technology has emerged as a powerful tool for monitoring and modeling agricultural water regimes due to its high-resolution, all-weather, and day-and-night observation capabilities. This study investigates the application of SAR in modeling agricultural water dynamics, with a focus on soil moisture estimation, crop evapotranspiration (ET_c) modeling, and water stress detection. By leveraging SAR-derived backscatter and interferometric coherence, the proposed techniques enable the monitoring of surface water dynamics, analysis of regional irrigation demand, and assessment of crop water requirements. Furthermore, the integration of machine learning algorithms, such as Support Vector Machines (SVM), with hydrological models (e.g., Water Balance) using SAR data facilitates precise water regime predictions and supports real-time decision-making for irrigation scheduling and inland excess water management. Case studies in the Hajdúság region demonstrate the effectiveness of SAR in regional irrigation water demand budgeting, highlighting its potential to enhance water use efficiency and reduce environmental impacts. The findings underscore SAR's transformative role in precision agriculture, offering advanced support for sustainable water resource management in the face of climate variability and increasing agricultural demands.

Keywords: Evapotranspiration, Soil moisture, SAR, Machine learning

Acknowledgements: The research presented in the article was carried out within the framework of the Széchenyi Plan Plus program with the support of the RRF 2.3.1 21 2022 00008 project. This research was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.

AUTOMATED VEGETATION INDEX CALCULATION FOR LYSIMETER MONITORING USING A SIMPLIFIED PYTHON SCRIPT

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Abstract

The Vegetation Index (VI) is a crucial metric for assessing vegetation health, particularly in precision agriculture and environmental monitoring. Traditionally, computing Normalized Difference Vegetation Index (NDVI), Green Normalized Difference Vegetation Index (GNDVI), or Blue Normalized Difference Vegetation Index (BNDVI) from drone imagery involves complex workflows requiring extensive pre-processing and manual band selection. This study presents a streamlined Python-based script utilizing ArcGIS Pro's arcpy library to automate VI calculations from multispectral drone imagery. The script simplifies the process by dynamically extracting the necessary spectral bands—Near-Infrared (NIR) and Green or Blue—from a single multi-band raster file, eliminating the need for manual band selection or multiple raster inputs.

This approach is particularly beneficial for lysimeter stations, where continuous vegetation monitoring is required to analyze plant responses under controlled soil and water conditions. The script enables automated calculations for each lysimeter tank, generating statistical outputs such as mean and standard deviation. By automating VI computation, this method enhances data processing efficiency, ensuring rapid and reliable VI generation for lysimeter studies. The script is designed for ease of use, requiring only the specification of input and output file locations before execution. It seamlessly integrates ArcGIS spatial analysis tools for raster operations, making it accessible to researchers and agronomists without extensive GIS expertise. Moreover, the script runs independently of ArcGIS Pro in a standard Python environment.

The inputs include the raster file (e.g., aerial survey image etc.) and mask vector layers for delineating lysimeter tank areas. The outputs consist of calculated vegetation indices for each tank, along with statistical summaries, which are automatically saved into an Excel table. This methodology significantly reduces processing time, enhances reproducibility, and improves monitoring accuracy for lysimeter-based vegetation studies. By integrating this script into lysimeter data analysis workflows, researchers can streamline vegetation health monitoring without manual GIS processing, ultimately leading to more efficient and scalable insights into plant-soil-water interactions.

Keywords: Python scripting, Vegetation index, Automated raster processing, Lysimeter station, Lysimeter tank

SESSION : WATER QUALITY

INVESTIGATION OF TEMPORAL AND SPATIAL CHANGES OF NITROGEN POLLUTION IN DRAINAGE OF LANDS WITH DIFFERENT LAND-USES IN SHIROOD CATCHMENT LOCATED IN MAZANDARAN PROVINCE

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Abstract

The impact of eroded soil sediments on the environment depends on the geochemical background of the watershed. Nitrogen, a crucial agricultural nutrient, is widely used in farming; however, excessive application can deteriorate water quality. We aimed to assess nitrogen pollution in soil across different land uses and examine the relationship between land use and drainage contamination during rainy periods in the Bostankar River region, Iran. Accordingly, soil samples were collected during winter and spring from six types of land use: forest, orange orchards, kiwi orchards, flower gardens, rice fields, and tea plantations; water samples were taken from drainage systems. The levels of total nitrogen were measured in both soil and water samples. The findings indicated that nitrogen concentrations in drainage water were higher in spring compared to winter, likely due to agricultural activities such as fertilization and tillage during this period. The highest and lowest nitrogen concentrations in spring were recorded in flower gardens (6.60 mg/L) and forests (0.30 mg/L), respectively. To mitigate the amount of nitrogen with the runoff and pollution in the study area, fertilizer application should be tailored to plant requirements and guided by soil test results.

Keywords: Water Pollution, Nitrogen Fertilizer, Drainage

HARNESSING INTERNET OF THINGS (IOT) AND ADVANCED ANALYTICS FOR SUSTAINABLE WATER QUALITY MANAGEMENT

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Abstract

Effective water quality management is essential for supporting ecosystems and safeguarding public health. The traditional methods of monitoring water quality are often labor-intensive and time-consuming, making it difficult to obtain real-time data and respond quickly to issues. To address these challenges, Internet of Things (IoT) technology has emerged as a transformative tool. This utilizes interconnected sensors and automated data transmission, IoT enables continuous, real-time monitoring of critical water quality parameters. This study presents an innovative approach to water quality management that integrates IoT technology with advanced data analytics, focusing on the University of Ilorin's water treatment plant as a case study. A solar-powered IoT-enabled system was developed and deployed to enable real-time, continuous monitoring of critical water quality parameters. Advanced statistical analysis were performed using Python, employing tools such as Principal Component Analysis (PCA), correlation matrix analysis, Sen's Slope Estimator, Ordinary Least Squares (OLS) regression, and the Mann-Kendall trend test. These analyses revealed significant relationships between specific water quality parameters and reduced data dimensionality. They identified significant decreasing trends in Electrical Conductivity (EC) and Total Dissolved Solids (TDS), suggesting improvements in water quality over time. The Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI) was evaluated, yielding an overall score of 94.42%, categorizing the water quality as Excellent. This study underscores the effectiveness of real-time monitoring systems and provides sustainable, efficient, and reliable solutions to water quality issues, thereby reducing the risk of waterborne diseases.

Keywords: Water Quality, IoT, Principal Component Analysis, CCME-WQI, Sen's Slope Estimator, Correlation matrix

Acknowledgment: We are grateful to all those who participated in the survey, and to the students who helped with the data entry. The authors acknowledge the Tertiary Education Trust Fund - TETFUND (National Research Fund, NRF) for sponsoring this study through the TETF/DR & D – CE/NRF/2020/SETI Grant and the University of Ilorin, Ilorin for providing the enabling environment.

INFLUENCE OF INTENSE RAINFALL ON THE WATER QUALITY AND MICROBIAL CHARACTERISTICS OF AN URBAN STREAM

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Abstract

Extreme rainfall events, driven by climate change, significantly impact urban streams by introducing pollutants such as nutrients, heavy metals, and microbial contaminants. This study objective is to find out the effects of intense rainfall on the physicochemical and microbiological properties of the Tócó Stream, focusing on water quality dissimilarities. Two sampling sites were selected: one in a near-natural area and another in an industrial zone near a highway. Measurements were conducted before and after rainfall, including water level, temperature, dissolved oxygen, and precipitation. Laboratory analyses evaluated pH, electrical conductivity (EC), and nutrient concentrations (NH_4^+, NO_2^-, NO_3^-, PO_4^{3-}, K^+, SO_4^{2-}), furthermore chemical oxygen demand (COD), biological oxygen demand (BOD_5), and microbiological parameters (total count, total coliforms, and proportion of yeasts and molds) were also determined. Results revealed site-specific differences. At the industrial site, nutrient concentrations and EC decreased after rainfall, while the near-natural site exhibited minimal change. Microbiological analysis showed an increase in total coliforms and microbe count at the industrial site due to variable sources of rainwater as well as the municipal wastewater, however this effect was less recognizable in the natural area. These findings highlight the underexplored short- and long-term impacts of sudden rainfall on urban stream water quality and microbial dynamics, emphasizing the need for further research on their environmental consequences.

