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MCYR

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MCYR

MULTIDISCIPLINARY CONFERENCE FOR YOUNG RESEARCHERS

ABOUT MCYR

The MCYR conference provides a dynamic platform for early-career researchers to present their work, exchange ideas across disciplines, and engage in meaningful scientific discussions. It aims to cultivate an open and supportive environment that encourages constructive feedback, collaboration, and professional growth. Beyond showcasing research, MCYR offers valuable opportunities for networking, helping participants connect with peers, experts, and institutions that can inspire future partnerships and advance their academic and professional journeys.

The annual MCYR conference is held in Prague at the Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague.



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MCYR 2026

The 7th International Multidisciplinary Conference for Young Researchers (MCYR) was held on 8–9 October 2026 in Prague, Czech Republic, hosted by the Czech University of Life Sciences Prague (CZU) and organised by the BioResources & Technology Division (BRT) of the Faculty of Tropical AgriSciences (FTZ). Bringing together early-career researchers from around the world in a hybrid format, the conference explored the theme “Research Innovation to Action: Pathways Toward Resilience in a Risk-Prone World.”

MCYR 2026 fostered interdisciplinary exchange across five thematic areas spanning technology, agriculture, sustainability, ecology, and society. Through research presentations, keynote addresses, poster sessions, and interactive workshops, participants shared their findings, exchanged perspectives, and explored how scientific innovation can address global challenges. Key partners, including AgriSci-UA, OSIRIS, ADAPT-FIN, BIO-CAPITAL, MWAZACO, and UNICOM, enriched the conference with diverse perspectives on research, sustainability, and international cooperation. MCYR 2026 reaffirmed its commitment to empowering young researchers, strengthening cross-disciplinary connections, and advancing science towards a more resilient and sustainable future.

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MCYR 2026 SCIENTIFIC SESSIONS

This year's MCYR conference featured a range of thematic sessions that cover key aspects of global and societal challenges:











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MCYR 2026 KEYNOTES

The keynote speeches explored the role of bioenergy in advancing a circular economy and building a more sustainable society, alongside the importance of making open science effective and accessible in research practice. Together, they highlighted how scientific innovation, collaboration, and openness can drive meaningful change, inspiring early-career researchers to turn knowledge into action.



The Role of Bioenergy in Achieving a Circular Economy: Toward a Sustainable Society

Prof. Dr. Hassan El Bari
Ibn Tofail University, Morocco



Making Open Science Work

Dr. Inge Stegeman,
Utrecht University, Netherlands

Technology & Innovation – Online Session Opening Keynote

BIO CNG: Supporting Indonesia's Transition to Clean and Sustainable Energy

Prof. Ir. Tarsisius Kristyadi,
Institut Teknologi Nasional, Indonesia

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Assoc. Prof. Dr. Hynek Roubík
Dean of the Faculty of Tropical AgriSciences; BRT Director
Czech University of Life Sciences Prague

Dr. Inge Stegeman
Researcher
University Medical Center Utrecht

Dr. Martina Komárková
Vice-Dean for Faculty Development
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BRT Postdoctoral Researcher
Czech University of Life Sciences Prague

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BRT Junior Researcher; PhD Candidate
Czech University of Life Sciences Prague

Ing. AbdulAzeez Shobajo
BRT Junior Researcher; PhD Candidate
Czech University of Life Sciences Prague

Ing. Manvendra Kumar
BRT Junior Researcher; PhD Candidate
Czech University of Life Sciences Prague

Ing. Hidayatul Fitri
BRT Junior Researcher; PhD Candidate
Czech University of Life Sciences Prague



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Climate & Sustainability

Scientific Session



Groundwater Quality Assessment Using Microbiological and Physicochemical Indicators for Sustainable Water Security in Ijebu-North, Nigeria

Hikmat Balogun-Abiola [1]*, Oluwatimileyin Akinbola [1], Muftiat Olupebi [1], Nwafejokwu Ebube [1]

[1] Microbiology, Science, Olabisi Onabanjo University, Ago-Iwoye, Nigeria, hikmat.balogun-abiola@oouagoiwoye.edu.ng; akinbolaoluwatimileyin24@gmail.com; favourobi990@gmail.com

* **Correspondence:** hikmat.balogun-abiola@oouagoiwoye.edu.ng

Abstract: Groundwater is a critical drinking-water source worldwide, but anthropogenic activities and environmental changes increasingly threaten its quality, particularly in low- and middle-income countries where monitoring is limited, underscoring the need for comprehensive quality assessment to protect public health and support sustainable water management. This study assessed the microbiological and physicochemical quality of borehole water from three locations in Ago-Iwoye, Ogun State, Nigeria, to identify risks and establish baseline evidence for sustainable monitoring and community health protection. Samples were analysed using standard methods based on WHO and NIS guidelines. Descriptive statistics and one-way analysis of variance (ANOVA) were used to evaluate spatial variations in water quality at a 5% level of significance. Bacillus, Staphylococcus, and Streptococcus species were detected in the borehole water samples, while total and faecal coliforms were absent, indicating no evidence of recent faecal contamination. Total viable bacterial counts ranged from 2.25×10^1 to 2.99×10^3 CFU/mL, with no significant differences among sampling locations ($p > 0.05$). Most physicochemical parameters, including conductivity, salinity, total dissolved solids, nitrate, sulphate, and heavy metals, complied with WHO and Nigerian Industrial Standards. However, pH values (8.7–10.4) exceeded recommended limits, identifying excessive alkalinity as the principal groundwater quality concern. Groundwater quality should integrate microbiological and physicochemical indicators, with routine surveillance of elevated pH to support risk-informed management, protect community health, and guide future molecular and antimicrobial resistance studies.

Keywords: groundwater quality; sustainable water security; microbiological indicators; physicochemical indicators; environmental monitoring

The Perception of Sustainable Development Among College Students: A Comparative Study of Selected Universities in the Czech Republic and the Kingdom of Thailand

Pavel Crha [1]*, Ivana Karberová [1]

[1] Department of Environmental Science and Natural Resources; Faculty of Regional Development and International Studies; Mendel University in Brno; Zemědělská 1665/1 Brno, 613 00; pavel.crha.cz@gmail.com; ivana.karberova@mendelu.cz

* **Correspondence:** pavel.crha.cz@gmail.com

Abstract: This study was aimed to determine the rankings of selected universities in the Czech Republic and the Kingdom of Thailand within the international ranking indexes of Times Higher Education. Furthermore, the study analyses the relationship between institutional education in the field of sustainable development in these regions and changes in the perceptions and attitudes of students at the selected universities. The universities were selected based on two parameters: their ranking and the duration of the university existence. The methods that have been used were based on combination of semi-structured interviews with academic staff and a questionnaire survey of students from the Thai universities of Mae Fah Luang and Chiang Mai, as well as the Czech University of Ostrava and Palacký University in Olomouc. We have found out, what are the probable influences of: the age of universities and the university´s position in international rankings, on student´s perception of Sustainable Development. We´ve also evaluated the changes in these student perceptions during their studies. Over 360 students from all 4 universities together, have participated in this study. It is therefore important to say, that this is not a representative study. However, the results have brought us important usable findings. While older universities were more focused on global issues (political background; deforestation and air pollution), the younger universities from both countries were focused on local problems (industrial burden of the region; cultural differences of the region). The results further indicated, that the placement of universities in Times Higher Education ranking index has minimal impact on classes. At the same time, we have found that universities have been increasingly incorporating the SDGs into their curriculum in recent years and are also gradually linking them to real-world practice through new fields of study. At the end of the study, we´ve highlighted the innovative strategies related to sustainable development, which were used by studied universities. These strategies can serve as a recommendation not only for the universities that have been studied, but also for other readers.

Keywords: sustainable development; higher education; Kingdom of Thailand; Czech Republic

Mapping Post-Fire Recovery Dynamics and Critical Vulnerability Hotspots in East Mediterranean Forests Using Multi-Source Data Integration to Guide Nature-Based Solutions

Maher Dayyoub [1]*

[1] Department of Environment, Arab Technical Institute for Agriculture, Resources and Environment, Latakia, Syria.

* **Correspondence:** maher.lat@gmail.com

Abstract: This study evaluated forest resilience and guided nature-based solutions (NbS) under climate-anthropogenic stress across the forests of the Latakia region (2016–2026), ensuring ecosystem sustainability and maintaining the continuous provision of ecological services for climate change mitigation and adaptation. Utilizing the Google Earth Engine platform, we analyzed Landsat 8/9 time-series, Normalized Difference Vegetation Index (NDVI), Normalized Burn Ratio (NBR), and summer Land Surface Temperature (LST), within a spatial cross-tabulation framework to map ecological dynamics across a 47,266-hectare study area. Long-term monitoring prior to the 2025 wildfire demonstrated a successful pre-fire recovery trajectory, where natural regeneration effectively restored 2,415.30 hectares (5.11% of the total study area). This extent exhibited complete recovery signals verified through the simultaneous stabilization of NBR and LST. Following the 2025 wildfire, NBR decreased to 0.26 while summer LST reached 35.9°C. By 2026, spatial zoning identified 1,847.84 hectares (3.91%) as critical vulnerability hotspots exhibiting transient superficial greening (false recovery) that masks underlying structural deficits, whereas stable forest covered 15,833.86 hectares (33.50%). These results indicate that post-fire recovery follows non-linear dynamics, and that Latakia's forests possess inherent resilience. Therefore, we recommend a five-year 'passive management' period post-fire to protect natural regeneration pathways. This strategic approach provides an objective diagnostic tool for climate-resilient spatial zoning, allowing for the identification of areas that genuinely require active reforestation, thereby avoiding unnecessary intervention in naturally recovering sites.

Keywords: forest resilience; nature-based solutions; natural regeneration; climate adaptation; ecosystem sustainability

Hydroecological Assessment and Revitalization of Small Rivers: The Case of the Boromlia River

Tarasenko Denys [1], Danylchenko Olena [1]*, Korol Olena [1]

[1] Department of general and regional geography, Faculty of Natural Sciences and Geography, Sumy State Pedagogical University named after A.S. Makarenko, Romenskaya street, 87, Sumy, 40002, tatasenkod2007@gmail.com; olena_danylchenko@ukr.net; korolelena1976@gmail.com

* **Correspondence:** olena_danylchenko@ukr.net

Abstract: The current state of small rivers in Ukraine is characterized by significant anthropogenic pressure, resulting in deteriorating water quality, channel siltation and overgrowth, and reduced water availability. One such watercourse is the Boromlia River, a right-bank tributary of the Vorskla River within the Middle Dnipro sub-basin. The aim of this study was to conduct a hydroecological assessment of the Boromlia River, identify its main environmental problems, and propose revitalisation measures. Cartographic, field, water balance, and scoring assessment methods were applied. The ecological condition of the river was evaluated using a visual assessment methodology based on three groups of indicators. Analysis of the basin water balance over two periods revealed a 10.7% decrease in annual precipitation, a 4.7% increase in evaporation, and a 51.3% reduction in runoff depth. It was found that climate change accounts for only 15.4% of runoff transformations, while anthropogenic factors have the dominant influence. The integrated anthropogenic pressure coefficient of the basin is 3.89, indicating a high level of human impact. The main environmental problems include water pollution, channel siltation and overgrowth, and degradation of riparian buffer zones. The ecological condition of 67% of the studied river section was assessed as satisfactory, while 33% was classified as unsatisfactory. To revitalize the river, the following measures are proposed: clearing the most obstructed channel sections, restoring riparian buffer zones, optimizing drainage systems, reassessing flow regulation and the feasibility of drainage reclamation systems.

Keywords: small river; Boromlia River; hydroecological assessment; anthropogenic pressure; river revitalization

Spatial Distribution and Morphology of Fluvial Islands Driven by Channel Flow: The Jizera River Case Study (Železný Brod – Mladá Boleslav)

Baldo Gregor [1*]

[1] Katedra Fyzické Geografie a Geoekologie, Přírodovědecká Fakulta, Univerzita Karlova, Albertov 6, Prague, Czech Republic, gregorba@natur.cuni.cz

* **Correspondence:** gregorba@natur.cuni.cz

Abstract: Comprehensive monitoring of complex river channel evolution requires robust spatial data methods to quantify how dynamic geomorphic features adapt to shifting environmental and climate stressors. This study applies quantitative spatial analysis to examine the geographic distribution and morphometric variability of fluvial islands along a 60 km reach of the Jizera river between 2015 and 2025. The methodology leverages high-resolution, multi-temporal remote sensing data processed within a GIS environment across six biennial observation steps, combined with statistical frameworks including Pearson correlation coefficients, linear regression models, and Fisher's LSD tests. Spatial tracking identified 365 unique fluvial islands, revealing high concentration hotspots located immediately downstream of weirs and confluences. Quantitative shape metrics confirmed that channel width influences island scale, with the most stable and long-term structures exhibiting streamlined orientations parallel to the flow line. Furthermore, geospatial analysis captured profound morphological shifts induced by major floods in 2017, 2023, and 2024, revealing an 84.54% increase in cumulative island area from 2023 to 2025 due to rapid sediment deposition, structural merging, and bank attachments. This research highlights the efficacy of combining multi-temporal remote sensing with spatial data analytics to decode river dynamics, offering an objective, data-driven framework essential for modern sustainable water resource management.

Keywords: fluvial islands; GIS remote sensing; morphometric analysis

Ten Years of Experimental Experience with Superabsorbents in Forest Regeneration under Drought Conditions

Jan Macků [1], Kateřina Hájková [2]*, Ivana Tomášková [3], Tomáš Holeček [2], Karolina Resnerová [4]

[1] Department of Forestry Technologies and Construction, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6 – Suchdol, Czech Republic, macku@fld.czu.cz

[2] Department of Wood Processing and Biomaterials, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6 – Suchdol, Czech Republic, hajkovakaterina@fld.czu.cz; holecekt@fld.czu.cz

[3] Department of Forest Genetics and Physiology, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6 – Suchdol, Czech Republic, tomaskova@fld.czu.cz

[4] Department of Forest Protection and Entomology, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6 – Suchdol, Czech Republic, resnerovak@fld.czu.cz

* **Correspondence:** hajkovakaterina@fld.czu.cz

Abstract: Superabsorbents represent a promising measure for mitigating drought impacts on forest tree seedlings during stand regeneration. Over the past ten years, our research has evaluated the effects of polyacrylamide-based superabsorbents on seedling survival, growth, physiological performance and biochemical responses under semi-arid and temperate climatic conditions. Greenhouse, nursery, and field experiments were conducted in Iran and Central Europe. Superabsorbents were applied alone or with sawdust or organic fertilizer. Seedling survival, growth, water status, osmotic potential, and selected physiological and biochemical parameters were compared with untreated controls. Superabsorbent effectiveness depended on tree species, climate and substrate composition. Under semi-arid conditions, superabsorbents, particularly in combination with sawdust or organic fertilizer, improved survival, osmotic potential and selected biochemical characteristics in most tested species. Under temperate Central European conditions, mortality decreased only slightly, while morphological parameters generally did not differ from controls. A clear positive physiological response was observed mainly in sessile oak. Superabsorbents are most beneficial under severe drought and for drought-sensitive species. Their effects in temperate climates are limited and species-specific. Because synthetic polyacrylate- and polyacrylamide-based materials are being progressively restricted, current research focuses on biodegradable absorbents produced by chemical modification of agricultural residues as a more sustainable option for forest regeneration.

Keywords: superabsorbents; drought stress; forest regeneration; seedling survival; biodegradable absorbents

Acknowledgement: This research was supported by projects funded by the Technology Agency of the Czech Republic (TAČR) and the National Agency for Agricultural Research of the Czech Republic (NAZV). The authors also gratefully acknowledge all collaborating institutions and research partners involved in the long-term experiments on superabsorbent application, drought stress and forest regeneration.

Climate Change and Environmental Sustainability

Alagie E Jallow [1]*

[1] Agriculture, Gambia College, Brikama, Gambia

* **Correspondence:** abdouazizj67@gmail.com

Abstract: Environmental challenges, including climate change, ecosystem degradation, and unsustainable resource use, pose serious risks to public health, food security, livelihoods, and sustainable development. These challenges are particularly significant in Africa because of the region's dependence on natural resources and limited adaptive capacity. This study examines how environmental awareness, community participation, and sustainable resource management can contribute to conservation and climate resilience. A qualitative and descriptive approach was adopted through a review of existing literature, policy documents, and reports on climate change and environmental sustainability. The review identified major environmental challenges, their impacts, and commonly proposed mitigation and adaptation strategies, with particular attention to community-based conservation, environmental education, and sustainable resource management. Although existing studies recognize the importance of these approaches, the literature remains fragmented in linking community engagement, conservation practices, and policy implementation within a broader climate-resilience framework. This study synthesizes these perspectives to highlight their complementary roles in addressing environmental challenges. The findings indicate that community engagement, responsible resource use, environmental education, and effective policies can strengthen local capacity to respond to climate-related pressures and improve natural resource protection. The study concludes that integrated and coordinated approaches are essential for advancing environmental sustainability and supporting resilient communities.

Keywords: environmental sustainability; climate resilience; environmental conservation

Terrestrial Stilling in Northeastern Ukraine: Implications for Climate Change Adaptation

Matfii Kalitsinskyi [1], Anatolii Kornus [1,2]*, Olesia Kornus [1], Nataliia Khukhria [1], Maryna Kholodenko[1]

[1] Department of General and Regional Geography, Faculty of Natural Sciences and Geography, Sumy State Pedagogical University named after A.S. Makarenko, Romenska str. 87, Sumy, 40002, Ukraine; ekonomistmip@ukr.net; zavgeogr@sspu.edu.ua; klugeraleks87@gmail.com; marchenkom18@gmail.com

[2] Department of Ecology and Environmental Protecting Technologies, Faculty of Technical Systems and Energy Efficient Technologies, Sumy State University, Kharkivska str. 116, Sumy, 40007, Ukraine; a.kornus@ecolog.sumdu.edu.ua

* **Correspondence:** a.kornus@ecolog.sumdu.edu.ua

Abstract: Near-surface wind speed is a key climate variable affecting atmospheric circulation, renewable energy potential, pollutant dispersion, and rural environmental resilience. Although widespread terrestrial stilling has been reported worldwide, evidence from Ukraine remains scarce. This study investigates long-term changes in wind speed across the Sumy Region and their implications for climate change adaptation and rural sustainability. Long-term wind observations from three meteorological stations covering 2005–2025 were analysed using descriptive statistics, kernel density estimation, interquartile range analysis, and linear trend analysis. Spatial and seasonal variability of wind speed was assessed to identify regional patterns and long-term changes. Trend analysis revealed a gradual decline in mean wind speed across the study region, providing evidence of terrestrial stilling in northeastern Ukraine. The decrease was most pronounced during the warm season, whereas no statistically significant increase was detected in the frequency or magnitude of extreme wind gusts. A distinct spatial gradient was identified, with the lowest mean wind speeds in Konotop and the highest in Sumy, while monthly wind-speed distributions exhibited a bimodal seasonal pattern. The identified changes indicate a shift in regional wind regimes with potential implications for wind energy resources, atmospheric pollutant dispersion, and the resilience of rural landscapes. The findings contribute to understanding regional manifestations of climate variability and provide a scientific basis for climate change adaptation and sustainable rural development.

Keywords: terrestrial stilling; wind speed; climate change adaptation; climate variability; Sumy Region

Continuous Biohydrogen Production from Cacao Pod Husk via Synergistic Biochar-Magnetic Nanoparticle Immobilization

Jayen Aris Kriswantoro [1]*, Chen-Yeon Chu [2], Onjira Kongthong [2]

[1] School of Life Sciences and Technology, Institut Teknologi Bandung, Ganesa 10, Bandung, 40132, Indonesia, kriswantoro@itb.ac.id

[2] Institute of Green Products, Feng Chia University, 100, Wenhua Rd. Xitun Dist., Taichung City, 407102, Taiwan, cychu@fcu.edu.tw

***Correspondence:** kriswantoro@itb.ac.id

Abstract: Lignocellulosic biomass waste, cacao pod husk (CPH), became a promising substrate as a carbon source for biohydrogen production in dark fermentation. This study examined the use of CPH as a substrate in a continuous dark fermentation system with *Clostridium tertium* IGP01 as a single culture inoculum. Hydrothermal pretreatment of dried CPH powder was performed by adding 10% w/v to 1% v/v H_2SO_4 and autoclaving at 130°C for 1 h. The enhancement approach investigated the effect of supplementing immobilized biochar (2% w/v) and magnetite (100 mg/L) in 3% w/v sodium alginate on fermentation. Biohydrogen was detected by GC-TCD and sugar content using HPLC. In the batch reactor, the optimum growth conditions for C. *tertium* IGP01 were 37°C, pH 5.5, and sucrose as a carbon source, which achieved 2.10±0.05 mmol H_2/mmol glucose and 71.7±0.06% hydrogen content. Following these initial findings, in the continuous reactor with the sucrose medium, it was observed that a hydraulic retention time (HRT) of 26 hours resulted in the highest average hydrogen content (56.8±3.2%) and production rate (2.54±0.08 L/L.day). Substrate replacement from the sucrose medium to 100% CPH hydrolysate resulted in a drop of hydrogen content from 56.8% to 1.7%. The addition of immobilized biochar and nanoparticles showed the biohydrogen production enhancement from 1.16±0.01 to 3.80±0.1 mmol H_2/gram sugar, representing a threefold increase compared to the control. As the first study on *C. tertium* IGP01 in a single culture for biohydrogen production, these findings highlight its potential and provide critical insight into dark fermentation control conditions.

Keywords: biohydrogen; *Clostridium tertium*; dark fermentation; enhancement; immobilization

Determinants of the Ecological Footprint and its Influencing Factors in Syria (1965-2022): An Econometric Analysis Using the ARDL Model

Sliman Moualla [1]*, Ghaith Ali [2], Bushra Abo Dest [2], Rand Hassan Junaid [2]

[1] Department of Agricultural Economics, Faculty of Agriculture Tehran University, Tehran, Iran

[2] Department of Agricultural Economics, Faculty of Agriculture, Latakia (Tishreen) University, Lattakia, Syria.

* **Correspondence:** sulaiman1998.8@gmail.com

Abstract: This study comprehensively examines the primary macroeconomic and demographic factors influencing the size of the ecological footprint in Syria from 1965 to 2022. Specifically, the research aims to evaluate the responsiveness of environmental degradation to dynamic changes in Gross Domestic Product (GDP), population growth, and key foreign trade indicators, including trade openness and the national export ratio, thereby establishing a broader context for sustainable economic planning. The research employs a rigorous econometric approach by analyzing annual time-series data. The advanced Autoregressive Distributed Lag (ARDL) bounds testing model is applied via Stata software to effectively address the mixed order of integration among the selected variables. Empirical findings demonstrate that GDP is the most influential factor driving the ecological footprint, exhibiting a high elasticity coefficient of 1.04, indicating that domestic productive expansion heavily increases resource consumption. Conversely, population growth exerts a slight inverse long-term impact (-0.2402), while trade openness and export volume remain statistically insignificant. Furthermore, the model reveals a robust error correction capacity, automatically resolving 94.46% of short-term random disequilibria within one year. The drivers of environmental change in Syria are deeply rooted in the internal economic structure rather than foreign trade dynamics. Consequently, policymakers must prioritize the reform of domestic productive sectors and mandate a transition toward cleaner production technologies to mitigate the environmental footprint associated with economic growth.

Keywords: ecological footprint; Gross Domestic Product; population growth; foreign trade

Early Warning of Tropical Forest Disturbance Using Sentinel-1 and Sentinel-2 in the Peruvian Amazon

Aissa Neyra [1]*, Jan Staš [1], Adenan Yandra Nofrizal [2], Bojana Petrovic [1]

[1] Department of Sustainable Technologies, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Prague, Czech Republic, aissakenia@gmail.com; stas@ftz.czu.cz; petrovic@ftz.czu.cz

[2] Department of Applied Geoinformatics and Cartography, Faculty of Science, Charles University, Prague, Czech Republic, adenannofrizal23@gmail.com

* **Correspondence:** aissakenia@gmail.com

Abstract: Tropical forests face accelerating anthropogenic disturbances, yet most current monitoring systems typically detect forest loss only after complete canopy removal has already occurred. This study investigated whether multi-sensor satellite observations can provide an effective early warning of subtle tropical forest disturbance prior to confirmed deforestation in the cloud-prone Ucayali Region of the Peruvian Amazon. Monthly Sentinel-1 SAR backscatter (VV, VH channels) and Sentinel-2 optical spectral indices (NBR, NDMI, NDRE) were extracted across 12,303 sample locations from April 2019 to July 2025. These data were validated against Hansen Global Forest Change reference data using three complementary analytical approaches: paired before–after comparison, superposed epoch analysis, and PELT-based breakpoint detection. Clear forest disturbance signals were successfully detected one to three years before Hansen-confirmed forest loss, yielding a median lead time of two years across variables. Sentinel-1 VV backscatter achieved the highest detection rate (52%), showing a gradual decline approximately two years prior to loss. Conversely, Sentinel-2 optical indices responded primarily at the exact year of confirmed loss, confirming a distinct temporal asymmetry between radar and optical sensors. Between 82% and 84% of all detected breakpoints preceded the official Hansen loss year. Combining radar and optical satellite observations offers significant potential for the early warning of tropical forest disturbances, carrying direct implications for proactive conservation monitoring in cloud-prone areas of the Western Amazon.

Keywords: tropical forest degradation; early warning; Sentinel-1; Sentinel-2; Google Earth Engine

Promoting Public Goods in the Livestock Sector: A Systematic Review

Anh Nguyen Le Minh [1]*, Caspar Krampe [2], Raimon Ripoll-Bosch [3]

[1] Marketing & Consumer Behavior, Wageningen University & Research - Animal Production Systems, Wageningen University & Research; anh2.nguyen@wur.nl

[2] Marketing & Consumer Behavior, Wageningen University & Research; caspar.krampe@wur.nl

[3] Animal Production Systems, Wageningen University & Research; raimon.ripollbosch@wur.nl

* **Correspondence:** anh2.nguyen@wur.nl

Abstract: Agricultural outputs include private goods such as food, fiber or fuel, and also public goods, such as landscape amenities, climate regulation or biodiversity (FAO, 2025). Although both private and public goods are demanded by society, they are not acknowledged equally in the market, leading to an unequal prioritisation of agricultural outputs. Existing incentive structures often fail to compensate producers for generating societal and environmental value, thereby discouraging investments in practices that sustain public goods. Traditionally, the provision of public goods in agriculture has been addressed through government policies and environmental regulation however, a market perspective is also needed to understand how market mechanisms and marketing strategies can support the delivery of public goods. Our study aims to explore the theoretical understanding of the current market and marketing system concerning public goods, considering the roles of different actors. Following PRISMA guidelines, we conducted a systematic literature review of forty-one journal articles and book chapters after two screening rounds of 1,348 records. Our study revealed a high interest in landscape character and cultural heritage. We found an imbalance in the roles of public goods beneficiaries, payers and producers. There is a need to rearrange the roles of actors to ensure the effectiveness of the provision for public goods. Moreover, we suggest an approach to combine Social-Ecological System framework and Institutional Analysis and Development framework to develop a theoretical understanding of market system. By considering ecology and society simultaneously, public goods can be produced and consumed sustainably.

Keywords: public goods; agriculture; systematic literature review; Social-Ecological System framework; Institutional Analysis and Development framework

Livelihood Impacts of *Salvinia molesta* Invasion: Coping Strategies and Adaptive Capacity among Small-Scale Fishers in Lukanga Swamp, Zambia

Jimmy Njobvu [1]*, Jan Banout [1]

[1] Department of Food & Bioresources Technology, Faculty of Tropical AgriSciences, Czech University of Life Sciences, Kamycka 129, Prague. njobvu@ftz.czu.cz; banout@ftz.czu.cz

* **Correspondence:** njobvu@ftz.czu.cz

Abstract: Invasive aquatic plants threaten the sustainability of inland fisheries by degrading aquatic ecosystems and disrupting livelihoods that depend on them. This study examined the impacts of *Salvinia molesta* on small-scale fishing livelihoods in the Lukanga Swamp, Zambia, and evaluated the effectiveness of the coping strategies adopted by artisanal fishers. A sequential exploratory mixed-methods design was employed, combining household surveys (n = 150), semi-structured interviews (n = 41), key informant interviews (n = 5), and two focus group discussions. Quantitative data were analyzed using descriptive statistics and a linear mixed-effects model, while qualitative data were analyzed thematically. *Salvinia molesta* functioned as a significant livelihood shock by restricting access to fishing grounds, obstructing waterways, damaging fishing gear, and reducing fish catches. Fishers relied primarily on autonomous coping strategies, including manual weed removal, shifting to open waters, increasing fishing effort, and livelihood diversification. Farming diversification, manual weed removal, and shifting to open waters were perceived as the most effective strategies, although none was considered fully effective. Significant differences in perceived effectiveness were detected among coping strategies ($F(6,b517) = 41.88$, $p < 0.001$), but existing responses provided only a limited capacity to reduce long-term livelihood vulnerability. Autonomous coping alone is insufficient to address the persistent impacts of *S. molesta*. Strengthening resilience in wetland-dependent fishing communities requires integrated adaptation strategies that combine biological control, livelihood diversification, stronger institutional support, and coordinated governance to reduce vulnerability and enhance sustainable livelihoods.

Keywords: invasive species; sustainable livelihoods; wetland fisheries; livelihood resilience; *Salvinia molesta*

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Projected Shifts in Summer Tourism Flows across European Coastal Destinations under Climate Change Scenarios

Anna Pauk [1]*, Anatolii Kornus [1,2], Olesia Kornus [1], Serhii Lutsenko [1], Olena Korol [1]

[1] Department of General and Regional Geography, Faculty of Natural Sciences and Geography, Sumy State Pedagogical University named after A.S. Makarenko, Romenska str. 87, Sumy, 40002, Ukraine; susharmanaing@gmail.com; zavgeogr@sspu.edu.ua; kornus@sspu.edu.ua; s.lutsenko@sspu.edu.ua; o.korol@sspu.edu.ua

[2] Department of Ecology and Environmental Protecting Technologies, Faculty of Technical Systems and Energy Efficient Technologies, Sumy State University, Kharkivska str. 116, Sumy, 40007, Ukraine; a.kornus@ecolog.sumdu.edu.ua

* **Correspondence:** a.kornus@ecolog.sumdu.edu.ua

Abstract: Climate change is increasingly reshaping the spatial and temporal distribution of tourism by altering climatic suitability for recreation. Although global tourism demand continues to grow, significant changes are expected in the attractiveness and seasonality of coastal destinations. This study assesses projected shifts in summer tourism flows across selected Mediterranean (Mallorca, Barcelona, Rimini, Antalya) and Baltic (Binz, Sopot, Pärnu) coastal regions under future climate change scenarios. A scenario-based assessment combined CMIP6 climate projections with tourism statistics and seasonal climate comfort indices to evaluate potential changes in summer tourism flows by 2050. Two warming scenarios were considered: moderate (1.5–2°C) and high (approximately 3°C), enabling comparison of regional responses to changing climatic conditions. Projected changes reveal contrasting regional responses. Mediterranean destinations are expected to experience declining summer tourism flows, particularly in highly urbanised mass-tourism areas, owing to increasing heat stress, coastal overheating, and more frequent climate extremes. In contrast, Baltic coastal resorts may benefit from moderate increases in summer tourism under the lower warming scenario. However, these gains are likely to diminish under stronger warming because of eutrophication, harmful algal blooms, and increasing vulnerability of coastal ecosystems. Climate change is likely to redistribute summer tourism flows across European coastal regions rather than reduce overall tourism demand. The findings highlight the importance of climate change adaptation, diversification of tourism products, and sustainable destination management to strengthen the long-term resilience of coastal tourism systems.

Keywords: climate change; summer tourism; coastal regions; scenario-based assessment; climate-induced impacts.

Driving Factors of Built-Up Area Development and Land Use Change: Implications for Landscape Resilience, Land Protection and Restoration in Central and Eastern Europe

Yana Prados [1*]

[1] Czech University of Life Sciences Prague, Faculty of Environmental Sciences, Kamycka 1176, 165 00 Prague 6-Suchdol, Czech Republic

* **Correspondence:** prados@fzp.czu.cz

Abstract: Urbanisation serves as a physical indicator of socio-economic and environmental change. However, unregulated built-up area (BUA) expansion acts as a major driver of land-use and land-cover (LULC) transformation and irreversible environmental degradation. This study quantified how spatiotemporal factors influenced BUA patterns, dynamics, and trajectories across degrees of urbanisation in the Czech Republic during two periods, 1842-1950 and 1950-2019. The analyses used ArcGIS tools and integrated historical cadastral maps (1842), aerial imagery (1950), randomly sampled BUA sites, and nationwide building blocks data (2019). The methodological approach included spatial autocorrelation, transition matrix analysis, centroid-based proximity metrics, boundary-based distribution analysis, spatial statistics and generalised additive modelling (GAM). The empirical findings revealed pronounced BUA growth between 1842 and 1950, with a fragmented expansion amounting to 47.26%, nearly 1.5 times greater than the combined infill and edge-expansion observed during 1950-2019 (37.45%). LULC changes occurred mainly in lowlands, with excessive arable-to-urban transition shifting the local ecosystem beyond a critical threshold into ecological vulnerability. Among environmental factors, topographic constraints (elevation and slope) were the strongest determinants of BUA patterns, whereas precipitation exerted a secondary influence. Analysis of BUA near protected areas (PAs) at ±1000 m intervals revealed upward-trending curves towards PA boundaries from both sides, indicating a concentration of development near biodiversity-rich and aesthetically valuable environments while suggesting the influence of regulations limiting development within PAs. The findings underscore the need for context-sensitive, ecologically integrated and climate-resilient strategies, providing a critical framework for urban planners and policymakers to balance long-term socio-economic changes with ecological preservation.

Keywords: socio-economic; environmental factor; urban; land use; protected area; spatial analysis

Rural Women as Agents of Sustainable Agricultural Practices: Rainwater Harvesting and Irrigation Systems in Central Province of Zambia

Muchimba Sinzala [1], Bavorova Miroslava [1*]

[1] Department of Economics and Development, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamycka 129, sinzala@ftz.czu.cz

* **Correspondence:** bavorova@ftz.czu.cz

Abstract: Climate variability and increasing dependence on rain-fed agriculture continue to threaten smallholder farming systems in Zambia. Rainwater harvesting (RWH) and small-scale irrigation are increasingly promoted as climate adaptation strategies, yet limited research has examined rural women's role in adopting and managing these technologies. This study investigates how rural women in Central Province of Zambia contribute to sustainable agriculture through engagement in RWH and irrigation systems. The study employs a concurrent parallel mixed-methods design integrating household surveys, in-depth interviews, key informant interviews, photovoice, field observations, and GIS mapping. A sample of 370 rural women, stratified into adopters and non-adopters of RWH and irrigation technologies, will be selected from five districts in Central Province. Quantitative data will be analysed using descriptive statistics, regression, and mediation analysis, while qualitative data will undergo thematic analysis. The study is expected to identify the major RWH and irrigation technologies used by rural women and determine the socio-economic, institutional, and technological factors influencing adoption. It is further expected to demonstrate how women's involvement in water management contributes to agricultural outcomes, household water security and empowerment outcomes. The study will provide gender-responsive evidence to inform sustainable agriculture, climate adaptation and inclusive water management policies in Zambia.

Keywords: rainwater harvesting; small-scale irrigation; rural women; agricultural outcomes; Zambia

Acknowledgement: This study is being conducted as part of PhD research at the Czech University of Life Sciences Prague.

A Network-Based Community Governance Model for Community Fisheries: Evidence from Coastal Cambodia

Somaly Oum [1]*, Verner Vladimír [2], Saroeun Soeung [3], Sochoeun Chen [3]

[1] Department of Economics and Development, Faculty of Tropical AgriSciences, Kamýcká 129 165 00 Praha - Suchdol, Czech Republic, oum@ftz.czu.cz

[2] Faculty of Tropical AgriSciences, Kamýcká 129 165 00 Praha - Suchdol, Czech Republic, vernerv@ftz.czu.cz

[3] The NGO Forum on Cambodia, #9-11, Street 476, Toul Tompoung 1, Phnom Penh, Cambodia, saroeun@ngoforum.org.kh; sochoeun@ngoforum.org.kh

* **Correspondence:** oum@ftz.czu.cz

Abstract: Community Fisheries (CFis) play a critical role in fisheries co-management and sustainable coastal resource management in Cambodia. However, many CFis operate independently, limiting their capacity for collective action, coordinated advocacy, and effective engagement with government institutions. This study examines a Network-Based Community Governance Model (NCGM) implemented across 34 Community Fisheries in Kep, Kampot, Koh Kong, and Preah Sihanouk provinces to explore how provincial networking can improve local governance and policy engagement. The model connects individual Community Fisheries through provincial networks, enabling collective learning, coordinated representation, and structured engagement with government institutions beyond the community level. A qualitative case study approach was employed using document review, participant observation, community consultations, stakeholder meetings, and project monitoring records. The data were analyzed thematically to examine changes in collaboration, governance, and stakeholder engagement. The findings show that establishing two new provincial Community Fisheries networks and strengthening two existing networks enabled communities to coordinate priorities, enhance peer learning, and engage collectively with the Fisheries Administration, provincial authorities, and relevant ministries. The network approach also created institutional mechanisms for evidence-based dialogue on illegal fishing, community boundaries, environmental pollution, fisheries management, and coastal infrastructure, strengthening community representation in governance processes. Unlike conventional approaches that support individual Community Fisheries, the proposed model demonstrates how provincial networking can facilitate collaborative governance, improve policy engagement, and strengthen community participation in coastal resource management. The model provides a practical framework that can be adapted to other community-based natural resource governance initiatives in Cambodia and comparable contexts.