Keywords: rainfall, urban stream, water quality, microbiology

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THE ENVIRONMENTAL IMPACT OF THE PRESENCE OF PSYCHOACTIVE SUBSTANCES

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Abstract

Due to the accumulation of stressors that humanity is currently undergoing, it has been observed an increasing trend in the consumption of different types of psychoactive risk substances.

According to current results of scientific studies, illegal drugs are becoming the main subject of scientists' interest because their impact on the central nervous system, once in contact with these types of pollutants, leads to changes in the behaviour of exposed living beings.

Studies have shown that illegal substances in aquatic systems inhibit various stimulants (e.g., sertraline) and lead to algal growth and development regression.

In conclusion, starting from the premise that some drugs are not metabolized in the body and are therefore released into sewage systems through excreta and sweat, the following paper will highlight the main effects of the presence of these substances on aquatic systems.

Keywords: Psychoactive substances, Pollution, Environment, Aquatic system

SESSION: PLANT PHYSIOLOGY AND WATER

EXTREME DROUGHT IN SZARVAS REGION IN 2022

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Abstract

In 2022 very severe drought hit the Szarvas Region. The yield of the wheat was less than the half and sunflower yield was 1/3 of the last years average. The maize yield was totally destroyed in most part of the area. In our research we analysed the monthly temperature, sunshine and precipitation data measured at Szarvas Weather Station in the agricultural year 2022 to find the causes led to the extreme drought. We also compared the meteorological parameters and the Palfai Drought Index (PaDI) with ones of other years from 1951. The combination of low amount of precipitation, high temperature and a lot of sunshine characterized most of the growing season. The starting soil moisture content was also much smaller than usual. The period of May to August was the 2nd warmest and 3rd driest in the last 70 years. Only the year 2003 showed more unfavourable weather conditions in this period. The Pálfai Drought Index (PaDI) for 2022 was 12.1. This value is in the „very severe drought" category. However, the drought in 2022 can be considered extreme according to some agricultural effects.

Keywords: Precipitation, Temperature, Drought index, PaDI, Maize yield

INFLUENCE OF TEMPERATURE AND RAINFALL ON THE NETTLE PLANT MOISTURE CONTENT

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Abstract

Stinging nettle (*Urtica dioica L.*) is a valuable perennial plant, appreciated for its medicinal and nutritional benefits, therapeutic properties and its agricultural uses.

The water content of plants is an essential indicator of their physiological state and ability to adapt to environmental conditions. The water content of the nettle plant is an important indicator of its health and ability to adapt to its environment.

Climatic factors, such as temperature and precipitation, can significantly influence the hydration level of nettle, affecting its development and use. In a period marked by climate change, understanding how these variables influence plants is becoming increasingly important.

Temperature and precipitation are essential climatic factors that influence plant growth and development. High temperatures can accelerate metabolic processes, while low temperatures can slow or even inhibit them. Precipitation provides the necessary water supply, essential for photosynthesis and other physiological processes.

The aim of this study is to investigate the relationship between temperature and precipitation variations to determine how meteorological conditions influence the water content of nettle samples.

Nettle plant and soil samples were collected from Recaş, Timiş county for three months. The water content of samples was measured using thermogravimetric method and climatic data was obtained from local meteorological sources.

Temperature and rainfall quantity play a key role in the variability of water content.

Keywords: Climate factors, Nettle parts, Adaptability, Monthly variations

WATER AS AN ESSENTIAL FACTOR IN THE DEVELOPMENT OF FOOD PRODUCTS FROM AMARANTHUS RETROFLEXUS AND CHENOPODIUM ALBUM

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Abstract

Water is one of the most important elements in nature, which is present everywhere and in everything. Having an essential role in our lives, water plays an important role in the physical and chemical functions of our body, in the food we eat and in the materials that surround us. In many industries, measuring the water content is important if not critical to evaluate product quality, adjust manufacturing processes and to ensure product compliance.

The water content determination is one of the basic methods used in food control. For example, the presence of water is food has a significant impact on its susceptibility to chemical, enzymatic and microbial activity.

In this study, the water content was determinate with the Sartorius Thermobalance, which ensured the monitoring of the dehydration process of the analyzed products and the vegetable matter through a continuous measurement.

The aim of the study is to analyze the essential role of water, in the development of functional food of the *Amaranthus retroflexus* and *Chenopodium album* plants.

Keywords: Moisture content, Water activity, Bioactive compounds, Food processing

THE IMPACT OF TILLAGE ON SOYBEAN GROWTH DYNAMICS AND POD PRODUCTION

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Abstract

The present study was conducted to investigate the effect of tillage, irrigation and nutrient levels on soybean plant height and pod number. Soybean is the fourth most cultivated crop globally in terms of production area; therefore, experimental research on this plant is of particular importance. The experiment was carried out in the Szarvas area in 2024. Precipitation was low in the first half of the year, especially in February and March (10.9 mm and 11.2 mm), then increased in June (70.4 mm) and July (58.8 mm), peaking in September (89.3 mm). The soil type was identified as chernozem, a clay loam. It was characterized by an acidic pH of 6 and a medium-supplied humus content. The cultivated soybean variety was a well-adapted type commonly grown in Hungary. We separated irrigated and non-irrigated parcels with four different tillage practices (conventional tillage, minimum tillage, tine tillage and strip tillage). A hose reel irrigation machine (with a 30-metre console) was used for irrigation. In the case of nutrient supply, the experiment incorporated both fertilized and unfertilized control plots. Two key growth parameters were measured: plant height and pod number. The soybean height ranged from about 43 to 66 cm, with the highest value (66.3 cm) recorded under tine tillage combined with irrigation and fertilization. In contrast, the highest number of pods (64 pods per plant) was obtained under conventional tillage. Significant differences were found between irrigation and tillage methods. This marked the first year of a comprehensive, long-term experiment.

Keywords: Irrigation, Tillage, Soybean, Growth

COMPARATIVE ANALYSIS OF PHOSPHORUS FERTILIZER EFFECTS ON ZINC CONCENTRATIONS IN SOIL AND WHEAT UPTAKE UNDER IRRIGATED AND RAINFED CONDITIONS

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Abstract

The long-term use of phosphorus fertilizers increases zinc (Zn) accumulation in soil, affecting plant uptake and food safety. This study examines the effect of phosphorus fertilization on Zn concentration in soil and its uptake by wheat in different land uses. A total of 105 soil samples and 26 wheat samples were collected from rainfed and irrigated fields in Hamadan province, with rangeland soil as a control. The total and available Zn concentrations were analyzed in soil, along with its distribution in wheat roots, stems, and grains. Additionally, Zn fractionation was assessed in organic, carbonate, residual, and exchangeable forms. The results showed that Zn levels in rainfed and irrigated soils exceeded critical thresholds, with fertilization increasing Zn content in residual and organic fractions. The Zn distribution in wheat tissues followed the pattern grain > root > stem, with a soil-to-grain transfer factor of 0.06. These findings highlight that phosphorus fertilization contributes to Zn accumulation in soil and plant tissues, which may impact crop quality and environmental health.