Keywords: collective action; multi-stakeholder dialogue; policy engagement; natural resource management; participatory governance

Acknowledgement: This study was conducted under the Strengthen CSOs to Take Action on Economic Governance (SCAEG) project, funded by the European Union and implemented by ActionAid Cambodia (AAC), the NGO Forum on Cambodia (NGOF), the Cambodian Center for Human Rights (CCHR), and Open Development Cambodia (ODC), in partnership with local civil society organizations, including Mlup Promviheathor Center (MPC), Cambodia National Resources Organization (CNRO), and the Children and Women Development Center in Cambodia (CWDCC).

Combined Effects of Irrigation Method and Organic Soil Amendments on Soil Salinity, CO_2 Emissions, and Bean (*Phaseolus vulgaris* L.) Yield under Saline Irrigation

Seren Zedan [1]*, Loujaine Seddik [2], Géza Tuba [3], József Zsembeli [4]

[1] Doctoral School of Plant Sciences, Hungarian University of Agriculture and Life Sciences, MATE, Páter Károly 1, Gödöllő, H-2100, Hungary; Email: serenalaazedan@gmail.com

[2] Doctoral School of Plant Sciences, Hungarian University of Agriculture and Life Sciences, MATE, Páter Károly 1, Gödöllő, H-2100, Hungary; Email: loujaineseddik0720@gmail.com

[3] National Research Centre for Climate and Regional Land Management, Hungarian University of Agriculture and Life Sciences, Kisújszállási 166, H-5300 Karcag, Hungary; Email: Tuba.Geza@uni-mate.hu

[4] National Research Centre for Climate and Regional Land Management, Hungarian University of Agriculture and Life Sciences, Kisújszállási 166, H-5300 Karcag, Hungary; Email: Zsembeli.Jozsef@uni-mate.hu

* **Correspondence:** serenalaazedan@gmail.com

Abstract: Secondary soil salinization is an increasing challenge for agricultural sustainability, particularly in regions characterized by heavy clay soils and limited freshwater availability. Sustainable irrigation strategies and soil amendment practices are therefore essential to maintain soil quality and crop productivity under saline conditions. A field experiment was conducted at the National Research Centre for Climate and Regional Land Management of MATE, Karcag, Hungary, to evaluate the combined effects of two irrigation methods (drip and sprinkler) and three organic soil amendment treatments (compost, mulch, and plant conditioner) on soil electrical conductivity (EC), soil CO_2 emissions, and bean (*Phaseolus vulgaris* L.) yield under saline irrigation. Mulch application significantly influenced soil EC dynamics in interaction with irrigation method ($p = 0.019$), with drip irrigation maintaining lower soil salinity than sprinkler irrigation. Soil CO_2 emissions also differed significantly under sprinkler irrigation, reflecting irrigation-induced changes in microbial activity. The combination of sprinkler irrigation and compost resulted in significantly higher bean yields than the untreated control ($p = 0.037$). These findings suggest that integrating appropriate irrigation management with organic soil amendments can mitigate the adverse effects of secondary salinization while enhancing crop performance. In particular, mulch and compost represent promising management practices for improving soil quality and supporting sustainable horticultural production in salt-affected environments.

Keywords: secondary salinization; drip irrigation; electrical conductivity; mulch; compost; bean yield; CO_2 emission; soil conditioning; horticultural production

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Content Analysis of Czech Biology, Physics and Chemistry Textbooks

Anna Zelená [1]*

[1] Department of Biology Education, Faculty of Science, Charles University, Albertov 6, 128 00 Praha 2, zelenaann@natur.cuni.cz

* **Correspondence:** zelenaann@natur.cuni.cz

Abstract: To what extent, and in what specific thematic sections, are human health and contemporary environmental issues integrated into current natural science textbooks? A pattern content analysis was conducted on 46 Czech biology, physics, and chemistry textbooks by six different publishers. Topics across all three subjects were systematically analyzed and assigned to predefined thematic categories based on core scientific concepts. The categories were evaluated to identify cross-disciplinary alignment, structural patterns, and conceptual continuity. More than half (≥50%) of the analyzed textbooks lack coverage for 24 specific concepts and sub-concepts. Concept 2.3 "By maintaining a healthy lifestyle, we can prevent a number of diseases. Early diagnosis of illnesses is made possible, for example, by preventive check-ups and self-examination. Infectious diseases can be prevented through hygienic habits or vaccination, both of which provide protection for the individual and society." was the most comprehensively covered, missing in only one textbook and present in 98% of the sample. A nonparametric Friedman test revealed a highly statistically significant difference in the overall representation of the three main thematic areas: Environment and Anthropogenic Activities, Human Health, and Changes in Genetic Information. The findings indicate that current Czech textbooks are not yet prepared to support integrated science education. If the implementation of an integrated science curriculum expands across lower-secondary schools, developing a new generation of unified textbooks addressing these conceptual gaps and thematic imbalances will be essential.

Keywords: content analysis; textbook; integrated science education

Acknowledgement: This work was supported by the Charles University Grant Agency under project No. 506626, titled "Understanding Interdisciplinary Topics in Science".

Perception and Practice: A Multivariate Probit Analysis of Determinants of Climate Change Adaptation Strategy Adoption Among Smallholder Farmers in Chiang Mai Province, Thailand

Mamadee M Kamara [1]*, Bavorová Miroslava [1]

[1] Department of Economics and Development, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Praha 6, 16500 Prague, kamara@ftz.czu.cz; bavorova@ftz.czu.cz

* **Correspondence:** kamara@ftz.czu.cz

Abstract: Climate change is altering rainfall patterns and intensifying drought, flooding, and disease and pest infestation across Southeast Asia, threatening smallholders. Although research increasingly documents farmers' climate perceptions and individual coping strategies, few studies treat household adaptation choices as interdependent, shaped by shared, unobserved factors. This study jointly examines climate risk perception and adoption of multiple, potentially interrelated adaptation practices among smallholder farmers in Chiang Mai Province, Thailand, using a mixed-methods design combining a household survey, key informant interviews, and focus group discussions. Descriptive statistics were used to present results for farmers' perception of climate change impacts and a multivariate probit (MVP) model estimated determinants of adoption among smallholder farmers. Results show that most farmers (77.8%) perceived a change in climate, reporting reduced water availability, declining crop yield, and reduced soil fertility as the leading impacts on production, and 71.2% adopted at least one adaptation practice, with multi-cropping, irrigation, and changing cropping date ranking as the most intensively practiced. Multivariate probit estimation across nine adaptation practices showed that location, farm size, education, and farming type were the most consistent determinants, while access to credit, climate information, and extension services each significantly shaped only one specific practice rather than adaptation broadly. Given that adaptation choices are often jointly determined, policies should be designed as coordinated packages targeting complementary practice bundles rather than promoting isolated practices.

Keywords: climate change adaptation; smallholder farmers; multivariate probit; perception

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Enhancing Methane Production of Rice Straw Using Crude Fungal Enzymes Pretreatment

Hidayatul Fitri [1]*, Kateřina Hájková [2], Tomáš Kudera [3], Ladislav Kokoška [3], Hynek Roubík [1]

[1] Department of Food and Biotechnology, Faculty of Tropical Agriscience, Czech University of Life Sciences Prague.

[2] Department of Wood Processing and Biomaterials, Faculty of Forestry and Wood Science, Czech University of Life Sciences Prague

[3] Department of Tropical Crops and Agroforestry, Faculty of Tropical Agriscience, Czech University of Life Sciences Prague.

* **Correspondence:** roubik@ftz.czu.cz

Abstract: Rice straw is an abundant agricultural residue and considered a potential renewable substrate for biogas generation. However, as a lignocellulosic material, it has a complex structure that restricts microbial access and limits its conversion during anaerobic digestion. This study assesses changes in the structural composition of rice straw and investigates the effectiveness of crude enzymes produced by *Aspergillus niger* in improving the anaerobic conversion. Rice straw was treated under controlled conditions using crude enzymes obtained from *A. niger*. Untreated rice straw was included as the control for comparative evaluation. Changes in lignocellulosic structure were evaluated by determining cellulose, hemicellulose, and lignin contents before and after pretreatment. Treated and untreated straw were assessed through batch anaerobic digestion. Compositional analysis showed a reduction in cellulose from 42.11% in untreated straw to 35.41% in treated straw, suggesting the fungal enzyme capacity to hydrolyze structural carbohydrates. After 30 days of anaerobic digestion, treated rice straw achieved a specific methane yield of approximately 123.5 L CH_4/kg VS, compared with 114.4 L CH_4/kg VS for untreated straw, representing an increase of approximately 8.0%. This finding suggests that crude fungal enzymes produced by *A. niger* can modify the structural carbohydrate of rice straw and enhance conversion during anaerobic digestion. Therefore, enzymatic pretreatment using fungal enzymes represents a promising biological approach for supporting the valorization of agricultural residues.

Keywords: rice straw; lignocellulosic; *Aspergillus niger*; enzymatic pretreatment; anaerobic digestion.

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From Agricultural Waste to Climate Resilience: Valorizing Banana Stems and Pineapple Leaves for Sustainable Textile Applications

Salsabilla Aulia Aini [1], Erwin Yuniar Rahadian[2]

[1] Undergraduate Student, Architecture Department, Faculty of Architecture and Design, Institut Teknologi Nasional Bandung (ITENAS), Jl. PKHH. Mustapa No. 23, Bandung, West Java, INDONESIA, salsabilla.aulia@mhs.itenas.ac.id

[2] Architecture Department, Faculty of Architecture and Design, Institut Teknologi Nasional Bandung (ITENAS), Jl. PKHH. Mustapa No. 23, Bandung, West Java, INDONESIA, ears@itenas.ac.id

* **Correspondence:** salsabilla.aulia@mhs.itenas.ac.id

Abstract: The fashion industry generates over 92 million tons of textile waste annually and accounts for 10% of global carbon emissions due to heavy reliance on synthetic materials. Concurrently, rural farming communities discard or open-burn up to 90% of post-harvest agricultural waste—mainly banana stems and pineapple leaves—releasing greenhouse gases and missing local economic opportunities. This study addresses these dual challenges by proposing a practical circular economy model to valorize post-harvest residues into high-value, functional natural textiles. Using a design-based research approach, mechanical extraction (decortication), eco-friendly retting, and sun-drying were standardized for banana pseudostems (Musa spp.) from Sumedang and pineapple leaves (*Ananas comosus*) from Subang. Extracted fibers were developed into market-ready products, including bags, lanyards, bracelets, and garment elements. Additionally, Gender Equality, Disability, and Social Inclusion (GEDSI) principles were integrated by training local smallholders as active supply chain partners and delivering community workshops. The project repurposed 15 tons of agricultural waste, trained over 30 farmers (increasing household income by up to 20%), achieved 200+ product sales in its first batch, engaged 100+ community members in circular economy workshops, and established 20 local partnerships. Converting agricultural waste into natural textiles is technically feasible, commercially viable, and effective in strengthening socio-economic resilience against climate risks within rural communities.

Keywords: circular economy; GEDSI framework; natural fibers; decortication; retting

Acknowledgement: The synopsis of this scientific work is presented at a scientific event at CZU as part of the partnership implementation between Institut Teknologi Nasional Bandung (ITENAS) - Indonesia, and Czech University of Life Sciences Prague (CZU) - Czech Republic, with appreciation to the AVOCAIN project team for their valuable collaboration throughout this research and community implementation.

Impact of Climate Change on Water Well Drilling in Ethiopia: Challenges and Adaptation Strategies

Andinet Ejigu [1*]

[1] Department of Water well Drilling and Supply, Addis Ababa, Ethiopia, Email andilove304@gmail.com

*** Correspondence:** andilove304@gmail.com

Abstract: Climate change poses significant threats to groundwater resources in Ethiopia by altering hydrological cycles and compromising community water infrastructure. This study evaluates the technical and operational impacts of climate change on the water well drilling sector and identifies practical adaptation strategies. A mixed-methods approach was employed, combining historical hydrogeological data analysis with field observations of Air Rotary, Down-the-Hole (DTH), and Mud Rotary drilling methods across diverse regions. Findings indicate that declining groundwater levels necessitate deeper drilling, markedly increasing operational costs, drilling time, and technical demands. Furthermore, erratic weather patterns and complex geological formations accelerate equipment wear and reduce efficiency. To strengthen long-term water security, Ethiopia's drilling sector must adopt climate-resilient engineering practices. Key adaptation measures include implementing advanced hydrogeological pre-assessments, updating technical specifications for deeper aquifers, investing in modern high-capacity drilling rigs, and improving equipment maintenance and technical capacity. Integrating climate projections into well design and groundwater management is essential to reduce operational risks, optimize costs, and guarantee sustainable community water access across Ethiopia.

Keywords: climate change; groundwater resources; water well drilling; climate-resilient engineering; hydrogeological assessment

Media Framing of Climate Change in Nigeria: Implications for Agricultural Sustainability and Food Security

Joseph Omoh Ikerodah [1]*, Gbenga Arikenbi [2]

[1] Department of Journalism; College of Communication, Media, Design, and Information. joseph.ikerodah@colorado.edu

[2] Department of Advertising, Public Relations, and Design; College of Communication, Media, Design, and Information. gbenga.arikenbi@colorado.edu

* **Correspondence:** joseph.ikerodah@colorado.edu

Abstract: Climate change poses a significant threat to agricultural sustainability and food security in Nigeria, where agriculture remains a major source of livelihoods and economic development. This study examines how Nigerian newspapers frame climate change in relation to agriculture and food security and explores the implications of these frames for public discourse and policy. The study employed a quantitative content analysis of 386 climate change-related articles published between January 2023 and December 2024 in The Guardian, The Sun, and Vanguard. Data were analyzed using descriptive statistics and cross-tabulations. The findings reveal that the economic/food security frame dominated newspaper coverage (47%), emphasizing the effects of climate change on agricultural productivity, food prices, and livelihoods. Few reports presented farmers as resilient, adaptive, or beneficiaries of policy interventions, while none portrayed them as agents of innovation. Policy discussions appeared in only 35% of the analyzed articles, with government intervention emerging as the dominant policy response, whereas climate adaptation and technological innovation received minimal attention. Most reports (64%) focused on national-level issues, with relatively little coverage of local climate impacts and community experiences. The study concludes that Nigerian newspapers frame climate change predominantly as an economic and food security challenge while giving insufficient attention to adaptation, innovation, and farmer-centred perspectives. It recommends more inclusive and solution-oriented reporting that amplifies farmers' voices, promotes climate-smart agricultural practices, and supports evidence-based policymaking to strengthen agricultural sustainability and food security in Nigeria.

Keywords: agricultural sustainability; climate change; food security; media framing

Yet Plenty of Unknowns, but Another Hurdle to Estimating a Fully Formative Hierarchical PLS-SEM Model with Solid Theoretical and Empirical Support: Convergent Validity

Tewodros Tarekegn Lapiso [1]*, Assoc. Prof. Dr. Hynek Roubik [1]

[1] Department of Food and BioResource Technolog, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague; tarekegn@ftz.czu.cz; roubik@ftz.czu.cz

* **Correspondence:** tarekegn@ftz.czu.cz

Abstract: PLS-SEM is a second-generation method for predictive causal analysis of complex models, including hierarchical ones, using separate ordinary least squares regressions and relatively small samples. This study assesses PLS-SEM's capacity to estimate a fully formative hierarchical model, an emerging area where limitations remain. We built a model based on the UN Agenda 2030 SDGs and the Stockholm Resilience Center's "wedding cake" SDG classification, using empirical evidence on small-scale biogas plants' contributions to SDG progress in rural Sidama, Ethiopia. Analyses were conducted in R using the seminr package. Five-point Likert items were pilot-tested (n=25) and reviewed for face and content validity by 7 experts. A household survey covered 317 households in five districts in Sidama's four zonal clusters; 302 responses were valid and 279 analyzed, meeting gamma-exponential and inverse-square-root sample-size criteria. An initial formative-formative-formative hierarchical model specified 24 indicators, 10 SDGs, 3 sustainable development (SD) dimensions, and SD as a third-order construct. However, iteration and bootstrapping produced a relatively stable model with 13 indicators, 5 SDGs, 2 dimensions, and SD as a third-order construct, except for one negative indicator weight. All five convergent validity paths were unacceptable, although VIF values were 1-2, indicating no collinearity. Overall, the results show that, with current approaches, obtaining a stable, fully formative hierarchical PLS-SEM model, especially with acceptable convergent validity, is highly difficult, given our study's limitations, highlighting the need for improved methodological approaches tailored to such models for mandatory scenarios across various disciplines.

Keywords: exploratory model estimation; predictive analysis; redundancy test; renewable rural household energy; sustainable rural development

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Water Stress Responses of *Castanea sativa* Mill.: A Literature Review and a Greenhouse Experiment Across Six Provenances

Anjana Mohandas [1]*, Karola Plümpe[1], Dominik Thom[1]

[1] Department of Forest Sciences, Faculty of Environmental Sciences, TU Dresden, Germany, anjana.mohandas@mailbox.tu-dresden.de

* **Correspondence:** mohan.anjana3593@gmail.com

Abstract: *Castanea sativa* Mill. is increasingly relevant to climate-adaptation debates in forestry, yet provenance-level evidence remains fragmented as previous studies treat growth, physiology, and structural traits in isolation. Our objective was to characterize provenance-level drought responses during early establishment across multiple response domains. We conducted a factorial greenhouse common-garden experiment comprising 360 first-year seedlings from six provenances representing France, Germany, and the Caucasus under well-watered and deficit treatments, and evaluated across growth and canopy development, seedling condition, physiology, and structural strategy. Soil moisture deficit strongly constrained canopy deployment, growth, and gas-exchange. Leaf area declined by 85.4%, accompanied by marked reductions in shoot growth, biomass accumulation, net photosynthesis, and stomatal conductance. Specific Leaf Area changed only modestly and largely retained provenance rank order, whereas Huber value (proxy) increased in a provenance-dependent manner. Mortality remained low (1.7%) despite marked vitality decline. The Lesser Caucasus provenance showed the strongest absolute dry treatment expression across several growth/canopy traits, whereas Roitzsch (Germany) exhibited the strongest proportional retention. Conversely, Central Greater Caucasus showed comparatively weak proportional retention despite marked structural adjustment. An exploratory climate-of-origin interpretation suggested partial hydroclimatic structuring along a summer water limitation axis. The findings demonstrate that provenance-level drought response during early establishment in *Castanea sativa* is multidimensional, and integrating absolute performance with proportional retention provides a comprehensive basis for characterizing provenance performance. Such integrated seedling-stage evaluation supports pre-selection of candidate forest reproductive material for subsequent field-based testing.

Keywords: *Castanea sativa*; provenance variation; drought stress; climate adaptation; forest reproductive material

Acknowledgement: This research was conducted within the project "Development of a Novel Provenance Test using the Example of the Tree Species *Castanea sativa* Mill. and a Model Approach for the Pre-Selection of Provenances in Climate Change" funded by the Deutsche Bundesstiftung Umwelt (DBU: German Federal Environmental Foundation).

Effect of Low-Dose Phosphogypsum on Methane Kinetics, Gas Quality and Digestate Nutrient Enrichment in Anaerobic Digestion of Sugarcane Bagasse

AbdulAzeez Shobajo [1]*, Viktoriia Chubur [1], Yelizaveta Chernysh [1, 2, 3], Stacy Hammond [1], Hynek Roubík [1]

[1] Department of Food and BioResource Technology, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague, Czech Republic

[2] Department of Ecology and Environmental Protection Technologies, Sumy State University, Kharkivska St., 40007, Sumy, Ukraine

[3] Muğla Sıtkı Koçman University, Kötekli Yerleşkesi - 48050 Menteşe/Muğla, Turkey

* **Correspondence:** roubik@ftz.czu.cz

Abstract: Phosphogypsum (PG), a calcium-sulfate by-product of phosphoric acid manufacture, accumulates globally at over 7 billion tonnes with minimal reuse, largely owing to its radiological and trace-element burden. Sustainable pathways that simultaneously valorise PG and upgrade agricultural inputs remain understudied, particularly in anaerobic digestion (AD) of lignocellulosic feedstocks, where PG has the potential to enrich the resultant biofertilizer. This study evaluated in-situ PG dosing (0, 0.3 and 0.5 g L^{-1}; n = 3) during 38-day mesophilic batch AD of sugarcane bagasse, integrating gas-production kinetics, a sulfur mass balance, a chemical-oxygen-demand electron balance, dry-weight digestate elemental analysis and radiological screening. PG did not reduce the ultimate methane yield (135 vs. 134 L CH_4 kg^{-1} VS; $p = 0.92$) but significantly slowed the first-order rate constant by up to 25% ($p < 0.001$), accompanied by a 10–20-fold rise in biogas H_2S. The electron balance confirmed that sulfate reduction diverted only ~2% of substrate reducing equivalents, explaining the preserved yield. On a dry-weight basis, the digestate was dose-dependently enriched in sulfur (+22%), calcium (+39%) and strontium (+43%), while Cu, Pb, Cd, Zn and Ni were depleted in agreement with metal-sulfide solubility predictions. All regulated metals remained far below EU fertilising-product limits. Low-dose PG can thus convert lignocellulosic digestate into a sulfur- and calcium-enriched, biofertiliser at no methane-yield cost, provided biogas desulfurisation is available.

Keywords: phosphogypsum; anaerobic digestion; sugarcane bagasse; digestate valorisation; circular economy

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Integrating Regenerative Futures in Mathematics in the Modern World: A Knowledge, Attitude, and Skills-Based Action Research

Jerd Dela Gente [1]*, Maricar Prudente [1]

[1] Department of Science Education, De La Salle University, Manila, Philippines, jerd_delagente@dlsu.edu.ph; maricar.prudente@dlsu.edu.ph

* **Correspondence:** jerd_delagente@dlsu.edu.ph

Abstract: Climate change, environmental degradation, and unsustainable resource use require educational approaches that promote regenerative and sustainability-oriented thinking. Higher education institutions play a vital role in preparing learners to address complex environmental and societal challenges through transformative and interdisciplinary learning experiences. Mathematics education, often perceived as abstract and disconnected from real-life concerns, can foster systems thinking, critical reflection, and problem-solving when contextualized within authentic sustainability issues. This study examined the effects of integrating regenerative futures concepts into the Mathematics in the Modern World course on students' knowledge, attitudes, and skills (KAS). A quantitative one-group pretest-posttest action research design was employed involving 32 students enrolled in Mathematics in the Modern World at Davao Oriental State University during the second semester of Academic Year 2024–2025. The intervention integrated regenerative and sustainability themes into lecture-based mathematics instruction, contextualized examples, and problem-solving activities. Data were collected using validated pretests and posttests and analyzed through descriptive statistics and paired-sample t-tests. Findings revealed significant improvements in students' knowledge and attitudes toward regenerative futures, while skills improved from moderate to high levels following the intervention. Students demonstrated a stronger understanding of regenerative practices, an increased appreciation of mathematics as a tool for addressing environmental challenges, and an enhanced ability to apply mathematical reasoning to sustainability-related problems. Very high levels of student engagement with content, peers, and teachers were also observed throughout the intervention. Integrating regenerative futures into mathematics education is feasible and effective in promoting transformative, sustainability-oriented learning and developing future-ready, socially responsible, and environmentally conscious learners.

Keywords: regenerative futures; transformative learning; sustainability in mathematics; curriculum integration; mathematics education

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Regenerative Futures in Mathematics Education: A Meta-Synthesis

Jerd, De La Gente [1], Diether, Montejo [1]*

[1] Department of Science Education, De La Salle University, Manila, Philippines

* **Correspondence:** diether_montejo@dlsu.edu.ph

Abstract: Amid growing ecological, social, and technological uncertainties, Regenerative Futures Thinking (RgF) has emerged as a transformative educational framework that promotes sustainability, systems thinking, and learner agency. However, despite the growing interest in futures-oriented pedagogy, limited studies have explored its application within higher mathematics education. This study employed a meta-synthesis approach to examine 16 empirical and conceptual studies published between 2010 and 2025. Relevant literature was systematically retrieved from OpenAlex, Scopus, Crossref, Semantic Scholar, and Google Scholar using Harzing's Publish or Perish (PoP) software. Guided by two research questions, the selected studies were analyzed through inductive coding and thematic synthesis to identify recurring content and pedagogical themes. The synthesis identified six major content themes: futures literacy and anticipatory competence; systems thinking and complexity awareness; sustainability and ecological regeneration; agency, empowerment, and transformative action; interdisciplinarity and design thinking; and hope, imagination, and narrative futures. Additionally, five pedagogical themes emerged: learner-centered participation, collaborative problem-solving, critical reflection and futuring, transdisciplinary learning, experiential/place-based methods, and emotionally grounded and identity-based learning. The findings indicate that RgF has strong potential to transform higher education pedagogy through future-oriented and sustainability-driven approaches, although its explicit integration into mathematics education remains limited. The study concludes that Regenerative Futures Thinking offers promising pedagogical directions for fostering transformative and sustainability-oriented learning in higher education. However, its application within mathematics education remains underexplored, highlighting the need for future research on discipline-specific implementations that can prepare learners to become active contributors to regenerative futures.

Keywords: regenerative futures thinking; mathematics education; systematic review; meta-synthesis; higher education

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Evaluation of Antimicrobial Effects of Thyme and Rosemary Essential Oils Against Foodborne Pathogens Using a Vapour Phase Broth Microdilution Method

M.Şefik Özel [1]*, Markéta Houdková[1], Aishwarya Chaure[1], Urbanová Klára[1]

[1] Department of Sustainable Technologies, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague, Czech Republic; ozel@ftz.czu.cz

* **Correspondence:** ozel@ftz.czu.cz

Abstract: The growing demand for clean-label and naturally preserved foods has increased interest in plant-derived antimicrobial compounds as viable alternatives to synthetic preservatives. Essential oils, particularly thyme and rosemary oils, contain bioactive compounds with proven antimicrobial properties against foodborne pathogens. In this study, in vitro antibacterial activities of thyme (t.e.o) and rosemary (r.e.o) essential oils were evaluated against Salmonella spp. and *Staphylococcus aureus* using the broth microdilution volatilization (BMV) method alongside standard agar dilution assays. Minimum inhibitory concentrations (MICs) were determined across multiple independent biological and technical replicates using two-fold serial dilutions. The results revealed that t.e.o exhibited consistent antibacterial efficacy, with MIC values of 512 µg/mL in broth microdilution and 1024 µg/mL in agar dilution against both Gram-negative (Salmonella) and Gram-positive (*S. aureus*) strains. In contrast, r.e.o failed to inhibit bacterial proliferation within the evaluated concentration range for either pathogen (MIC > 1024 µg/mL). The reference antibiotic control validated assay precision, demonstrating broth MICs of 4 µg/mL for Salmonella and 0.25 µg/mL for S. aureus. These findings highlight the superior antibacterial potential of thyme essential oil compared to rosemary oil and establish baseline inhibitory thresholds essential for subsequent development. The obtained data will directly support the second phase of the project, focusing on the incorporation of thyme essential oil into bio-based smart and active food packaging systems to mitigate microbial proliferation and extend product shelf life.

Keywords: essential oils; antimicrobial activity; foodborne pathogens; thyme oil; rosemary oil

Historical Development and Perspectives of Viticultural Research at Karlštejn Research Station: Genetic Resources Conservation and Climate Change Adaptation

Nina Muntean [1]*, Zdeněk Beneš [1], Radomíra Střalková [1]

[1] Viticulture Research Station Karlštejn, Czech Agrifood Research Center, Drnovská 507/73, 161 00 Praha 6 – Ruzyně, Czech Republic, nina.muntean@carc.cz; zdenek.benes@carc.cz; radomira.strackova@carc.cz

* **Correspondence:** nina.muntean@carc.cz

Abstract: The Karlštejn Viticultural Research Station, established in 1919, is one of the oldest specialised viticultural institutions in the Czech Republic. As part of the Czech Agrifood Research Centre (CARC), it has contributed to grapevine breeding, genetic resource conservation and sustainable cultivation practices under the marginal climatic conditions of the Bohemian wine region. This study provides a historical-institutional review of the station's development from 1919 to 2026 and assesses its current strategic relevance in the context of climate change. The analysis is based on a systematic review of official institutional documents from CARC and the former Research Institute of Plant Production (VÚRV), national genetic resources programme reports, project records and historical sources. The review shows that the station has maintained continuous activity for more than a century and currently holds a field collection of approximately 230 Vitis accessions. It serves as the official maintainer of unique clones of traditional Czech varieties (Müller-Thurgau, Sylvánské zelené, Svatovavřinecké, Modrý Portugal and Rulandské bílé) and contributed to the registration of Auxerrois. Recent documented activities include the 2025–2028 renovation of the historic Vrše terraces with climate-resilient cultivars (Kerner, Ryzlink rýnský and interspecific hybrids such as Regent and Cabernet Cortis) and earlier participation in international projects (e.g. COST Action FA1003-GRAPENET). The main insight emerging from the review is that Karlštejn Research Station functions as an important repository of viticultural genetic heritage and a strategically positioned site for studying grapevine adaptation at the northern edge of Central European viticulture. Its long-term conservation efforts and ongoing renovation projects strengthen its capacity to address climate-related challenges.

Keywords: viticulture; genetic resources conservation; climate change adaptation; czech republic; karlštejn research station

Sustainable Rejuvenation of Reclaimed Asphalt Pavement Binders Using Waste-Derived Oils for Sustainable Infrastructure Applications

Mohammad Farhad Ayazi [1]*, Maninder Singh [1], Rajiv Kumar [2]

[1] Civil Engineering Department, Punjabi University, Patiala, India, ayazi_rs23@pbi.ac.in; Maniravi79@gmail.com

[2] Flexible Pavement Division, CSIR- Central Road Research Institute, New Delhi, ranjitrajiv@gmail.com

* **Correspondence:** ayazi_rs23@pbi.ac.in

Abstract: The long-term oxidation of asphalt binders in reclaimed asphalt pavement (RAP) increases binder stiffness and limits the performance and sustainable utilization of RAP. This study investigated the potential of waste cooking oil (WCO) and waste engine oil (WEO) as sustainable rejuvenators for modifying aged RAP binder and evaluated their effectiveness at different dosages. RAP binder was treated with WCO and WEO at dosages of 5%, 10%, and 15% by weight of the aged binder. Conventional binder tests, performance grading, Dynamic Shear Rheometer (DSR) temperature sweep and Multiple Stress Creep Recovery (MSCR) tests, and Saturates–Aromatics–Resins–Asphaltenes (SARA) analysis were conducted to evaluate changes in physical, rheological, and compositional properties. Both WCO and WEO progressively modified the physical and rheological properties of the aged RAP binder with increasing dosage. WEO generally produced lower non-recoverable creep compliance (Jnr), indicating better resistance to permanent deformation, while WCO resulted in slightly lower G* sinδ values at comparable dosages. A 10% rejuvenator dosage provided a comparatively balanced response across the investigated performance indicators. WCO and WEO demonstrate potential as sustainable waste-derived rejuvenators for modifying aged RAP binder. However, their effects differ with respect to rutting- and fatigue-related rheological characteristics. Among the investigated dosages, 10% provided the most balanced overall response, highlighting the importance of optimizing rejuvenator type and dosage for effective RAP binder rejuvenation.

Keywords: reclaimed asphalt pavement; waste engine oil; waste cooking oil; sustainable infrastructure; rejuvenators

A Rural Case Study on the Geo-toxicological Footprints of Microplastic Traces in the Rural Drinking Water

Chayan Munshi [1]*, Ishika Pal [1], Swapnanil Mondal [1]

[1] Ethophilia Research Foundation, Santiniketan, 731235, India

* **Correspondence:** chayan.munshi@ethophilia.com

Abstract: For the past few decades, with increased perspectives in the area of emerging toxicology, urban and industrial areas have received excessive attention, whereas there is comparatively less emphasis on rural areas. It is, however, an established fact that rural ecosystems are less exposed to environmental contaminants or anthropogenic pollutants. This work deals with the occurrence of microplastics and/or organic contaminants in rural ponds, agricultural fields and groundwater. Raman Spectroscopic technique was used to quantify the trace compounds in water samples from a rural (non-industrial) area in West Bengal, India, near the suburban town of Santiniketan. During the field study, we concentrated on groundwater, freshwater ponds, and agricultural fields. Water samples were collected according to the standard protocol and were analysed under Raman Spectrometer (micro-Raman setup from Jobin Yvon; model: LabRAM HR, 633 nm, He-Ne laser). Analysing the robust Raman peaks, our findings indicated that there are certain chances of trace microplastic occurrence in the aforementioned water sources, along with the possibility of organic pollutants. Although vibrant Raman plots from environmental water samples are normal and indicate a suspension of diverse molecules, including biological specimens. Our study deals with pilot data. However, the preliminary report indicates that anthropogenic pressure can not only contaminate the agricultural area but can also affect the groundwater system. Warningly, this groundwater is used as a drinking water source by the locals, which can be an issue of public health hazard in the rural case study area.

Keywords: microplastics; emerging contaminants; fresh water

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Climate Resilience and Water Management: The Case of Morocco

Amine El Bakkouri [1]*

[1] Department of Economics, Faculty of Economics and Management, Ibn Tofail University, Kenitra, amine.elbakkouri@uit.ac.ma

* **Correspondence:** amine.elbakkouri@uit.ac.ma

Abstract: Morocco is one of the countries most affected by hydrological and climatic risks in the Middle East and North Africa (MENA) region. Furthermore, rapid urbanisation and climate change are likely to increase the frequency and severity of extreme weather events. Morocco faces major climate and water challenges as a highly vulnerable area. Climate change is likely to intensify the cumulative effects on Morocco's water security. The central question this research proposes to explore is: What strategies has Morocco implemented to ensure effective water management and strengthen economic resilience to climate challenges? We will conduct a quantitative study using mathematical functions and econometric analyses to describe the relationship between variables and draw interpretations from it. This study aims to demonstrate that the procedures and interventions undertaken by Morocco in the economic context can be a powerful lever for addressing the challenges associated with climate change, improving water management, and reducing the costs of environmental preservation. In conclusion, this research aims to understand how Moroccan strategies will reconcile two main objectives: ensuring environmental protection, including effective water management, and reducing the costs of pollution control for society by imposing performance or resource standards and establishing control mechanisms to ensure compliance with these standards by economic agents.