Keywords: Zinc, Phosphorus Fertilizer, Soil Contamination, Wheat, Heavy Metal Uptake

SESSION: ECOSYSTEMS AND SERVICES, WATER MANAGEMENT

ECONOMIC VALUATION OF THE MULTIPLE BENEFITS OF FISHPONDS

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Abstract

Fishponds are interesting freshwater systems where natural and anthropogenic processes interact, mirroring the biogeochemical cycles found in natural wetlands, and providing a wide range of ecosystem services (ES) such as provisioning, regulating and cultural services. The investigation of a wide range of services provided by fishponds, both in terms of biophysical and monetary accounting, remains critical to ensure the cost-effective provision of ES. Therefore, the aim of our study was to carry out a model-based assessment of the ecosystem services (ES) provided by fishpond aquaculture and, furthermore, to perform a monetary valuation of these ecosystem services. The work was carried out in two steps: first, a biophysical process-based model of the pond food web and associated reed vegetation was developed to adequately quantify ES and identify ES indicators such as CO_2 sequestration rate, cooling effects, fish and reed biomass as direct product etc. In the next step, a monetary valuation of these ecosystem services was carried out using various methods such as replacement cost method, market price method, application of social cost of carbon etc. to determine the value in economic terms. The results of this study will be helpful in designing diversified policies, regulations and programmes for the protection and sustainable management of freshwater fishpond systems.

Keywords: Fishponds, Ecosystem Services, Valuation, Indicators

Acknowledgements: This research has been performed in the scope of the European Union's Horizon 2020 research project EATFISH (grant no. 956697).

THE CHANGE OF WETLAND ECOSYSTEM SERVICES IN BÉKÉS COUNTY

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Abstract

The change in the appearance of the landscape can be classified as a natural process over a long time scale. Therefore, it is often depicted with a static image. The role of the human factor (human activity) in the change in the appearance of the landscape has been increasingly decisive since the middle of the 19th century. The change in the landscape occurs at a significant speed. The change in the appearance of the landscape due to human activity can be measured through the change in land use. Land use changes have a negative impact on natural processes such as evaporation, precipitation runoff, and soil formation. These further affect the local and larger-scale climate, further strengthening its global change.

In this study, we track the land use changes that have taken place in Békés County, with a special focus on those that affect the water balance of the area. For example, natural forests, reed beds, grasslands, and fish ponds are good water retention areas. Artificial areas with good water retention capacity and high evaporation capacity are plantations, gardens, orchards, and vineyards.

In my work, I collect the results of the Agricultural Microcensus data series of the Central Statistical Office for the past 50 years. From the data, I examine the quantitative changes in the above-mentioned areas with good water retention capacity versus the less well-managed arable land in Békés County. I will examine the proportion of areas that contribute to climate change (extreme drought), such as covered areas and built-up areas, which change during this period. From the results of this change, it can be concluded to what extent the change in land use has contributed to the drying of the area. The sectors that promote land use with low water retention capacity can be identified.

Keywords: Landscape, Land use, Water balance, Natural process

"WHERE COULD THE PRACTICE OF SUBSURFACE DRAINAGE STAND IN HUNGARY? AN OVERVIEW OF THE INTERNATIONAL STATUS OF TILE DRAINAGE APPLICATION AND RESEARCH

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Abstract

Subsurface drainage is a widely applied water management intervention worldwide, primarily used in agricultural areas with unfavorable water management conditions to regulate groundwater levels and soil moisture, as well as to remove excess water from the soil. While the application of subsurface drainage for this purpose has a long history, modern agricultural water management increasingly requires operational solutions that facilitate the retention of excess water and the reuse of drainage outflows. This study presents international research directions and application methods of subsurface drainage that may be relevant to the national water management practices. A particular focus is placed on showcasing specific applications of subsurface drainage, such as controlled drainage and complex irrigation methods aimed at reusing drainage water.

Keywords: Agricultural water management, Subsurface drainage, Drainage water utilization

SUSTAINABLE URBAN DEVELOPMENT IN DEBRECEN: ADDRESSING WATER SCARCITY, AGRICULTURAL DECLINE, AND INDUSTRIAL EXPANSION THROUGH COMMUNITY-BASED HYDROPONIC SOLUTIONS

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Abstract

Debrecen is the second largest city in Hungary and faces pressing challenges of rapid industrial growth, urban sprawl, and decline of agricultural areas, enhanced by limited water resources. Machine learning methods like RF classification enable land cover changes to be performed in this research with the help of the 2018-2022 satellite imagery from the Landsat 8. The results given show a dramatic loss of vegetated areas, especially forests and croplands, due to increasing urbanization and industrialization, which threatens biodiversity, water availability, and food security.

In the face of these challenges, this study calls for novel, community-driven approaches to ensuring sustainable urban living. We present a workshop-based approach to involving residents in the use of hydroponic systems for food production at the household level. Hydroponics addresses food safety and economic independence, with the additional advantage of lower water usage than conventional agriculture. Empowerment of communities to understand and provide the wherewithal to implement such systems allows cities like Debrecen to reduce further impacts of agricultural decline, enhance food security, and reduce household economic burdens.

This study underscores the importance of integrating land cover analysis with participatory urban planning to foster resilience and sustainability. The findings call for policymakers, urban planners, and community leaders to collaborate on alternative approaches that balance industrial growth with environmental preservation and social well-being. By involving citizens in sustainable practices, Debrecen can serve as a model for cities worldwide facing similar challenges.

Keywords: Land cover changes, Food security, Machine learning algorithm, Landsat 8, Hydroponics

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POSTER SESSION

INVESTIGATING THE INTERCEPTION EFFECT OF SELECTED PERMEABLE SOIL COVERING MATERIALS

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Abstract

Mulching is widely used in landscape and urban hydrology to regulate surface water dynamics, however, little is known about to the process of intercepting and storing water. This study examines several urban materials to better understand their water-holding capacity and their uses in stormwater management, considering that many studies concentrate on mulch in connection to soil.

In this study, four different types of permeable materials (i.e. straw, red pine, gravel, and lava) at three thicknesses (2cm, 4cm, and 6cm) were examined for their interception and water retention properties. The materials were completely submerged in water to saturation and then allowed to completely drain with three replicates per material and per thickness. Weighing the samples both before and after saturation allowed us to determine their retained water content, which directly revealed how much water they could retain. To guarantee that the data accurately represent the characteristics of the mulch alone, no soil was used in the experiment.

The preliminary findings indicate that organic mulches, red pine and straw, retained noticeably more water in terms of weight compared to inorganic materials. However, their bigger particle size and structure could result in these differences. At the same time, lava and gravel, inorganic mulches, showed a decreased absorption capacity, even if they still retained some moisture. Thickness played a role in water retention, with thicker layers storing more water.

These results can contribute to a deeper understanding of how various mulch types behave as independent water-holding layers, which is quite important for applications in urban design, green infrastructure, as well as erosion control. Engineers and landscape planners may optimize water retention techniques and reduce excessive runoff in constructed areas by selecting permeable coverings as efficiently as possible.

Keywords: Mulch, Water retention, Interception, Urban hydrology, Water management

HOW AI CAN BE THE SOLUTION TO AGRICULTURAL PROBLEMS

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Abstract:

Agriculture provides food, services and resources and guarantees the livelihood of millions of people worldwide. In the EU alone, 22 million people are directly employed in the farming sector — up to 44 million people rely on the wider food sector (farming, food processing and retail/services). Agriculture is one of the most climate-dependent socio-economic sectors, since most of the agriculture productivity and quality are directly dependent on different climatic factors. Climate change is already affecting agriculture, with effects unevenly distributed across the various regions of the world and within Europe.