Keywords: sustainability; economic resilience; climate change; water management

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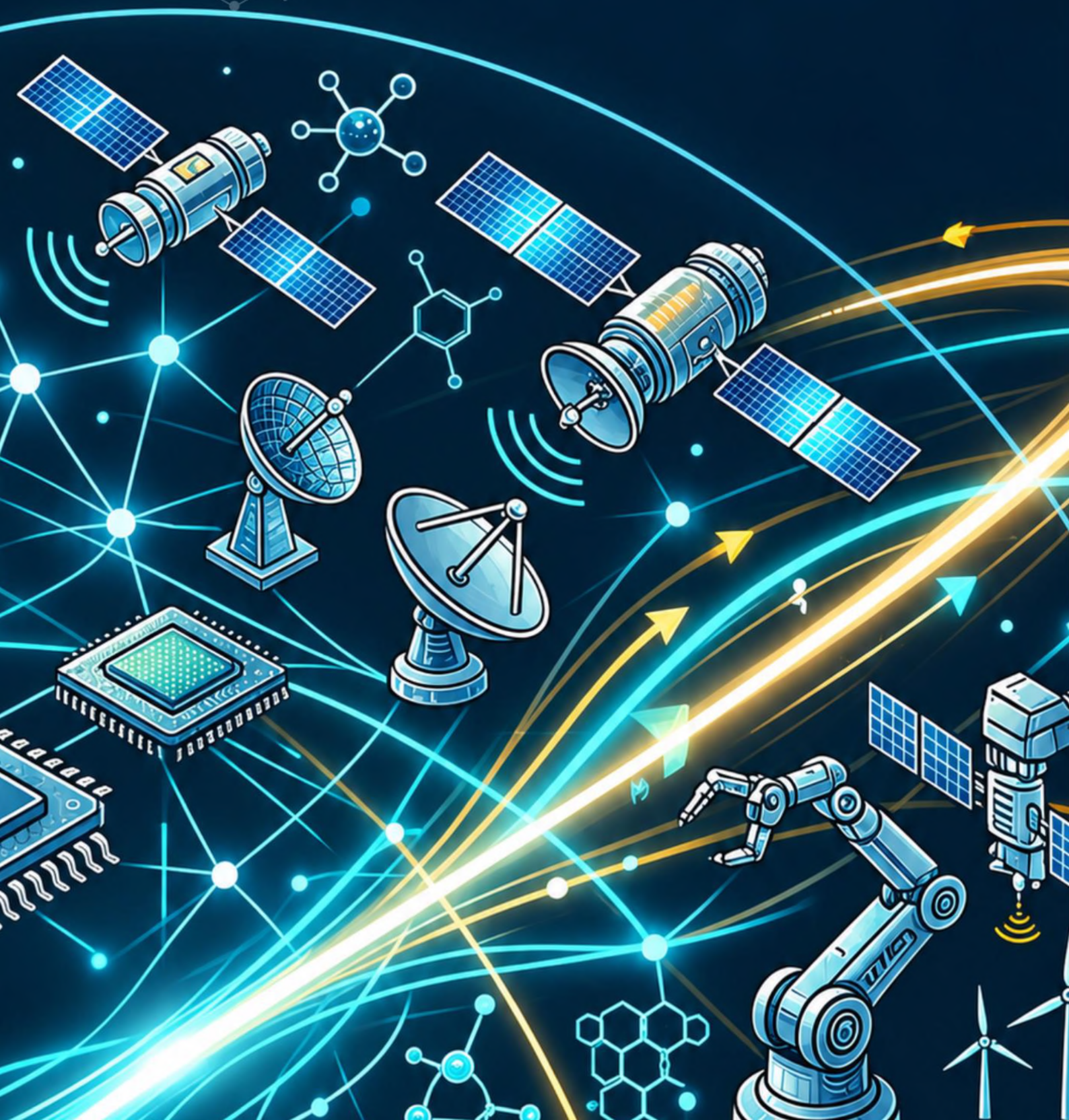

Fragility Based Seismic Risk Assessment of Unreinforced Masonry Structures Using a Low-Cost Hybrid Retrofitting Scheme

Syed Ashraf Abbas [1]*, Amir Ali [2], Aslam Faqeer Mohammad [3], Maciej Dutkiewicz [1]

[1] Faculty of Civil, Environmental Engineering and Architecture, Bydgoszcz University of Science and Technology, Al. Prof. Sylwestra Kaliskiego 7, Bydgoszcz, 85-796, Poland

[2] Department of Civil Engineering, Lakehead University, 955 Oliver Rd., P7B 5E1 Thunder Bay, Ontario, Canada

[3] Department of Civil Engineering, NED University of Engineering and Technology, Karachi, 75270, Pakistan

* **Correspondence:** syeabb000@pbs.edu.pl

Abstract: Unreinforced masonry structures are widely prevalent in developing countries and are highly vulnerable to seismic loading due to limited tensile strength and poor resistance to lateral forces. Although numerous studies have investigated their seismic performance, comparatively few have evaluated retrofit effectiveness through a probabilistic risk-based assessment. This study presents an integrated framework combining experimental testing, fragility analysis, and seismic risk indicators to evaluate low-cost hybrid retrofitting system comprising polypropylene bands and Cementitious Fiber-Reinforced Mortar plaster. The developed fragility functions were further employed to assess structural resilience under representative seismic hazard conditions in selected developing countries across South Asia, Latin America, the Middle East and North Africa, and Sub-Saharan Africa using PGA values obtained from the Global Earthquake Model seismic hazard database. Results show that the proposed retrofitting significantly shifted the fragility curves towards right, reducing the probability of slight damage from 27% to 10% and moderate damage from 21% to 7% at a PGA of 0.2 g. The greatest regional improvement was observed in Latin America, where damage probabilities decreased by up to 26% under the seismic hazard conditions of Peru. HAZUS-based assessment further indicated that at 0.2 g, retrofitting reduced expected downtime from 49.4 to 22.5 days, economic loss from 8% to 4% of replacement cost, and fatalities from 0.34 to 0.17 per 100 occupants. These findings demonstrate that the proposed hybrid retrofit provides an affordable and sustainable strategy for enhancing the seismic resilience of URM buildings, particularly under low-to-moderate seismic intensities.

Keywords: unreinforced masonry; fragility analysis; seismic risk assessment; hybrid retrofitting; seismic resilience

Anaerobic Co-Digestion of Banana Pseudo-Stem and Cattle Manure for Biogas Production: A Laboratory-Scale Study in the Syrian Coastal Region

Kinda Ali [1]*, Raed Jafer [1], Rana Kassem [1], Dema Abde [1], Hynek Roubik [2]

[1] Department of Environmental Engineering, Faculty of Civil Engineering, Lattakia University, Syria, keen5tymj@gmail.com; raed.jafar@univ-cotedazur.fr; rana.kasem@latakia-univ.edu.sy; dimah.alabdeh@latakia-univ.edu.sy

[2] Department of Sustainable Technologies, Czech University of Life Sciences Prague, roubik@ftz.czu.cz

* **Correspondence:** keen5tymj@gmail.com

Abstract: The banana pseudo-stem is considered a low-lignin, cellulose-rich organic matter, making it an effective feedstock for biogas production. On the other hand, cattle manure possesses characteristics that make it an essential partner as a co-substrate in anaerobic digestion, particularly due to its richness in carbon. Anaerobic co-digestion has recently gained significant attention as a renewable energy resource and a supportive system for waste management production. This contributes to achieving sustainable development for local communities in the Syrian coast, which produces bananas. This research aims to study biogas production by testing a mixture of cattle manure and banana pseudo-stem as a substrate for biogas production. A laboratory UASB (Upflow Anaerobic Sludge Blanket) reactor was designed and operated by using 11 kg of cattle manure and 1 kg of chopped banana pseudo-stem at a temperature of 20–25°C for a duration of 50 days. Gas production began lightly on day 7, then gradually increased until it reached its peak on day 25 at a rate of 7.35 liters. This peak lasted for eight days, after which gas production declined gradually and stopped on day 50. The current study demonstrates the practical feasibility of anaerobic co-digestion of banana waste and cattle manure within the Syrian coast. The dynamics of biogas production—specifically regarding digestion retention time and peak occurrence—align with standard curves reported in international literature. However, the production process required a longer duration (50 days) due to the lower operating temperature of the laboratory reactor (20–25°C) compared to mesophilic systems.

Keywords: biogas; cow manure; Banana Pseudo-Stem; anaerobic treatment method

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Photocatalytic CO_2 Conversion Over Visible Light Active g-C3N4 Modified with Few-Layer Graphene

Nayan Moni, Baishya [1]*, Prof. Mahuya De [2]

[1] School of Energy Science and Engineering, Research Scholar, IIT Guwahati, Assam, India-781039, nmoni@iitg.ac.in

[2] Department of Chemical Engineering, Professor, IIT Guwahati, Assam, India-781039

* **Correspondence:** nmoni@iitg.ac.in

Abstract: The translation of scientific breakthroughs into practical environmental solutions is a vital pathway toward mitigation of anthropogenic climate risks. This study presents an efficient chemical route to convert CO2 into valuable liquid fuels, shifting from research innovation directly to sustainability-focused action. The application of graphitic carbon nitride (CN) for photocatalytic CO2 reduction is limited by rapid exciton recombination. To overcome this limitation, this work establishes the structural modification of visible light active CN using few-layer graphene (FLG). The FLG was synthesized through a one-pot microwave-assisted liquid-phase exfoliation method using H2SO4 as a mild intercalant. Composite photocatalysts were fabricated by grafting the FLG onto CN matrix via single-step in-situ thermal pyrolysis at varied loadings (10, 15, and 20 wt%). Modifying CN with FLG narrowed the bandgap from 2.74 eV to 2.35-1.97 eV, yielding enhanced visible-light absorptivity and charge delocalization. TRPL confirmed a prolonged charge carrier lifetime of 2.46 ns at optimal 15 wt% loading (15GHM2S/CN), confirming that the inter-layer Schottky barrier successfully suppressed electron-hole recombination. In a batch photoreactor (alkaline medium), all modified catalysts achieved 97-99% methanol selectivity. Optimized 15GHM2S/CN reached a maximum CO2 conversion efficiency of 64% and an AQY of 2.67%, achieving a 2.5-fold performance enhancement over pristine CN. Structural implementation of microwaved FLG creates a highly conductive junction that accelerates surface reduction reactions via a formaldehyde pathway. Successive cyclic testing showed robust operational durability over seven runs, validating durable, highly stable solar fuel production strategy capable of bridging the gap between innovative materials research and resilient climate action.

Keywords: photocatalyst; CO_2 reduction; graphitic carbon nitride; few-layer graphene; methanol selectivity

Rheological Insight to the Nanocellulose Solutions and Gel From Hemp (*Canabis Sativa* L.)

Josef Bárta [1]*, Kateřina Hájková [1], Adam Sikora [1], Viera Kučerová [2], Jakub Dušek [1]

[1] Department of Wood Processing and Biomaterials, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague - Suchdol Czech Republic, bartajosef@fld.czu.cz; hajkovakaterina@fld.czu.cz; sikoraa@fld.czu.cz; dusekjakub@fld.czu.cz

[2] Department of Chemistry and Chemical Technologies, Faculty of Wood Sciences and Technology, Technical University in Zvolen, Ul. T. G. Masaryka 24, 960 01 Zvolen, Slovak Republic, viera.kucerova@tuzvo.sk

* **Correspondence:** bartajosef@fld.czu.cz

Abstract: Hemp (*Canabis Sativa* L.) bast fiber represents a promising lignocellulosic feedstock for further chemical utilization due to its high cellulose and low lignin content. Despite hemp has these favourable characteristics, it remains an underutilized crop in the Czechia with low industrial processing. In this work, hemp bast fiber was evaluated as a sufficient feedstock for nanocellulose production based on its chemical composition, determined by standard gravimetric analysis and high-performance liquid chromatography (HPLC) for monosaccharide composition. Seifert cellulose isolated from hemp was dissolved in the FeTNa (iron-tartrate-sodium complex) solvent system, and rheological properties of dilute solutions were characterized alongside with degree of polymerization. Lastly, a gelation experiment identified a percolation threshold at approximately 3 wt%, above which a stable aggregated nanocellulose gel formed. Following SEM analysis confirmed the presence of a mixed cellulose nanocrystals and nanofibrils. The results demonstrate that hemp bast fiber enables production of nanocellulose solution and stable gels with low chemical input, supporting a circular economy framework and providing a new value-added product that could support the increase to grow hemp for industrial purposes.

Keywords: lignocellulosic biomass; monosaccharide composition; degree of polymerization; scanning electronic microscopy

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Automated Filtering of Articles in Anaerobic Digestion to Facilitate Data Sharing

Antoine Bercy [1]*, Adam Hruška [1]

[1] Department of Food and BioResource Technology, Faculty of tropical agrisciences, Czech University of Life Sciences Prague (CZU) Kamýcká 129 165 00 Praha - Suchdol

* **Correspondence:** bercy@ftz.czu.cz

Abstract: Scientific publication is suffering from an increasingly rapid publication rhythm and a more fragmented space, where publication pressure drives optimization towards search engines, reducing scientific quality in favour of visibility. This phenomenon is also evident in the Anaerobic digestion field, where fragmentation makes identifying relevant information difficult. Therefore, this study aims to develop a pilot framework that demonstrates the feasibility of standardized, automated article classification using a hierarchical, keyword-based logic, thereby showing that bypassing the limitations of search engines is possible. To observe LLM (Large Language Models) performance, at this task, a random selection of 53 articles, from the anaerobic digestion pretreatment field, was compared with manual filtering. The study tested six different language models (three 30b flagship and three 8b) using, when available, the reasoning and non-reasoning options. Each LLM was run on 3 different Agentic models to study speed and accuracy trade-offs. The 30b flagship models, such as Gemma4 and Qwen3.6, showed strong accuracy exceeding 84%, with few false predictions. Mistral, by comparison, showed lower accuracy, with a tendency towards omission. The 8b models showed poorer performance, except for Gemma3 and Qwen3.5 in reasoning mode, which reached a correction prediction of 70%. These promising results demonstrate that, though such tools cannot be fully automated, they reduce the time required to filter articles and allow for a realistic approach to article classification. They reduce research uncertainty and the drawbacks of classical search engine-based information gathering.

Keywords: open science; keywords; filtering; anaerobic digestion; LLM

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Green Extraction Technologies for the Sustainable Recovery of High-Value Bioactive Compounds from Pitaya (*Hylocereus purpusii*) Peels

Feby E. Carmen [1]*, Laurie Barthe [2], Christine Frances [2]

[1] University of the Philippines Visayas, Miagao, Iloilo, 5023, Philippines

[2] Laboratoire de Génie Chimique, Université de Toulouse, CNRS, INPT, UPS, France

* **Correspondence:** fecarmen@up.edu.ph

Abstract: Valorization of agricultural waste through the recovery of bioactive compounds represents a sustainable strategy for biomass utilization. Pitaya (*Hylocereus spp*.) peel, which accounts for approximately one-third of the fruit mass, is an abundant source of valuable biomolecules; betacyanins, phenolic compounds, flavonoids, sugars, and pectin. Conventional maceration is commonly employed for extracting these compounds; however, it is constrained by prolonged extraction times and limited efficiency. This study evaluated two green extraction technologies—ultrasound-assisted extraction (UAE) and stirred bead milling (SBM)— for recovering bioactive compounds from pitaya peels harvested in Réunion Island, France. UAE used low-frequency ultrasound (20 kHz, 15–60 W), while SBM employed zirconia microbeads under recirculation mode. Extraction performance was assessed under controlled temperature conditions by examining the effects of biomass pretreatment, particle size, pH, solid-to-liquid ratio, and processing parameters. Industrially dried peels produced betacyanin yields comparable to those obtained from fresh peels, whereas laboratory-dried samples exhibited reduced extraction efficiency following maceration. UAE significantly enhanced the recovery of all target compounds, yielding approximately two-fold higher concentrations of betacyanins, total phenolics, and flavonoids, and three-fold higher sugar and pectin contents. SBM promoted rapid release of bioactive compounds from finely milled particles but resulted in pigment degradation during prolonged processing, particularly for light-sensitive betacyanins. Both UAE and SBM improved pectin recovery; however, UAE produced highly esterified pectin suitable for food applications, whereas SBM generated higher-quality pectin with greater potential for pharmaceutical use. These findings demonstrate that green extraction technologies provide efficient and sustainable alternatives for the valorization of pitaya processing waste.

Keywords: biorefinery; ultrasound assisted technology; green extraction; phytochemicals; pectin

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Enhanced Electrocatalytic Detection of Doxorubicin via Gold Nanoparticle/Reduced Graphene Oxide Modified Screen-Printed Electrodes

Iva Dimitrievska [1]*, Anita Grozdanov [1]

[1] Faculty of Technology and Metallurgy, Ss. Cyril and Methodius University in Skopje, Rugjer Boshkovikj 16, 1000, Skopje, North Macedonia, iva@tmf.ukim.edu.mk; anita@tmf.ukim.edu.mk

* **Correspondence:** iva@tmf.ukim.edu.mk

Abstract: Enhancing the clinical sensitivity of screen-printed carbon electrodes (SPCEs) is vital for transitioning electrochemical devices into reliable point-of-care diagnostics. In this study, we engineered high-performance sensors by modifying SPCE surfaces with reduced graphene oxide (rGO) decorated with varying loads of gold nanoparticles (0.5, 2, and 4 wt% AuNPs). Successful nanohybrid assembly was verified via XRPD, FTIR, Raman, SEM/EDS, and TGA. Raman analysis specifically identified n-type doping via a G-band redshift, confirming intense electronic coupling within the composite. The 2 wt% AuNP/rGO formulation displayed the best graphitic alignment and thermal resilience and was subsequently applied to detect the anticancer therapeutic doxorubicin (DOX). When evaluated voltammetrically, the modified architecture promoted a highly favorable quasi-reversible redox pathway, achieving an anodic peak current density of 18.912 μA cm-2 (a 3.3-fold rise compared to bare electrodes). Electrokinetic studies confirmed swift electron transport kinetics, supported by a diminished Tafel slope (140 mV dec-1) and an elevated rate constant (k0 = 2.57 × 10-5 cm s-1). Consequently, the platform offered a 1.45-fold increase in sensitivity (0.221 μA / μmol L-1) and lowered the limit of detection by 20.9% (13.193 μmol L-1) in a 0.5 to 10.5 μmol L-1 concentration range. These outcomes demonstrate the strong promise of AuNP/rGO frameworks for next-generation, high-sensitivity medical sensors.

Keywords: screen-printed electrodes; electrochemical sensor; doxorubicin; reduced graphene oxide; gold nanoparticles

Drying Beyond Heat: Desiccant Assisted Intensification of Coffee Drying via Gas Solid Dehydration

Eduardo Duque-Dussán [1]*

[1] Engineering Discipline, National Coffee Research Center - Cenicafé, Manizales, Colombia

* **Correspondence:** eduardo.duque@cafedecolombia.com

Abstract: Coffee drying in humid tropical regions is frequently limited by high relative humidity, which reduces the psychrometric driving force and prolongs drying times, increasing risks of microbial contamination and quality degradation. This study introduces a novel conceptual framework that interprets coffee drying as a gas–solid dehydration process analogous to catalytic systems, where regenerable desiccants act as kinetic promoters. A coupled reactor model was developed integrating fixed-bed adsorption kinetics with tensorial heat and mass transfer in a 70 kg batch of parchment coffee. Two desiccants, silica gel type A and zeolite 13X, were evaluated under drying conditions of 40–50 °C, simulating moisture reduction from 53% to 10–12% (wet basis). The system was modelled as a two-stage process: air dehumidification followed by convective drying, with numerical implementation using finite-volume methods. Desiccant-assisted drying significantly enhanced performance, reducing drying times by 35–37% with silica gel and 46–50% with zeolite, corresponding to kinetic promotion factors up to 2.3. Lower outlet humidity ratios sustained higher vapor pressure gradients, accelerating moisture removal, particularly during the falling-rate period. Energy analysis showed net savings of 17–25% for silica gel and 6–12% for zeolite, confirming overall feasibility. The proposed framework demonstrates that controlling air humidity, rather than solely increasing temperature, is an effective pathway for process intensification. Desiccant-assisted drying offers a scalable, energy-efficient strategy for improving coffee postharvest processing in humid environments.

Keywords: coffee drying; desiccant-assisted drying; adsorption kinetics; heat and mass transfer; process intensification

Acknowledgement: This work was supported by Cenicafé and the European Union's Horizon EUSPA-2022-SPACE program (Project COMUNIDAD)

Impact of Drying Rate on Germination and Embryo Viability of Coffee Seeds under Controlled Low-Temperature Conditions

Eduardo Duque-Dussán [1]*, Juan R. Sanz-Uribe [1]

[1] Engineering Discipline, National Coffee Research Centre - Cenicafé, km 4 vía antigua Chinchiná-Manizales, Caldas, Colombia. eduardo.duque@cafedecolombia.com; juanr.sanz@cafedecolombia.com

* **Correspondence:** eduardo.duque@cafedecolombia.com

Abstract: Rapid moisture removal may induce internal stresses, cellular damage, and loss of viability, particularly at intermediate and low moisture contents. Therefore, this study evaluates drying as a rate-controlled process to identify stage-specific conditions that preserve seed quality while improving drying efficiency. Experiments were conducted using *Coffea arabica* L. parchment seeds dried at a constant temperature of 38 °C in a custom-designed dryer with reversible airflow. Five target moisture removal rates (30, 50, 70, 90, and 110 g water·kg dry matter^{-1}·h^{-1}) were imposed through airflow control. Samples were collected at moisture contents of 42%, 32%, 22%, and 12% (wet basis). Seed performance was evaluated through germination tests, tetrazolium staining, and microscopy, while drying kinetics and energy consumption were monitored. Airflow intensification markedly shortened washed coffee seed drying while maintaining, and in several cases improving, physiological quality compared with the conventional drying protocol. Increasing airflow from the control value of 2.5 m^3 min^{-1} to 5.66 m^3 min^{-1} reduced the time required to reach 11% moisture from approximately 58 to 44 h, while final germination increased from 82% in the control to 92.8% and tetrazolium viability from 83% to 96%. Seed response, however, depended on both airflow and moisture stage; for example, the 4.01 m^3 min^{-1} treatment reached 100% tetrazolium viability and 93.5% germination at 11% moisture, whereas the 3.05 and 4.87 m^3 min^{-1} treatments showed final germination values of approximately 86–87%. Overall, the results indicate that higher airflow can substantially accelerate seed drying without necessarily impairing viability or germination, while the differences observed among moisture intervals provide a basis for selecting stage-specific airflow rates to further reduce drying time while preserving seed quality.

Keywords: coffee seed drying; drying rate; seed viability; tetrazolium test; microstructure

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Microbiological Challenge Testing of *β*-Thujaplicin and Thymoquinone Vapours Evaporated from Solid Volatilisation Matrix Against Foodborne Pathogens

Adrish Dutta [1]*, Marketa Houdkova [1], Miroslava Kacaniova [2, 3], Ladislav Kokoska [1]

[1] Department of Crop Sciences and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamycka 129, Prague, 165 21, Czech Republic, duttaa@ftz.czu.cz; houdkovam@ftz.czu.cz; kokoska@ftz.czu.cz

[2] Institute of Horticulture, Faculty of Horticulture and Landscape Engineering, Slovak University of Agriculture, Nitra 949 76, Slovakia

[3] School of Medical & Health Sciences, University of Economics and Human Sciences in Warsaw, Okopowa 59, Warszawa 01 043, Poland, kacaniova.miroslava@gmail.com

* **Correspondence:** duttaa@ftz.czu.cz

Abstract: Growing consumer demand for preservative-free foods has driven research into natural antimicrobial agents to extend shelf life. Plant-derived volatile agents serve as safe and eco-friendly alternatives for food preservation by distributing evenly without leaving chemical residues on food surfaces. Among them, *β*-thujaplicin and thymoquinone exhibit excellent antimicrobial properties; however, microbiological challenge studies of their vapours are limited. It is necessary to test efficacy of antimicrobial vapours using a structured challenge test within realistic food models. Therefore, the antimicrobial activity of *β*-thujaplicin and thymoquinone vapours were tested in challenge test using food commodity. The volatiles were tested against food pathogens: *Aspergillus niger*, *Bacillus cereus*, *Escherichia coli* O157:H7, *Listeria monocytogenes* and *Shigella flexneri*. For antimicrobial evaluation, vegetables were tested on growth media in Petri dishes using lid inoculated with volatile agents, while bread was tested in 500 mL jars without media. The doses of the agents used ranged from 62.5 to 500 µg/mL. Results demonstrated that at the highest dose of 500 µg/mL, thymoquinone most effectively inhibited L. monocytogenes on carrots (96.27%) and *S. flexneri* on potato (94.20%), while β-thujaplicin inhibited *A. niger* on bread by 96.49%. Overall, both agents showed similar dose-dependent inhibitions across all pathogens. Released volatiles inhibited most pathogens on carrots at lowest dose (62.5 µg/mL) but required ≥125 µg/mL on bread and potato. Therefore, *β*-thujaplicin and thymoquinone vapours possess broad-spectrum antimicrobial activity, highlighting their potential as effective packaging biofumigants; however, further research regarding safety, organoleptic properties, and vapour-phase efficiency from solid carriers is necessary.

Keywords: active packaging; antimicrobials; food model; food pathogens; vapour phase

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The Effect of Animal-Based Milks and Plant-Based Drinks on the Rheological Properties and Stability of Bioactive Compounds in Beverages Made with Matcha Tea Powder

Klaudia Eperjesi [1]*, Tímea Kaszab [1], Judit Tormási [2]

[1] Department of Food Measurement and Process Control, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, Villányi Str. 29-43, Hungary

[2] Department of Food Chemistry and Analysis, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, Villányi Str. 29-43, Hungary

* **Correspondence:** Eperjesi.Klaudia@stud.uni-mate.hu

Abstract: Recent years have seen such a surge in the popularity of matcha tea worldwide, largely thanks to social media, Japanese matcha farms are unable to keep up with the increased demand. Research by Korir et al. (2014) suggests that proteins in cow's milk, particularly casein, may interact with matcha catechins, reducing their antioxidant activity. However, current findings remain contradictory regarding the effects of different animal milks on the stability of bioactive compounds, especially polyphenols. Therefore, further investigation is warranted, particularly using matcha powders available in Hungary. This research investigates whether the type of milk consumed with matcha affects its health benefits. The total polyphenol, caffeine, and tannin contents of control samples and matcha beverages prepared with various animal-based milks and plant-based drinks will be determined. In addition, viscosity, density, homogeneity, sedimentation, and pH are measured to evaluate the rheological properties of the beverages. The study is expected to provide a comparative evaluation of the effects of different animal-based milks and plant-based drinks on the rheological properties and the stability of bioactive compounds in matcha-based beverages. It is anticipated that differences in protein composition and other physicochemical characteristics of the beverages may influence the retention of polyphenols and antioxidant activity. The findings of this ongoing research are expected to contribute to a better understanding of how commonly consumed milk alternatives affect the quality and potential health benefits of matcha beverages, providing a scientific basis for future dietary recommendations and product development.

Keywords: matcha; rheology; bioavailability

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Evaluation of Multiple Linear regression and Machine learning Performance to predict Al-Sin Lake water quality in Syria

Aliaa Gbilly [1]*, Zaina Mayea [2], Raed Jafar [3], Hynek Roubik [4]

[1] Department of Ecology, Pal Juhasz-Nagy Doctoral School–University of Debrecen, Debrecen 4032, Hungary

[2] Department of Environmental Engineering, University of Debrecen, Hungary

[3] Universite Cote d'Azur, Polytech' lab, Nice, France

[4] Department of Sustainable Technologies, Faculty of Tropical Agrisciences, Czech University of life Sciences, Prague, Czech Republic

* **Correspondence:** aliaagbilly1992@gmail.com

Abstract: Forecasting within the artificial intelligence relies on analyzing historical data and has become widely used in surface resources monitoring. This study compares the performance of multiple linear regression (MLR) and machine learning models, like random forest (RF) and Support vector regression (SVR), to forecast the surface water quality of Al-Sin Lake in Syria using the Iranian Water Quality Index (IRWQI_sc). Ten physiochemical and biological parameters, measured at three monitoring stations from 2021 to 2023, were used as inputs for each model including dissolved oxygen, pH, chemical oxygen demand , total hardness, nitrates, turbidity, electrical conductivity, ammonium, fecal coliforms , and phosphates. They were selected after correlation analysis and multicollinearity diagnostic, while the IRWQI_sc was adopted as an output of the model. All models were trained and validated using cross-validation to reduce overfitting. The performance was evaluated using regression metrics such as RMSE, MAE, MSE and determination coefficient R^2. The MLR model had the best performance with lowest test error (RMSE = 1.06) and the highest test R^2=0.87. The RF and SVR demonstrate higher sensitivity to data division and hyperparameters settings. The Exceptional performance of MLR is linked to the quasi-linear nature of the IRWQI_sc formulation and the moderate sample size (N = 216), which makes the linear structure outperform the complex non-linear ones. These findings suggest that a well-structured MLR model can provide accurate and robust predictions of the water quality from a reduced set of key variables, offering a useful practical tool for monitoring and managing Al-Sin Lake.

Keywords: surface water quality, Iranian water quality index, multiple linear regression, random forest, determination coefficient

Digital Inclusion, Rural Transformation, and the Agricultural Digital Divide: Evidence from Myanmar

Shamsurrahman Hamdard [1]*, Ayat Ullah [1], Miroslava Bavorova [1]

[1] Department of Economics and Development, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague, Czech Republic, shamshamdard100@gmail.com; ullah@ftz.czu.cz; bavorova@ftz.czu.cz

* **Correspondence:** shamshamdard100@gmail.com

Abstract: Digital technologies are increasingly recognized as critical enablers of agricultural productivity and rural transformation. Despite rapid connectivity growth, significant disparities in technology adoption persist among agricultural households in developing countries. Existing research often focuses on single tools or localized contexts, leaving limited evidence on the broader factors shaping digital inclusion. This study examines how socioeconomic, farm-related, economic, and spatial factors jointly influence the adoption of multiple technologies among agricultural households in Myanmar. Using nationally representative data from 5,162 agricultural households in the Myanmar Household Welfare Survey (MHWS) Round 7, this study employs a Multivariate Probit (MVP) model. The model jointly analyzes the adoption of three foundational technologies: computers, internet services, and smartphones. It also explicitly accounts for potential interdependence among adoption decisions. The results show that education is a central driver, significantly increasing the likelihood of adopting computers and internet services. Persistent gender disparities are evident, with female respondents showing lower adoption probabilities for all three technologies. Farm size, crop and fish production, remittances, and family labor positively influence adoption, whereas credit access is not significant. Substantial rural–urban and regional divides highlight uneven progress across Myanmar. Importantly, positive correlations between internet and smartphone adoption confirm that households adopt these technologies as complementary bundles rather than isolated decisions. These findings underscore the need for integrated investments in digital infrastructure, digital literacy, gender-responsive policies, and place-based strategies. Such interventions are essential to promote inclusive technological transformation and ensure equitable participation of agricultural households in the emerging digital economy.

Keywords: digital divide; digital technology adoption; rural development; multivariate probit; Myanmar

Fixed Points, Stability, Basin Geometry, and Global Convergence of the 3×3 Correlation Map

Ishrak, Alhajj Hassan [1*]

[1] Department of Mathematics, Faculty of Sciences, University of Ostrava, Ostrava, ishrak.alhajj.s01@osu.cz

* **Correspondence:** ishrak.alhajj.s01@osu.cz

Abstract: For more than half a century, iterated Pearson correlation has underpinned methods for network blockmodeling, clustering, seriation, and information visualization. Despite its continued use and the longstanding assumption of convergence, the global convergence problem remained open even in dimension three. We resolve this problem completely for the 3 × 3 correlation map: every admissible orbit is well defined for all forward iterates and converges to one of exactly seven fixed points. In arbitrary dimension, we establish an exact row-wise Gram factorization and the identity rank C(A) = rank(AH_n), which gives the precise rank-reduction mechanism and forces every fixed point to be singular. We identify the all-ones matrix as the unique Pearson-degenerate correlation matrix, prove forward invariance of the Pearson-nondegenerate elliptope, and classify the $2^{n-1} - 1$ nondegenerate, sign-valued fixed points. For n = 3, we prove a complete analytical fixed-point classification: three rank-one patterned points, three rank-two mixed points, and one rank-two equicorrelation point. We also prove the complete relative Lyapunov stability classification: precisely the patterned points are locally asymptotically stable, while the mixed and equicorrelation points are unstable. The global proof reduces the rank-two dynamics to a one-dimensional projective kernel coordinate; an exact order identity produces monotone projective ratios, excludes nontrivial periodic and recurrent limit sets, and forces convergence to a fixed point. Finally, the initial conditions converging to the four unstable fixed points form a Lebesgue-null set. Hence almost every admissible initial condition converges to a patterned fixed point; the three patterned basins are relatively open and permutation-equivalent, and each has Lebesgue measure exactly one third of that of the elliptope.

Keywords: pearson correlation; correlation matrices; iterated correlation maps; fixed-point classification; Lyapunov stability; global convergence; basins of attraction; elliptope

Hyfo Aromadifuzer: From Lab to Real Application of a Mycelium-Based Biocomposite

Miroslav Jozífek [1]*, Benjamín Petržela [2], Adéla Višová [3]

[1] Department of Horticulture; Faculty of Agrobiology, Food and Natural Resources; Czech University of Life Sciences Prague; Kamýcká 129, Prague 165 00, Czech Republic; jozifek@af.czu.cz

[2] Department of Wood Processing and Biomaterials; Faculty of Forestry and Wood Sciences; Czech University of Life Sciences Prague; Kamýcká 129, Prague 165 00, Czech Republic; petrzela@fld.czu.cz

[3] Department of Animal Science; Faculty of Agrobiology, Food and Natural Resources; Czech University of Life Sciences Prague; Kamýcká 129, Prague 165 00, Czech Republic; xvisa002@studenti.czu.cz

* **Correspondence:** petrzela@fld.czu.cz

Abstract: Mycelium-based biocomposites are bio-derived materials grown from fungal mycelium on lignocellulosic substrates, offering lightweight, low-cost, biodegradable structures with favorable mechanical and thermal properties. Although widely studied for insulation and packaging, their potential for functional, market-ready applications remains underexplored. Properties like selective oil-over-water sorption, biodegradability, and reproducible 3D geometry are essential for moving mycelium-based biocomposites from laboratory prototypes toward real products such as an aroma diffuser but have not been sufficiently characterized. This study investigates the sorption, biodegradation, morphology, and 3D visualization of hyfo aromadifuzer, a mycelium-based biocomposite grown on straw using the fungal species *Ganoderma sessile*. Specimens were produced under controlled growing conditions and tested for sorption behavior following the ČSN EN ISO 16535 protocol. Biodegradation was assessed in vermicompost. Morphology was evaluated using Scanning Electron Microscopy, and 3D scanning was performed using an ATOS Compact Scan 12M Essential Line scanner. Statistical analysis used a two-sample Student's t-test with Bonferroni correction. After 24-hour immersion, hyfo type B showed significantly higher oil uptake (78.6 ± 1.9%) than water uptake (39.4 ± 2.0%), a twofold increase. Full biodegradation of hyfo type A (10 samples) in vermicompost was achieved within 6 weeks, 3D scanning enabled volume calculation and thus density calculation resulting in 206 ± 19 $kg \cdot m^{-3}$ (hyfo type A) and 189 ± 14 $kg \cdot m^{-3}$ respectively and SEM identified tight, yet porous hyphal structure. Hyfo aromadifuzer shows that mycelium-based biocomposites can combine strong, type-dependent oil sorption, complete biodegradability, and reproducible 3D-scanned geometry, supporting their transition from laboratory prototypes to a functional, sustainable diffuser product.

Keywords: biomaterial; sorption; biodegradation; mycelium; product design

Combined Effects of Faba Bean Protein Enrichment and Cooking Technology on the Quality Attributes of Plant-Based Meat Analogues

Karina Ilona Hidas [1]*, Koppány Majzinger [1], Gábor Jónás [1], Vilmos Lehota [1], Anna Visy [1]

[1] Department of Animal Products and Food Preservation Technology, Institute of Food Science and Technology, Food Engineering, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, Ménesi Street 43-45, Hungary hidas.karina.ilona@uni-mate.hu; majzinger.koppany.laszlo@uni-mate.hu; jonas.gabor@uni-mate.hu; lehota.vilmos2@phd.uni-mate.hu; visy.anna@uni-mate.hu

* **Correspondence:** hidas.karina.ilona@uni-mate.hu

Abstract: The growing demand for sustainable protein sources has increased interest in plant-based meat analogues. Faba bean protein has emerged as a promising ingredient due to its favourable nutritional profile and functional properties. However, its influence on product quality depends on both formulation and processing conditions. This study investigated the combined effects of faba bean protein enrichment and cooking technology on the quality attributes of plant-based meat analogues. Meat analogue formulations based on textured pea or soy protein were supplemented with 5%, 7.5%, or 10% faba bean protein isolate. Samples were cooked using either hot-air frying or griddle cooking. Instrumental colour (CIELAB), texture profile analysis, and cooking loss were determined, followed by a consumer sensory evaluation using a 10-point hedonic scale. Hot-air frying resulted in lower hardness and lower cooking loss, whereas griddle cooking produced firmer products. Consumer sensory evaluation indicated that formulations containing 7.5% faba bean protein achieved the most favourable balance between flavour, appearance, and texture. Faba bean protein can be successfully incorporated into pea and soy-based meat analogues without compromising product quality. An enrichment level of 7.5%, combined with an appropriate cooking technology, appears to provide the best overall quality and sensory acceptance, supporting the application of faba bean protein as a sustainable ingredient in plant-based meat analogues.

Keywords: plant-based meat analogue; faba bean protein; cooking technology; texture profile analysis; sensory evaluation

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Epoxy-Based Optical Phantoms for Training and Validation of Near-Infrared Transmittance Localization of Solitary Pulmonary Nodules

Yonghyeon Kim [1]*, Uliana Finaeva [1], Martin Zmeskal [1]

[1] Division of Precision Mechanics and Optics, Department of Instrumentation and Control Engineering, Faculty of Mechanical Engineering, Czech Technical University in Prague

* **Correspondence:** justinkim.yes@gmail.com

Abstract: A near-infrared (NIR) transmittance imaging system for intraoperative localization of solitary pulmonary nodules (SPNs) is being developed at FME CTU. An NIR light source is delivered bronchoscopically while transmitted light is recorded by an external NIR camera accessing a thoracic cavity. Local changes in light transmission correspond to the inhomogeneities (e.g. SPN). Since the acquisition of human or animal pulmonary nodules for systematic testing and surgical training is ethically and practically limited, realistic optical phantoms with controlled optical properties are required. This study provides a material characteristics basis for designing epoxy phantoms with predictive absorption and scattering coefficients for systematic evaluation of NIR transmittance imaging limitations and medical specialists training in localization and therapy of SPN. Epoxy resin samples containing increasing concentrations of black ink were prepared and their optical properties measured with integrating sphere at 850 nm, a work wavelength of the diagnostic system. The measurements quantify the effect of ink concentration on light scattering and absorption coefficients. Preliminary measurements indicate that the optical response of black ink in epoxy is not governed solely by absorption. At specific concentrations, the ink also contributes to light scattering. These observations emphasize the importance of experimentally determining both optical parameters when tailoring phantom compositions for realistic tissue simulation under diagnostic conditions. Characterization of phantom material is an essential step toward the fabrication of SPN phantoms supporting physician training in nodule localization and biopsy procedures and providing standardized targets for sensitivity analysis of the diagnostic system. This knowledge enables reproducible phantom fabrication, improves validation of imaging performance, and facilitates future optimization of clinically applicable localization protocols for surgical training.