Climate change affects agriculture in a few ways. Changes in temperature and precipitation as well as weather and climate extremes are already influencing crop yields and livestock productivity in Europe. Weather and climate conditions also affect the availability of water needed for irrigation, livestock watering practices, processing of agricultural products, and transport and storage conditions. Climate change is projected to reduce crop productivity in parts of southern Europe and to improve the conditions for growing crops in northern Europe. Although northern regions may experience longer growing seasons and more suitable crop conditions in future, the number of extreme events negatively affecting agriculture in Europe is projected to increase

The effect of global climate change on food production will probably be changes in precipitation periods as well as in the distribution and extent of storms; in addition, extreme weather events will increase. If we fail to satisfy the rising demand through sustainable production methods, crop failures will lead to exorbitant price increases.

Keywords: Climate change, Agriculture, Food processing

EFFECT OF NUTRIENT MANAGEMENT AND IRRIGATION ON WINTER WHEAT YIELD

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Abstract

As in many places in the world, in Hungary winter wheat is the crop that plays a prominent role both in terms of the size of the sown area and human nutrition. In addition to its use as human food, it is also used as feed and industrial raw material, not to mention that its by-product also represents value. Various stress factors, such as drought and heat stress, can have a significant negative effect on the plant. As a result of global climate change, extreme vintages are more common, and due to extreme weather conditions, plants are forced to endure various stress effects more and more often and over a longer period of time. Nowadays, whether it is worth irrigating wheat is a question that is asked more and more often. However, as a result of global changes, we have to think about whether to take this step, at least in order to eliminate crop fluctuations during periods of drought. In the course of the research, we searched for the answer to the ecological features of the Szarvas area in the 2023/2024 season, in the case of the application of different fertilizer doses, which treatments gave the highest yield, thousand-grain weight in irrigated and non-irrigated conditions . Depending on the weather of the year 2023/2024 and the applied nutrients, the yield of the wheat variety tested in the experiment varied between 7.15-9.42 t/ha, and the grain moisture at the time of harvest was between 11.2-12.1%.

Keywords: Wheat, Irrigaiton, Yield, TGW, SPAD

DATA ON THE WATER REQUIREMENTS OF FARM ANIMALS

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Abstract

In animal nutrition, breeders primarily focus on the amount of feed rations. However, it is equally important for animals that, in addition to the appropriate quality and quantity of feed, they always have an adequate amount of drinking water at their disposal. The utilization of feed largely depends on the animal's fluid balance, since thirsty animals also consume less feed.

The daily water consumption of individual animal species can usually be inferred based on the dry matter content of the feed they consume. For example, pigs require 7–8 liters of water for one kilogram of dry matter, while poultry and sheep require 2–3 liters of water for the same amount. The amount of water consumed depends, among other things, on the age of the animals, the composition of the feed, the ambient temperature, and the physiological state of the animal. Young animals, for example, require much more water than older ones, and the same applies to regularly lactating mothers. Animals that are encouraged to perform regularly (e.g. hens set to produce eggs) also consume more fluids.

Especially during the summer heat, it is important not to forget to change the animals' drinking water regularly, even several times a day. This is primarily necessary because the reproduction of harmful microorganisms in the water accelerates in high heat, and therefore special care must be taken to keep the drinkers clean. The temperature of the drinking water used for drinking should be around 10–12 degrees, if it is lower than this, the animal's body must waste extra energy to raise it to the temperature level of its body. Drinking water that is too cold can also cause various diseases, while water that is too hot does not sufficiently reduce thirst and can also be a carrier of disease germs.

Keywords: Farm animal, Water consumption, Drinking water, Heat stress

THE IMPACT OF TILLAGE METHODS ON SOIL WATER CONTENT IN GREEN PEA (PISUM SATIVUM L.)

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Abstract

Recently a variable application of conventional and conservation tillage methods has been used in order to increase the volume of protein plant production in Europe. However, Hungary can be marked with traditional agriculture, special attention must be given to soil protection in the sustainable agriculture system. Due to the need of high protein resources, green pea (*Pisum sativum* L.) is one of the most important sources of essential protein in Hungary. Additionally, due to the short growing season, green pea allows the cultivation of a second crop after harvest.
However, the long-term viability of agricultural production can be influenced by soil management practices, as the process of soil tillage modifies the surface cover and directly impacts the water content of the soil.

This research presents the results of determining the effects of conventional tillage (ploughing at a depth of 25-30 cm) and conservational tillage methods (disking at a depth of 12-16 cm, subsoiling at a depth of 28-35 cm, and direct drilling) on the soil water content under the conditions of Gödöllő region, Hungary.

The experiment was conducted in Szárítópuszta Experimental Station of the Hungarian University of Life Sciences, located in the Gödöllő-hills, where climatic condition is moderately dry continental, and the soil type is rust-brown forest soil.

Based on the comparisons, tillage methods significantly affected the soil water content and direct drilling showed more water retention in the upper layer of the soi. However, soil compaction in direct drilling restricted crop growth and yield potential, highlighting the need for deeper soil tillage to support optimal plant development in a short-term experimental field.

Keywords: Sustainability, Pisum sativum, Conventional tillage, Water management, Conservation tillage

RESERCHES ON THE IMPORTANCE OF AGRICULTURE IN THE ROMANIAN ECONOMY

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Abstract

Agriculture was and remains the mainstay of human existence, representing the backbone of the Romanian rural economy. The authors of the paper propose an analysis of the main factors involved in the development of agriculture in Romania: the share of agriculture in the Gross Domestic Product (GDP), the land base, the agricultural labour force, the development of agricultural holdings, the structure of agricultural production, the level of agricultural machinery and equipment and the use of chemical fertilisers in agriculture. The methodology used in the research consists of collecting statistical data, processing them, interpreting them graphically, and analysing and synthesising information on the evolution of agriculture from the literature in the field. At the end of the paper, the authors highlight the primary function of agriculture in ensuring the population's food security, thus underlining the need for farm consolidation, modernisation of technologies, and general improvement of farmers' activity.

Keywords: Agriculture, Evolution, Economy, Romania

FROM WASTE TO WELLNESS – SHEEP WOOL A REMEDY FOR INDOOR AIR QUALITY

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Abstract

At present, human beings spend approximately 87% of their time indoors. In Europe, between 55% and 67% of total energy consumption is allocated to maintaining indoor comfort in residential areas, office buildings, and commercial spaces. Since the 1990s, indoor air quality (IAQ) has emerged as a significant environmental issue, attracting the attention of governments and the public. Poor indoor air quality significantly affects individuals' health and work productivity.

Consequently, a sustainable building process may be realized by utilizing natural insulation materials as alternatives to conventional options. Natural insulation materials like wood fibre, cellulose, sheep wool, hemp, cotton, and flax typically exhibit water vapor permeability. They can regulate indoor air humidity by absorbing environmental moisture.

Sheep wool, a byproduct of sheep farming, is a material that is renewable, recyclable, and environmentally sustainable. Sheep wool fibre, characterized by its natural properties and composition, including 60% animal protein fibres, 15% moisture, 10% fat, 10% sheep sweat, and 5% impurities, serves as a versatile material across various fields and sectors, particularly in enhancing thermal efficiency in buildings. So, wool is frequently disposed of improperly, for instance, buried or incinerated, significantly affecting soil and air quality.

This research will examine the unique properties of sheep wool that can mainly increase indoor air quality and represent an innovative use for wool waste.

Keywords: Sheep wool, Indoor air quality, Waste, Filters, Valorisation

AIRBORNE LIDAR-BASED VOLUME DETERMINATION AND WATER RETENTION CAPACITY ESTIMATION OF FLUVIAL OXBOW LAKES

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Abstract

In the early 2000's, several major floods occurred on the Tisza River, following a prolonged period of precipitation, which was also contributed to by snow melting in the catchment. These floods reached record water levels and caused one of the most significant flood disasters in Eastern Hungary in the last 50 years.