Keywords: near-infrared imaging; optical phantoms; solitary pulmonary nodules; biomedical optics; surgical training.

Optimization and Stabilization of a LAMP Mastermix through Systematic Evaluation of Reaction Additives

Lucie Komárková [1]*, Adam Norek [2], Petra Stejskalová [1], Ondřej Zítka [1]

[1] Department of Chemistry and Biochemistry, Faculty of AgriSciences, Mendel University, Zemědělská 1 613 00 Brno, Czech Republic, lucik095@gmail.com; petravoparilova@seznam.cz; zitkaondra@gmail.com

[2] Department of Infectious Diseases and Preventive Medicine, Veterinary research institute, v.v.i., 621 00 Brno, Czech Republic, adam.norek@vri.cz

* **Correspondence:** lucik095@gmail.com

Abstract: Rapid and reliable point-of-care molecular diagnostics are essential for effective infectious disease management. Loop-mediated isothermal amplification (LAMP) is a rapid and sensitive nucleic acid amplification method with great potential for point-of-care diagnostics. However, its performance is strongly influenced by the composition of the reaction mixture. The aim of this study was to optimize and stabilize a LAMP mastermix through the systematic evaluation of reaction additives. Initially, seven reaction additives were evaluated individually to assess their effect on LAMP performance. Each additive was tested at five different concentrations across a temperature gradient. Based on the screening results, the additives were classified as amplification enhancers or protective/stabilizing additives. Subsequently, the combination of the two most effective enhancers, betaine and formamide, was optimized, and sugar-based stabilizers were incorporated into the optimized formulation to improve mastermix stability while maintaining its performance. Betaine exhibited the strongest enhancing effect, and the optimized combination of 1.5 M betaine and 0.25 M formamide provided the most consistent amplification performance. Trehalose and sucrose were subsequently evaluated at 100 mM as potential stabilizers. During 14 days of storage at 4 °C, amplification was progressively delayed in all formulations, and neither sugar improved the stability of the liquid mastermix compared with the control. Nevertheless, the trehalose-containing formulation retained amplification across the entire tested DNA concentration range after three days of storage. The optimized LAMP mastermix provides a robust basis for further stabilization studies and represents an important step toward future integration into microfluidic diagnostic platforms.

Keywords: lamp; reaction additives; mastermix optimization; point-of-care diagnostics

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An Image-Based Framework for Dynamic Validation of DEM Models Using 3D Particle Trajectory Reconstruction

Barbora Kuřetová [1]*, Jiří Kuře [1], Miloslav Linda [1], Monika Hromasová [1]

[1] Department of Electrical Engineering and Automation, Faculty of Engineering, Czech University of Life Science Prague, Kamýcká 129, 165 00 Prague – Suchdol, Czech Republic, kuretova@tf.czu.cz; kure@tf.czu.cz; linda@tf.czu.cz; hromasova@tf.czu.cz

* **Correspondence:** kuretova@tf.czu.cz

Abstract: The Discrete Element Method (DEM) has become a widely used numerical tool for simulating the behaviour of particulate materials and their interaction with agricultural tools. Its reliable application, however, depends on precise experimental validation. Ideally, such validation should be conducted under conditions that closely reflect real agricultural operating conditions. This study introduces an image-based framework for the dynamic validation of DEM models by comparing experimentally measured and simulated particle trajectories. The proposed framework integrates synchronized stereo imaging, artificial neural network (ANN)-based three-dimensional trajectory reconstruction, and automated trajectory matching to evaluate the agreement between experimental observations and DEM simulations. The proposed framework was evaluated during tillage experiments conducted under field-representative conditions. The ANN-based trajectory reconstruction achieved a mean spatial deviation of 2.7 mm. Comparison with DEM simulations yielded mean nRMSE values of 4.7% and 9.4% for operating velocities of 1.0 and 1.5 $m \cdot s^{-1}$, respectively, demonstrating the applicability of the proposed framework for DEM model validation. Unlike conventional validation procedures based on static tests, the proposed framework enables direct evaluation of dynamic particle motion during tillage operations and provides a practical approach to the experimental validation and calibration of DEM models in agricultural engineering.

Keywords: discrete element method; model validation; particle tracking; image analysis

Development of Meat Product with Modified Nutritional Value Using Apple Pomace

Csenge László [1]*, Judit Tormási [1]

[1] Department of Food Chemistry and Analysis; Institute of Food Science and Technology; Hungarian University of Agriculture and Life Sciences; Hungary, Gödöllő, Páter Károly street 1.; lcsenge2002@gmail.com; Tormasi.Judit@uni-mate.hu

* **Correspondence:** lcsenge2002@gmail.com

Abstract: Apple pomace is a major by-product of fruit processing and a promising upcycled ingredient due to its dietary fibre and polyphenol content. Several of these components have been studied for their lipase enzyme inhibitory properties, which may reduce fat digestibility. This study aimed to develop a beef meatball containing different levels of powdered or rehydrated apple pomace (0, 2.5, and 5%) and to evaluate the effects of its incorporation on technological and sensory properties and on lipid digestion. Moreover, consumer attitudes toward upcycled products were investigated through a questionnaire completed by 137 respondents. The effects of hydration on texture and cooking loss were determined by texture profile analysis and gravimetric measurements. Fat digestibility was assessed using the INFOGEST 2.0 in vitro model followed by GC-FID analysis of free fatty acids. Apple pomace significantly reduced cooking loss (by 10.74 ± 2.94%) when applied with appropriate rehydration, whereas increasing hydration decreased product hardness ($r = -0.92$). The tested apple pomace concentrations did not reduce fat digestibility (total in vitro digestibility of 49.58 ± 1.57% for control, 55.99 ± 2.31% at 2,5% and 51.30 ± 3.24% at 5%), indicating that higher incorporation levels are required to achieve the desired effect. Survey results demonstrated positive consumer interest (89.6%) in upcycled and nutritionally modified meat products despite limited nutritional awareness. Apple pomace shows considerable potential as a functional upcycled ingredient for hybrid meat products, although further formulation optimization is necessary to achieve the targeted reduction in fat digestibility without compromising product quality.

Keywords: apple pomace; fat digestibility; upcycling; functional foods

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Effects of Natural Colouring Ingredients on Colour, pH and Cooking Loss of Nitrite-Free Frankfurters

Vilmos Lehota [1]*, Gábor Jónás [2], Karina Hidas [2], László Péter Abrankó [3], László Ferenc Friedrich[2]

[1] Department of Livestock Products and Food Preservation Technology; Department of Food Chemistry and Analytics, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Villányi út 29–43, H-1118 Budapest, Hungary, Lehota.Vilmos.2@phd.uni-mate.hu

[2] Department of Livestock Products and Food Preservation Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, 29–43 Villányi Road, H-1118 Budapest, Hungary, Jonas.Gabor@uni-mate.hu; Hidas.Karina.Ilona@uni-mate.hu; Hungary, Friedrich.Laszlo.Ferenc@uni-mate.hu

[3] Department of Food Chemistry and Analytics, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, 29–43 Villányi Road, H-1118 Budapest, Hungary, Abranko.Laszlo.Peter@uni-mate.hu

* **Correspondence:** Lehota.Vilmos.2@phd.uni-mate.hu

Abstract: Sodium nitrite provides the characteristic cured colour and contributes to the technological stability of frankfurter-type products; however, demand is increasing for formulations containing more natural ingredients. This study evaluated the colour-compensating potential of beetroot, blackcurrant and porcine blood powder in nitrite-free frankfurters. Nine formulations were produced: a conventional nitrite-cured control and eight nitrite-free treatments containing beetroot powder, pre-dispersed beetroot powder, beetroot juice, blackcurrant powder, pre-dispersed blackcurrant powder, blackcurrant juice, blood powder or pre-dispersed blood powder. Instrumental colour (CIE L*, a* and b*) and pH were measured before and after heat treatment, while cooking loss was determined gravimetrically. Visual product preference was assessed using a questionnaire completed by 64 respondents. Treatment significantly affected all colour parameters and pH. Heat treatment influenced redness and pH ($p<0.001$), and significant treatment-by-heat-treatment interactions were observed for L* ($p=0.027$), a*, b* and pH (all $p<0.001$). Beetroot powder and pre-dispersed beetroot powder produced the highest initial redness; after heating, their mean a* values remained above that of the conventional control, although redness decreased markedly. Cooking loss differed among formulations according to Welch's ANOVA ($p<0.001$). Beetroot-powder frankfurters were preferred by 37.5% of respondents. Beetroot powder therefore showed the greatest potential for improving the appearance and visual acceptance of nitrite-free frankfurters. However, colour compensation alone cannot replace the antimicrobial and antioxidant functions of nitrite; therefore, further microbiological, oxidative-stability and sensory studies are required.

Keywords: nitrite reduction; frankfurter; beetroot powder; natural colourants; cooking loss

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Analytical Method Development Opportunities for the Determination of Patulin in Apples

Rozália Maldrik [1]*, Csilla Sörös [1], Enikő Horváthné Szanics [1]

[1] Department of Food Chemistry and Analytics, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Villányi út 29-43, 1118 Budapest, Hungary, Maldrik.Rozalia@stud.uni-mate.hu

* **Correspondence:** Maldrik.Rozalia@stud.uni-mate.hu

Abstract: Since the apple is the most widely distributed fruit worldwide, the mycotoxin patulin represents a significant food safety risk in the fruit and processed apple products. Regulation (EU) 2023/915 sets the maximum permissible level of patulin contamination at 50 μg/kg for the examined apple juice. My objectives were to compare the standard AOAC and modern QuEChERS sample preparation methods and subsequently establish an in-house-validated method for patulin determination in apple juice that meets regulatory performance criteria. Instrumental measurements were performed using an HPLC-UV system at 276 nm. The finalized method is based on the QuEChERS procedure, which proved faster, simpler, and more routine during experiments, with a lower organic solvent requirement than the official AOAC method. The limits of detection and quantification (LOD: 3 μg/l, LOQ: 10 μg/l) and average recovery values (86% to 96%) complied with legal requirements. Following validation, the method was applied to a more complex matrix: apple puree from fresh apples. This required modifying chromatographic parameters from an isocratic program to gradient elution. The average recovery values for these samples were low (38–42%), indicating that further optimization is needed to improve yield. The developed QuEChERS-based method is suitable for the rapid routine analysis of commercial apple juices and can serve as a basis for future experiments monitoring the safe utilization of fresh apples and apple pomace, a by-product increasingly targeted for valorization.

Keywords: patulin; apple juice; food safety; method development

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Unmanned Systems in the Process of Building Operational Capabilities and Modernization of the Armed Forces in the 21st Century

Paweł Kwaśny [1], MA Grzegorz Malitka [2]*

[1] Military University of Technology, Faculty of Electronics, pawelkwas123456@gmail.com

[2] War Studies University, Faculty of National Security, grzegorz.malitka91@gmail.com

* **Correspondence:** grzegorz.malitka91@gmail.com

Abstract: The dynamic development of emerging technologies has fundamentally transformed the contemporary security environment and accelerated the modernization of armed forces worldwide. In particular, unmanned systems have become an essential component of military transformation, influencing the way armed forces plan, conduct, and support military operations. Their increasing role results from the growing demand for enhanced improved situational awareness, reduced risks to personnel, and the ability to operate effectively in increasingly complex operational environments. The aim of this article is to examine the role of unmanned systems in the process of building operational capabilities and supporting the modernization of armed forces in the twenty-first century. The study is based on a critical review of the scientific literature, an analysis of strategic and doctrinal documents, and selected case studies illustrating the employment of unmanned systems in contemporary military operations and modernization programs. The analysis considers technological, operational, organizational, and strategic dimensions of military transformation. The analysis suggests that unmanned systems contribute to improving reconnaissance, logistics. At the same time, their growing integration with artificial intelligence, autonomous technologies, highlights challenges related to cybersecurity, interoperability, legal frameworks, and ethical considerations. The study indicates that unmanned systems are becoming an increasingly important element of armed forces modernization and the development of operational capabilities. Their effective adoption depends not only on technological progress but also on appropriate, organizational, and regulatory adaptations, as well as sustained investment in personnel training and international cooperation.

Keywords: unmanned systems; military modernization; military transformation

Sustainable Biomass-Derived Carbon Nanomaterials for Ultra-Sensitive Monitoring of Hazardous Chromium Ions in Aqueous Systems

Moamen F. Rabea [1,2]*, Marek Wojnicki [1]

[1] Department of Physical Chemistry and Metallurgy, Faculty of Non-Ferrous Metals, AGH University of Krakow, al. A. Mickiewicza 30, 30-059 Krakow, Poland, moamenfouad@agh.edu.pl; marekw@agh.edu.pl

[2] Department of Chemistry, Faculty of Science, Tanta University, Tanta 31527, Egypt, moamen.fouad@science.tanta.edu.eg

* **Correspondence:** moamenfouad@agh.edu.pl

Abstract: Global environmental and public health concerns are the growing pollution of water resources by hazardous heavy metals. Therefore, there is a necessity for innovative, sustainable, and cost-effective detection technologies for rapid and precise monitoring to resolve this issue. This study transformed biomass waste into carbon-based nanomaterials, which were employed as a sensor for the ultra-sensitive detection of Cr^{6+} ions in aqueous media. Carbon nanomaterials were produced from cherry pit waste by an eco-friendly hydrothermal method and evaluated using spectroscopic techniques to assess their optical and surface properties. Sensitivity and selectivity studies were performed to examine the interaction between carbon nanomaterials and Cr^{6+} ions in aqueous solutions. The sensor's analytical performance was evaluated via calibration tests and the determination of the detection limit and quantum yield. The nanomaterials exhibited exceptional photoluminescence and analytical characteristics with a quantum yield of 31% and a (LOD) of 0.94 μM, underscoring their proficiency in trace-level monitoring of harmful chromium ions. Furthermore, the sensor retained 98% of its initial fluorescence intensity after prolonged UV irradiation, 90% after 30 days of storage, and 100% in the presence of NaCl (up to 2000 μM), while exhibiting negligible changes in different solvent environments, demonstrating its potential suitability for practical applications. The findings emphasize the potential of sustainable nanotechnology to address critical water quality challenges and contribute to the development of advanced, cost-effective, and environmentally friendly sensing systems.

Keywords: biomass waste; carbon nanomaterials; Cr^{6+} detection; environmental monitoring; sustainable technology

Mechanized Weed Management in Colombian Coffee Plantations: Operational Evaluation of a Remote-Controlled Tracked Terrestrial Drone

Sergio Muñoz-Salazar [1]*, Eduardo Duque-Dussán [1]

[1] Engineering Discipline, National Coffee Research Centre - Cenicafé, km 4 vía Chinchiná-Manizales, Caldas, Colombia. sergio.munoz@cafedecolombia.com; eduardo.duque@cafedecolombia.com

* **Correspondence:** sergio.munoz@cafedecolombia.com

Abstract: Weed management is a frequent and labor-demanding operation in Colombian coffee production, particularly on sloping and irregular terrain. Remote-controlled terrestrial machines may reduce the physical burden on workers and increase their separation from the cutting mechanism. This study evaluated the operational suitability of a tracked, remote-controlled mower for mechanized weed management under representative coffee-growing conditions. The equipment was evaluated in three complementary phases: an open-field preliminary assessment, coffee plantations in the establishment stage, and productive coffee plantations. The evaluation considered remote-control response, forward and reverse movement, turning ability, maneuverability, visual cutting quality, stability on slopes, visibility, risk of contact with coffee plants, operational safety, accessibility, and basic maintenance requirements. The machine showed controlled movement and adequate remote-control response in open-field conditions. Its operation was more favorable in young coffee plantations because of greater visibility, wider maneuvering space, and less interference from branches. In productive plantations, low branches, obstacles, reduced visibility, and limited space required slower and more controlled operation. In rows approximately 1.4 m wide, the equipment could not be operated adequately because of the risk of contact with plants and insufficient space for safe maneuvering. The operational feasibility of remote-controlled tracked mowers in coffee plantations depends strongly on row width, crop development, visibility, accessibility, terrain conditions, and available maneuvering space. Their greatest potential is expected in accessible plots with wide rows, manageable slopes, few obstacles, and continuous visual contact between the operator and the machine.

Keywords: weed management; coffee plantations; terrestrial drones; remote-controlled mower; agricultural mechanization

Leveraging Artificial Intelligence and Machine Learning for Sustainable Natural Products Drug Discovery in Sub-Saharan Africa

Oluwafunmilola Ogundipe [1]*

[1] Department of Chemistry, Faculty of Natural and Applied Sciences, Federal University of Agriculture and Development Studies, Iragbiji, Osun State, Nigeria

* **Correspondence:** ogundipefunmilola5@gmail.com

Abstract: Over the decades, natural products in Sub-Saharan Africa have been exploited as a rich source of therapeutic agents, contributing essentially to the development of anticancer drugs, antibiotics, antimicrobials, antidiabetics, and other medicines. The conventional method of natural product drug discovery in this region is often limited by low phytochemical screening efficiency, complex bioactive compound matrices, high costs, and labor-intensive isolation processes, thereby causing a major decline for natural products to be properly documented inside pharmacopoeias. Thus, recent evolutions in technology such as artificial intelligence and machine learning offer groundbreaking solutions to address these limitations. Artificial intelligence and machine learning are data-driven computational tools capable of identifying patterns, optimizing decision-making processes, and predicting outcomes. In natural product drug discovery research, these tools help in the identification of potential molecular targets, predicting biological activity, modeling structure-activity relationships, and virtual screening of large compound libraries. The algorithms of machine learning improve dereplication processes and assist in the interpretation of spectroscopic data such as ^{1}H NMR, ^{13}C NMR, and mass spectrometry, thereby intensifying compound identification and characterization. Also, artificial intelligence-driven tools such as SwissADME and ADMETlab help in drug discovery and optimization by predicting physicochemical properties, drug-likeness, toxicity, and pharmacokinetic profiles at early stages. By incorporating computational tools with natural product drug discovery, researchers can reduce time and cost while discovering promising novel and hit bioactive compounds in Sub-Saharan Africa.

Keywords: natural products; drug discovery; computational tools; computational pharmacology

Effect of Lignin on the Properties of Waterborne (Meth)Acrylic Polymer Composites

Marija Prosheva [1]*, Jadranka Blazhevska Gilev [1]

[1] Ss. Cyril and Methodius University in Skopje, Faculty of Technology and Metallurgy, Ruger Bosković 16, 1000 Skopje, N. Macedonia

* **Correspondence:** marija@tmf.ukim.edu.mk

Abstract: The development of sustainable polymeric materials has driven increasing interest in the incorporation of renewable bio-based components without compromising material performance. This study investigates the effect of lignin incorporation on the properties of waterborne (meth)acrylic polymer composites prepared through an environmentally friendly approach. Lignin was incorporated into waterborne (meth)acrylic polymer matrices by *in situ* semicontinuous miniemulsion polymerisation. Composite films containing 0.5 and 1 wt% lignin were obtained by water evaporation and characterized in terms of their optical, mechanical, thermal, barrier, and photodegradation properties. The addition of lignin enhanced UV and visible light absorption improved tensile properties, particularly at 1 wt% lignin loading, and increased the thermal stability of the composites. Moreover, despite the hydrophilic nature of lignin, the composite films exhibited lower water permeability than the neat polymer matrix. UV-aging studies demonstrated that lignin chromophoric groups generate free radicals under ultraviolet irradiation, initiating controlled degradation of both the lignin and polymer phases. These findings demonstrate that lignin acts as a multifunctional bio-based additive, simultaneously improving the performance of waterborne polymer composites while promoting controlled degradation under UV exposure. The proposed approach provides a sustainable strategy for the development of high-performance functional polymer composites with enhanced environmental compatibility.

Keywords: lignin; waterborne polymer composites; miniemulsion polymerisation

Chemical Composition and Ignition Characteristics of European Ash Wood (*Fraxinus excelsior* L.)

Anna Mária Rajnohová [1]*, Linda Makovická Osvaldová [1], Kateřina Hájková [2]

[1] Department of Fire Engineering, Faculty of Security Engineering, University of Žilina, 1. mája 32, 010 26 Žilina, Slovakia, anna_maria.rajnohova@uniza.sk; linda.makovicka@uniza.sk

[2] Department of Wood Processing and Biomaterials, Faculty of Forestry and Wood Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6 – Suchdol, Czech Republic, hajkovakaterina@fld.czu.cz

* **Correspondence:** anna_maria.rajnohova@uniza.sk

Abstract: Wood is a widely used renewable material, but its combustibility requires reliable information on its composition, energy content and ignition characteristics for fire-safety assessment. This study aimed to characterise European ash wood (*Fraxinus excelsior* L.) by determining its chemical composition, gross calorific value and ignition characteristics. Chemical composition was determined in three replicate samples. Gross calorific value was measured in ten specimens by oxygen-bomb calorimetry using a procedure based on STN ISO 1928 (ISO 1928:2020). Flash-ignition and spontaneous-ignition behaviour were evaluated in a hot-air furnace using a procedure based on ISO 871, with samples of approximately 3 g exposed to 320–410 °C and 430–520 °C, respectively. Ignition time, mass loss, and burning mode were recorded. Lignin, holocellulose, hemicellulose, cellulose and ash contents were 40.61 ± 0.40%, 78.99 ± 1.97%, 38.38 ± 1.59%, 15.22 ± 0.94% and 0.577 ± 0.040%, respectively. Acetone-, ethanol-, and ethanol–toluene-soluble extractives were 0.741 ± 0.064%, 2.138 ± 0.125% and 2.203 ± 0.259%, respectively. Glucose and xylose were the dominant identified monosaccharides. The mean gross calorific value was 18.70 ± 0.32 MJ kg^{-1}. The lowest tested temperatures at which flash ignition and spontaneous ignition were observed were 320 °C and 430 °C, with ignition times of 8.1 and 4.0 min, respectively. Ignition delay generally decreased with increasing temperature, and burning was predominantly homogeneous. The results provide a chemical, energetic and ignition-related characterisation of European ash wood and reference data for comparisons among wood species under controlled laboratory heating conditions.

Keywords: ash wood; chemical composition; gross calorific value; flash ignition; spontaneous ignition

Innovative Microbial Co-Cultures and Advanced Chemical Profiling Reveal Hidden Risks in Polyurethane Bioremediation

Anshu Shaw [1]*, Lenka Wimmerova [1]

[1] Department of Applied Ecology, Faculty of Environmental Sciences, Czech University of Life Sciences Prague, Kamycka 129, Prague - Suchdol, 165 00, Czechia, shawa@fzp.czu.cz; wimmerova@fzp.czu.cz.

* **Correspondence:** shawa@fzp.czu.cz

Abstract: As plastic waste continues to accumulate worldwide, microbial degradation is emerging as a promising technology for breaking down persistent materials such as polyurethane (PU) foams. Yet most research stops at measuring how well a material degrades, without examining what is actually released in the process. This study combines microbial co-culture technology with advanced analytical chemistry to address that gap, evaluating both the degradation performance of bacterial combinations and the safety of the compounds they generate. Two bacterial strains and their co-culture were applied to aliphatic and aromatic PU foams and monitored over four months. Degradation was tracked through weight loss and surface analysis. Advanced two-dimensional chromatographic profiling was used to identify the resulting breakdown products with high precision. The safety of these products was then tested using a set of complementary bioassays representing different levels of the ecosystem. The co-culture consistently outperformed either single strain, achieving approximately 83% weight loss in the aliphatic foam compared to markedly lower losses for the individual strains, and driving the only significant bulk degradation (49%) observed in the more resistant aromatic foam. Detailed chemical profiling revealed that degradation caused alteration of compounds compared to the original material, including the disappearance of 1-octen-3-ol and the emergence of sulfur-containing metabolites such as dimethyl disulfide. Toxicity testing showed that these byproducts had clear harmful effects, including organism mortality, impaired growth, and altered biological activity, depending on the test system used. Advanced analytical and biological testing tools reveal a side of bioremediation that is often overlooked: degradation success does not equal environmental safety. Integrating chemical and toxicological technologies into bioremediation research is essential for developing methods that are both effective and genuinely safe.

Keywords: polyurethane biodegradation; bacterial co-culture; chemical profiling; ecotoxicology; green technology

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Predicting Environment-Related Health Issues in a Naturally Ventilated Multipurpose University Auditorium Using Machine Learning

Abida Ebnat [1]*, Protyasha Sinha [1], Firuja Tasneem [1], Mohammad Nyme Uddin [2], Umma Nourin Sawon [3]

[1] Building Energy & Environmental Management (BEEM) Enhanced by AI, Dhaka, Bangladesh, ab.idaebnat.iubat@gmail.com; si.nhaprotyasha@gmail.com; firuja.tsm@gmail.com

[4] Department of Architectural Engineering, College of Engineering, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh 11432, Saudi Arabia, mnuddin@imamu.edu.sa

[5] Building Energy & Environmental Management (BEEM) Enhanced by AI, Dhaka, Bangladesh, um.ma.nourin.sawon@gmail.com

* **Correspondence:** firuja.tsm@gmail.com

Abstract: Outdoor environmental conditions, including air quality, thermal conditions, noise, and illumination, significantly influence occupants' health and well-being in educational environments. However, limited studies have integrated Outdoor Air Quality (OAQ) data with explainable machine learning (ML) to predict environment-related health issues in the educational context. This study investigates the relationship between OAQ and environment-related health issues among occupants of a naturally ventilated multipurpose university auditorium located in Dhaka, Bangladesh, using environmental measurements and occupant survey responses. Data were collected during the winter season (December 2025 – April 2026), resulting in 566 responses comprising demographic (e.g., age and gender), environmental (e.g., temperature, humidity, CO_2, light intensity, noise level, etc.), and occupant behavioral and contextual (e.g., seating location, stay duration, adaptive behaviors, etc.) features. Data preprocessing included missing value handling, categorical encoding, correlation analysis, VIF assessment, and IQR-based outlier detection. Three ML models: Random Forest (RF), LightGBM, and CatBoost classifiers were developed to predict health issues and evaluated using accuracy and classification report. SHapley Additive exPlanations (SHAP) was applied to identify the most influential predictors. Results indicated that all evaluated models achieved classification accuracies above 80%, with RF achieving the highest accuracy of 89%. SHAP analysis identified perceived odor from the canteen and construction dust, CO2 level, air temperature, and seating arrangement as the most influential predictors of health issues. The study demonstrates the potential of explainable ML for predicting environment-related health issues in naturally ventilated educational environments. Future studies should incorporate real-time sensor data, seasonal variation, larger multi-site datasets, and additional contextual variables.

Keywords: outdoor air quality; environment-related health issues; explainable machine learning; random forest; SHAP analysis

Digital Twin Pre-Training for Smart Home Lighting Control

Tomas Sladcik [1*]

[1] University of Ostrava, Dept. of Informatics and Computers, st. 30. dubna 22, Ostrava, Czechia, Tomas.Sladcik@osu.cz

* **Correspondence:** tsladcik@gmail.com

Abstract: Smart home lighting systems rely on static rules that cannot adapt to changing room conditions. Deploying learning-based agents directly in homes is problematic: the trial-and-error exploration phase causes occupant discomfort, and most solutions depend on cloud services, introducing latency and privacy risks. A tabular Q-learning agent with a 5x2x7 state-action space was developed to regulate a dimmable smart bulb based on measured illuminance. A support vector regression (SVR) model with an RBF kernel, trained on three weeks of real-lux measurements paired with solar azimuth and elevation data, generated a synthetic year-round illuminance profile for Gymnasium-based agent training. The trained policy was deployed on a Raspberry Pi 5 via Node-RED, using a BH1750 digital lux sensor as the sole feedback input without cloud dependency. The agent converged within 300 training episodes. In real-world deployment, it continuously responded to changing ambient conditions, adjusting bulb brightness to compensate for natural illuminance variations, increasing output as daylight diminished, and reducing it as light levels recovered. In a representative fade-out scenario, the agent stabilized within 1 lx of the 22-lx target within 20 minutes, maintaining steady-state operation thereafter. Adaptive lighting control can be achieved with minimal operational hardware, specifically a single lux sensor and a low-cost single-board computer, without cloud dependency or disruptive exploration, provided a short initial measurement period is conducted to capture the room-specific illuminance profile for digital twin training. This pre-training eliminated the cold-start problem, making the approach deployable in real households with diverse optical characteristics.

Keywords: smart home; adaptive lighting; reinforcement learning; digital twin; edge computing

The Effect of *Monascus Purpureus* and *Rhus Typhina* Pigments for Reduce the Sodium Nitrite in Meat Products

Oleh Starynskyi [1]*, Tetiana Stepanova [1]

[1] Department of Technology of Nutrition, Faculty of Food Technologies, Sumy National Agrarian University, Herasyma Kondratiyeva 160, 40021 Sumy City, Ukraine; olehstarynskyi@gmail.com; tetiana.stepanova@snau.edu.ua

* **Correspondence:** tetiana.stepanova@snau.edu.ua

Abstract: The article presents the results of research on the use of *Monascus purpureus* and *Rhus typhina* to reduce the sodium nitrite level in meat products. The article focuses on the role of sodium nitrite in the technology of meat products. The study looked at how sodium nitrite affects the development of taste and smell, keeps the red-pink color of meat, and helps maintain the safety and stability of the meat by preventing harmful bacteria growth. A boiled sausages made from top-grade beef and semi-fat pork in a ratio of 1:1 were investigated. The samples were tested - control - boiled sausage by traditional technology with a mass fraction of $NaNO_2$ of 5 mg/100 g, sample 1 - boiled sausage with the addition of M.purpureus to the recipe with a mass fraction of $NaNO_2$ of 5 mg/100 g, sample 2 - boiled sausage made with the addition of M. purpureus to the recipe with a mass fraction of $NaNO_2$ of 2.5 mg/100 g, sample 3 - boiled sausage made with the addition of a mixture of M. purpureus and R. typhina in a ratio of 1:1 with a mass fraction of $NaNO_2$ of 5 mg/100 g. The dynamics of pH and aw values in samples with the addition of M. purpureus and R. typhina pigments were established. The samples have a pH in the range 6.21...6.27 depending on the amount of pigments added and their ratio. Aw values were in the range 0.98- 0.99, which indicates the antibacterial properties of the introduced plant component.

Keywords: sodium nitrite; meat products; reducing; *Monascus purpureus*; *Rhus typhina*; safety; bacteriostatic properties

Acknowledgement: We extend our deepest appreciation to all the courageous defenders of Ukraine, whose efforts have made this work possible.

Multifaceted Application of MALDI-TOF MS in the Research of Grapevine Microbial Diversity

Kristóf Utassy [1,2], Andrea Pomázi [2], Tamás Kocsis [2]*

[1] József Farkas Doctoral Program in Food Science, Doctoral school for Agriculture and Food Science, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, Hungary, Utassy.Kristof@phd.uni-mate.hu

[2] Department of Food Microbiology, Hygiene and Safety, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, Hungary, Pomazi.Andrea@uni-mate.hu; Kocsis.Tamas.Jozsef@uni-mate.hu

* **Correspondence:** Kocsis.Tamas.Jozsef@uni-mate.hu

Abstract: Rapid mapping of grapevine microbiome dynamics remains a challenge for viticulture and winemaking. Our research demonstrates the efficiency of MALDI-TOF MS in tracking seasonal culturable diversity and establishing strain collections. During spring and autumn of 2025, and spring of 2026, mixed cultures were obtained from inflorescences, leaves, shoots, and berries (Kéknyelű and Pinot Gris cultivars, organic and integrated management) using YEPD, TGE, RBC, and MRS media under aerobic and anaerobic conditions. To maximize taxonomic coverage, a targeted, diversity-oriented isolation approach was applied: morphologically distinct colonies were selectively inoculated into pure cultures, avoiding the overrepresentation of dominant taxa. Isolates were identified via MALDI-TOF MS and visualized with Krona charts, uncovering a rich microbial gene pool. Although the selective nature of the method means the results do not reflect the absolute quantitative composition of the complete *in situ* microbiome, they faithfully represent the seasonality of the culturable fraction. Spring 2025 samples revealed that among the lactic acid bacteria, *Lactococcus* spp. dominated inflorescences, while *Weissella* spp. colonized shoots and leaves. Overall, the diverse spring bacterial flora (*Bacillota*, *Pseudomonadota*, *Actinomycetota*) was replaced in the autumn by a diverse community of yeasts (*Ascomycota*, *Basidiomycota*) important from an oenological perspective. The combination of MALDI-TOF MS and diversity-focused isolation is excellently suited for the rapid and cost-effective mapping of the microbial potential inherent in vineyards. Although the obtained picture is qualitative, the method effectively supports the selection of wild strains valuable for winemaking and microbial ecological research.

Keywords: MALDI-TOF MS; wine microbiology; grapevine microbiome; seasonal dynamics; culturable diversity

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Dynamics of Farm Typologies and Livelihood Resilience Post Land Agrarian Reform: Case study of Zvimba District in Zimbabwe (1980–2024)

Welcome Zimuto [1]*

[1] Development Economics Department, Faculty of Tropical AgriSciences, Czech University of Life Sciences, Kamycka 129, 16500 Suchdol, zimuto@ftz.czu.cz

* **Correspondence:** zimuto@ftz.czu.cz

Abstract: In this study, the evolution and dynamic changes in land policies in Zvimba district, Zimbabwe, are examined post the Fast Track Land Reform Program of 2000. Specifically, the analyses focused on transitional changes in land tenure, cropping patterns, and land-use systems over a 25-year period. A longitudinal comparative approach was employed, in which historical data from scientific and non-scientific reports were synthesized with primary data from a contemporary sample of 120 farms. Evidence indicates that the Zvimba farm system has shifted from a dual farm system to a trimodal system. Tobacco remains the most profitable and preferred by small farmers, with mean revenues of up to 2045.65 USD/ha, while yields averaged 1.6 t/ha. The variable minimum cost to achieve this yield was 1282.05 USD/ha. On the contrary, soybeans yielded up to 1.92 tons per hectare, earning 1363 USD/ha. Beyond cropping, a new critical trend was observed in which farmers allocate their labour in the dry season to off-farm income streams, including thatch harvesting and tuckshop operations, which serve as small retail businesses In conclusion, this study suggests a holistic policy approach to optimize production and integrate cropping and off-farm activities, while providing a clear tenure that retains land as a bankable asset, enabling farmers to access credit from financial institutions.

Keywords: farm typologies; land tenure; smallholder agriculture; agricultural policy; off-farm income

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Digital-mediated Knowledge Pathways Shape Regenerative Agriculture Adoption among Smallholder Farmers

Rammah Zwan [1]*, Miroslava Bavorova [1], AyatUllah [1], Edvin Zhllima [2]

[1] Department of Economics and Development, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague

[2] Faculty of Economy and Agribusiness, Agricultural University of Tirana, Tiranë, Albania

* **Correspondence:** zwan@ftz.czu.cz

Abstract: Smallholder farmers in vulnerable agricultural systems are increasingly challenged to adopt regenerative agricultural methods due to persistent constraints in technical knowledge. Digital agricultural technology services (DATs) offer a potential pathway to enhance access to agricultural knowledge, but there is limited evidence of their contribution to regenerative agriculture adoption, especially in rural conflict-affected areas. This paper explores determinants of DATs use and its association with four regenerative practices (agroforestry, cover cropping, crop rotation and water management) using binary logistic regression, propensity score matching and inverse probability weighted regression adjustment, based on survey data from 400 farm households in coastal Syria. The use of DATs is primarily determined by human capital, institutional connectivity and digital infrastructure and not by the structural characteristics of the farm. Younger, better educated farmers who receive extension services, access credit, participate in cooperatives, and own smartphones are more likely to use digital agricultural information. We find that DATs' use is associated with a 15% increase in water management adoption, a 9% increase in cover cropping adoption, weaker effects on crop rotation adoption, and no statistically robust association for agroforestry. This pattern suggests that digital technologies may reduce information constraints for management-intensive practices, but they cannot overcome financial, institutional and long-term investment barriers to structural land-use transformations. Digital agriculture is therefore a driver of broader agricultural innovation systems. Policies should combine the digital advisory services with extension, financial inclusion and institutional support to translate access to information into sustainable farming transitions.