In recent years, however, water levels on the Tisza and its tributaries have been on a downward trend, driven by climate change and other local anthropogenic influences such as changes in rainfall distribution in the catchment areas and changes in land use. Low water levels and water discharge have a negative impact on the overall ecosystem of the Upper Tisza, leading to a decrease in average ground-water level, soil moisture and biodiversity.

From a water retention point of view, one of the greatest potentials is in the deep floodplains and the oxbow lakes.

In our study, we analysed the storage potential of ten oxbow lakes in the active floodp using an airborne LiDAR point cloud-derived digital terrain model (DTM). The lower and upper baselines of the beds of the oxbow lakes were determined by generating contour lines, while the data-missing areas were interpolated at the water surface level. The lower and upper baselines of the oxbow lakes were determined by generating contour lines, while the data-missing areas were interpolated at the water surface level. The resulting geometric data were used to calculate the water storage volume of the basins.

The water retention capacity of the ten oxbow lakes exceeds 3 million m3. Calculated on the basis of the average discharge at the Tivadar cross-section at the peak of the flood on 6 March 2001, this volume of water flowed through the crossing in about 13 minutes.

Our results highlight the efficient use of the water retention capacity of oxbow lakes, which can play a key role in reducing flood risk, improving the ecological status of river basins and mitigating the negative consequences of climate change.

Keywords: Upper-Tisza, LiDAR, Oxbow lakes, Climate change

Acknowledgements: We would like to thank the Upper Tisza Regional Water Directorate for providing us with the data used in the research.

HYBRID SOLUTIONS: ULTRAFILTRATION AND REVERSE OSMOSIS FOR ELIMINATING PFBA AND PFOA FROM TEXTILE WASTEWATER

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Abstract

Per- and polyfluoroalkyl substances (PFAS) are persistent organic pollutants frequently found in industrial wastewater, especially in the textile industry. In this study, the efficiency of a hybrid membrane treatment process—ultrafiltration (UF) followed by reverse osmosis (RO)—for the removal of perfluorobutanoic acid (PFBA) and perfluorooctanoic acid (PFOA) from textile wastewater (TWW) is investigated.

A UF flat-sheet membrane (2000 Da) in combination with an RO membrane (100–200 Da) was used for the experimental setup using gas chromatography-tandem mass spectrometry.

The results showed that the UF-RO process has a significant removal efficiency: the removal of PFBA reached 96.0%, while the removal of PFOA was 100%. Specifically, UF removed 84.4% of PFBA and 80.8% of PFOA, while RO additionally reduced PFBA by 74.3% and PFOA by 100%. These results indicate that the hybrid UF-RO system is an effective method for reducing PFAS contamination in TWW. The study highlights the potential for integrating membrane-based technologies into industrial wastewater treatment processes to reduce PFAS pollution and improve environmental sustainability.

Keywords: PFAS, PFBA, PFOA, Ultrafiltration, Reverse osmosis, Textile wastewater, Membrane treatment

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EVALUATION OF CROP GROWTH PERFORMANCE OF WINTER WHEAT AND MAIZE IN HUNGARIAN CLIMATIC CONDITIONS AND WATER STRESS

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Abstract

Winter wheat and maize production is a significant aspect of Hungarian agriculture, with crops occupying a substantial portion of the country's arable land. However, water scarcity poses a significant challenge to cereal growth, influencing phenological traits, bioactive components, and water use efficiency. A two-year field monitoring was conducted in Hungary with different crop varieties on local conditions. This study conducted a two-year field monitoring (2021–2023) in Hungary to assess crop growth performance under local conditions. Field visit monitoring was done on certain time of the year corresponding with Sentinel 2 satellite pass, crop growth stages and agricultural practices. The research was conducted to evaluate crop growth performance in estimating biomass production; canopy growth and comparison of modelled green canopy to derived from AquaCrop. Evaluation of vegetation indices to measure green canopy cover measured by AquaCrop. The growth parameters of plants which were modelled were to estimate the growth of winter wheat and maize. The AquaCrop is more suitable for analysis as less demanding for regional scale applications, needing less data and not many mechanisms of the stress factor affecting its limitations.

Keywords: Crop growth, Water, Harvest index, Biomass, Hungary

RELOCATION AND RECONFIGURATION OF A DRAINAGE CHANNEL IN TIMIŞOARA, ROMANIA

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Abstract

The reallocation and reconfiguration of a drainage channel are important processes in the efficient management of excess moisture of a pluvial nature, ensuring flood prevention and protecting infrastructure and the environment. These operations can include several stages, and each project is unique depending on local conditions and the desired purpose. To achieve this, it is essential to analyze the ecological impact of the channel reallocation. The channel that is the subject of this work was located between two plots located in the built-up area of the municipality of Timişoara, Timiş County. The reallocation of the building was desired because the two plots were adjacent to facilitate the extension of a construction in the neighboring building. By reallocating the channel, its geometric elements are not modified, the functioning of the reallocated drainage channel and its flow transport is ensured, the length being 693m. To carry out the work, a topographic survey was carried out in the Stereographic 1970 projection system, using the RTK kinematic method in real time by using differential corrections from the specialized ROMPOS service. In order to carry out the measurements, the Leica 1200 GPS device was used, and the data obtained was processed using the Leica Geo Office Tools software, after which the calculated points were reported in the AutoCAD program, with the help of which the building's situation plan was drawn up, the surface calculation was performed analytically. A concrete tympanum with a stepped trapezoidal shape was placed on the reallocated channel.

Keywords: Reconfiguration, Channel, Water, Environment, Moisture

COMPARISON OF QUALITY PARAMETERS IN IRRIGATED AND RAIN-FED MAIZE (*ZEA MAYS* L.): A CASE STUDY IN SZARVAS, HUNGARY

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Abstract

The intercropping of maize (*Zea mays L.*) with fast-growing tree species such as willow (*Salix alba L.*) and poplar (*Populus spp.*) has been shown to enhance yield potential, particularly under water-limiting conditions. This study evaluates maize quality parameters under different irrigation conditions in an agroforestry system. The experimental field spans 85 m in width and is divided into six plots categorized by inter-row tree spacing: X (24 m), Y (9 m), and Z (6.5 m), each replicated twice. Samples were collected in the two middle rows of each plot (X, Y and Z) where there was exposure to maximum irradiance. A two-way ANOVA was performed to examine the effects of tree spacing, irrigation, and their interaction on moisture, protein, starch, and oil content in maize. The results indicate that protein and starch content were significantly influenced ($P < 0.05$) by both tree spacing and irrigation, whereas moisture content was significantly affected only by tree spacing. The highest protein content was observed in Z plots, with values of 10.04 ± 0.26% (irrigated) and 10.61 ± 0.16% (non-irrigated). Conversely, the highest starch content was recorded in the widest-spaced plot (X), with values of 73.50 ± 0.07% (irrigated) and 72.57 ± 0.11% (non-irrigated). These results highlight the potential of agroforestry systems in modulating maize quality under different water availability.

Keywords: Quality parameters, Protein content, Moisture content, Oil content, Starch content, Soil water content, Tree spacing, Irrigation

Acknowledgements: Corteva Agriscience for providing maize seeds (cultivar Harmonium 380) for the experiment.

WATER FOOTPRINT ESTIMATION FOR SELECTED MAJOR CROPS IN HUNGARY

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Abstract

The aim of our study was to assess potential regional and temporal variations in the water footprint of the three most commonly cultivated crops in Hungary: wheat, corn/maize and sunflower. We have utilized FAO's AquacCrop model, to calculate the green water footprint, and evaluate yield data of the selected crops at the different counties of Hungary, for the time period of 2000-2023. Soil information was extracted from the AGROTOPO database, while meteorological data was obtained from the online data repository of HungaroMet. Model results were compared to the county-level statistics of the Hungarian Central Statistical Office (KSH), as well as to the yield data of a farm in Öcsöd, Hungary. Temporal trends were evaluated using the Mann-Kendall test (utilized in R), while spatial processing was carried out with the QGIS software. Results have indicated that while there are increasing thends in crop yields and water use, the increase in yield seems to be higher than the increase in water use, resulting in smaller water footprint. This effect is potentially due to the utilization of more efficient crop varieties.