Keywords: digital agriculture; climate adaptation; smallholder resilience; agricultural innovation systems; propensity score matching

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Bias in Artificial Intelligence: Addressing Fairness and Discrimination in Machine Learning Systems

Richard Marfo [1]*, Vesely Arnost [1]

[1] Faculty of Economics and Management, Department of Information Engineering

* **Correspondence:** marfo@pef.czu.cz

Abstract: Artificial Intelligence (AI) is increasingly applied in high-stakes domains such as healthcare, employment, finance, and criminal justice. Although AI can improve efficiency and decision-making, it may also inherit and amplify societal biases embedded in data, algorithms, human decisions, and deployment environments, resulting in discriminatory outcomes. This study employed a qualitative case study approach to examine documented examples of AI bias in healthcare, hiring, and criminal justice. Evidence was synthesized from peer-reviewed literature, industry reports, and investigative studies using a socio-technical analytical framework. The findings identified four interconnected sources of bias: data bias, algorithmic bias, human bias, and deployment bias. Across the analyzed cases, biased AI systems contributed to unequal outcomes, including disparities in healthcare access and diagnosis, gender and racial discrimination in recruitment, and disproportionate impacts on marginalized populations in criminal justice settings. Technical mitigation approaches such as dataset balancing, fairness-aware machine learning, and post-deployment monitoring were found to be beneficial but insufficient when applied in isolation. Addressing AI bias requires a socio-technical approach that integrates technical safeguards with governance measures, including transparency, auditing, regulatory oversight, and inclusive stakeholder engagement to promote fairness, accountability, and equitable AI outcomes.

Keywords: algorithmic bias; artificial intelligence; fairness; responsible ai governance; socio-technical systems

Adoption Impact of Provitamin a Biofortified Cassava on Women's Socioeconomic Empowerment: A Socio-Ecological Analysis among Farming Households in Nigeria

Sylvia Ukamaka Echefu [1]*, Jana Mazancova [1]

[1] Department of Food and Bioresource Technology, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, echefu@ftz.czu.cz; mazan@ftz.czu.cz

* **Correspondence:** echefu@ftz.czu.cz

Abstract: Despite global recognition of gender equality, significant disparities persist in agriculture across sub-Saharan Africa. In Nigeria's cassava (*Manihot esculenta* Crantz) value chain, women dominate labour-intensive production and processing yet have limited access to productive resources and control over income. Reliance on traditional cassava contributes to Vitamin A Deficiency (VAD) among rural women and children. Although biofortified provitamin A cassava (PVA) is a promising nutrition-sensitive innovation, its impact on women's socioeconomic empowerment remains underexplored, particularly regarding intra-household power dynamics. This study integrates Rogers' Diffusion of Innovations theory and Kabeer's Empowerment framework within a socio-ecological approach to examine how contextual and institutional factors shape the relationship between PVA cassava adoption and women's empowerment. Using a mixed-methods quasi-experimental design, survey data will be collected from 480 women cassava farmers across four agro-ecological zones in Nigeria. Propensity Score Matching, Probit, and interaction-effect models will be used to assess determinants of adoption, intensity, and empowerment outcomes as measured by the Women's Empowerment in Agriculture Index. Quantitative findings will be complemented by thematic analysis of 16 focus group discussions and 12–20 key informant interviews. The study is expected to show that empowerment outcomes from PVA cassava adoption are automatic but depend on socio-ecological and institutional factors. Where enabling conditions exist, adoption is likely to enhance women's agency, income autonomy, and decision-making power, while constrained conditions may limit these benefits. The study will inform gender-responsive, nutrition-sensitive agricultural policies aligned with Sustainable Development Goals 1, 2, 3, 5, and 8.

Keywords: biofortification; yellow cassava; agricultural innovation; women's empowerment; socio-ecological model

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Development of Low-Cost Solar Dryer for Horticultural Crops

Ghulam Hassan Shah [1*]

[1] Department of Horticulture, Food Science and Postharvest Technology, Arba Minch University, Arba Minch, Ethiopia

* **Correspondence:** drghshah2@gmail.com

Abstract: Global postharvest losses of horticultural crops range from 31 to 45%. In developing countries such losses for some crops are as high as 70%, as the postharvest handling and processing infrastructures in such countries are unaffordable. Open-sun drying is a cheap and commonly used preservation technique, but exposure of products to contamination makes it unsafe. Mechanical dryers require electricity or fossil fuels. The present study presents a low-cost solar dryer designed for rural and semi-commercial processing units using locally available materials and passive solar energy. A naturally ventilated solar dryer was designed using greenhouse heating and natural-convection principles. The dryer consists of a 90 × 90 cm wooden frame with a total height of 180 cm, a dome-shaped transparent polyethylene roof, black polyethylene side walls, an inclined 150 × 20 × 15 cm solar air-inlet duct, adjustable drying trays, and a roof-top exhaust vent. The adjustable tray permits flexible loading according to product and drying requirements, with an approximate capacity of 10 kg fresh produce per batch. Under ambient temperatures of 24–35°C, the dryer achieves internal drying temperatures of approximately 40–58°C. Number of products including mango bars, mango chips and lemongrass dried faster in this dryer and were ranked superior to sundried products. The developed dryer is simple, energy-independent and can be fabricated locally in developing countries. Its adjustable capacity and passive operation make it suitable for rural, small-scale and community-level processing while contributing to the reduction of postharvest losses.

Keywords: solar dryer; natural convection; postharvest losses; dehydration; low-cost technology

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Short-Contact Disinfection Workflow Exposes Material-Dependent Biofilm Survival in *Pseudomonas aeruginosa* and Other Food Spoilage Microorganisms

Abel Muoki [1*], Andrea Brückner [1], Gabriella Kiskó [1]

[1] Doctoral School of Agricultural and Food Sciences, Department of Food Microbiology, Hygiene and Safety, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary. muoki.abel.mwiwi@phd.uni-mate.hu; taczmanne.bruckner.andrea.erzsebet@uni-mate.hu; kisko.gabriella@uni-mate.hu.

* **Correspondence:** muoki.abel.mwiwi@phd.uni-mate.hu

Abstract: Biofilms by food spoilage microorganisms pose persistent hygiene challenges in food processing environments, making rapid and reliable antimicrobial assessment tools and an understanding of how disinfectant performance varies across surface materials and biofilm developmental stages essential for effective risk reduction and the design of resilient sanitation strategies. This study aimed to develop an integrated workflow capable of evaluating antimicrobial sensitivity and biofilm tolerance using reproducible methods suitable for both research and industry laboratories. Six food spoilage isolates, including *Pseudomonas aeruginosa* and *Hafnia alvei*, were tested using oxytetracycline agar diffusion assays to determine concentration dependent inhibition profiles. Early biofilms were grown on stainless steel and polypropene coupons and subjected to one minute immersion in sodium hypochlorite. Biofilm survival was assessed by quantifying viable colonies post-treatment. Planned follow-up experiments will evaluate 48-hour mature biofilms. Oxytetracycline hydrochloride produced clear, concentration dependent inhibition zones across all isolates, confirming broad antimicrobial susceptibility. Short-contact Sodium hypochlorite (NaOCL) treatment revealed strong material-dependent differences in biofilm resilience. At 4.32 mg/ml, *P. aeruginosa* biofilms were eliminated on stainless steel coupons whereas polypropene biofilms retained viable colonies, this shows that surface type significantly influences disinfectant effectiveness. The integrated workflow provides a rapid, scalable approach for assessing antimicrobial efficacy and biofilm tolerance. Material dependent survival highlights the need for surface-specific hygiene strategies. Further tests will clarify how structural complexity influences resistance to short-contact NaOCL treatment.

Keywords: Oxytetracycline; *Pseudomonas* spp; *Hafnia alvei*, biofilms; stainless steel; polypropene

Acknowledgement: The research was supported by József Farkas Doctoral Program in Food Science, Doctoral School of Agricultural and Food Sciences, Hungarian University of Agriculture and Life Sciences.

Towards a Conceptual Framework for AI-Based Simulation and Prediction of Older Adults' Behaviour in Health and Social Care

Dita Vaclavikova [1*]

[1] Department of Assistive Technologies, Faculty of Biomedical Engineering, Czech Technical University in Prague (CTU), nám. Sítná 3105, 272 01 Kladno, Czech Republic

* **Correspondence:** dita.vaclavikova@cvut.cz

Abstract: Population ageing challenges health and social care systems worldwide. Recent advances in large language models (LLMs), agent-based modelling (ABM), and assistive technologies offer new opportunities to understand and support older adults' needs and behaviours. However, these approaches are typically studied in isolation, limiting their ability to capture complex decision-making and behavioural adaptation in ageing populations. This study proposes a conceptual framework integrating LLMs and ABM for simulating and predicting older adults' behaviour in health and social care. It adopts a conceptual research design based on a structured review and synthesis of recent literature on LLMs, ABM, conversational artificial intelligence, and assistive technologies for older adults. The review identified three complementary research streams relevant to healthy ageing: LLM agents, ABM, and conversational AI in assistive care. The analysis shows that these approaches are currently developed largely independently despite their potential synergies. Based on this research gap, a conceptual framework is proposed integrating LLM-driven cognitive agents with ABM to represent heterogeneous older adult populations characterised by demographic, psychographic, social, and health-related attributes and simulate decision-making, communication, and behavioural adaptation in health and social care settings. The findings suggest that integrating LLMs and ABM is a promising direction for research on healthy ageing and assistive technologies. The proposed conceptual framework provides a foundation for future development of simulation models capable of representing complex behavioural, social, and health-related processes in older adult populations. Future research should focus on implementation, validation, and evaluation of such models in real-world health and social care contexts.

Keywords: healthy ageing; large language models; agent-based modelling; assistive technologies; behavioural simulation

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Transmediation *(Alih Wahana)* "La Galigo" to UI/UX-Based Interactive Multimedia as a Strategy to Strengthen Digital Heritage

Agustina Kusuma Dewi [1]*, Adi Surahman [2], Ganis Resmisari [1], Asep Ramdhan [1], Inko Sakti Dewanto [1]

[1] Desain Komunikasi Visual, Fakultas Arsitektur dan Desain, Institut Teknologi Nasional Bandung, Jalan PHH Mustofa No.23 Jawa Barat - Indonesia, agustina@itenas.ac.id; ganis@itenas.ac.id; asep.ramdhan@itenas.ac.id; inkosakti@itenas.ac.id

[2] Desain Komunikasi Visual, Fakultas Sains dan Teknologi, Universitas Aisyiyah Bandung, Jalan Palasari No. 9A Jawa Barat - Indonesia, adisurahman@unisa-bandung.ac.id

* **Correspondence:** agustina@itenas.ac.id

Abstract: "La Galigo", the Bugis people's intangible cultural heritage, holds significant historical, philosophical, and cultural value. However, its preservation faces challenges due to the younger generation's limited access to its extensive manuscripts and complex narratives. Transforming "La Galigo" into UI/UX-based interactive multimedia offers a promising strategy for digital heritage preservation and dissemination. Digital heritage extends beyond documentation by enabling immersive cultural interpretation through interactive engagement with stories, characters, artifacts, and cultural values. This study employs qualitative-constructive method to analyzed how digital heritage, transmediation, UI/UX design, and gamification contribute to cultural preservation. UNESCO defines digital heritage as cultural resources that are either digitally created or converted from analog to digital formats. In this context, the oral epic and manuscripts of "La Galigo" transmediated into interactive multimedia through transformations from text to visual representation, narration to interaction, reading to digital exploration, and documentation to user experience; allowing Bugis epos to be experienced digitally. Multimodality, encompassing text, images, audio, animation, and interaction flows; also include ease of learning, accessibility, engagement and intuitive navigation, and clear storytelling within UI/UX for cultural heritage education stimulates and enhances both learning and user engagement and an experience that is both educational and enjoyable. Furthermore, gamification techniques such as interactive storytelling, AR/VR, missions and reward systems increase user participation and appreciation of heritage. Integrating digital heritage, UI/UX, and gamification theories demonstrates that digitalization is not merely a change of format but the creation of meaningful cultural experiences that transform users from passive readers into active participants in cultural heritage.

Keywords: la galigo; digital heritage; transmediation; interactive storytelling; multimodal

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Quality of Mango and Lemongrass Powders as Influenced by Blending Ratios and Storage Period

Yonatan Seid Mohammed [1]*, Ghulam Hassan Shah [1]

[1] Department of Horticulture, Food Science and Postharvest Technology, Arba Minch University, Ethiopia

* **Correspondence:** drghshah2@gmail.com

Abstract: Mango and lemongrass grows in Ethiopia and both have nutritional and functional significance. But it is difficult to preserve the fresh produce for long due to their highly perishable nature and seasonal availability. This study aimed to dry mango and lemongrass, convert dehydrated product into innovative blended powders in different ratios, conduct storage studies and assess their feasibility for beverage preparations at different intervals. Utilizing a multilevel factorial experimental design, mango and lemongrass powders were developed using a local solar drying chamber with cabin temperatures ranging from38 to 550C. Five distinct blending ratios of mango: lemongrass (94:6, 95:5, 96:4, 97:3 and 98:2, with a 100:0 control) were evaluated over a-90 day storage period. Samples were systematically analysed in triplicate for proximate, physicochemical, microbiological, and sensory attributes using Minitab (v.18.1) for statistical analysis and response surface optimisation. Fortification of mango powder with lemongrass powder markedly enhanced the nutritional and functional profile of the blended product. Ash, protein, fibre, vitamin A, beta-carotene and Total soluble solids were significantly higher compared to the control. The multilevel D-optimizer designated the 94:6 blending ratio (R5) at 90 days of storage as the global optimal solution, demonstrating a top composite desirability score of 0.945. This formulation maintained safe microbial thresholds and earned the highest scores for flavour, colour, and overall sensory acceptability.

Keywords: fortified mango powder; lemongrass; solar drying; response optimization; storage stability

Acknowledgement: The laboratory facilities provided by Arba Minch University are acknowledged. We also acknowledge with thanks the financial support provided by South Ethiopia Pastoral Development Bureau, Ethiopia, and Mendel University, Czech Republic, for conducting this research.

Integrating Multidimensional CEFR Diagnostic Profiles with Retrieval-Augmented Generation for Adaptive Speaking Feedback

Azhar Albaaqi Fadhullah [1]*, Nur Fitrianti Fahrudin [1], Corry Caromawati [1]

[1] Information System Department, Faculty of Industrial Technology, Institut Teknologi Nasional Bandung (ITENAS), Jl. PKHH. Mustapa No. 23, Bandung, West Java, Indonesia, azhar.albaaqi@mhs.itenas.ac.id; nurfitrianti@itenas.ac.id; corry@itenas.ac.id

* **Correspondence:** azhar.albaaqi@mhs.itenas.ac.id

Abstract: Automatic speaking assessment systems can efficiently estimate language proficiency, but their outputs often provide limited diagnostic information for generating personalized learning feedback. This study presents the I-Speak Diagnostic Application Programming Interface, a Retrieval-Augmented Generation (RAG)-based system designed to transform multidimensional speaking assessment outputs into a Common European Framework of Reference for Languages (CEFR)-based diagnostic profile and generate adaptive feedback for English as a Foreign Language learners. The system was developed following the Generative AI Life Cycle, comprising problem definition, data investigation, data preparation, development, and evaluation. Its architecture integrates a Supabase pgvector knowledge base using multilingual-e5-large-instruct embeddings with Groq-hosted Llama 3.3 70B and Gemma2 9B models. The system first aggregates assessment outputs to determine an overall proficiency level and construct a structured DiagnosticProfile identifying learners' strengths and skill gaps. The profile is then combined with retrieved CEFR-related knowledge to ground the generation of personalized feedback. System performance was evaluated using retrieval metrics and a comparative evaluation of grounded (RAG with DiagnosticProfile) and non-grounded feedback across eight dimensions. The retrieval component achieved Recall@3 and Recall@5 of 81.2%. Comparative evaluation showed that the grounded approach generated more specific and proficiency-appropriate feedback than the non-grounded baseline, particularly in identifying skill gaps and reducing hallucination risk. The non-grounded approach frequently missed specific weaknesses and produced recommendations inconsistent with learners' proficiency levels. These findings demonstrate that integrating structured diagnostic profiles with RAG can improve the specificity, contextual relevance, and reliability of AI-generated feedback. The proposed architecture offers a practical framework for integrating automated assessment, retrieval systems, and large language models in adaptive learning applications.

Keywords: adaptive learning; automated speaking assessment; diagnostic profile; large language models; retrieval-augmented generation

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Direct-Melt Extrusion of Recycled PET Strips into FDM Filament without Pelletization

Muhammad Ravli Sbastio [1]*, Rais Purnama Sidiq[1], Diki Ismail Permana [2]

[1] Undergraduate Student, Mechanical Engineering Department, Faculty of Industrial Technology, Institut Teknologi Nasional Bandung (ITENAS), Jl. PKHH. Mustapa No. 23, Bandung, West Java, Indonesia, muhammad.ravli@mhs.itenas.ac.id; dicky91permana@gmail.com; rais.purnama@mhs.itenas.ac.id

[2] Mechanical Engineering Department, Faculty of Industrial Technology, Institut Teknologi Nasional Bandung (ITENAS), Jl. PKHH. Mustapa No. 23, Bandung, West Java, Indonesia, dicky91permana@itenas.ac.id

* **Correspondence:** muhammad.ravli@mhs.itenas.ac.id

Abstract: The growing demand for decentralized recycling requires simplified manufacturing routes for converting post-consumer polyethylene terephthalate (PET) into value-added products. Conventional filament manufacturing relies on pelletization followed by screw-based extrusion, increasing process complexity and cumulative thermal exposure. This study aimed to design and experimentally validate a laboratory-scale processing system capable of directly converting post-consumer PET strips into 1.75 mm filament without pelletization. A laboratory-scale processing system employing controlled heat transfer and synchronized extensional drawing was designed, modeled, and experimentally validated. Processing performance was evaluated by determining the stable operating window, filament dimensional accuracy, production rate, and tensile properties. A stable operating window was identified between 160 and 210 °C. Within this range, diameter fluctuation decreased by 77.8% (0.09–0.02 mm), producing an average filament diameter of 1.752 mm with a deviation of only +0.11% from the nominal specification and dimensional variation within ±0.02 mm. The production rate increased by 64.9% (0.57–0.94 g min^{-1}), while the tensile strength reached 20.06 ± 1.09 MPa, representing a 36.2% improvement over the polylactic acid (PLA) reference. The proposed processing system demonstrated the technical feasibility of producing dimensionally accurate and mechanically competitive filament directly from post-consumer PET strips while eliminating pelletization. This simplified processing approach provides a practical manufacturing route for distributed recycling and additive manufacturing.

Keywords: distributed recycling; additive manufacturing; thermomechanical control; extensional drawing; value-added products

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Hybrid Voxel Terrain Using Neural Style Transfer for Preserving Geospatial Morphology Based on Perlin Noise

Muhammad Aryawardhana [1]*, Galih Ashari Rakhmat [1]

[1] Department of Informatics, Faculty of Industrial Technology, Institut Teknologi Nasional Bandung, Jl. PHH. Mustafa No. 23, Bandung 40124, Indonesia, muhammad.fauzan15@mhs.itenas.ac.id; galihas@itenas.ac.id

* **Correspondence:** muhammad.fauzan15@mhs.itenas.ac.id

Abstract: Simulation-based applications, including military training, disaster mitigation, and spatial planning, rely on realistic three-dimensional terrain to represent real-world environments. However, manual terrain creation is time-consuming and costly, while conventional Procedural Content Generation (PCG) methods, such as Perlin Noise, often produce landscapes that lack realistic geospatial features. This study proposes a hybrid terrain generation pipeline that combines Neural Style Transfer (NST) with Digital Elevation Model (DEM) data to incorporate real-world morphological characteristics into procedurally generated terrain. The method was evaluated across five study areas: Mount Kelud, Mount Malang, Mount Munggang, Makassar City, and the Pangalengan Hills. Three deep learning architectures, VGG-19, ResNet-50, and InceptionV3, were assessed for their ability to transfer terrain morphology. The resulting heightmaps were converted into voxel-based terrain using Marching Cubes and Transvoxel with adaptive Level of Detail (LOD). Evaluation metrics included the Structural Similarity Index Measure (SSIM), Root Mean Square Error (RMSE), and Hydrological Correlation. ResNet-50 achieved the highest SSIM of 0.95 on the Makassar City dataset, compared with 0.4605 for the pure Perlin Noise baseline, and yielded the strongest hydrological correlation among the evaluated architectures. Transvoxel with adaptive LOD also reduced terrain generation time and geometric complexity. However, hydrological correlation remained low across all architectures. These findings demonstrate the potential of combining NST and procedural generation to create efficient voxel-based terrain while preserving important morphological features.

Keywords: procedural content generation; neural style transfer; digital elevation model; voxel terrain; marching cubes

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SiapSiaga: An AIoT-Based Application Prototype for Disaster Preparedness and Early Warning in Indonesia

Dyka Hatawa [1]*, Diash Firdaus

[1] Informatics Department, Faculty of Industrial Technology, Institut Teknologi Nasional Bandung,Jl. PHH. Mustapa No. 23, Bandung, West Java, Indonesia, dyka.hatawaa@mhs.itenas.ac.id

* **Correspondence:** dyka.hatawaa@mhs.itenas.ac.id

Abstract: Indonesia's geographic position within the Ring of Fire necessitates robust disaster management solutions. In 2025, the National Agency for Disaster Countermeasure (BNPB) recorded 3,176 natural disasters resulting in 1,554 fatalities. To address this critical vulnerability, this study introduces SiapSiaga, an Artificial Intelligence of Things (AIoT) application framework designed to enhance disaster preparedness. The preliminary phase focused on deploying an ESP32-based vibration sensor on a faculty building for real-time earthquake detection, alongside the evaluation of a localized user interface prototype. While the hardware infrastructure was successfully installed and calibrated, quantitative real-world seismic data collection is currently pending natural occurrences. To evaluate the software component, a user acceptance test was conducted on the localized prototype. Quantitatively, the user interface achieved an 85% satisfaction rate regarding its design and usability. Qualitatively, user evaluations yielded constructive feedback and suggestions that will guide future iterations of the application. SiapSiaga provides a scalable technological foundation for integrating AIoT frameworks into disaster mitigation strategies.While currently in the prototype stage, the platform establishes a viable pathway for future hardware integration and real-world deployment to optimize emergency response capabilities.

Keywords: AIoT; disaster management; early warning system; earthquake; preparedness

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Electrolysis-Assisted Anaerobic Digestion of Fish Farm Sludge Inoculated with Municipal Activated Sludge: Biogas Quality and Nutrient Release

Yelizaveta Chernysh [1, 2, 3]*, Ahmet Demirak [3], Dilek Yıldız [3], Hynek Roubík [2]

[1] Department of Ecology and Environmental Protection Technologies, Sumy State University, Kharkivska St., 40007, Sumy, Ukraine

[2] Department of Food and BioResource Technology, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague, Czech Republic, chernysh@ftz.czu.cz; roubik@ftz.czu.cz

[3] Environmental Problems Research and Application Center, Muğla Sıtkı Koçman University, Kötekli Yerleşkesi - 48050 Menteşe/Muğla, Turkey, ademirak@mu.edu.tr; dyildiz@mu.edu.tr

* **Correspondence:** chernysh@ftz.czu.cz

Abstract: Fish farm sludge is rich in nitrogen, phosphorus and biodegradable organic matter, representing both an environmental challenge and a resource recovery opportunity. This study evaluated anaerobic digestion of fish farm sludge using municipal activated sludge as inoculum (inoculum-to-substrate ratio 2:1, VS basis). Four batch series were operated under mesophilic conditions (38–40 °C) for 25 days; in one series, electrolysis (20 A, 5 min every day) was applied. Biogas composition was monitored with a Geotech BIOGAS 5000 analyser, and orthophosphate and ammonium were determined spectrophotometrically. Cumulative biogas production was similar with and without electrolysis (2650 and 2700 mL), but electrolysis markedly improved gas quality: on day 25, methane reached 62.8% versus 48.0%, CO_2 30.8% versus 39.7%, and H_2S 137 versus 532 ppm, corresponding to an estimated 28% higher methane volume. Without electrolysis, pH dropped from 6.66 to 6.58 on day 3 and recovered to 6.84-7.25 (days 12–25), whereas with electrolysis it rose steadily from 6.57 to 7.01. The pH recovery was consistent with organic nitrogen mineralisation, as liquid-phase NH_4^+ increased from 70-91 to 120-196 mg/L. Liquid-phase PO_4^{3-}-P increased from 41.51 to 92.75 mg/L, while acid-extractable phosphate in the solid digestate increased by 30.7–50.8% without electrolysis and by 70.4% with electrolysis. These preliminary results indicate that municipal activated sludge is a suitable inoculum for fish farm sludge and that electrolysis can upgrade biogas towards engine-grade quality (H_2S < 200 ppm) and enhance phosphorus mobilisation. Future work will include replicated reactors, VS-normalised methane yields and a full energy balance.

Keywords: fish farm sludge; anaerobic digestion; activated sludge inoculum; electrolysis; biogas upgrading; phosphorus recovery

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Natural Deep Eutectic Solvents for Enhanced Extraction of Anthocyanins and Polyphenols from Plant Materials

Eugene Androshchuk [1]*, Viktor Husak [1], Volodymyr Shvadchak [1], Olena Bobrova [2], Volodymyr Marych [3], Andrew Kotsyubynsky [3]

[1] Department of Biochemistry and Biotechnology, Vasyl Stefanyk Carpathian National University, Ivano-Frankivsk, Ukraine yevhen.androshchuk@cnu.edu.ua; viktor.husak@cnu.edu.ua;volodymyr.shvadchak@cnu.edu.ua

[2] Plant Physiology and Cryobiology Team, Czech Agrifood Research Center, Drnovska 507/73, 16100 Prague, Czech Republic olena.bobrova@carc.cz

[3] Department of Environmental Protection Technology and Occupational Safety, National Technical University of Oil and Gas

* **Correspondence:** yevhen.androshchuk@cnu.edu.ua

Abstract: Natural deep eutectic solvents (NADES) are sustainable solvent systems whose physicochemical properties can be tuned for extraction of plant bioactive compounds. This study evaluated glycerol-based NADES for recovering anthocyanins from blueberry powder and total phenolics from Rhodiola root powder. NADES were prepared from glycerol with proline, oxalic acid, or citric acid at component:glycerol molar ratios from 0.01:1 to 0.2:1. Flow behavior and apparent pH were assessed, while DSC and ATR-FTIR were used to characterize thermal behavior and changes in the molecular environment. Polarity and proton-acceptor ability were evaluated using 4-DEHF and 3HQ solvatochromic probes. Dried blueberry and Rhodiola powders were extracted at a 1:20 solid-to-solvent ratio. Anthocyanins were determined spectrophotometrically and total phenolics by the Folin-Ciocalteu assay, with 70% ethanol extracts used as references. Water addition, extraction temperature, and extraction time were subsequently optimized. Pro:Gly NADES resisted freezing and thawing without crystallization, whereas Ox:Gly showed crystallization. Difference ATR-FTIR spectra deviated from the additive spectra of the individual components, indicating changes in their molecular environment. Among the tested formulations, oxalic acid:glycerol at a 0.1:1 molar ratio gave the highest extraction efficiency for both blueberry anthocyanins and Rhodiola total phenolics. For blueberry powder, the highest performance was obtained with water addition equal to 90% of the initial NADES volume, extraction at 70 °C, and extraction times of 15, 45, or 105 min. For Rhodiola root powder, the best conditions were 110-140% water addition, 60 °C, and 45-75 or 120 min. Oxalic acid:glycerol (0.1:1) was the most effective NADES composition for both plant materials. The results demonstrate that NADES composition and processing conditions can be adjusted to optimize extraction while their thermal and molecular properties provide additional criteria for solvent selection.

Keywords: natural deep eutectic solvents; NADES; anthocyanins; polyphenols; blueberry; Rhodiola; green extraction.

Temporal Explanation Reliability: A Conceptual Framework for Trustworthy Explainable AI in Sequential Financial Decision-Support Systems

Maryam Ahmadniay Motlagh [1]*

[1] Department of Statistics, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6 – Suchdol, Czech Republic

* **Correspondence:** ahmadniay_motlagh@pef.czu.cz

Abstract: Artificial intelligence (AI) is increasingly used in financial decision-support systems, yet model explanations are commonly evaluated at individual prediction points, leaving their consistency across prediction horizons insufficiently examined. This study proposes temporal explanation reliability as a conceptual framework and evaluates one component—cross-horizon explanation consistency—in a preliminary proof-of-concept. Using a public panel of U.S.-listed companies, four-year accounting histories were constructed from 17 non-redundant financial variables after removing one exact duplicate from the 18-variable source. To reduce outcome-censoring bias, only histories with observable three-year follow-up or bankruptcy within that period were retained, yielding 37,209 firm-history windows from 4,792 companies. Event timing was inferred from the documented pre-bankruptcy labeling scheme. Within each of five firm-disjoint train-test splits, one horizon-conditioned XGBoost model with a monotonic horizon constraint estimated 1-, 2-, and 3-year bankruptcy risk. TreeSHAP attributions for the same histories were compared across horizons using global rank correlation, top-five Jaccard overlap, and local cosine similarity. Mean ROC-AUCs were 0.896, 0.868, and 0.846, while mean average precision was 0.205, 0.226, and 0.239. Mean pairwise Spearman correlations ranged from 0.989 to 0.995, mean top-five Jaccard overlap from 0.800 to 0.867, and split-averaged median local cosine similarity from 0.996 to 0.999. Market value, net income, and total liabilities consistently appeared among the five most influential variables. These findings indicate high cross-horizon explanation stability with limited horizon-sensitive changes and illustrate how cross-horizon consistency can be operationalized as one measurable component of temporal explanation reliability.

Keywords: temporal explanation reliability; explainable artificial intelligence; financial decision support; corporate bankruptcy prediction; SHAP

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Ready-to-Eat Products: Enrichment with Whole Egg: Is It a Sustainable Nutritional Improvement

Adrienn Varga-Tóth [1]*, Csaba Németh [2], János Piróth [2], Bende Pál Kánai [1], László Friedrich [1]

[1] Hungarian University of Agriculture and Life Sciences (MATE), Institute of Food Science and Technology, Dept. of Livestock Product and Food Preservation, toth.adrienn@uni-mate.hu; kanai.bende.pal@stud.uni-mate.hu; friedrich.laszlo.ferenc@uni-mate.hu

[2] Capriovus Ltf.,2317 Szigetcsép, Hungary , Duna sor 073/72 hrsz. Nemeth.csaba@capriovus.hu; piroth.janos@capriovus.hu

* **Correspondence:** toth.adrienn@uni-mate.hu

Abstract: The increasing consumer demand for convenient food options highlights the need to improve the nutritional value of convenience meals without compromising quality. This study evaluated the sensory and techno-functional quality of ready-to-eat (RTE) egg rice enriched with whole egg, preserved using High-Pressure Processing (HHP) treatment at 400, 500, and 600 MPa for 5 minutes. To assess quality attributes, a Kramer shear cell was utilized for texture profile analysis, alongside instrumental color and pH measurements. Furthermore, a sensory evaluation was conducted with consumers using a hedonic scale to determine product acceptability. The findings revealed that a higher whole egg content significantly improved the overall nutritional quality of the RTE rice. A 14-day shelf-life stability experiment demonstrated that HHP treatments at 500 and 600 MPa successfully extended the shelf-life of the product without causing any detrimental loss in sensory or functional quality. In conclusion, whole egg can serve as an effective functional ingredient for protein enrichment in ready-to-eat food products, offering a viable strategy for sustainable nutritional improvement when combined with HHP technology.

Keywords: whole egg; ready-to-eat food products; minimal processing

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First Standard-Model IND-CCA2: A scheme of Cramer-Shoup Encryption on Hyperelliptic Genus-2 Jacobians

Partha Sarker [1]*, Ajoy Kumar Khan [2]

[1] Department of Computer Science and Engineering, Narula Institute of Technology , Kolkata, India , pscsedu1989@gmail.com

[2] Department of Computer Engineering, Mizoram University, Aizawl, India , ajoycse@mzu.edu.in

* **Correspondence:** pscsedu1989@gmail.com

Abstract: Cramer-Shoup Encryption is one type of public key encryption scheme that provides IND-CCA2 (indistinguishability under adaptive chosen-ciphertext attack) security in this proposed Standard-Model (without using the random Oracle). The Cramer-Shoup scheme is under the Decisional Diffie-Hellman (DDH) assumption, but the practical implementations of it have been limited to elliptic curves and also finite fields. Hyperelliptic Jacobians of genus 2 offer smaller field sizes for equivalent security; however, no standard-model CCA2-secure scheme has yet been reported. It has been adopted for the Jacobian of a genus-2-based hyperelliptic curve. The group is the divisor class group with a Mumford representation (operation follows Cantor's Algorithm). A hash function (target-collision-resistant) maps group elements to scalars. It uses random secret exponents and public generators to produce the keys, and the encryption uses a random nonce with a verification tag to prevent adaptive chosen-ciphertext attacks. Based on the pseudocode of the proposed algorithm, the implementation demonstrates that key generation, encryption, and decryption have successfully confirmed the scheme's soundness. Using a random curve over a 64-bit prime field p, it has been proved that the proposed methodology is correct. This work on the proposed Standard-Model Cramer-Shoup Encryption establishes that genus 2 Jacobians can serve as a foundation for the security of tightness. In the future, it will be directed to include optimising the Jacobian arithmetic for lightweight, energy-efficient variants suitable for resource-constrained devices, and to explore post-quantum security using higher-genus isogenies.

Keywords: cramer-shoup encryption; hyperelliptic jacobian; genus-2 curves; IND-CCA2 security; standard-model

A Lightweight Authentication Framework for Secure Resource-Constrained IoT Devices

Amit Kumar Bag [1]*, Ajoy Kumar Khan [1]

[1] Mizoram University, Aizawl, India

* **Correspondence:** amitbag7689@gmail.com

Abstract: Resource-constrained Internet of Things (IoT) devices have become an essential component of modern digital infrastructures, supporting applications in smart agriculture, healthcare, industrial automation, environmental monitoring, and intelligent transportation. However, their limited processing capability, memory capacity, and battery power make conventional authentication mechanisms computationally expensive and unsuitable for practical deployment. Therefore, there is a growing need for lightweight authentication mechanisms that provide secure communication while preserving the limited resources of IoT devices. This study proposes a lightweight authentication framework that employs lightweight cryptographic primitives, nonce-based verification, and dynamic session establishments to authenticate communicating entities efficiently. The framework consists of four sequential phases: device registration, streamlined identity verification, nonce-based challenge-response authentication, and secure session establishment. The proposed design minimizes computational complexity, communication overhead, and memory requirements while maintaining authentication reliability. The proposed framework is designed to provide efficient authentication with low resource consumption while addressing common security threats such as replay attacks, impersonation attacks, and unauthorized device access. A preliminary assessment indicates that the framework is suitable for resource-constrained IoT environments by balancing authentication efficiency, communication cost, and security requirements. The proposed lightweight authentication framework provides a practical foundation for strengthening secure communication in next-generation IoT systems. Future work will focus on implementation, formal security verification, and comparative performance evaluation against existing lightweight authentication protocols to validate its effectiveness in real-world IoT environments.

Keywords: Internet of Things; Lightweight Authentication; Resource-Constrained Devices; IoT Security; Cryptographic Protocols

Enhancing Innovation in Moroccan Business Clusters through Adapted Knowledge Management Practices

Nouha Belmahi [1*]

[1] Tofail University,Superior School of Technology, Kenitra, Morocco

* **Correspondence:** nouha.belmahi@uit.ac.ma

Abstract: In a knowledge-driven economy, Knowledge Management (KM) is key to innovation, yet most frameworks are designed for individual firms and overlook inter-organizational contexts. Business clusters, especially in emerging economies like Morocco, offer strong potential for collective learning and innovation but face challenges such as weak collaboration, fragmented knowledge flows, and limited governance. This raises the need to adapt KM practices to better fit cluster dynamics. This study aims to explore how KM can be reconfigured to act as a catalyst for innovation in Moroccan business clusters. This study uses a mixed-methods approach combining a structured literature review and qualitative fieldwork. The review follows PRISMA-inspired guidelines to analyze existing KM frameworks. Empirical data is collected through semi-structured interviews with actors in Moroccan clusters, including firms and coordinators. Data is analyzed using thematic analysis (NVivo) to identify patterns related to knowledge sharing, governance, and innovation, supporting the development of an adapted KM framework. Findings show that traditional KM frameworks are limited in cluster contexts as they focus on internal processes and neglect inter-organizational dynamics. Key barriers include low trust, weak governance, and lack of coordination. However, informal networks and proximity play a crucial role in knowledge exchange. The study proposes an adapted KM framework integrating governance, trust, and collaboration as central drivers of innovation in clusters. KM must be adapted to cluster environments, where innovation depends on relationships, governance, and collective coordination rather than internal practices alone. The proposed framework extends KM to a network level and provides practical insights for enhancing innovation in Moroccan clusters, contributing to both theory and policy.