Keywords: Water footprint, Wheat, Corn, Maize, Sunflower, AquaCrop

A REVIEW OF CROP WATER STRESS ASSESSMENT USING REMOTE SENSING TECHNIQUES

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Abstract

Accurate detection of crop water stress is crucial for optimizing agricultural water management and enhancing crop productivity. This review comprehensively explores various techniques for detecting crop water stress, with a focus on remote sensing methods. Traditional approaches like the Gravimetric Method provide direct but labor-intensive measurements of soil moisture. Remote sensing techniques offer more efficient alternatives, including the use of Vegetation Indices (VIs), which assess plant health through spectral reflectance, and Water Indices (WIs), which highlight moisture content in vegetation. Water Balance Indices estimate water stress by analyzing the relationship between water inputs and outputs in the soil-crop system. Additionally, remote sensing-based Evapotranspiration (ET) estimation using energy balance models helps quantify water loss and plant water use. The Crop Water Stress Index (CWSI), often derived from infrared thermometers, measures plant canopy temperature to detect stress levels. Advanced satellite-based techniques have expanded the scope of water stress monitoring, leveraging high-resolution imagery to assess large agricultural areas. Furthermore, Multispectral Sensing Systems and Spectral Indices have proven effective in capturing subtle changes in crop physiology associated with water stress. This review highlights the strengths, limitations, and recent advancements of these techniques, offering insights into their practical applications for precision agriculture. The integration of remote sensing technologies provides a scalable and accurate means of crop water stress detection, contributing to sustainable water resource management and improved agricultural practices.

Keywords: Water indices, Evapotranspiration, Crop Water Stress Index

THE EFFECT OF DIFFERENT IRRIGATION LEVELS AND DROUGHT STRESS ON SORGHUM

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Abstract

Nowadays, sorghum is not only common in Asian countries, but also all over the world. Its popularity is due to its good stress tolerance and drought tolerance, which is why it can also be grown successfully in areas with arid climate. It can be an alternative solution to replace maize sowing; its content is similar to maize, its protein content is higher, does not contain gluten, GMO-free, and toxin-free. In periods of drought, it can produce up to 10-15% more than maize. Its use is very broad, suitable for both human and animal consumption.
In the experiment, we used the ES-ALBANUS sorghum variety. During the research, we set three different levels of water supply, each of the three levels included 3 breeding pots. We determined the soil water capacity (VKsz). The three different water supply levels were the following: First treatment: WC: 40%, second treatment: WC: 60%, third treatment: WC: 80%. The following measurements were made during the experiment: SPAD, leaf area (LAI), plant height, green mass, wet root mass, dry plant mass, dry root mass, and dry seed mass. Based on the data from the experiment, it can be established how important the role of irrigation is and the choice of its correct amount. In almost all cases, the WC: 80% sorghum experiment responded best. It received the largest water dose, a total of 53,000 ml, while the WC:40% sorghum only received 28,625 ml. Striking results were obtained by examining the dry grain weight. The grain weight of the sorghum receiving the largest amount of irrigation was 62g, which is more than one and a half times that of the sorghum received with the smallest dose, which was 35g.

Keywords: Sorghum, Soil water capacity, SPAD, LAI, Yield

APPLICATION OF REDOX POTENTIAL IN WATER QUALITY ASSESSMENT

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Abstract

The rapid determination of water quality in many technologies (food industry, swimming pools, waste water treatment) facilitates regulatory tasks and controls. Parameters that can be used for rapid determination include chemical and/or biological oxygen demand (COD, BOI), pH or redox potential (ORP) based classification. The use of the latter, which is in fact a measure of the oxidising-reducing potential, is a widely used method, despite the many uncertainties due to the multiplicity of parameters that influence the value of the ORP, and their synergistic effects.

In our studies, we tried to replace the monitoring of free chlorine content for disinfection purposes by redox potential values, measuring in parallel the temperature and pH of the water body. We have determined the correlation between these parameters and attempted to establish a more accurate mathematical model than hitherto for these two parameters: free chlorine and redox potential.

In the course of our research, we installed sensors in existing recirculation systems and set up an automatic temperature-controlled recirculation measuring circuit at the Szent István Campus of the Hungarian University of Agricultural and Life Sciences, which is capable of continuously measuring and storing the above-mentioned physical and chemical parameters. Our measurements were supplemented by periodic laboratory tests to determine other possible influencing parameters (COD, BOI, NO3-, etc.).

The applicability of the redox potential value was checked by correlation analysis and mathematical correlations between other parameters determining water quality were sought.

Keywords: Water quality, Redox potential, Free chlorine

MAGNESIUM CONCENTRATION IN PLANT PARTS OF SORGHUM SILAGE IRRIGATED WITH HIGH-SALINITY EFFLUENT UNDER DIFFERENT TREATMENTS

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Abstract

This study examines the agronomic response of three forage sorghum hybrids to irrigation with high-salinity and organic matter-rich effluent from an intensive fish farm. The experiment included five different treatments, combining two types of irrigation water and weekly irrigation doses of 30 mm and 45 mm, along with a non-irrigated control. The study utilized three forage sorghum hybrids bred in Hungary ('GK Áron', 'GK Balázs', 'GK Erik'). Magnesium concentration was analyzed in the aboveground plant parts, specifically in chopped leaf and stem samples, to assess the impact of saline irrigation on nutrient uptake and accumulation. Statistical analysis revealed significant differences between treatments in the 'GK Áron' hybrid. The lowest magnesium concentration (895 mg/kg dry matter) was measured in samples irrigated with 45 mm of effluent water, whereas the highest value (1366 mg/kg dry matter) was observed in samples treated with 30 mm of effluent water. In contrast, no significant differences between treatments were detected for the 'GK Balázs' and 'GK Erik' hybrids. The results indicate that the sorghum hybrids responded differently to the treatments, with variations in magnesium storage in their aerial plant tissues. These findings highlight the influence of irrigation water composition and application rates on nutrient dynamics, which is crucial for optimizing sorghum production under saline conditions. The study contributes to a better understanding of nutrient management strategies in salt-affected irrigation systems and provides valuable insights for improving the sustainability of forage crop cultivation using alternative water sources.

Keywords: Silage sorghum, Irrigation, Effluent water, Magnesium content

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A BIBLIOMETRIC ANALYSIS OF LITERATURE ON THE WASTEWATER MANAGEMENT ALONGSIDE OF BIOENERGY PRODUCTION

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Abstract

We conducted a systematic review of existing literature about wastewater management alongside bioenergy production to find the research trends and future outlook. After applying the PRISMA flow, we evaluated 425 documents retrieved from the Scopus database, published from 1996 to 2025. We used the Biblioshiny interface of the R package program Bibliometrix to explore the annual publications, source networks, co-occurrence of keywords analysis, author analysis, citation, and co-citation analysis. The results showed that although there was an upward trend in annual scientific production by 2022, a notable drop happened during the last 2 years. China led in research contributions, was also the most cited country, and had the strongest collaboration network. The next places regarding research contributions were India, the USA, and Malaysia. The Journal of Bioresource Technology was the most relevant source. Considering trend topics, the "Microbial Fuel Cell" was the most studied system for wastewater management and bioenergy production. By and large, the publications' progress throughout time is visually illustrated by this comprehensive overview of the discipline, which also identifies areas of current study focus and possible future research initiatives. The results offer a solid roadmap for more research in this area.