Keywords: knowledge management; business clusters; innovation; Morocco

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Artificial Intelligence in Human Resource Management: A Validated Framework for Understanding Employee Responses and Responsible AI Governance

Benhayoun Hajar [1]*, Fatima Zohra Sossi Alaoui [1]

[1] Economie, Ibn Tofail University, Kenitra, Anoual Street, Asamia Residence, Apt. 12, hajar.benhayoun@uit.ac.ma; fatimazohra.sossialaoui@uit.ac.ma

* **Correspondence:** hajar.benhayoun@uit.ac.ma

Abstract: Artificial Intelligence (AI) is rapidly transforming Human Resource Management (HRM), reshaping recruitment, performance management, and organizational decision-making. While AI offers significant opportunities to improve efficiency and strategic workforce management, it also raises concerns regarding employee autonomy, organizational justice, trust, and workplace well-being. Despite the growing adoption of AI-driven HR systems, validated instruments for comprehensively assessing employees' perceptions and responses to these technologies remain limited. This study addresses this gap by developing and validating a measurement framework for AI-enabled HRM and its implications for employees and responsible AI governance. A quantitative research design was adopted using survey data collected from 204 employees. Data were analyzed using IBM SPSS Statistics. The reliability and validity of the proposed framework were assessed through Cronbach's alpha and Exploratory Factor Analysis (EFA), examining factor structure, loadings, communalities, and explained variance. The findings demonstrate excellent internal consistency across all constructs, with Cronbach's alpha coefficients ranging from 0.905 to 0.978. EFA revealed a clear and coherent factor structure, with strong factor loadings, high communalities, and substantial explained variance, confirming the reliability and construct validity of the measurement instrument. The validated framework provides a robust foundation for future research on AI-enabled HRM and employee perceptions of AI, while offering practical value for organizations seeking transparent, ethical, and human-centered AI implementation.

Keywords: artificial intelligence; human resource management; employee well-being; organisational justice; responsible AI

Determination of the Sorption Capacity of Textile Sorptive Materials

Dušan Bóna [1]*

[1] Department of Fire Engineering, Faculty of Safety Engineering, University of Žilina in Žilina, 1. maja 32, 01026 Žilina, Slovakia

* **Correspondence:** bona1@uniza.sk

Abstract: The study focuses on the determination of the sorption capacity of textile sorbent materials when exposed to selected hazardous substances. The results demonstrated significant differences in performance among the tested sorbents, with universal sorbents generally exhibiting the highest adsorption capacity. These findings provide practical insights into the selection and application of sorbent materials by fire and rescue services for mitigating hazardous substance spills. The study was carried out in accordance with the ASTM F726-17 standard, adapted to specific experimental conditions. The textile sorbent is cut into squares with dimensions of 13 × 13 cm². Each test sample should weigh at least 4 g. The sorbent remains in the container for 24 hours ± 30 minutes. Six types of textile sorbents, categorized as hydrophobic, chemical, and universal, were tested in laboratory experiments. Sorbent samples were conditioned, weighed, and subjected to immersion in controlled volumes of substance for 24 hours. The average value of sorptive capacity for hydrophobic carpents was 11,72. The average value of sorptive capacity for hydrophobic carpents was 11,39. The average value of sorptive capacity for hydrophobic carpents was 12,61. The experimental results demonstrated that textile sorbents vary in their efficiency depending on material composition and purpose. Overall, the study offers useful insights for crisis management and supports more effective deployment of sorbent materials in emergency interventions.

Keywords: sorption capacity; hazardous substances; textile sorbents; ASTM F726-17; engine oil

Development and Characterization of a Protein-Enriched Mayonnaise-Based Sauce

Anikó Boros [1]*, Adrienn Vargáné Tóth [2], Andrea Bajkai Sallainé [3], László Ferenc Friedrich [2]

[1] Doctoral School of Food Science, Hungarian University of Agriculture and Life Sciences, Villányi Road 29-43, H-1118 Budapest, Hungary Boros.Aniko.6@phd.uni-mate.hu

[2] Department of Livestock and Food Preservation Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Ménesi str. 43-45, 1118 Budapest, Hungary Toth.Adrienn@uni-mate.hu

[3] Kifli.hu Shop Limited Liability Company, Jászberényi 45., 1106 Budapest, Hungary andi.bajkai@gmail.com

* **Correspondence:** Boros.Aniko.6@phd.uni-mate.hu

Abstract: Mayonnaise-based sauces are widely consumed but are typically high in fat and energy. This study aims to develop a protein-enriched mayonnaise-based sauce by partially replacing mayonnaise with ToTu, a high-protein dairy-based ingredient, and to evaluate the effects of substitution on nutritional, physicochemical, technological, and sensory properties. A conventional mayonnaise-based sauce will serve as the control, while experimental formulations will contain increasing proportions of ToTu, with the remaining ingredients kept constant. Nutritional composition and energy value per 100 g will be calculated from ingredient data using the energy conversion factors specified in Regulation (EU) No 1169/2011, including the proportion of energy derived from protein. Physicochemical and technological analyses will include pH, dry matter content, instrumental colour (L*, a*, b*), texture or spreadability, and emulsion stability, complemented by sensory evaluation. Partial replacement of mayonnaise with ToTu is expected to reduce energy density and fat content while increasing protein content and relative protein contribution. Higher substitution levels may also influence colour, texture, spreadability, emulsion stability, and sensory acceptance. Comparison of the formulations will identify the substitution level that provides the most favourable balance between nutritional improvement and product quality. The optimised formulation may support the development of nutritionally improved sauces suitable for protein-oriented meals and physically active consumers.

Keywords: mayonnaise-based sauce; protein enrichment; nutritional reformulation; physicochemical properties; sensory evaluation

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Performance Evaluation of a Compact Crawler Carrier for Agricultural Transportation in Steep-Slope Coffee Production Systems

Jorge Alexander Londoño Castañeda [1]*, Sergio Muñoz Salazar [1], Eduardo Duque Dussan [1]

[1] Discipline of Engineering, National Coffee Research Center, Cenicafé, Manizales, Caldas, Colombia, jorge.londono@cafedecolombia.com; sergio.muñoz@cafedecolombia.com; eduardo.duque@cafedecolombia.com

* **Correspondence:** jorge.londono@cafedecolombia.com

Abstract: Mountain coffee production systems are characterized by steep slopes that restrict the use of conventional agricultural machinery, making agricultural input transportation labor-intensive and physically demanding. Although compact crawler carriers have shown potential for operating on uneven terrain, their technical performance under steep-slope coffee farming conditions has been scarcely documented. A crawler carrier was evaluated through controlled tests and field trials under representative coffee farming conditions. Travel speed was measured in the 1st, 2nd, 3rd, and reverse gears by recording the time required to travel a predefined distance. Stability, maneuverability, and traction were assessed on longitudinal and lateral slopes in coffee plantations to verify machine performance under actual operating conditions. Data were analyzed using descriptive statistics. The carrier operated successfully under controlled and field conditions. Travel speed ranged from 0.16 to 1.05 m s^{-1}, depending on the selected gear and throttle setting. With a 300 kg payload, the machine maintained stable operation with moderate speed reductions. The machine maintained satisfactory stability, while track slip remained low under most operating conditions, increasing primarily during loaded turning maneuvers on sloping terrain. The evaluated crawler carrier is a promising alternative for mechanizing agricultural input transportation in steep-slope coffee production systems. However, increased track slip during turning maneuvers and reduced stability during downhill travel were identified as operational limitations. In addition, engine shutdowns observed on slopes of approximately 30% with low fuel levels revealed a limitation of the original fuel supply system, highlighting opportunities for future design improvements and adaptation to mountainous agricultural environments.

Keywords: crawler carrier; coffee farming; steep-slope agriculture; agricultural mechanization; input transportation

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Response Surface Methodology Analysis applied to the Sensory Evaluation of Mushroom-Beef Patties

Attila Dénes Méhes [1]*, György Kenesei [1], István Dalmadi [1]

[1] Department of Livestock Products and Food Preservation Technology, Hungarian University of Agriculture and Life Sciences, Budapest 1118, Hungary, Mehes.Attila.Denes@phd.uni-mate.hu; kenesei.gyorgy@uni-mate.hu; Dalmadi.Istvan@uni-mate.hu

* **Correspondence:** Mehes.Attila.Denes@phd.uni-mate.hu

Abstract: While meat provides high-quality proteins, its high fat content poses risk for human health. Mushrooms are low-fat, relatively rich in protein, and rich in bioactive compounds offering both health and techno-functional benefits. Driven by rising consumer health-consciousness, the global mushroom market is growing alongside the increasing demand for functional foods. For burger patty formulation, 2n experimental design was used, beef with 20% fat content was substituted at 20%, 35%, and 50% with oyster (*Pleurotus ostreatus*) or white button (*Agaricus bisporus*) mushrooms. Following standardized oven cooking, samples underwent sensory evaluation and the gathered data were analyzed using response surface model fitting to assess consumer acceptance. Response surfaces showed that while increasing mushroom content enhanced juiciness, it weakened structural texture for both species. Button mushroom outperformed oyster mushroom, which caused off-flavors, poor aroma, and undesirable grey discoloration. Conversely, button mushroom worked synergistically with fat to enhance flavor, overall likeness, and promote an appealing brown color. Although higher mushroom levels maximized consumer acceptability by enhancing taste and juiciness, they also led to a softer texture. However, fat content played a crucial role in mitigating this structural softening. To optimize both physical stability and sensory quality, a balanced formulation with mushroom and fat is recommended. While this approach was successful in achieving a firm texture alongside highly-rated sensory attributes, further investigation of these formulations is necessary to fully confirm their physical behavior.

Keywords: oyster mushroom; button mushroom; meat replacement; response surface; sensory evaluation

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Biochar from Biogas Digestate and Mimosa pigra for Enhanced Anaerobic Digestion of Tofu Wastewater

Van Hau Duong [1]*, Banerjee Sandipan [1], Diah Pangastuti Rahayu [2], Le Dinh Phung, [3], Hynek Roubík [1]

[1] Department of Food and Bioresource Technology, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague

[2] Faculty of Agriculture, University of Lampung, Indonesia

[3] University of Agriculture and Forestry, Hue University, Hue City, Thua Thien Hue, Vietnam

* **Correspondence:** duongh@ftz.czu.cz

Abstract: In this study, biochar was prepared from biogas digestate and *Mimosa pigra* through the pyrolysis process. The physicochemical properties of the derived biochar were characterized using elemental analysis, scanning electron microscopy (SEM), and X-ray diffraction (XRD). The obtained biochar was used as an additive in anaerobic digestion to enhance methane production. Digestion performance was evaluated by monitoring changes in substrate characteristics, including total suspended solids (TSS), total solids (TS), volatile solids (VS), chemical oxygen demand (COD), pH, and methane (CH_4) production. The results demonstrated that the addition of *M. pigra* biochar significantly improved the efficiency of organic matter degradation, as indicated by greater reductions in TSS, TS, VS, and COD compared with the control without biochar. Overall, these findings demonstrate that M. pigra biochar is a promising sustainable additive for improving the efficiency and stability of anaerobic digestion, thereby contributing to the development of renewable energy technologies.

Keywords: biogas digestate; biochar; *Mimosa pigra*; anaerobic digestion; methane production

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Does Digital Intensity Matter? Mobile Money and Enterprise Performance in Ghana's Informal Sector

Bernard Kwamena Cobbina Essel [1*]

[1] Living Innovation Hub-Kumasi, Ghana

* **Correspondence:** esselb42@gmail.com

Abstract: Informal microenterprises play a central role in creating employment and generating income across developing countries. In Sub-Saharan Africa, many of these enterprises are informal and led by young people. Despite their economic significance, informal microenterprises remain largely excluded from formal financial systems. This study, therefore, seeks to examine the determinants and performance of mobile money adoption among youth-led informal microenterprises in Ghana. Using cross-sectional data from 712 enterprises drawn from the 2021–2022 wave of the World Bank's Informal Sector Enterprise Survey (ISES), the study addresses three research questions: (i) What entrepreneur-level and firm-level factors influence mobile money adoption? (ii) Does mobile money adoption improve enterprise performance? (iii) Do performance effects vary across specific uses and levels of digital intensity? A doubly robust Inverse Probability Weighted Regression Adjustment (IPWRA) estimator was used to mitigate selection bias and estimate the causal effect of MoMo adoption on enterprise profitability. Adoption was significantly associated with entrepreneur education, record-keeping practices, internet usage, bank account ownership, access to informal credit, firm size, and geographic location. IPWRA estimates revealed that MoMo adoption is positively and significantly associated with profitability, with adopting firms earning approximately 40.9% profits than non-adopters. Integrating digital and financial literacy training into youth enterprise development programmes is recommended.

Keywords: digital financial inclusion; mobile money; informal enterprises; youth entrepreneurship

Foaming Properties of Plant Protein Isolates and Their Technological Performance as Egg White Replacers in Sponge Cake Production

Koppány László Majzinger [1]*, Vilmos Lehota [2], Anna Visy [3], Ágnes Abai [4], Karina Ilona Hidas [5]

[1] Department of Livestock Product and Food Preservation Technology, Institute of Food, Science and Technology, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, Ménesi road 43-45. Building 'D'. Hungary, majzinger.koppany.laszlo@uni-mate.hu; lehota.vilmos2@phd.uni-mate.hu; visy.anna@uni-mate.hu; horvath-mezofi.zsuzsanna@uni-mate.hu; hidas.karina.ilona@uni-mate.hu

* **Correspondence:** majzinger.koppany.laszlo@uni-mate.hu

Abstract: Egg white is essential in sponge cake production due to its excellent foaming properties, which are responsible for batter aeration and cake structure. Although various plant proteins have been proposed as egg white replacers, their technological suitability cannot be predicted from foaming properties alone. This study evaluated the foaming properties of selected plant protein isolates and their technological performance as egg white replacers in sponge cake production. Protein suspensions containing 1.5% (w/w) protein were prepared from pea, faba bean, and soy protein isolates under identical conditions. Foaming capacity and foam stability were determined before the suspensions were incorporated into sponge cake formulations as egg white replacers. Batter density and spreadability were evaluated prior to baking, while cake volume, baking loss, and texture profile analysis were determined after baking. The investigated protein isolates differed in their foaming properties, resulting in significant differences in batter density, spreadability, cake volume, baking loss, and texture. Faba bean protein isolate produced sponge cakes with favourable volume and texture compared to the other investigated protein isolates. The investigated plant protein isolates differed in their suitability as egg white replacers for sponge cake production. Among the tested proteins, faba bean protein isolate showed the most promising technological performance based on its foaming properties and the quality characteristics of the final product.

Keywords: egg white replacer; foaming capacity; sponge cake; protein functionality

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Why Do We Need Philosophy for Lawmaking Regarding Technologies that Mediate Human Desires? The Case of Child-Like Sex Robots

Cécilia A. M. Lombard [1]*

[1] 1 Center for Applied Philosophy, Faculty of Theology, University of South Bohemia. Address: Kněžská 8, 370 01 České Budějovice 1, Czechia

* **Correspondence:** Lombac00@tf.jcu.cz

Abstract: The emergence of humanoid sex robots, including child-like models, has raised international concern and led to legislative discussions, as relevant laws are globally uneven. Some researchers claim that sex robots alleviate the risks of harm to children, while others claim that they reinforce immoral desires and normalize abuses, thus posing a threat to the potential victims and ethical values of the society that allows them. This paper draws on the debate about child-like sex robots to highlight how empirical data and legal procedures address the potential risks of new devices (e.g. by banning the production and importation of specific products) but fail to provide a consistent ontological account as to why those risks exist in the first place. In consequence, the available data seems contradictory and laws inadequate to prevent harm. I combine existing studies with a philosophical analysis of these contradictory views, arguing that to make sense of them we need to pay attention to the structure of human desire itself, i.e., stressing the conflict between immediate impulses and ethical choices, as we find in the thoughts of Aristotle and Søren Kierkegaard. This framework is designed as a groundwork for the regulation of any related new technologies (e.g. adult sex robots, AI-dating platforms) where such paradoxical results may raise a moral dilemma. I conclude that the assessment of such technologies must be grounded on a deep ontological analysis and not only empirical data, because coherent research and lawmaking often come too late to prevent risks in this fast-changing context.

Keywords: ontology; virtue ethics; existentialism; desires; new technologies

Modeling Student Perceptions of the Use of Educational Artificial Intelligence Tools in Mathematics Education at a Philippine State University

Diether Montejo [1]*, Jhonnel Villegas [2,3], Lanie Laureno [3], Rodrigo Salimaco [3], Jovelito Dora [4]

[1] Master of Science in Teaching Mathematics Program, College of Education, Science Education Department, De La Salle University, Taft Avenue, Manila 1004, Philippines Center for Research and Development, Holy Cross of Davao College, Davao City, Philippines

[2] Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague – Suchdol, Czech Republic

[3] Faculty of Computing, Engineering, and Technology, Davao Oriental State University, City of Mati, Davao Oriental, 8200 Philippines

[4] Faculty of Teacher Education, Davao Oriental State University, City of Mati, Davao Oriental, 8200 Philippines

* **Correspondence:** diether_montejo@dlsu.edu.ph

Abstract: Educational Artificial Intelligence Tools (EAIT) have emerged as potential learning supports that can enhance students' understanding of mathematical concepts. This study examined the Knowledge, Attitude, Practice, and Ethics Concern (KAPE) factors and their influence on the use of EAIT among university students in Southern Philippines A parallel-convergent mixed-methods design was employed. Quantitative data were collected from 150 students and analyzed using Structural Equation Modeling (SEM) using the Partial Least Squares (PLS) approach. Qualitative data were gathered through a Focus Group Discussion (FGD) involving nine participants to support and enrich the quantitative results. The findings revealed that knowledge and attitude significantly influenced students' Educational Artificial Intelligence Tool (EAIT) practices in mathematics learning. Knowledge positively predicted EAIT practices ($\beta = 0.19$, $p = 0.03$), while attitude demonstrated a stronger positive effect ($\beta = 0.61$, $p < 0.001$). Furthermore, EAIT practices significantly predicted students' concerns ($\beta = 0.50$, $p < 0.001$) and perceived ethics ($\beta = 0.66$, $p < 0.001$). Qualitative results further showed that students viewed EAIT as beneficial for learning and academic support, while also recognizing its limitations and the importance of responsible and ethical use. The study concludes that students' familiarity with EAIT and their positive attitudes toward its use increase their likelihood of integrating AI tools into mathematics learning. Greater engagement with EAIT also heightens students' awareness of concerns related to dependency, academic integrity, and critical thinking, while strengthening their recognition of ethical boundaries and the need for responsible AI use.

Keywords: artificial intelligence; technology acceptance; Philippines; structural equation modeling; PLS-SEM

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ORBIT: Onboard Resilient Behavior and Image-Based Tracking for Anomaly Detection in Earth Observing Satellites using Vision-Based AI and Federated Learning

Joshua Salazar [1]*, Hedi Tabia [2], Hicham Hadj-Abdelkader [2], Imen Kachouri [2]

[1] Doctoral School of Science and Technology for Information and Communication, IBISC Laboratory, Universite Paris-Saclay, France, joshua.salazar@universite-paris-saclay.fr

[2] IBISC Laboratory, Universite Paris-Saclay, France, hedi.tabia@univ-evry.fr; hicham.hadjabdelkader@univ-evry.fr; imen.kachouri@univ-evry.fr

* **Correspondence:** joshuapsalazar9@gmail.com

Abstract: Earth-observing satellites increasingly rely on onboard artificial intelligence for timely anomaly detection and image-based monitoring, but centralized learning can be constrained by communication costs, data heterogeneity, privacy requirements, and limited onboard resources. ORBIT (Onboard Resilient Behavior and Image-based Tracking for Anomaly Detection in Observing Satellites) aims to develop a resilient federated learning framework for distributed satellite intelligence while preserving data locality. The current phase establishes the foundational federated learning architecture, with emphasis on server-side optimization for heterogeneous and partially participating clients. A comparative and experimental study of federated optimization methods is conducted using image-classification benchmarks and controlled variations in client participation and data distributions. Building on these findings, a resource-aware server-side optimization approach is being developed to jointly consider model convergence, communication efficiency, and computational constraints. Preliminary experiments demonstrate that server-side optimizer performance is sensitive to data heterogeneity and partial client participation, highlighting the need for optimization strategies specifically designed for resource-constrained federated environments. These findings provide the methodological foundation for subsequent integration of privacy and security mechanisms, scalable algorithms, lightweight vision models, and satellite-oriented datasets. ORBIT is being developed as a progressive pathway from federated learning optimization toward an integrated onboard learning and anomaly-detection framework, with the current work establishing the optimization foundation required for resilient and scalable satellite intelligence.

Keywords: federated learning; satellite Ai; anomaly detection; edge intelligence; adaptive optimization

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A Hybrid Third-Term Inertial Forward–Backward Viscosity Algorithm for Convex Optimization and Deep Learning Applications

Natasha Seemab [1]*, Muhammad Bilal Riaz [2]

[1] Department of Mathematics, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

[2] IT4Innovations, VSB – Technical University of Ostrava, Ostrava, Czech Republic

* **Correspondence:** natashaseemab980@gmail.com

Abstract: The rapid advancement of artificial intelligence, deep learning, and optimization theory has significantly increased the demand for efficient iterative algorithms capable of solving complex fixed point and convex optimization problems. Traditional forward–backward methods often suffer from slow convergence and numerical instability when applied to high-dimensional machine learning applications. Therefore, this study aims to develop an Adaptive 3rd-Term Inertial Forward–Backward Viscosity Algorithm to improve convergence speed, computational stability, and predictive performance in deep learning classification problems. The proposed framework integrates inertial acceleration, viscosity approximation, and proximal forward–backward splitting techniques in Hilbert spaces. Theoretical analysis was established using properties of nonexpansive mappings and Lipschitz continuous operators to derive weak and strong convergence results. Numerical experiments were conducted on benchmark biomedical datasets including Heart Disease, Irish datasets. The proposed Natasha algorithm was compared with PITI/NAGA and FISTA algorithms using classification accuracy, loss curves, and ROC analysis. Experimental findings demonstrated that the proposed Natasha algorithm achieved superior predictive performance with testing accuracies of 97.78% for the Iris dataset, 88.13% for the 68.82% for the heart disease dataset. Furthermore, the proposed method produced lower loss values and improved convergence behavior compared with competing approaches. The proposed adaptive forward–backward viscosity framework provides an efficient, stable, and accurate optimization method for deep learning and machine learning classification applications, particularly for biomedical datasets and high-dimensional artificial intelligence systems with improved convergence speed and predictive performance.

Keywords: fixed point theory; forward--backward splitting; inertial viscosity algorithm; convex optimization; deep learning classification

Development of Functional Ice Cream Mixes Using Buttermilk and Milk Protein Concentrate

Enikő Szücs [1]*, Karina Ilona Hidas [1], Ildikó Csilla Nyulas-Zeke [1]

[1] Department of Livestock Product and Food Preservation Technology, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary; szucseni15@gmail.com; Hidas.Karina.Ilona@uni-mate.hu; Nyulasne.Zeke.Ildiko.Csilla@uni-mate.hu

* **Correspondence:** szucseni15@gmail.com

Abstract: The increasing demand for sustainable food production has encouraged the utilisation of dairy by-products as valuable functional ingredients. Buttermilk is rich in phospholipids and bioactive compounds, while milk protein concentrate (MPC) provides high-quality proteins with excellent water-binding and stabilising properties. The aim of this study was to develop high-protein, reduced-fat ice cream mixes using buttermilk and MPC and to investigate the influence of fermentation on their technological characteristics. Ice cream mixes containing different buttermilk-to-MPC ratios were prepared in fermented and non-fermented forms. The samples were analysed for pH, overrun, melting behaviour, and rheological properties. Flow behaviour was characterised using the Herschel–Bulkley model, while oscillatory rheological measurements were performed to determine the viscoelastic properties of the samples. Increasing the MPC content enhanced the structural stability of the ice cream mixes, resulting in higher storage modulus (G′) values and improved melting resistance. Protein-rich formulations showed delayed dripping, indicating stronger water-binding capacity and a more stable protein network. Fermentation significantly reduced pH and modified the rheological behaviour through protein aggregation, leading to changes in the internal structure of the mixes. The results demonstrate that buttermilk and MPC are promising ingredients for the development of sustainable functional ice cream mixes with improved structural stability and melting performance. These findings support the utilisation of dairy by-products in value-added food products while contributing to more sustainable dairy processing. Future work will focus on evaluating protein digestibility and amino acid bioaccessibility using an in vitro digestion model.

Keywords: buttermilk; fermentation; by-products; functional; dairy by-products

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Synergistic Effects of Milk Protein Concentrates and Apple Pomace Polyphenols on Starch Digestibility in Gluten-Free Corn Bread

Judit Tormási [1]*, Anna Koharek [2], László Abrankó [1]

[1] Department of Food Chemistry and Analysis, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, 1118 Budapest Villányi street 29-43. Hungary, tormasi.judit@uni-mate.hu; abranko.laszlo.peter@uni-mate.hu

[2] University of Cambridge, Christ's College, St. Andrew's St, Cambridge CB2 3BU, United Kingdom, alk61@cam.ac.uk

* **Correspondence:** tormasi.judit@uni-mate.hu

Abstract: The demand for gluten-free foods has expanded beyond individuals with celiac disease to include health-conscious consumers, leading to the increased use of gluten-free cereals and pseudocereals. However, these ingredients typically contain less protein and more carbohydrates than wheat, and the absence of a gluten network is often associated with less favourable glycaemic properties. High-glycaemic-index (GI) foods can cause rapid increases in blood glucose levels, contributing to the long-term risk of type 2 diabetes and obesity. Strategies to reduce GI include increasing protein content and incorporating bioactive compounds such as polyphenols, which can inhibit digestive enzymes. In this study, two milk protein concentrates (MPC and a modified MPC with enhanced DIAAS, iMPC) and a polyphenol-rich apple pomace extract (POE) were incorporated into corn-based gluten-free breads at different concentrations. The samples were subjected to *in vitro* digestion using a hybrid INFOGEST protocol, and glucose release was quantified by UV-Vis spectrophotometry at multiple time points. Estimated GI values were calculated and compared with those of white wheat bread and untreated corn bread. Corn bread exhibited higher glucose release during digestion than reference white bread, confirming the impact of gluten absence on starch digestibility. The addition of MPC and iMPC moderately reduced starch digestion, although the effects were not statistically significant. In contrast, the combination of iMPC and POE significantly decreased glucose release in both gastric and intestinal phases, with significant reductions observed at 120 min ($p = 0.017$), 180 min ($p = 0.020$), and 210 min ($p = 0.039$). These findings demonstrate a synergistic effect of modified milk proteins and polyphenol-rich apple extract in lowering glucose release and suggest a promising strategy for improving the glycaemic properties of gluten-free bread.

Keywords: glyceamic index; gluten-free bakery products; in vitro digestion simulation; valorisation

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AI-Driven IoT Thermal Optimisation for Hybrid PVCPC Systems

Fares Touaref [1]*, Istvan Seres [2], Istvan Farkas [3]

[1] Doctoral School of Mechanical Engineering, Hungarian University of Agriculture and Life Sciences, Pater K. u.1., Gödöllő, H-2100, Hungary

[2] Institute of Mathematics and Basic Science, Hungarian University of Agriculture and Life Sciences, Pater K. u.1. Gödöllő, H-2100, Hungary

[3] Institute of Technology, Hungarian University of Agriculture and Life Sciences, Pater K. u. 1., Gödöllő, H-2100, Hungary

* **Correspondence:** Touaref.Fares@phd.uni-mate.hu

Abstract: The increasing demand for sustainable energy and freshwater has intensified interest in integrated renewable energy systems capable of addressing both challenges simultaneously. Conventional photovoltaic (PV) systems suffer from efficiency losses caused by high operating temperatures, dust accumulation, and limited monitoring capabilities. This study presents an IoT-enabled hybrid photovoltaic–cylindro-parabolic collector (PVCPC) system integrating intelligent thermal management, automated cleaning, real-time monitoring, and solar desalination to improve energy production and freshwater generation. A prototype was developed by combining PV modules, a cylindro-parabolic solar concentrator, automated cooling and cleaning subsystems, battery energy storage, and an ESP32-based IoT monitoring platform. Real-time measurements of solar irradiance, temperature, electrical output, and water production were collected and analyzed under different operating conditions. Experimental results demonstrated an 8-15% increase in solar irradiance capture and up to a 12% improvement in photovoltaic energy yield compared with conventional PV systems. Automated cooling and cleaning maintained stable operating conditions while reducing performance degradation. In addition, the solar desalination unit produced approximately 160 L/day of distilled water with a salt rejection efficiency exceeding 99.9%, confirming its suitability for freshwater production. The integration of IoT-based monitoring, intelligent thermal management, and automated cleaning significantly improved the performance, reliability, and sustainability of the hybrid PVCPC system. The proposed approach provides a scalable and cost-effective solution for simultaneous electricity generation and freshwater production, making it suitable for off-grid and water-scarce regions.

Keywords: hybrid PVCPC system; IoT-based monitoring; solar desalination; predictive maintenance

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A Multi-Sensor Satellite and Machine-Learning Framework for Sugarcane Monitoring in India

Abhishek Mani Tripathi [1*]

[1] Macrocosmos Creations Private Limited, Bangalore, Karnataka, India, amani@macrocosmoscreations.com

* **Correspondence:** amani@macrocosmoscreations.com

Abstract: Timely information on crop type, planting cycle, soil condition, and expected yield is essential for efficient and climate-resilient sugarcane management. This study developed an integrated remote-sensing and machine - learning framework for fieldscale characterization of sugarcane systems in India. Multitemporal optical and synthetic aperture radar (SAR) observations were integrated with field-reference data using in-house machine-learning algorithms developed by MacroCosmos Creations. The framework classified autumn-planted, spring-planted and ratoon sugarcane in Uttar Pradesh, and pre-seasonal, adsali, suru and ratoon sugarcane in Maharashtra. Separate regression workflows were developed for sucrose prediction and satellite-assisted estimation of 13 soil nutrients and properties using spectral bands, bare-soil observations, and derived indices. On the held-out validation datasets, the framework accurately distinguished region-specific sugarcane planting systems. The autumn-planted sugarcane classifier achieved 97.66% overall accuracy, with precision, recall and F1-score of 94.59%. The spring-planted sugarcane classifier correctly classified 223 of 225 samples, achieving 99.11% overall accuracy; sugarcane precision, recall and F1-score were each 97.30%. The multisensor workflow also supported identification of planting and harvesting periods. Preliminary models for sucrose and soil-property estimation were developed, and broader validation across seasons, varieties and agroecological regions is ongoing. Integrating optical and SAR satellite data with machine learning provides a scalable approach for identifying sugarcane planting systems and monitoring planting and harvesting dynamics. The framework is already operationally deployed and demonstrates practical value for crop assessment, production planning, and harvest management, while continued validation will further strengthen its statistical robustness.

Keywords: sugarcane; crop classification; multisensor remote sensing; machine learning; harvest monitoring

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Characterisation and Anti- Diabetic Evaluation of Aplysiapalythine D from *Brasilonema* sp. Using Integrated Biochemical, In Vivo and In Silico Approaches

Arka Mondal [1]*, Dipanjan Chattopadhyay [2], Snehasis Das [2], Sutapa Mukherjee [2], Jnanendra Rath [1]

[1] Department of Botany, Visva-Bharati, Santiniketan, India, arkamondal17@gmail.com; jnanendra@gmail.com

[2] Department of Zoology Visva-Bharati, Santiniketan, India, dchatterjee01@gmail.com; snehasis1992@gmail.com; sutapa.mukherjee@visva-bharati.ac.in

* **Correspondence:** arkamondal17@gmail.com

Abstract: Cyanobacterial secondary metabolites represent an underexplored source of bioactive compounds. Although mycosporine-like amino acids (MAAs) are known for their photoprotective and antioxidant activities, they are little known for their therapeutic potential against insulin resistance and type 2 diabetes. This study investigated Aplysiapalythine D isolated from *Brasilonema* sp. as a potential natural anti-diabetic agent. *Brasilonema* sp. was isolated and cultured, and MAAs was extracted, purified by HPLC, and characterised using mass spectroscopy. Its biosynthetic pathway was predicted through genome-based analysis. Antioxidant activity was assessed by the DPPH assay. Anti-diabetic potential was evaluated using palmitate-induced insulin-resistant C2C12 myotubes and high-fat diet-induced insulin-resistant mice. Molecular docking analyses were performed to investigate interactions with the insulin receptor kinase to assess its activity through in silico validation. The isolated MAAs was successfully identified as Aplysiapalythine D (258.1274 Da). Genomic analysis further identified the biosynthetic pathway involving the mysA, B, C and D genes. Aplysiapalythine D restored insulin signaling by enhancing the expression of phosphorylated IRβ, IRS1, and AKT, promoting GLUT4 translocation under palmitate-induced insulin-resistant conditions. The oral administration of a high-fat diet in insulin-resistant mice improved glucose tolerance and insulin sensitivity, reduced circulating glucose, insulin, free fatty acids, triglycerides, cholesterol, and restored skeletal muscle insulin signaling. Molecular docking showed favourable interaction with the insulin receptor kinase with a binding score of 6.32 kcal mol^{-1}. Aplysiapalythine D from *Brasilonema* sp. demonstrated promising anti-diabetic properties by restoring insulin signaling and improving metabolic homeostasis, which supports its potential as a natural lead compound for type 2 diabetes.

Keywords: aplysiapalythine d; *Brasilonema* sp.; type 2 diabetes; insulin resistance; molecular docking

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Bioconversion of Water Hyacinth into Biogas and Application of Bio-Slurry for Rice Production

Binoy Kumar Show [1]*, Vijayanand Suryakant Moholkar [1], Srinivasan Balachandran [2]

[1] Department of Chemical Engineering, Indian Institute of Technology Guwahati, Guwahati, Assam–781039, India, binoyshow@iitg.ac.in; vmoholkar@iig.ac.in

[2] Department of Environmental Studies, Visva-Bharati, Santiniketan, West Bengal-731235, India, s.balachandran@visva-bharati.ac.in

* **Correspondence:** binoyshow@iitg.ac.in

Abstract: Water hyacinth (WH), an invasive aquatic weed that can serve as a renewable substrate for biogas production while providing nutrient-rich bio-slurry for agricultural applications. This study evaluated the effects of biological, chemical, and thermal pretreatments on the anaerobic digestion of water hyacinth and examined the use of the resulting bio-slurry for rice production. Water hyacinth was pretreated using 2% and 5% NaOH for 4 h, autoclaved at 121°C and 15 lb (2 bar) pressure, and biological treatment with Ochrobactrum sp. for 48 h at 37°C. Anaerobic digestion was conducted at an inoculum-to-substrate ratio of 3:1, and biogas production and methane content were monitored. The biologically pretreated substrate produced the highest methane content, reaching 66.48%. This was followed by 5% NaOH treatment, which produced 64% methane and 142 L kg^{-1} volatile solids of biogas. Physical treatment produced 54% methane and 139 L kg^{-1} volatile solids, whereas 2% NaOH treatment resulted in 50% methane and 137 L kg^{-1} volatile solids. Thermal pretreatment offered no further improvement or significant effect on the digestion of WH. Further application of the anaerobic-digestion bio-slurry, particularly in combination with recommended NPK fertilizer, improved rice yield-related parameters in pot and field experiments. These findings demonstrate the potential of integrating water hyacinth valorization, renewable biogas production, and bio-slurry-based crop fertilization within a circular bioeconomy framework, reducing dependency on expensive imported fertilizers and enhancing agricultural production choices in the face of nutrient scarcity.

Keywords: water hyacinth; anaerobic digestion; biogas; methane; bio-slurry

Seamlessly Combining Renewable Energy

Papa Daouda Faye [1]*

[1] Cheikh Anta Diop University of Dakar, Thies, Senegal

* **Correspondence:** ousmansey147@gmail.com

Abstract: Climate change and environmental degradation continue to place significant pressure on natural resources and ecosystems, particularly in regions with limited capacity for effective environmental monitoring and resource management. Although renewable energy, artificial intelligence (AI), and data science are increasingly used to address sustainability challenges, there remains a need to better understand how these technologies can be integrated to improve environmental decision-making and resource efficiency. This study examines the potential of combining renewable energy systems with AI and data-driven approaches to support environmental monitoring, optimise resource utilisation, and strengthen climate resilience. An interdisciplinary approach was employed through a review and comparative analysis of technological applications across different environmental contexts. Environmental and operational data from relevant sources were analyzed to assess the effectiveness, adaptability, and sustainability of integrated technological approaches. The findings indicate that combining renewable energy with AI-assisted data analysis can improve the collection and interpretation of environmental information, enhance resource management, and support more informed decision-making. The study further shows that integrated technological systems can provide adaptable and scalable solutions for addressing environmental challenges. The study concludes that strengthening the integration of renewable energy, AI, and data science can contribute to sustainable environmental management and climate resilience. However, further research is needed to address challenges related to infrastructure, data availability, technical capacity, and the practical implementation of these technologies in different regional contexts.

Keywords: renewable energy; artificial intelligence; environmental sustainability

Determinants of Biogas Technology Adoption in Cameroon: Insights from Household Decisions

Ayeah Gideon Gobti [1]*, Hynek Roubík [1]

[1] Department of Food and BioResource Technology, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague, Czech Republic

* **Correspondence:** binoyshow@iitg.ac.in

Abstract: Research on biogas technology continues to gain global attention due to its triple benefits: waste management, environmental conservation, and energy needs. This study focuses on identifying the determinants of biogas technology adoption in Bamenda, Cameroon. A multistage sampling approach was used to select biogas technology adopters and non-adopters for this study. Semi-structured, self-administered questionnaires were used to collect primary data from 129 respondents, comprising 112 non-biogas adopters and 17 biogas adopters. Descriptive statistics and Firth's penalised-likelihood logistic regression model were used to analyse the data in R. The results indicated that livestock holding, extension services, and income significantly increased the likelihood of biogas technology adoption, whereas household size did not have a significant effect. The low adoption of biogas technology is due to a lack of household-level funding. Hence, stakeholders should incentivise and subsidise households to promote adoption.

Keywords: anaerobic digestion; circular economy; renewable energy; waste-to-energy; climate change

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Plants & Agriculture

Scientific Session



Assessment of Near Infrared Spectral Data Acquired Using Different Spectroscopic Devices: A Study of Bioactive Compound-Enriched Blue Grape Juices

Mercy Mukite Barasa [1]*, Flora Vitalis [2], John-Lewis Zinia Zaukuu [3], Christian Huck [4], Zoltan Kovacs [2]

[1] Department of Food Chemistry and Analytical Chemistry, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary, Barasa.Mercy.Mukite@uni-mate.hu

[2] Department of Measurement and Process Control, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, Budapest, Hungary, Vitalis.Flora@uni-mate.hu; Kovacs.Zoltan.food@uni-mate.hu

[3] Department of Food Science & Technology, Kwame Nkrumah University of Science & Technology, Kumasi-Ghana 00233, Ghana; zaukuu.jz@knust.edu.gh

[4] Institute of Analytical Chemistry and Radiochemistry, University of Innsbruck, Innsbruck, Austria; christian.w.huck@uibk.ac.at

* **Correspondence:** Barasa.Mercy.Mukite@uni-mate.hu

Abstract: This study investigates the potential of near infrared (NIR) spectroscopy for distinguishing blue grape juices enriched with different plant extracts and examines how spectral data obtained from different NIR devices can be used for this purpose. Cranberry, grapeseed and pomegranate extracts were added to blue grape juices at concentrations ranging from 0 to 2.5 g/100 mL, either individually or in combinations. The spectra were collected using benchtop and handheld NIR spectrometers and analysed across different spectral ranges with various preprocessing to identify the most suitable evaluation approach. Principal component analysis-based linear discriminant analysis was used for classification, partial least squares regression was applied to predict the degree of enrichment in the juices. Generally, the predictive models based on benchtop-data achieved higher accuracy than those based on the handheld device. The classification demonstrated clear differentiation of the juice samples according to extract concentration. The regression models provided good predictive performance, with coefficients of determination above 0.9 and root mean square errors below 0.5 g/100 mL in both calibration, validation and prediction. The findings indicate that appropriate spectral preprocessing is important for improving model performance and that calibration transfer could support the use of different NIR instruments in practical, in situ measurements.

Keywords: juice; fortification; quality control; near infrared spectroscopy; chemometrics

Acknowledgement: The study was supported by the Doctoral School of Food Science of the Hungarian University of Agriculture and Life Sciences; the Cooperative Doctoral Programme (KDP-2023), the University Research Scholarship Programme (EKÖP-MATE/2025/26), the 2023-1.2.4-TÉT-2023-00068 Program of the Ministry for Innovation and Technology (Hungary) from the source of the National Research, Development and Innovation Fund, and the CEEPUS mobility grant.

Deciphering the Biogeochemical Weathering of Potassium-Bearing Minerals by Novel Rhizospheric Isolates: Coupled Proton- and Ligand-Mediated Mineral Dissolution

Raju Biswas [1]*, Bomba Dam [1]

[1] Microbiology Laboratory, Department of Botany, Visva-Bharati, Santiniketan, West Bengal, India

* **Correspondence:** rajubiswas.26041995@gmail.com

Abstract: The use of synthetic potassium fertilizer (K) has been intensive, and it is causing significant quality degradation of the soil, so there is a need for eco-friendly microbial mineral weathering. This study elucidates the biochemical and biophysical mechanisms underlying K solubilization from K-bearing minerals (feldspar) by the novel rhizospheric isolates Pantoea tagorei MR1 and Burkholderia sp. SR8 was performed using HPLC, SEM-EDS, FTIR, DLS, and AFM. The growth of the bacteria in modified Aleksandrov broth resulted in severe medium acidification (drop in pH from 7.0 to 3.0 and 4.4 for Pantoea and Burkholderia, respectively), which was accompanied by significant oxalic acid exudation (up to 57.77-92.46 μg L^{-1}) and exopolysaccharide (EPS) excretion (up to 43.75-124.49 μg mL^{-1}). The SEM-EDS and FTIR spectral analyses showed mineral lattice destabilization, localized pitting on the surface of the minerals, and significant depletion of framework K, Al, and Si. Mechanistically, EPS-mediated biofilm microenvironments, focused on the formation of organic acids and the chelation of Al^{3+}, led to accelerated dissolution of aluminosilicates. Overall, silica was accumulated in the cells, which supported the biogenic synthesis of silicon nanoparticles (109-352 nm). In summary, Pantoea and Burkholderia follow a multifactorial weathering action with protonation, ligand-mediated chelation, and biofilm entrapment with their great potential as biofertilizers for sustainable agriculture.

Keywords: potassium solubilization; mineral weathering; acidification; exopolysaccharides; mineral-microbe interaction

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Subcritical Water Extraction and Fractionation: A Green Approach to Recovering Secondary Metabolites from Teas and Tea-like Plants

Kateřina Bláhová [1]*, Michal Jágr [2], Anna Mascellani [3], Ladislav Kokoška [1], Johana Rondevaldová [1]

[1] Department of Crop Science and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences, Kamýcká 129, 165 00 Prague-Suchdol, Czech Republic, berkovak@ftz.czu.cz; kokoska@ftz.czu.cz; rondevaldova@ftz.czu.cz

[2] Quality of Plant Products, Czech Agrifood Research Centre, Drnovská 507/73, 161 06 Prague-Ruzyně, Czech Republic,

[3] Department of Food Science, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, Kamýcká 129, 165 00 Prague-Suchdol, Czech Republic

* **Correspondence:** blahovak@ftz.czu.cz

Abstract: Tea (Camellia sinensis (L.) Kuntze) is valued for its health benefits (antioxidants) and stimulating properties (caffeine). Teas, but also tea-like plants such as yerba maté (Ilex paraguariensis A.St.-Hil.) are used in various dietary supplements, but its manufacturing often relies on inefficient and environmentally harmful extraction methods. Subcritical water extraction (SWE) is a promising green alternative, enhancing yields of desired compounds and efficiency of extraction. However, inconsistent methodologies lead to varying scientific assessments. This study optimized SWE to maximize content of biologically active compounds, using fractionated extraction (5x2min, 2x5min, 10min, 20min). SWE extracts were compared with water infusions (WI). Results showed that antioxidant activity increased with longer extraction times, particularly in the 2nd fraction of 5min extraction (black and green tea) or at 3rd and 4th fractions of 2min extraction (yerba maté). The overall strongest antioxidant potential (DPPH IC50 9.73 µg/mL; ORAC IC50 6.50 µg/mL; TPC 778.53 mg GAE/g) was found in the 2nd 5min green tea fraction and highest caffeine content (60.76 µg/mL) in the 1st 5min green tea fraction. LC-MS/MS analysis showed that several phenolics (chlorogenic acid, quercetin, rutin) required precise extraction timing, with peak concentrations in the 1st 5min or selected 2min fractions. Conversely, catechin in black tea or matesaponins in yerba maté reached their highest levels in WI or were unaffected by fractionation. These findings demonstrate that extraction time significantly affects final extract composition. Since different compounds respond to varying SWE conditions, further optimization of temperature and pressure is necessary to enhance extraction efficiency.

Keywords: antioxidant activity; caffeine; extraction optimization; phenolic compounds; pressurized water

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Ethalfluralin as an Alternative Antimitotic for Chromosome Doubling in *Brassica Juncea*

Pavla Bryxová [1]*, Eloy Fernández Cusimamani [1], Miroslav Klíma [2]

[1] Department of Crop Science and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences, Czech Republic, bryxova@ftz.czu.cz; eloy@ftz.czu.cz

[2] Czech Agrifood Research Center v.v.i., Czech Republic

* **Correspondence:** bryxova@ftz.czu.cz

Abstract: *Brassica juncea* from the family Brassicaceae is important source of vegetables as well as edible or industrial oils, condiments and forage. Breeding programmes of this species benefit from methods that accelerate the development of homozygous material, since conventional breeding requires six to eight generations of self-pollination to approach homozygosity. Microspore culture technique is a tool for obtaining doubled haploid (DH) lines, which are completely homozygous within a single generation and can be used in a wide spectrum of genotypes. As microspore regenerants are formed from haploid cells, artificial or spontaneous chromosome doubling is required. However, the frequency of spontaneous chromosome doubling is usually low. Thus, the application of antimitotic agents is required for most genotypes. In this study, selected microtubule depolymerising herbicide was used, because it proved to be efficient for in vitro chromosome doubling and the rate of their toxicity is lower than for the common antimitotic agent – colchicine. The aims of this study were to evaluate the efficiency of the selected antimitotic agent and to obtain doubled haploids in Brassica juncea. Immature pollen grains were isolated from fertile plants and cultures were enriched with the herbicide ethalfluralin. The ploidy level was assessed via flow cytometry. Flow cytometry revealed that 76.7% of the regenerated plants were doubled haploids after ethalfluralin treatment. Optimized protocol of microspore culture technique was established and can be used in subsequent breeding programmes.

Keywords: microspore culture; indian mustard; dihaploidization

Acknowledgement: This study will be carried out in cooperation with the Czech Agrifood Research Centre in Prague. The research will be financially supported by the Internal Grant Agency of the Faculty of Tropical AgriSciences and by the CARC project NAZV QL26010249, Molecular Smart Breeding — Modern Approaches for Efficient Breeding of Brassica Vegetables and Oilseed Crops (2026–2030).

Evolutionary Trends of Rice Varietal Diversity across Agro-ecosystems in Battambang Province, Cambodia

Dany Koun [1*], Adeline Barnaud [1,2], Mr. Raksmey Phoeurk [1], Ms. Clemence Aujogue [1,2],

[1] Faculty of Agricultural Economic and Rural Development, Royal University of Agriculture, Sangkat/Khan Dangkor, Phnom Penh, Cambodia, dany.koun2222@gmail.com, praksmey@rua.edu.kh

[2] DIADE, Univ Montpellier, CIRAD, IRD, Montpellier, France, adeline.barnaud@ird.fr; clemence.aujogue@ird.fr

* **Correspondence:** dany.koun2222@gmail.com

Abstract: Rice (*Oryza sativa* L.) is the foundation of food security, rural livelihoods, and agricultural development in Cambodia. Battambang Province is one of the country's major rice-producing regions, where rice agroecosystems have changed over time because of agricultural modernization, irrigation development, market integration, and environmental and climatic changes. This study examines rice varietal diversity across different agroecosystems in Battambang Province. It also investigates changes in varietal composition and seed management practices over time. Structured interviews were conducted with 77 rice-farming households across four districts of Battambang Province, selected to represent four rice-cropping systems: floating rice, irrigated upland, irrigated lowland, and non-irrigated lowland. Data were collected using a structured questionnaire in Khmer through face-to-face interviews on rice varieties, farming techniques, seed management, and factors impacting variety adoption and abandonment. A total of 45 rice varieties were documented: 26 currently cultivated and 19 abandoned. The three most widely cultivated varieties were Sro Nge (36.4%), OM5451 (35.1%), and Neang Khon (24.7%). Findings show a shift toward varieties selected for agronomic performance, environmental adaptation, and grain quality; abandoned varieties are mainly associated with lower productivity, longer maturity periods, and reduced adaptation to changing environmental and socioeconomic conditions. These findings highlight the dynamic nature of rice varietal diversity in Battambang Province and raise concerns about ongoing genetic erosion and the potential loss of culturally significant landraces. The study recommends targeted conservation strategies, participatory plant breeding, and stronger seed systems to safeguard agro-biodiversity while sustaining productivity across Battambang's varied rice-growing landscapes.

Keywords: rice variety diversity; agro-ecosystems; genetic erosion; floating rice; upland irrigated; irrigated lowland; non-irrigated lowland; Battambang; seed systems; landraces; agrobiodiversity.

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Development of Alginate Pearls as a Sustainable Solution for Increasing the Resilience of Honeybee Colonies

Darvas Tamara [1,2*], Kuzman Ildikó Hajnalka [1,2], Bartos Hunor [1,2], Keresztesi Ágnes [1,2,3]

[1] Research and Development Institute for Wildlife and Mountain Resources, Miercurea Ciuc, Romania

[2] Hungarian University of Agriculture and Life Sciences, Doctoral School of Agricultural and Food Sciences, Budapest, Hungary"

[3] University of Pécs, Doctoral School of Chemistry, Pécs, Hungary

* **Correspondence:** darvastamara@icdcrm.ro

Abstract: Honeybee (Apis mellifera) colonies are exposed to multiple stressors, including nutritional deficiencies, pathogens, parasites, pesticides, and climate-related challenges, highlighting the need for innovative and sustainable approaches to improve colony resilience. This study investigated the feasibility of sodium alginate beads as natural carriers for the controlled delivery of vitamin C and thymol, two bioactive compounds with nutritional and protective benefits for honeybees. Alginate beads were produced by ionotropic gelation using sodium alginate solutions (1%, 1.5%, and 2%) crosslinked in a 2.5% calcium chloride solution. Bead morphology and size were evaluated by optical microscopy, encapsulation efficiency was determined by spectrophotometry, and internal pH, dehydration behavior, and thermal stability at 35°C were assessed to estimate suitability under hive conditions. Uniform beads (3–4 mm) were obtained, with encapsulation efficiencies ranging from 73–90% for vitamin C and 90–93% for thymol, while internal pH values (6.5–7.45) indicated compatibility with the bee intestinal environment. However, dehydration reduced bead diameter to approximately 1 mm after 24 hours, and thermal stability tests revealed structural contraction at 35°C, particularly in thymol formulations. These findings demonstrate the potential of alginate beads as delivery systems for bioactive compounds in apiculture while emphasizing the need for further optimization to improve thermal stability and enable controlled release under hive conditions during prolonged exposure to realistic environmental conditions encountered by colonies.

Keywords: honeybee; sodium alginate; microencapsulation; thymol; vitamin C.

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Electrophysical Parameters of Chernozems in the Context of Military Degradation

Yurii Dehtiarov [1]*, Vladyslav Shemiakin [1]

[1] Department of Soil Science, Faculty of Agronomy and Plant Protection, State Biotechnological University, p/o Dokuchaevske - 2, Kharkiv, 62483, Ukraine; degt7@ukr.net; vladislav.shemyakin.93@gmail.com

* **Correspondence:** degt7@ukr.net

Abstract: As a result of military actions and anthropogenic pressures, typical chernozems are subjected to mechanical compaction, thermal damage, and chemical contamination, which alter their water regime and self-regeneration capacity. The aim of the study was to assess changes in electrical conductivity, mineralization, salinity, and the content of water-soluble calcium, sodium, and potassium salts to determine the degree of soil degradation and the potential for soil recovery. Soil samples were collected from the 0–40 cm layer in areas with different types of impact: fallow land, roads, arable land, and equipment parking areas. The water-soil paste method (1:1), an EZODO-8200 M conductometer, and HORIBA LAQUAtwin ion meters were used. The data were statistically analyzed using correlation analysis. Thermal exposure caused a decrease in electrical conductivity with depth. Natural fallow land was characterized by salt accumulation in the lower layers. Roads exhibited uneven distribution of parameters due to anthropogenic compaction. Arable land had the highest values of electrical conductivity and mineralization, reflecting agrogenic salt accumulation. Equipment parking areas revealed a risk of local contamination with fuel and lubricants. Electrophysical parameters are sensitive indicators of chernozem degradation. The vertical distribution of salts reflects various types of disturbances: pyrogenic depletion, agrogenic accumulation, and technogenic heterogeneity. The obtained data confirm the diagnostic value of electrical conductivity for assessing soil condition and formulating recommendations for their restoration.

Keywords: typical chernozems; electrical conductivity; salt content; military action; anthropogenic pressure

Acknowledgement: This study was conducted as part of the research project “Impact of Military Actions on the Soil Cover and Soil Quality in Ukraine” (State Registration No. 0124U005030).

Particle Size Distribution of Typical Chernozems Under the Influence of Military and Anthropogenic Factors

Yurii Dehtiarov [1]*, Vasyl Degtyarjov [1], Vladyslav Shemiakin [1]

[1] Department of Soil Science, Faculty of Agronomy and Plant Protection, State Biotechnological University, p/o Dokuchaevske - 2, Kharkiv, 62483, Ukraine; degt7@ukr.net; dvv4013@gmail.com; vladislav.shemyakin.93@gmail.com

* **Correspondence:** degt7@ukr.net

Abstract: Particle size distribution is an important indicator that allows for assessing the condition of the soil cover and determining its potential for recovery. The aim of the study was to identify the characteristics of the particle size distribution under various types of stress. Soil particle size was determined using the laser diffraction method on a Mastersizer 3000E analyzer (Malvern Instruments) equipped with the Hydro EV module. Classification was performed according to the USDA system. Samples were collected from the 0–40 cm layer in areas with different types of disturbance, including fallow land, roads, cultivated fields, and equipment parking areas. In the fallow variant, after burning, the top layer was characterized as clay loam, while the lower horizons consisted of silty clay. Natural fallow soil at all depths consisted of silty clay. The road had a top layer of clay, and the lower horizons consisted of silty clay. The plowed road and arable land consisted of silty clay at all depths. The equipment parking area exhibited a top layer of clay, while the lower horizons were silty clay. Thus, most variants are characterized by a predominance of silty clay, while the upper horizons of individual plots undergo local changes toward clay or clay loam, which is associated with mechanical compaction and pyrogenic effects. The particle size distribution of typical chernozems remains stable in deeper horizons, but the upper layers are more sensitive to mechanical and thermal disturbances.

Keywords: typical chernozems; particle size distribution; military action; anthropogenic pressure

Acknowledgement: This study was conducted as part of the research project “Impact of Military Actions on the Soil Cover and Soil Quality in Ukraine” (State Registration No. 0124U005030).

Strengthening Sustainable Plant-Based Agriculture in The Gambia

Lamin Fatty [1]*

[1] Agriculture Department, University of The Gambia, Faraba, West Coast Region

* **Correspondence:** ousmanloum17@gmail.com

Abstract: Agriculture plays a vital role in The Gambia by supporting rural livelihoods, food security, and economic development. However, climate variability, soil degradation, deforestation, and limited crop diversification continue to constrain agricultural productivity and increase food insecurity. This study examined the potential of sustainable plant-based agriculture to improve productivity, climate resilience, and rural livelihoods in The Gambia. A qualitative and descriptive approach was employed through a review of existing literature, agricultural reports, and policy documents on regenerative farming and climate-smart agricultural practices. The study focused on agroforestry, conservation agriculture, organic inputs such as compost and bio-pesticides, drought-resistant crops, and solar-powered drip irrigation. The findings indicate that these practices can improve soil fertility, reduce environmental degradation, and strengthen farmers' resilience to climate variability. Crop diversification using cassava, sweet potatoes, cowpeas, and improved millet varieties can reduce dependence on rainfall and minimize the risk of crop failure. Solar-powered drip irrigation can also support year-round vegetable production, contributing to increased farm income and improved food availability. The study concludes that promoting sustainable farming practices, climate-smart crop diversification, improved irrigation, and stronger agricultural value chains can contribute significantly to food security, environmental sustainability, and rural development in The Gambia. Greater collaboration among farmers, communities, and policymakers is essential for long-term agricultural resilience.

Keywords: crop diversification; climate resilience; soil health

Chlorophyll Dynamics of Hungarian Winter Wheat under Intramontane Environmental Conditions and Ambient Ozone

Hajnalka Kuzman [1,2]*, Keresztesi Ágnes [1,2,3], Zalán Zsolt [2], Boga Réka [1], Farkas András [1], Szép Róbert [1,3,4,5]

[1] Research and Development Institute for Wildlife and Mountain Resources, Miercurea Ciuc, Romania;

[2] Hungarian University of Agriculture and Life Science, Doctoral School of Agricultural and Food Sciences, Food Sciences Program, Budapest, Hungary;

[3] University of Pécs, Faculty of Natural Sciences, Doctoral School of Chemistry, Pécs, Hungary;

[4] Sapientia Hungarian University of Transylvania, Miercurea Ciuc, Romania

[5] University "Alexandru Ioan Cuza" of Iaşi, Doctoral School of Geosciences, Iași, Romania

* **Correspondence:** kuzman.hajnalka@gmail.com

Abstract: Leaf chlorophyll content is an important indicator of photosynthetic activity and stress status in wheat. Drought, high temperatures, and ambient ozone can accelerate chlorophyll loss and leaf senescence, potentially reducing plant performance and yield. This study evaluated the temporal dynamics of leaf chlorophyll in Hungarian-bred winter wheat cultivars grown under the intramontane agroclimatic conditions of eastern Transylvania, Romania, with emphasis on their relationships with meteorological conditions and ambient ozone exposure. Eleven winter wheat cultivars developed by Cereal Research Non-Profit Ltd. (Szeged, Hungary) and the HUN-REN Agricultural Research Centre (Martonvásár, Hungary) were evaluated at ICDCRM demonstration plots near Miercurea Ciuc. Relative leaf chlorophyll content was monitored weekly using an atLEAF CHL BLUE portable chlorophyll meter from the beginning of booting (Zadoks GS43; flag leaf sheath extending) to the hard dough stage (Zadoks GS87). Measurements were conducted from 28 May to 10 July 2026, and multiple readings per cultivar and sampling date were converted to estimated SPAD values. Ambient ozone exposure was assessed using the AOT40 index, cumulative exposure over different time windows, and weekly mean O_3 concentrations. Relationships among ozone exposure, meteorological conditions, and physiological and agronomic characteristics were investigated using statistical methods. Estimated SPAD values generally remained high until late June, with several cultivars exceeding 45–55 SPAD units, but declined sharply thereafter. The overall mean across cultivars decreased to approximately 13.2 SPAD units on 2 July and 10.8 SPAD units on 10 July, indicating rapid chlorophyll loss associated with leaf senescence. These findings improve our understanding of cultivar-specific physiological responses to environmental variability and ambient ozone exposure and may support the selection of more resilient winter wheat cultivars for sustainable cereal production in Central and Eastern Europe.

Keywords: Eheat; chlorophyll dynamics; Abiotic stress

Hidden in the Green: Persistence of Nontuberculous Mycobacteria in an Indoor Vertical Green Wall

Ivana Karberová [1]*, Tadeáš Hrušovský [1], Ivo Pavlík [2]

[1] Department of Environmental Science and Natural Resources, Faculty of Regional Development and International Studies, Mendel University in Brno, Czech Republic, Zemědělská 1, 613 00 Brno; ivana.karberova@mendelu.cz; tadeas.hrusovsky@mendelu.cz

[2] Department of Area Studies, Faculty of Regional Development and International Studies, Mendel University in Brno, Czech Republic, Zemědělská 1, 613 00 Brno

* **Correspondence:** ivana.karberova@mendelu.cz

Abstract: Indoor vertical green walls can improve indoor microclimatic conditions, aesthetic quality, and the well-being of building occupants. However, their recirculating irrigation systems may provide suitable conditions for the persistence of opportunistic microorganisms, including nontuberculous mycobacteria (NTM). This study assessed the occurrence and viability of NTM in different components of an indoor vertical green wall and considered the potential implications for its safe operation. From July 2025 to June 2026, 75 samples were collected from a mobile indoor vertical green wall located at the Faculty of Regional Development and International Studies, Mendel University in Brno, Czech Republic. The samples comprised 36 samples of recirculating irrigation water, 15 root samples, 15 substrate samples, and 9 samples of granulated fertilizer. Mycobacteria were examined by an accredited laboratory using culture-based methods, quantitative polymerase chain reaction, and molecular hybridization tests with specific probes. Irrigation-water temperature and pH were also monitored. Mycobacterial DNA was detected in all analyzed samples (100%), while 38.7% of the samples were culture-positive, confirming the presence of viable mycobacteria. The dominant species was *Mycobacterium gordonae* (36%), followed by *M. chimaera* (22.7%), *M. fortuitum* (10.7%), *M. chelonae* (2.7%) and *M. peregrinum* (1.3%). The latter species was identified during the latest sampling rounds. The mean irrigation-water temperature was 21.7 °C, while the mean pH reached 5,2. The results demonstrate widespread molecular occurrence and long-term persistence of NTM within the monitored indoor green wall. Although the identified species are unlikely to represent a significant health risk to the general population, viable NTM and biofilm formation may be relevant for immunocompromised individuals and other vulnerable groups. Regular maintenance, microbiological monitoring, biofilm prevention, and minimisation of aerosol formation are therefore recommended.

Keywords: indoor vertical green wall, nontuberculous mycobacteria, irrigation water, biofilm, indoor environmental quality

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Sustainable Plants and Agriculture for Food Security and Environmental Conservation

Modou Lamin Jallow [1]*

[1] Agriculture, Gambia Collage Brikama, Gambia

* **Correspondence:** pannehalahagiehamad@gmail.com

Abstract: Plants and agriculture are fundamental to food production, economic development, and environmental sustainability. Rapid population growth, climate change, land degradation, and declining natural resources have increased the need for sustainable agricultural systems that can ensure long-term food security while protecting ecosystems. Integrating scientific research and innovative technologies is essential to improving agricultural productivity and resilience. This review synthesizes current knowledge on sustainable agricultural practices and modern crop science innovations. It examines approaches including crop rotation, conservation tillage, integrated pest management, organic farming, efficient irrigation, biotechnology, precision agriculture, climate-smart agriculture, and agrobiology. The study also considers the role of interdisciplinary research in strengthening sustainable food systems. Sustainable farming practices improve soil fertility, conserve water, enhance biodiversity, and reduce environmental pollution while maintaining or increasing crop yields. Advances in plant genetics, tissue culture, precision agriculture, drones, satellite monitoring, and smart irrigation enable farmers to optimize resource use and adapt to climate-related challenges. Climate-smart practices, including drought-tolerant crop varieties, agroforestry, and efficient fertilizer management, strengthen resilience, reduce greenhouse gas emissions, and support sustainable food production. These innovations contribute significantly to improving food security and farmers' livelihoods. Sustainable plants and agriculture are critical to achieving global food security, environmental conservation, and sustainable development. Continued investment in agricultural research, technological innovation, climate-smart practices, and farmer capacity building will enhance resilient agricultural systems capable of meeting future food demands while preserving natural resources.

Keywords: sustainable agriculture; food security; climate-smart agriculture

In Vitro Elicitation Strategies for Enhanced Production of Anticancer Bioactive Compounds in the Underutilized Crop *Momordica Charantia*

Muhammad Uzair Javed [1]*, Oushadee A J Abeyawardana [2], Iva Viehmannová [1]

[1] Department of Crop Sciences and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences, Kamycka 129, 16500 Prague – Suchdol, Prague, Czech Republic

[2] Czech Agri food Research Center, Drnovská 507/73, 161 00 Prague 6- Ruzyně

* **Correspondence:** javed@ftz.czu.cz

Abstract: The increasing global burden of cancer and the demand for safer, plant-based therapeutic agents underscore the need to explore underutilized medicinal crops. *Momordica charantia* L. (bitter melon) contains bioactive compounds, including cucurbitacins, phenolic acids, and flavonoids, with reported anticancer activities. However, variability in phytochemical composition and propagation constraints limit its consistent utilization as a reliable source of these compounds. Plant tissue culture provides a controlled and reproducible platform for rapid propagation and metabolite production, while elicitation can stimulate the accumulation of stress-responsive secondary metabolites. This study aimed to develop an efficient *in vitro* propagation system and apply elicitation strategies to enhance anticancer metabolite production. A reproducible micropropagation protocol was established using seed-derived explants, with shoot induction optimized on Murashige and Skoog (MS) medium supplemented with 1 mg L^{-1} 6-benzylaminopurine (BAP). Callus cultures were induced on MS medium containing 0.5 mg L^{-1} BAP, 2 mg L^{-1} naphthaleneacetic acid (NAA), and 2 mg L^{-1} 2,4-dichlorophenoxyacetic acid (2,4-D). A targeted panel of bioactive compounds with documented cytotoxicity against MCF-7, HeLa, HT-29, and A549 cancer cell lines was also compiled. Elicitation experiments involving chemical and nanoparticle-based inducers are ongoing. The established culture conditions provided a consistent platform for shoot regeneration and callus induction and offer a basis for controlled metabolite production. This study provides a framework for the sustainable production of anticancer phytochemicals from *M. charantia* using plant tissue culture and elicitation approaches. The findings help bridge the gap between laboratory-scale innovation and plant-based therapeutic development, with the potential for scalable and reliable production.

Keywords: *Momordica charantia*; *in vitro* propagation; anticancer metabolites; callus culture; elicitation

Acknowledgement: This work was financially supported by the Internal Grant Agency of the Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, IGA (Project No. 20253135).

Remote Sensing Assessment of Winter Wheat Response to Agrometeorological Conditions in the Southern Steppe of Ukraine

Antonina Panfilova [1]*, Dmytro Koshkin [2]

[1] Department of Plant Growing and Horticulture, Faculty of Agricultural Technologies Mykolaiv National Agrarian University 9 Georgy Gongadze St., Mykolaiv, 54008, Ukraine panfilovaantonina@ukr.net

[2] Institute of Mechanics and Technology Mykolaiv National Agrarian University 9 Georgy Gongadze St., Mykolaiv, 54008, Ukraine koshkindl@mnau.edu.ua

* **Correspondence:** koshkindl@mnau.edu.ua

Abstract: Winter wheat productivity in the Southern Steppe of Ukraine largely depends on seasonal variations in temperature and moisture availability, particularly during critical growth stages. The integration of remote sensing data with meteorological observations provides crop monitoring and early detection of water stress. To assess the influence of agrometeorological conditions on winter wheat vegetation index dynamics and evaluate crop response during the 2021–2025 growing seasons, a study was conducted at the Educational, Scientific and Practical Center of Mykolaiv National Agrarian University. Meteorological data from an automatic iMETOS weather station and Sentinel-2 SR Harmonized imagery processed in Google Earth Engine were used. NDVI, NDRE, and NDMI were calculated for the main phenological stages of winter wheat. The 2021–2022 and 2022–2023 growing seasons were most favorable for winter wheat development, with NDVI reaching 0.8–0.9 and NDRE 0.6–0.7. The 2023–2024 growing season was characterized by suppressed autumn growth followed by compensatory spring biomass accumulation, whereas in 2024–2025 favorable autumn conditions did not ensure vigorous spring development because of cold, relatively dry weather. NDMI detected water stress earlier than NDVI, while shortening of the NDVI plateau indicated reduced crop productivity potential. June was the most critical period for water stress development throughout the study. The combined use of NDVI, NDRE, and NDMI provides effective monitoring of winter wheat under varying agrometeorological conditions. NDMI is the most sensitive early indicator of water stress, whereas NDVI plateau duration reflects limitations in winter wheat productivity in the Southern Steppe of Ukraine.

Keywords: winter wheat; vegetation indices; sentinel-2; agrometeorological conditions

Genomic Evaluation of the Breeding Value of Bulls in Dairy Cattle Selection: Current State and Prospects in Ukraine

Olha Kruhliak [1]*, Andrii Kruhliak [2], Tetiana Kruhliak [2]

[1] Laboratory of Scientific Information Support, Economics and Innovation Marketing, Institute of Animal Breeding and Genetics nd. a. M.V.Zubets, National Academy of Agrarian Sciences of Ukraine, Chubynske village, Boryspil district, Kyiv region, 08321, Ukraine, ovokrug@gmail.com

[2] Laboratory of Dairy Cattle Breeding, Institute of Animal Breeding and Genetics nd. a. M.V.Zubets, National Academy of Agrarian Sciences of Ukraine, Chubynske village, Boryspil district, Kyiv region, 08321, Ukraine, ovokrug@gmail.com; ovokrug@gmail.com

* **Correspondence:** ovokrug@gmail.com

Abstract: Genomic evaluation of breeding value is one of the modern tools in dairy cattle selection, widely used in international practice to improve selection accuracy and accelerate genetic progress. The use of genomic information allows early evaluation of animals, reduction of the generation interval, and increased efficiency of breeding programs. In Ukraine, this method is integrated into the modern system of animal breeding, which determines the importance of evaluating its application and future prospects. The study is based on a review and synthesis of scientific literature on genomic evaluation of dairy bulls and an analysis of modern approaches to its application in dairy cattle breeding. The reviewed studies show that genomic evaluation allows early prediction of breeding value, increases selection accuracy, reduces the generation interval, and improves selection intensity. Genomically evaluated bulls are already used in dairy cattle selection in Ukraine, indicating the practical implementation of genomic information in breeding programs. This creates opportunities for further improvement of the genetic potential of dairy herds and acceleration of genetic progress. Genomic evaluation is an important tool for modern dairy cattle breeding, combining accurate prediction of breeding value with acceleration of genetic progress. Further use of genomic information and implementation of international approaches into the national breeding system will support the improvement of dairy cattle productivity in Ukraine.

Keywords: genomic evaluation; dairy cattle; breeding value; genomic selection; genetic progress

Post-Harvest Loss Management in African Staple Food Supply Chains: An Integrated Economic, Financial, and Strategic Analysis - A Multi-Country Panel Study with Risk-Weighted Indices

Elvis Kwakye [1]*

[1]Economy and Management, Faculty of Economics, VSB-Technical University of Ostrava

* **Correspondence:** elvis.kwakye.st@vsb.cz

Abstract: Post-harvest losses undermine food security and supply chain resilience across sub-Saharan Africa, yet policymakers lack precise tools to identify where losses concentrate and why certain stages generate disproportionate financial vulnerability. This study integrates structural, financial, and operational dimensions into a unified empirical framework, applying a fixed-effects panel regression model with country-clustered standard errors to 2,517 observations across 36 African countries, five staple crops, and eight supply chain stages (2019–2024), complemented by three purpose-built indices: the Stage-Dominance Index, the Risk-Weighted Loss Index, and the Financial Exposure Score. Farm and harvest stages account for 81.4% of total losses, while market-stage losses are negligible. Two distinct failure types emerge: capacity failures, characterised by large and predictable losses, and variability failures, driven by unpredictable outcomes. This distinction is illustrated by the rice paradox: although rice records lower average losses than maize, it shows the highest financial exposure at the packing and transport stages, owing to extreme outcome variability (coefficient of variation = 1.00–1.81). Single-metric approaches can systematically misdirect intervention resources; an integrated four-domain framework linking infrastructure investment, financial instruments, quality standardisation, and risk management tools offers a more effective pathway to reducing losses and building supply chain resilience across African food systems.

Keywords: post-harvest losses; supply chain resilience; food security; panel data; financial exposure

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Harnessing Beneficial Plant–Soil Microbial Interactions for Sustainable Crop Production and Food Security in a Changing Climate: A Systematic Review

Ing. Emmanuellah Lekete-Lawson [1]*, Ing. Shafika Mkhies [2], Prof. Fernández Cusimamani Eloy [1]

[1] Department of Crop Sciences and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague. lekete@ftz.czu.cz; eloy@ftz.cz.cz

[2] Department of Microbiology, Nutrition and Dietician, CZU, Prague, Czech Republic mkhies@af.czu.cz

* **Correspondence:** lekete@ftz.czu.cz

Abstract: Climate change, emerging plant diseases and increasing pest pressure continue to threaten global food production and agricultural sustainability. Beneficial plant–soil microorganisms, including arbuscular mycorrhizal fungi (AMF), nitrogen-fixing bacteria and plant growth-promoting rhizobacteria (PGPR), have emerged as sustainable alternatives for improving crop productivity and resilience while reducing reliance on synthetic agrochemicals. This review synthesises current evidence supporting their contribution to sustainable agriculture and food security. The review followed the PRISMA 2020 Statement. Peer-reviewed studies were systematically retrieved from seven scientific databases (Web of Science, Scopus, ScienceDirect, SpringerLink, PubMed, ProQuest and Google Scholar) using predefined search strategies and eligibility criteria. Following screening, 126 studies were included for qualitative synthesis. The reviewed evidence showed that beneficial plant–soil microorganisms improve crop productivity and resilience by enhancing nutrient acquisition, promoting biological disease suppression and increasing tolerance to abiotic stresses. However, inconsistent field performance, environmental variability and limited commercial adoption remain major constraints to their widespread agricultural application. Beneficial plant–soil microorganisms offer a sustainable approach to improving crop productivity and strengthening food security under changing climatic conditions. Advancing their adoption will require improved understanding of plant-microbe interactions and more consistent field performance.