Keywords: Wastewater management, Bioenergy, Bibliometric Analysis, Biblioshiny

DESIGNATION OF AGRICULTURAL RESERVOIR AREAS USING GIS-BASED SPATIAL PLANNING TOOLS

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Abstract

One possible alternative to the use of less favoured areas is the creation of small ponds (1-2 ha). These ponds can not only function as reservoirs, but also provide a complex range of alternative uses in accordance with local conditions and nature conservation requirements. The retention and use of water has a number of benefits: irrigation, fish farming, microclimate improvement, reduction of inland water damage, aesthetic and, last but not least, nature conservation value. From an economic point of view, it increases the range of farm activities and, last but not least, it produces fish.

Keywords: Spatial planning, GIS, Small-scale fish pond, Sustainability

THE EFFECT OF FOLIAR FERTILIZATION ON INCREASING OIL CONTENT IN WINTER OILSEED RAPE (BRASSICA NAPUS L.) CULTIVATION IN THE CASE OF A DRY SEASON

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Abstract

Foliar fertilization, which complements successful soil fertilization, is becoming increasingly widespread in Hungary as well, as it provides a more reliable or supplementary nutrient supply to the plant, especially during drier periods. In a year with a lack of precipitation - when the plant is unable to absorb sufficient nutrients from the soil - nutrients applied through the leaves can be of great assistance, playing an important role in the plant's development, yield formation, and internal composition. The most important factor in the internal composition of rapeseed is oil content, which is why our research focuses on this, examining whether foliar fertilization increases oil content in a year with very low precipitation and atmospheric drought. During the growing season, the total amount of precipitation was 272 mm, instead of the optimal 500-600 mm for rapeseed. The experiment was conducted in Szarvas in 2022. In the experiment, we applied additional foliar fertilization treatments at four different nutrient levels with varying fertilizer doses, which were examined in four replications. The four different treatments were as follows: Control (without fertilization), Environmental protection level (160 $kgha^{-1}$ N), Balance level (170 $kgha^{-1}$ N), Genesis regional (160 $kgha^{-1}$ N; 54 $kgha^{-1}$ P; 54 $kgha^{-1}$ K). The determination of oil content was carried out using a FOSS Infratec™ NIR grain analyzer. Out of all the nutrient levels, the Environmental protection supplemental foliar fertilizer treatment resulted in the highest oil content, 48.88%. The experiment also pointed to the fact that in case of a dry season, it is essential to use foliar fertilization in rapeseed cultivation, because in each treatment the oil content increased. Overall, it can be said that in the case of a dry season, the additional foliar fertilizer treatment has a positive effect on the increase of oil content in the case of rapeseed, both in nutrient-poor and nutrient-rich farming.

Keywords: Dry season, Atmospheric drought, Foliar fertilization, Winter oilseed rape, Oil content

THE CONTRIBUTION OF TOURISM TO THE SUSTAINABLE DEVELOPMENT OF RURAL AREAS. CASE STUDY – RELIGIOUS TOURISM IN THE NORTH-EAST REGION

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Abstract

Religion has played an important role in people's lives and activities since ancient times. The spiritual richness of some places of worship (monasteries, churches, hermitages), as well as the strong personality of some more spiritually dedicated people in these settlements attracted people's attention and admiration, leading to the manifestation of a special attitude towards all of this. The objective of the paper is to highlight the ways to support the development of the rural environment in the North-East Region, by capitalizing on its resources, especially the religious ones, through tourism. The main methodological approaches applied included the analysis and synthesis of information, direct observation, data collection, as well as the processing and interpretation of information from the specialized literature and from relevant statistical sources. The emergence and development of tourism, and especially of religious tourism in the development of North-East region, is largely linked to the existence of numerous places of worship. In order to develop and diversify the tourist offer, in addition to traditional forms of tourism, such as religious tourism, cultural-historical tourism, mountain tourism, holiday tourism, circulation tourism, spa tourism and weekend tourism, special attention to other forms of tourism such as rural tourism and agritourism. The significant tourist potential of the religious component in the region is not adequately exploited in the current offer of tourist services.

Key words: Rural areas, Religious tourism, Sustainable development, North-East region

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AVAILABILITY AND SUSTAINABLE WATER MANAGEMENT IN ROMANIA

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Abstract

The world's water resources are under increasing pressure. Population growth, growth and diversification of economic activities, improvement of living standards, pollution, climate change (severe drought), lead to increased competition for limited water resources and solving problems related to their degradation. We can say that there is currently a global "fight" for water resources. Within the EU, special attention is paid to this aspect and, through specific measures, member states align themselves with these requirements. The paper refers to the conditions and development directions of this sector in Romania, in order to ensure an efficient contribution to sustainable development, while meeting the requirements of the acquis communautaire and those of the international agreements and treaties to which Romania is a party. We must also take into account the opportunities that the sustainable use of water resources offers to Romanian citizens and the economy of our country, in the context of future challenges. The presentation and interpretation of statistical data highlight the measures that Romania is considering to achieve national and European objectives in this segment.

Keywords: Resources, Water management, Availability, Climate change

THE IMPORTANCE OF NEW TECHNOLOGY IN WATER IRRIGATION SYSTEMS FOR MODERN AGRICULTURE

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Abstract

Farming now rides the wave of modern tech, especially in watering. Old watering ways waste water and mess up efficiency, so hunting for clever fixes is a must. Farmers have wedded IoT gadgets to their watering setups, letting them peek at systems in real time. That tech twist sends water just where it needs to be, cutting down on waste and bumping up crop counts. Digital changes hand growers a ton of handy info, helping them pick moves that back the United Nations Sustainable Development Goals for green food production and smart water use Look at these leaps—it's clear we need to shake up old watering habits to tackle today's farm challenges.

Irrigation systems drive modern farming. They are built to give crops just the right splash of water, which boosts yields and makes farms more sustainable. Farmers mix up methods like drip, sprinklers, and even plain surface watering—each adding a bit of quirky efficiency. Engineers have wedded old watering ideas with some snazzy tech like automated controls and soil moisture sensors to apply water with exacting precision, cutting waste and sharpening resource management in places hit by climate change. A rock-solid irrigation rig keeps water flowing when the weather acts up, holding the farming scene together Blending modern gizmos with time-tested routines, these systems tackle food security issues today and look after long-run sustainability. They just get the job done.

Keywords: Water, Irrigation, Technology, Agriculture, Modernisation

MOISTURE IN SOME FRUITS: NUTRITIONAL IMPLICATIONS

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Abstract

Fruits are essential components of a healthy diet, providing essential nutrients, fiber, and bioactive compounds. Their composition varies significantly depending on moisture and dry matter content, which influences nutritional value, texture, shelf life, and processing properties. This paper explores the role of moisture and dry matter in fruits, emphasizing their impact on nutrition, preservation, and consumer preference.

Keywords: Moisture, Fruits, Water, Apple, Pear, Quince

SOCIOECONOMIC AND DEMOGRAPHIC DYNAMICS IN ARAD COUNTY AND THE WESTERN REGION OF ROMANIA: CHALLENGES, OPPORTUNITIES, AND POLICY IMPLICATIONS

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Abstract

This paper examines the multifaceted socioeconomic and demographic challenges facing Arad County, a key industrial and economic hub in western Romania, and its broader implications within the West Development Region. Arad County is characterized by significant industrial diversity including automotive, textile, furniture, food production, and electrical equipment sectors. Despite strong foreign investment and industrial activity, the county faces persistent issues of population decline, high urbanization, and youth vulnerability exacerbated by economic migration and declining birth rates. Detailed analysis of labour market data reveals that unemployment is chiefly concentrated in rural areas and among individuals aged over 40, with a particularly pronounced representation of populations with limited formal education. The study further explores the structural weaknesses in secondary regions, such as LAG territory, which faces aging demographics, insufficient educational engagement, and a heavy reliance on agriculture. These findings underscore the need for targeted interventions including vocational training, rural entrepreneurship, and youth engagement programs to mitigate labour market disparities and promote socioeconomic revitalization. The paper concludes by outlining strategic recommendations aimed at enhancing skill development, increasing access to cultural and educational opportunities, and fostering community-based economic initiatives to counteract ongoing migration trends and social exclusion.

Keywords: Socioeconomic challenges, Demographic decline, Unemployment, Rural development, Youth migration

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EFFECTIVE COMMUNICATION STRATEGIES FOR WATER RESOURCE MANAGEMENT: BRIDGING SCIENCE AND PUBLIC AWARENESS

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Abstract

Effective communication is a critical component in the management of water resources, particularly in the context of rising global water challenges. As scientific advancements and innovations in water management continue to evolve, it becomes increasingly important to bridge the gap between complex research findings and public understanding. This paper explores the role of communication in water resource management, focusing on how clear, transparent, and targeted messaging can foster public awareness, encourage sustainable practices, and facilitate policy changes. By examining case studies from diverse geographical regions, the paper highlights successful communication strategies that have led to positive environmental outcomes. Moreover, the paper discusses the integration of digital technologies and social media platforms in amplifying water-related messages, ensuring broader outreach and engagement. The findings suggest that a multidimensional communication approach—combining science, local knowledge, and interactive technologies—holds the key to building resilient communities and safeguarding vital water resources for future generations.

Keywords: Effective communication, Management of water resources, Multidimensional communication

THE ROLE OF WATER MANAGEMENT IN CLIMATE CHANGE ADAPTATION

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Abstract

Climate change is an ongoing process that is forcing us to rethink how we manage water. The water cycle is becoming unstable and unpredictable with increasing warming and unusual rainfall patterns, so managing water well is crucial to avoid extreme events like droughts, floods and declining water quality. Farmers are improvising water harvesting and irrigation methods to grow, helping them avoid the stress that unpredictable climate brings – especially when it comes to water-sensitive crops. Forecasts are a bit sketchy, which throws up uncertainties at both local and regional levels. Now we need innovative ways to address risks at different stages of plant growth. Adopting these solutions in terms of sustainable water use cannot ensure long-term supply while keeping development on track.

Efficient water management is an important issue for climate resilience, directly addressing climate challenges. Good water management boosts resource use and helps communities to be resilient when nature becomes unpredictable. Recent research tells us that local remedies, applied to specific conditions, can bridge long-standing weaknesses in interconnected water networks, increasing resilience to changes such as droughts and floods. Recognizing how different environmental hazards interact with each other is essential to keeping societies stable, as poorly managed water systems can create global risks and have serious social and political consequences. Adopting water policies that focus on resilience can improve environmental quality and community well-being, playing an important role in our fight to address climate change. This close water-climate-farmer connection shows that water management needs to be integrated with broader climate resilience plans.

Keywords: Climate change, Water management, Drought, Environmental hazard, Water policies

DOES WATER SCARCITY DRIVE POND AQUACULTURE TOWARD INTENSIFICATION?

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Abstract

Water scarcity is a growing concern for aquaculture system, as climate models forecast altered precipitation patterns and higher evaporation rates. Pond aquaculture, which has traditionally depended on surface water sources with little interference, might urgently require intensification to increase productivity per unit of water.

This research examines how water stress, different stocking densities, and feeding practices affect fish growth, water quality, and animal stress indicators through a comprehensive full factorial trial, model: 2^3 carried out in the initial production season on common carp (*Cyprinus carpio*). Compering Aller-Aqua fingerling feed with traditional nutritional practices characterized by plankton enhancement and cereal grain supplementation, we investigated the interaction effects of these factors on important performance metrics. Water scarcity, nutrient concentrations, food web interactions, and dissolved oxygen concentrations are anticipated to change, which could influence fish health and growth effectiveness. In the meantime, higher stocking densities, typically linked to intensification, might worsen these issues when combined with novel feeding strategies, deepening the negative impacts.

Initial results indicate that water scarcity issues can be overcome with smart intensification in aquaculture. A strategic equilibrium between stocking density and feed management maintains both fish well-being and ecological stability. Grasping these interactions is essential for formulating adaptive management approaches that maintain economic sustainability while reducing ecological effects.

With climate change leading to dwindling water resources, pond aquaculture needs to shift towards more controlled and efficient production techniques. This study adds to the expanding knowledge on sustainable intensification, providing perspectives on how the sector can actively address forthcoming environmental limitations.

Keywords: Pond aquaculture, Common carp, Fish feed, Stocking density, Water level

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EARTH OBSERVATION TECHNIQUES FOR OPTIMAL IRRIGATION MANAGEMENT

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Abstract

Agriculture depends heavily on water, and its proper use is becoming increasingly crucial, particularly in light of climate change and the growing water shortage. This study aims to assist farmers in using water more accurately and with less waste by utilising geoinformation technology to improve irrigation methods.

More specifically, the basic concept is to monitor crop health by combining information from geographic information systems (GIS) with satellite imagery. This research aims to create a method that can advise farmers on when and how much to irrigate by examining several factors such as evapotranspiration, soil moisture, and vegetation indices like the Normalized Difference Vegetation Index (NDVI).

This methodology enables more precise and rapid decisions than conventional procedures that frequently rely on set timelines or visual judgments. This research will process remote sensing data via tools like the Copernicus Data Space Ecosystem and analyse it using Python in a Jupyter environment. Hence, the methodology develops a dedicated framework for sustainable irrigation management adaptable to specific crop needs and environmental conditions.

The study focuses on the Kairouan region in central Tunisia, a typical Mediterranean semi-arid area with olive orchards. Water shortage is a significant problem, particularly in the mountainous Djebel Zaghdoud subregion, where effective water management is essential. Therefore, the research aims to offer practical recommendations that local farmers can readily implement by customising irrigation techniques to the particular conditions of this area. The study is based on a time series satellite data analysis and aims to identify olive trees' water stress by detecting deviations from the locally defined optimal NDVI values.

Keywords: Climate change, Water shortage, NDVI

CHANGES IN LAND USE SUPPORTING SUSTAINABILITY IN THE IPEL'/IPOLY BASIN BETWEEN 1990 AND 2018

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Abstract

In this research, we analysed the distribution of CORINE Land Cover classes in the Ipel'/Ipoly Basin between 1990 and 2018 using QGIS, Google Earth and Sentinel Hub. We have classified the land cover classes into four main categories (agricultural areas; forests and semi-natural areas; artificial surfaces and wetlands), and examined the proportion changes in the area in perspective of sustainability and climate protection. Through the comparison of satellite images and the changes in area size, we obtained the following results.

The area of non-irrigated agricultural land has decreased in recent decades, due to the rising usage of shelterbelts in agriculture and environmental protection guidelines. We can assume that this is the cause of the size of sparsely vegetated areas has almost completely disappeared. Due to the rising number of droughts in recent decades, the water demand of vegetation has increased, just as the importance of irrigation. The significant decline in wetland areas is due to climate change and the draining of swamps, while the area of natural and artificial water bodies has increased. Irrigation strategies were developed with the adoption of the Water Framework Directive (WFD), and regulations were established to protect wetlands. These measurements are aimed to maintain and preserve the biodiversity of marshes and wetlands. Environmental protection, climate protection and the greening program have become increasingly important since the 2013 Common Agricultural Policy (CAP) reforms.

In conclusion, it can be stated that both countries that are in contact with the Ipel'/Ipoly basin have many benefits from joining the European Union, considering climate protection, environmental protection and agricultural policy.

Keywords: Land use, Land cover, Ipel, Ipoly, Sustainability, Drought


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