Keywords: plant-soil microbial interactions; biological control; sustainable agriculture; climate change; food security

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Practical Use of Bioproducts Base on *Beauveria Bassiana* Against Cabbage Whitefly *Aleyrodes Proletella* on Cruciferous Plants

Rakshandha Luharch [1]*, Andrea Bohata [1], Jana Lencova [1], Ewumi Azeez Folorunso [2], Jan Mraz [2]

[1] Department of Plant Production and Agro-ecology, Section of Plant Protection, Faculty of Agriculture and Technology, University of South Bohemia, Branišovská 31a, 37005 České Budějovice, Czech Republic. email; luharr00@fzt.jcu.cz; bohata@fzt.jcu.cz; lencova@fzt.jcu.cz

[2] Institute of Aquaculture and Protectection of Waters, Faculty of Fisheries and Protection of Waters, University of South Bohemia, Branišovská 31a, 37005 České Budějovice, Czech Republic. efolorunso@frov.jcu.cz; jmraz@frov.jcu.cz

* **Correspondence:** luharr00@fzt.jcu.cz

Abstract: The cabbage whitefly (*Aleyrodes proletella*) represents a key pest of brassica crops, with a rapid development of resistance to synthetic insecticides that significantly complicates its control for vegetable growers. The damage is caused by direct sap-feeding on host plants and the excretion of honeydew, which serves as a substrate for sooty molds that degrade the photosynthetic leaf area. The present study compares the efficacy of the commercial biopreparations Naturalis L, BotaniGard ES, and BotaniGard 22 WP, while also evaluating the biological activity of pure *B. bassiana* strains re-isolated from these commercial products. Pathogenicity against fourth-instar nymphs (puparia) of *Aleyrodes proletella* was assessed using the Fungus Development Index, with infection progression monitored at 24-hour intervals following exposure to suspensions of individual *Beauveria bassiana* strains. Laboratory bioassays were further conducted on kohlrabi and kale seedlings artificially infested with A. proletella. The pest populations were treated with pure strains GHA and ATCC 74040 (1x107 spores/mL), and concurrently with suspensions of the biopreparations (doses recommended by the manufacturers). Ten days post-application, the efficacy of the tested strains and biopreparations was determined based on cumulative mortality within the unsynchronized population of *A. proletella*. Tested *Beauveria bassiana* strains and commercial biopreparations significantly increased mortality of *Aleyrodes proletella*. Infection progressed over time and was confirmed by mycelial development on treated nymphs. *Beauveria bassiana* shows potential as a biological control agent against *Aleyrodes proletella* and supports integrated pest management and sustainable brassica production by reducing reliance on synthetic insecticides.

Keywords: *Beauveria bassiana; Aleyrodes proletella*; bioproduct; efficacy

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Integrative Network Pharmacology and Molecular Docking Analysis of *Echinacea purpurea* against Gallbladder Cancer

Tehreem Mahmood [1]*, Muhammad Uzair Javed [1]

[1] Faculty of Tropical Agrisciences, Czech University of Life Sciences, Prague Kamýcká 129, 165 21 Prague 6, Suchdol, Czech Republic; mahmood@ftz.czu.cz; javed@ftz.czu.cz

* **Correspondence:** mahmood@ftz.czu.cz

Abstract: Natural products provide valuable opportunities for developing novel therapeutic strategies against complex diseases such as Gallbladder Cancer, a rare but highly aggressive malignancy with limited treatment options. *Echinacea purpurea* is a medicinal plant rich in bioactive compounds with diverse pharmacological activities. This study aimed to investigate the potential anti-cancer mechanisms of *E. purpurea* against gallbladder cancer using network pharmacology and molecular docking approaches. Active compounds of *E. purpurea* were identified through phytochemical databases and literature mining. Potential therapeutic targets were predicted using SwissTargetPrediction, while gallbladder cancer-related targets were retrieved from GeneCards and DisGeNET databases. Shared targets were analyzed using protein–protein interaction (PPI) network construction, Gene Ontology (GO), and KEGG pathway enrichment analyses. Molecular docking was performed to evaluate the binding affinities of major bioactive compounds with key target proteins. A total of 21 shared targets between *E. purpurea* compounds and gallbladder cancer were identified. Functional enrichment analyses revealed involvement in major cancer-related pathways, including MAPK signaling, TNF signaling, AGE–RAGE signaling, prolactin signaling, and pathways in cancer. PPI analysis identified ESR1, JAK2, MAPK3, and PIK3CA as key hub genes. Molecular docking demonstrated strong interactions of pubescine and tussilagine with target proteins, with binding energies ranging from −4.6 to −10.1 kcal/mol. The findings suggest that *E. purpurea* may exert anti-gallbladder cancer activity through multi-target and multi-pathway mechanisms. These computational results provide a scientific basis for further *in vitro* and *in vivo* studies to validate its therapeutic potential against gallbladder cancer.

Keywords: network pharmacology; molecular docking; echinacea purpurea; gallbladder cancer; phytochemicals

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Characterization, Fractionation and Untapped Potential of Phosphate-Amended Sewage Sludge Biochar in Soil-Plant Systems

Protogene Mbasabire [1]*

[1] Department of Applied Ecology, Faculty of Agriculture and Technology, University of South Bohemia, České Budějovice, mbasap00@fzt.jcu.cz

* **Correspondence:** yves.murindangabo@bc.cas.cz

Abstract: Sewage sludge poses major environmental and health risks due to its contaminants, and traditional disposal methods such as land application, dumping, and incineration contribute to pollution and greenhouse gas emissions. Pyrolysis offers a promising valorization pathway by converting sludge into biochar, which can improve soil quality and mitigate pollutants. This study aims to characterize phosphate amended sewage sludge biochar produced at 300 °C, 400 °C, and 500 °C, fractionate its phosphorus forms, and evaluate its performance in soil–plant systems by assessing nutrient bioavailability and plant growth responses. Biochar was produced from anaerobically digested sludge amended with phosphate and pyrolyzed at three temperatures, then characterized by chemical properties. Phosphorus speciation was determined using the Hedley fractionation protocol to separate short-, medium-, and long-term P pools. Soil incubation and plant growth experiments with corn and wheat were conducted to evaluate phosphorus availability and agronomic effects. Pyrolysis yielded highly alkaline biochars with ash contents of 56.9–87.3% and increasing phosphorus concentrations at higher temperatures. Phosphorus fractionation revealed a shift toward more stable forms, especially at 500 °C. Soil incubation showed enhanced phosphorus availability, with HCl extractable P reaching up to 94.95% extraction efficiency. Plant trials demonstrated substantial growth improvements, with corn height increasing by up to 28.8% and wheat by up to 86% compared to the control. Phosphate-amended sewage sludge biochar improves nutrient availability, enhances plant growth, and provides a sustainable strategy for sludge management, soil improvement, and carbon sequestration.

Keywords: sewage sludge management; waste valorization; biochar production; soil amendment; environmental remediation

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Dairy Feeding System Archetypes Reveal Intensification Pathways and Livelihood Outcomes Among Smallholder Farmers in Kenya

Francis Mucira Murage [1]*, Miroslava Bavorová [1]

[1] Department of Economics and Development, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague; murage@ftz.czu.cz; bavorova@ftz.czu.cz

* **Correspondence:** murage@ftz.czu.cz

Abstract: Smallholder dairy farmers combine multiple feeding practices, yet individual practices are often examined in isolation, providing limited evidence on patterns of feeding-system intensification and their associations with sustainability outcomes. The study addresses this research gap using household-level data from 838 dairy farmers across three major agroecological regions of Kenya represented by Nyandarua, Uasin Gishu, and Kakamega counties. Cluster analysis was conducted using the feeding variable: feeding management, forage cultivation and diversity, feed resource use intensity, and feeding costs. Three distinct feeding system archetypes representing low, medium, and high levels of feed system intensification were identified. Socioeconomic, farm-level, institutional, and regional factors associated with these archetypes were examined using multinomial logit regression, and the impacts of each archetype on productivity, economic performance, environmental indicators, human conditions, and social outcomes were estimated using a multivalued treatment effects model. Results show that high feed-system intensification is associated with substantially higher milk yields, greater market participation, reduced poverty risk, improved food security, and greater social engagement, albeit accompanied by higher feeding costs. Intermediate feeding systems achieve notable productivity gains with higher cost efficiency. Education, herd size, access to extension services, forage seed support, risk attitudes, complementary livestock health practices, and regional context are key determinants shaping intensification pathways. Recognising feeding system heterogeneity enables more precise targeting of government interventions and policies that reflect local conditions and align with development priorities in low- and middle-income countries.

Keywords: clustering; feeding systems; intensification; livelihoods; productivity; sustainability

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Pesticide Use in Cambodian Rice Farming: A Comprehensive Analysis and Identification of Reduction Pathways

Ngang Linna [1]*, Or Phirum [2], Ho Sorith [2], Mathilde Sester [3]

[1] Department of Economics and Development, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 16500 Prague, Czech Republic. Email: ngang@ftz.czu.cz

[2] Ecosystem Services and Land Use Research Centre (ECOLAND), Graduate School, Royal University of Agriculture, Phnom Penh, Cambodia. Email: phirumor@gmail.com; housorith@gmail.com

[3] CIRAD, UPR AIDA, Institute of Technology of Cambodia (ITC), Phnom Penh, Cambodia. Email: mathilde.sester@cirad.fr

* **Correspondence:** ngang@ftz.czu.cz

Abstract: Rice is Cambodia's staple food and a cornerstone of rural livelihoods, food security, and economic growth. However, many Cambodian rice farmers perceive pesticides as necessary to maintain productivity, despite awareness of associated health concerns. Understanding pesticide-use patterns is essential for developing sustainable and resilient rice production systems. This study examines pesticide use in rice production by 210 farmers across seven provinces in Cambodia along a gradient of intensification defined by the number of rice cultivations annually. A mixed-methods approach was employed, using descriptive statistics and thematic analysis of qualitative and quantitative data to compare rice production systems. Pesticide use intensity was assessed through spraying frequency, pesticide types, pests targeted by farmers, and their active ingredients. Application frequency differed significantly among the systems ($p<0.01$). The one-crop system averaged 2.57 applications per cycle, significantly fewer than the other two systems (4.19 and 4.55, respectively), which did not differ from one another. Number of products used also increased significantly from 3.77 in One-crop systems to 6.12 in two-crop and 7.73 in three-crop systems, respectively ($p<0.01$). Total pesticide quantity used was significantly greater in three-crop systems (5.11 L/ha/cycle) than in the other systems ($p<0.01$). Pesticide sellers emerged as farmers' primary information source, substantially influencing decisions on pesticide selection, application timing, dosage, and mixing. These findings indicate that production intensification is associated with greater pesticide use. Strengthening agricultural extension services, promoting evidence-based integrated pest management, and improving access to reliable technical information are essential for enhancing the sustainability and resilience of Cambodian rice production.

Keywords: rice farming; pesticide use; agricultural intensification; pest management; Cambodia

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How Do Microcredit Interventions Impact Agricultural Risk Management Strategies Among Smallholder Farmers? Review of African evidence

Victor Ogada [1]*, Dr. Ondřej Dvouletý [2]

[1] Czech University of Life Sciences Prague, Dept. of Economics and Development, Kamycka 129, Dormitory EFG ROOM 117, victorogada@gmail.com

[2] Prague University of Economics and Business, Dept. of Entrepreneurship, W. Churchill Sq. 4, ondrej.dvoulety@vse.cz

* **Correspondence:** victorogada@gmail.com

Abstract: Microcredit has increasingly become an important instrument for promoting financial inclusion, poverty reduction, and women's empowerment among smallholder farmers in Africa. Despite its growing importance, evidence on its effectiveness in helping farmers manage climate-related, market, and production risks remains fragmented. Therefore, the study aimed to synthesize existing research and provide a comprehensive understanding of the role of microcredit in strengthening agricultural risk management among smallholder farmers across Africa. The study employed a comprehensive systematic literature review to synthesize existing research on microcredit in Africa. It identified 518 articles from the major databases of Scopus and Web of Science, of which 35 met the inclusion criteria and were analyzed in detail. The review carefully considered both quantitative and qualitative evidence published between 2010 and 2025. The findings clearly show that access to microcredit has enabled smallholder farmers to adopt various risk management strategies, including investment in better inputs, the use of informal insurance mechanisms, and crop diversification, among others. However, the review also highlights notable ongoing challenges, such as loan repayment uncertainties, limited financial literacy, and persistent unequal access to credit—particularly the cultural barriers facing women in business and especially poor farmers. The study concludes that microcredit strengthens economic participation, social inclusion, and agricultural resilience among smallholder farmers. However, its effectiveness is limited by financial, institutional, and social barriers. The review emphasizes the need for inclusive, sustainable, and gender-responsive financial policies to enhance microcredit access, resilience, and livelihood outcomes across Africa.

Keywords: Africa; agricultural risk management; microcredit; smallholder farmers; systematic literature review

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Development of Micropropagation Biotechnologies for Essential Oil Plants of the Lamiaceae Lindl. Family in In Vitro Culture

Tetiana Manushkina [1]*, Konstantin Pehlak [1]

[1] Department of Agriculture, Geodesy and Land Management, Faculty of Agricultural Technologies, Mykolayiv National Agrarian University, 9 Georgiy Gongadze St., Mykolaiv 54008, Ukraine, manushkinatn@mnau.edu.ua; Pekhlakkonstantin.2002@gmail.com

* **Correspondence:** manushkinatn@mnau.edu.ua

Abstract: Essential oil crops are plant species cultivated for the production of essential oils, which are widely used in the perfume, cosmetics, pharmaceutical, and food industries. Expanding the cultivation of essential oil plants of the Lamiaceae Lindl. family has become increasingly important due to the growing demand for natural raw materials and the challenges posed by climate change. The development of efficient vegetative propagation methods is essential for producing high-quality, pathogen-free planting material. Among available approaches, in vitro microclonal propagation is considered the most effective because it ensures a high multiplication rate, genetic uniformity, and healthy plants. The aim of this study was to develop biotechnology for the microclonal propagation of Lamiaceae essential oil plants under in vitro conditions. The experimental material included Lavandula angustifolia Mill., Lavandula × hybrida Rev., and Hyssopus officinalis L. Standard plant tissue culture techniques commonly used in plant biotechnology were applied. The results demonstrated that Murashige and Skoog (MS) medium supplemented with cytokinins and gibberellins was optimal for morphogenesis induction and shoot multiplication. The regeneration frequency ranged from 85.0% to 100.0%, while the multiplication coefficient varied from 7.9 to 14.7 depending on the genotype. During rooting, the highest rhizogenesis frequency (70.0–100.0%) was obtained on half-strength MS (½ MS) medium supplemented with auxins. The developed biotechnology enables the production of true-to-type, pathogen-free planting material suitable for establishing commercial plantations of essential oil crops, conserving valuable genotypes, and supporting the sustainable cultivation of medicinal and aromatic plants under changing environmental conditions.

Keywords: essential oil plants; micropropagation; in vitro culture; planting material; Lamiaceae.

A Review of Dietary Transitions and Changing Fruit and Vegetable Consumption in Southeast Asia and the Pacific

Jakub Abelard Pospíšil [1]*, Johana Rondevaldová [1], Vladimír Verner [2]

[1] Department of Crop Science and Agroforestry, FTA, Czech University of Life Sciences, Kamýcká 129, 165 00 Praha-Suchdol, pospisil@ftz.czu.cz

[2] Department of Economics and Development, FTA, Czech University of Life Sciences, Kamýcká 129, 165 00 Praha-Suchdol, vernerv@ftz.czu.cz

* **Correspondence:** pospisilja@ftz.czu.cz

Abstract: Dietary patterns in Southeast Asia and the Pacific are undergoing a marked transition from diverse, locally based diets towards imported, industrially processed and fast-food products. This review examines changes in fruit, vegetable and traditional plant-food consumption and evaluates their nutritional, cultural and food-system implications. A narrative review of scientific literature was conducted, focusing on dietary transition, traditional and underutilized plant foods, food processing, urbanization, socioeconomic determinants and nutritional outcomes in Southeast Asia and the Pacific. Relevant publications were identified primarily through scientific databases, including Web of Science and Scopus. The reviewed literature indicates that urbanization, globalization, income changes, food availability and shifting cultural preferences are major drivers of dietary transition. Traditional fruits, vegetables and other locally adapted plant foods are increasingly displaced by energy-dense and highly processed products, contributing to reduced dietary diversity and the erosion of traditional food knowledge. Available evidence also suggests that many traditional and underutilized crops provide valuable micronutrients, dietary fibre and bioactive compounds, although their nutritional potential remains insufficiently documented and utilized. Traditional plant-based foods may contribute substantially to dietary quality, food biodiversity and the resilience of local food systems. Their systematic documentation, nutritional characterization and culturally appropriate promotion should therefore form an important component of future nutrition, agricultural and public-health strategies in Southeast Asia and the Pacific.

Keywords: nutrition transition; traditional foods; fruit and vegetable consumption; food biodiversity; Southeast Asia and the Pacific

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Why Hop Aroma Does Not Equal Beer Aroma: Thermal Transformations During Brewing

Jaroslav Přikryl [1]*, Tomáš Vrzal [2], Adam Varinsky [3], Martin Dolejš [4]

[1] Department of Analytical Chemistry, Faculty of Science, Charles University, Albertov 6, 128 00 Prague, Czech Republic, prikryl@beerresearch.cz

[2] Research Institute of Brewing and Malting, Plc., Lípová 511/15, 120 00 Prague, Czech Republic

[3] Department of Medicinal Chemistry, School of Science, Constructor university, Campus Ring 1, 28759, Bremen, Germany, avarinsky@constructor.university

[4] Department of Food Science, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague – Suchdol, Czech Republic, dolejsmartin@af.czu.cz

* **Correspondence:** prikryl@beerresearch.cz

Abstract: Beer aroma often differs from the characteristic aroma of the hop varieties used, indicating that hop essential oil composition alone cannot reliably predict the final aroma profile of beer. Thermal processes during wort production are believed to play a major role in these differences, yet their contribution remains insufficiently understood. The aim of this study was to investigate heat-induced transformations of hop-derived volatile compounds under brewing-relevant conditions. Individual hop essential oil constituents were dissolved in aqueous model solutions, thermally treated to simulate wort boiling, and analysed by HS-SPME-GC-MS. Changes in volatile composition were evaluated by comparing thermally treated and untreated samples, allowing transformation pathways to be identified. Thermal treatment caused substantial changes in the composition of several hop-derived volatiles, whereas others remained relatively stable. Three characteristic transformation pathways were identified: formation of new products from single precursors, formation of identical products from structurally related compounds, and convergence of multiple hop volatiles into common products. Several aroma-active oxygenated terpenoids, particularly α-terpineol, were repeatedly formed during heating even when absent from the original composition. The results demonstrate that thermal processing alone can markedly reshape hop volatile profiles before fermentation, providing an explanation for the frequently observed differences between hop aroma and beer aroma. Understanding these transformations may contribute to improved hop variety selection and optimization of brewing processes for beers with targeted aroma characteristics.

Keywords: hop essential oils; beer aroma; thermal transformation; hs-spme-gc-ms; brewing

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Integrated Effects of Pelleted Poultry Manure Compost and Azotobacter Inoculation on Sorghum Growth and Physiological Performance

Loujaine Seddik [1]*, Seren Zedan [1], Géza Tuba [2], József Zsembeli [2]

[1] Doctoral School of Plant Sciences, Hungarian University of Agriculture and Life Sciences, Páter Károly 1, Gödöllő, H-2100, Hungary. loujaineseddik0720@gmail.com; serenalaazedan@gmail.com

[2] National Research Centre for Climate and Regional Land Management, Hungarian University of Agriculture and Life Sciences, Kisújszállási 166, H-5300 Karcag, Hungary. Tuba.Geza@uni-mate.hu; Zsembeli.Jozsef@uni-mate.hu

* **Correspondence:** loujaineseddik0720@gmail.com

Abstract: Improving nitrogen availability is a major challenge in organic sorghum production, where sustainable nutrient management is essential for maintaining productivity while reducing environmental impacts. This pot experiment (n = 24 pots) investigated the effects of pelleted poultry manure compost and an Azotobacter-based microbial inoculant, applied individually and in combination, on growth and physiological performance of sorghum (*Sorghum bicolor* L.). Two compost rates (A1 = 0 t/ha, A2 = 1.5 t/ha) and two Azotobacter levels (B1 = 0 l/ha, B2 = 1 l/ha) were evaluated in a 2×2 factorial design (six replicates per treatment) for effects on green biomass yield, total dry biomass yield, and leaf chlorophyll concentration. Compost application significantly increased green biomass yield ($p = 0.002$), total dry biomass yield ($p = 0.005$), and chlorophyll concentration ($p = 0.01$). Azotobacter inoculation significantly increased green biomass yield ($p = 0.02$) but had no significant effect on total dry biomass yield ($p = 0.2$) or chlorophyll concentration, which showed only a non-significant increasing trend with compost rate ($p = 0.1$). No significant interaction was detected between compost application and microbial inoculation for any measured variable. Pelleted poultry manure compost and Azotobacter-based biofertilization independently improve sorghum growth and physiological performance, offering a promising strategy for enhancing nutrient use efficiency in organic sorghum production.

Keywords: sorghum bicolor; biofertilization; poultry manure compost; Azotobacter; nitrogen use efficiency

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Inducible Gene Activation System to Improve Transformation and Regeneration Efficiency in Recalcitrant Plant Species

Mohd Shahber [1]*, Tomas Moravec [2], Lucie Fischerova [2], Radek Vitek [2]

[1] Institute of Experimental Botany, Faculty of Science, Charles University, Czech Academy of Science, shahber.m@ueb.cas.cz

[2] Institute of Experimental Botany, Czech Academy of Science.

* **Correspondence:** moravec@ueb.cas.cz

Abstract: Efficient genetic transformation remains a major bottleneck for many economically important recalcitrant plant species, limiting the application of biotechnology for crop improvement, functional genomics, and the production of valuable compounds. Morphogenic transcription factors (MTFs), including BABY BOOM (BBM), WUSCHEL (WUS), and GRF-GIF etc., have emerged as promising tools to enhance plant regeneration. However, their constitutive or uncontrolled expression frequently results in developmental abnormalities and reduced regeneration efficiency, highlighting the need for precise regulation of their expression. This study aims to develop a controllable expression platform for regulating MTF activity during plant regeneration. To achieve this, a Bean yellow dwarf virus (BeYDV)-geminivirus based In Plant Activation (INPACT) system was constructed using the GoldenBraid 2.0 modular cloning platform to enable Rep/RepA-dependent activation and enhanced transgene expression. The system was initially evaluated using fluorescent reporter constructs in Nicotiana benthamiana, with transgene expression monitored by fluorescence imaging to validate inducible activation. Following successful validation, the platform is being adapted for the controlled expression of morphogenic regulators and further evaluated in *Cannabis sativa*, a representative recalcitrant crop species. This work aims to establish a tunable platform for controlled transgene expression that may contribute to improving regeneration and transformation efficiency in recalcitrant plants. We successfully developed a RepA-inducible gene system and demonstrated the functionality of the InPACT construct through inducible GFP expression, and the results indicate that the system provides effective control over transgene expression and has potential as a platform for the regulated expression of morphogenic transcription factors. This work establishes a tunable approach for controlled expression providing a potential strategy to overcome transformation limitations in recalcitrant plant species.

Keywords: plant regeneration; recalcitrant plants; morphogenic regulators; InPACT system; *Cannabis sativa*

Acknowledgement: The work was supported from European Regional Development Fund-Project "SMART Plant Biotechnology for Sustainable Agriculture, co-funded by the European Union. My sincere thanks to my Supervisors and colleagues for their valuable scientific guidance, technical support, and laboratory assistance.

Research Infrastructure for Conservation and Sustainable Development of Farm Animal Genetic Resources in Ukraine

Oksana Shcherbak [1]*, Svitlana Kovtun [1], Olha Kruhliak [2]

[1] Laboratory of Animal Reproductive Biotechnology, Institute of Animal Breeding and Genetics nd. a. M.V.Zubets, National Academy of Agrarian Sciences of Ukraine, Chubynske village, Boryspil district, Kyiv region, 08321, Ukraine, ov19792006@gmail.com; kovtun_si@i.ua

[2] Laboratory of Scientific Information Support, Economics and Innovation Marketing, Institute of Animal Breeding and Genetics nd. a. M.V.Zubets, National Academy of Agrarian Sciences of Ukraine, Chubynske village, Boryspil district, Kyiv region, 08321, Ukraine, ovokrug@gmail.com

* **Correspondence:** ov19792006@gmail.com

Abstract: Farm animal genetic resources are a key component of food security, agricultural resilience, and long-term sustainability of livestock production systems. Their conservation requires integrated research infrastructure to ensure monitoring, evaluation, and utilization of genetic diversity. The study focuses on the role of national research infrastructure for the conservation of animal genetic resources in Ukraine. The study is based on the synthesis of research outputs, monitoring data on livestock genetic resources, and analysis of strategic program documentation defining national priorities in animal breeding and conservation. Statistical data on breeding population sizes before and during the full-scale war in Ukraine were compared. The analysis shows significant reductions in breeding populations, including pigs (23.0%), sheep (25.7%), and horses (42.6%), increasing risks of genetic erosion. At the same time, a national research infrastructure, formed and coordinated by the Institute of Animal Breeding and Genetics named after M.V. Zubets, National Academy of Agrarian Sciences of Ukraine, operates as a core system for farm animal genetic resources management. It integrates breeding systems, molecular genetic analysis, reproductive biotechnologies, cryoconservation, and information systems for herd and breeding data management. This system coordinates activities across 14 research institutions and supports more than 50 coordinated research tasks on conservation and sustainable use of genetic resources. The existing research infrastructure provides both conservation capacity and a foundation for modernization of livestock breeding systems, development of adaptive breeding strategies, and post-crisis recovery of the sector under changing environmental conditions.

Keywords: farm animal genetic resources; research infrastructure; conservation; livestock breeding; agricultural resilience

Recovery of Valuable Components from Carrot Peel using Ultrasound-Assisted Extraction

Vivien Simon [1]*, Szilvia Bánvölgyi [2], Viktória Zsomné Muha [2]

[1] Department of Food Process Engineering and Department of Food Technology Automatization and Digitalization, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary, viviensimon375@gmail.com

[2] Department of Food Technology Automatization and Digitalization, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary, banvolgyi.szilvia@uni-mate.hu; Zsomne.Muha.Viktoria@uni-mate.hu

* **Correspondence:** viviensimon375@gmail.com

Abstract: In the context of a circular economy, the valorization of food industry by-products has gained significant importance. This study aimed to evaluate ultrasound-assisted extraction (UAE) for the recovery of natural pigments from carrot peel. The effects of key processing parameters—including ultrasound frequency (0, 20, 40 kHz), power (0, 180, 300 W), ethanol-water solvent concentration (0, 10, 40 v/v%), and extraction time (16–40 minutes)—were systematically investigated across 160 samples. A rapid, non-destructive CIELAB colour measurement method was applied to trace colour changes (L*, a*, b* parameters) as an indirect indicator of extraction dynamics. The results demonstrated that lightness (L*) decreased over time, suggesting an increase in the transfer of total soluble solids into the liquid phase. In parallel, redness (a*) and yellowness (b*) values increased over time, indicating potential carotenoid release. While water-only extraction triggered enzymatic browning, the addition of ethanol effectively prevented it, yielding more stable extracts. Ultrasound frequency and power significantly enhanced colour intensity compared to conventional extraction. Among the tested conditions, the most favourable colour intensity was achieved at 20 kHz frequency, 300 W power, and 10 v/v% ethanol concentration after 40 minutes, resulting in a maximum a* value of 11.97. In conclusion, UAE proved to be an efficient method for recovering natural pigments from carrot peel, offering promising potential for sustainable food applications.

Keywords: carrot peel; ultrasound-assisted extraction; carotenoids; cielab color measurement; valorization

Acknowledgement: This work was supported by the NTP-SZKOLL-26-0029 project and the Institute of Food Science and Technology of the Hungarian University of Agriculture and Life Sciences.

Armed Conflict and Agricultural Resilience: Evidence of Direct and Cross-Border Impacts

Eng. Emilia Sobczak [1]*, Paweł Kwaśny [2], BA Tomasz Samburski [3], MA Grzegorz Malitka [4]

[1] Warsaw University of Life Sciences, sobczakemilia2018@gmail.com

[2] Military University of Technology, pawelkwas123456@gmail.com

[3] Radom Academy of Economics, tomasz.samburski@interia.pl

[4] War Studies University, grzegorz.malitka91@gmail.com

* **Correspondence:** sobczakemilia2018@gmail.com

Abstract: Armed conflicts are among the most serious factors destabilizing the socio-economic development of countries, with a particularly strong impact on the agricultural sector, which underpins food security and the livelihoods of rural populations. Previous research has focused primarily on the direct impacts of conflicts in affected countries, while their cross-border impacts remain less well understood. The aim of this study was to comprehensively assess the direct and indirect impacts of armed conflicts on the agricultural sector and identify the economic, institutional, and geographic factors that shape the scale of these impacts. The study combines a narrative review of international scientific literature with analysis of secondary data from UCDP, FAOSTAT, FAO, and World Bank databases. A multi-stage comparative analysis was employed, encompassing conflict characteristics, assessing changes in agricultural production, food security, and trade indicators, and identifying the main channels through which cross-border impacts are transmitted. The analysis encompasses directly affected countries and neighboring countries in various regions of the world. The results indicate that conflicts reduce agricultural productivity, restrict access to production resources, disrupt infrastructure and supply chains, and worsen food security. At the same time, the impacts of conflicts extend beyond national borders through trade, migration, and market interdependencies. The scale of these effects depends on the quality of institutions, economic resilience, and the level of regional integration, highlighting the need to strengthen the resilience of agricultural and food systems at national and regional levels.

Keywords: armed conflicts; agriculture; food security; cross-border effects; resilience

Extension, Innovation, and Welfare: Evidence from Cultivated Forage Crops Adoption Among Buffalo Farmers in Nepal

Namdev Upadhyay [1]*, Miroslava Bavorova [1], Nils Teufel [2], Dini Imami [3], Giri Prasad Kandel [4]

[1] Faculty of Tropical AgriSciences, Ceska zemedelska univerzita v Praze, Kamycka 129, 16500 Prague, Czech Republic, Email: upadhyay@ftz.czu.cz; bavorova@ftz.czu.cz

[2] International Livestock Research Institute, PO Box 30709, Nairobi 00100, Kenya. Email: N.Teufel@cgiar.org

[3] Faculty of Economy and Agribusiness, Agricultural University of Tirana, Tirana, Albania. Email: drinimami@yahoo.com

[4] Faculty of Agrobiology, Food, and Natural Resources, Ceska zemedelska univerzita v Praze, Kamycka 129, 16500, Praha, Suchdol, Czech Republic. Email: kandelg@af.czu.cz

* **Correspondence:** upadhyay@ftz.czu.cz

Abstract: Cultivated forage crops (CFs) are vital yet underutilized innovations for smallholder dairy farmers facing persistent feed shortages, low-quality fodder, and rising feed costs. This study explored the drivers of CFs adoption and their association with farm performance and welfare outcomes. Survey data were collected from 990 buffalo farmers across six districts of eastern Terai, Nepal, using a multistage purposive sampling approach. The probit results revealed that CFs' adoption was positively and significantly associated with social capital, particularly farmers' social networks and use of village livestock promoters (VLPs). Human capital (e.g., education, record keeping), natural capital (e.g., farm size), and physical capital (e.g., herd size, ruminant diversity, irrigation availability) were also positively and significantly associated with adoption. Dominance analysis showed that physical capital contributed to the largest share of the model's explanatory power (37%), followed by human capital (24%), natural capital (23%), social capital (13%), and financial capital (1%). After correcting for observable selection bias, CFs adopters were associated with a 22% higher milk productivity, a 1-month longer lactation period, a 24% increase in annual livestock returns, and a 7% lower likelihood of living below the international poverty line of $2.5 per day than comparable non-adopters. These findings demonstrate that, while social capital facilitates technology diffusion, farmers' productive assets and human capital were more influential in shaping adoption decisions. The policies should therefore complement community-based technology delivery systems with investments that strengthen farmers' productive assets, knowledge, and management capacities to accelerate CFs adoption and improve dairy productivity and household welfare.

Keywords: cultivated forage crops; farm performance; household welfare; livestock extension services

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Effectiveness of selected disinfectants in reducing the microbial load on chicken eggshells

Mária Vargová [1]*, František Zigo [2], Michaela Harčárová [2]

[1] Department of Public Veterinary Medicine and Animal Welfare, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, Košice, 041 81, Slovakia, maria.vargova@uvlf.sk

[2] Department of Animal Nutrition and Husbandry, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, Košice, 041 81, Slovakia, frantisek.zigo@uvlf.sk; michaela.harcarova@uvlf.sk

* **Correspondence:** maria.vargova@uvlf.sk

Abstract: Eggs are widely used in the food industry, but improper handling, storage and processing practices are significant risk factors for food safety. Maintaining high hygiene standards in hatcheries is essential to minimize microbial contamination of hatching eggs. This study evaluates the effects of disinfectants on microbial load of eggshells from Plymouth Rock chickens. Disinfectants were applied to the eggshell surface (n = 96) by spraying and microbiological swabs were taken before and after disinfection (exposure time 1′-5′-15′minutes). The following disinfectants were used: 2.2 mM silver nitrate ($AgNO_3$); biosynthesized silver nanoparticles (AgNPs); plant extract from *Stachys recta* L. in a ratio of 1:20 (w/v); disinfectant Virocid in a concentration of 0.4%. The study revealed significant differences in the total bacterial count before disinfection compared to the state after disinfection ($P<0.0001$). After the exposure time, there was a 100% decrease in microbial load after the use of Virocid; AgNP caused a 38% reduction in microbial load; the use of $AgNO_3$ caused a 12% reduction and the effect of the plant extract was the weakest compared to the results of other disinfectants, as the microbial reduction was 5.83%. These results demonstrate that disinfection significantly reduces the microbial load of eggshells, with Virocid showing the highest antimicrobial efficacy. Given some negative properties of disinfectants, it is necessary to search for safe biocides with natural biologically active compounds without negative impact on the environment.

Keywords: eggshell; microbial load; disinfectants

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From Modular DNA Assembly to Biological Discovery: An Enhanced GoldenBraid Platform

Radek Vítek [1, 2]*, Shahber Mohd [1, 3], Tomáš Moravec [1]

[1] Laboratory of Pathologicala Plant Physiology, Institute of Experimental Botany of the Czech Academy of Sciences, Rozvojová 313, 165 00 Praha 6, Rozvojová 313, 165 00 Praha 6 - Lysolaje, Czech Republic, vitek@ueb.cas.cz; shahber.m@ueb.cas.cz; moravec@ueb.cas.cz

[2] The Department of Genetics and Breeding, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Praha - Suchdol, Czech Republic, vitek@ueb.cas.cz

[3] Department of Experimental Plant Biology, Faculty of Science, Charles University, Albertov 6, 128 00 Prague 2, Czech Republic, shahber.m@ueb.cas.cz

* **Correspondence:** vitek-radek@seznam.cz

Abstract: Modern plant biotechnology and research increasingly relies on rapid construction and testing of multigene expression vectors. Although modular cloning systems such as GoldenBraid provide a standardized framework for DNA assembly, routine generation of complex constructs and multiple construct variants remains labor-intensive. We developed a GoldenBraid-compatible plasmid platform designed to simplify multigene cloning and accelerate experimental workflows across diverse areas of plant molecular biology. The platform combines newly developed pDelta and pGamma master plasmids, dual antibiotic selection, chromogenic selection markers, and an optimized cloning workflow fully compatible with the GoldenBraid standard. The system was validated by assembling multigene constructs for a range of applications, including transient and stable expression in plants and the generation of constructs for studies of plant–microbe interactions. The developed workflow enables efficient assembly of master plasmids containing up to five transcriptional units and rapid generation of multiple construct variants through exchange of individual transcriptional units without PCR amplification. Dual antibiotic selection reduced background from incompatible donor plasmids, while chromogenic markers simplified screening of recombinant colonies. The platform proved readily adaptable to diverse experimental applications, including recombinant protein expression, synthetic biology, plant genetic engineering, and functional studies of phytopathogenic bacteria and fungi. Rather than addressing a single biological question, the presented plasmid platform provides a broadly applicable research tool that accelerates the design–build–test cycle in plant molecular biology. Reducing the time and technical barriers associated with multigene construct assembly enables faster development and evaluation of new hypotheses and technologies relevant to sustainable agriculture, plant health, and biotechnology.

Keywords: GoldenBraid; modular cloning; synthetic biology; plant biotechnology; plasmid engineering

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In-Vitro Antifungal Effect of Green-Synthesized Silver and Zinc Oxide Nanoparticles on the Dermatophyte *Trichophyton rubrum*

Subhajit Chakraborty [1*], Moumita Sil [1], Amrita Sil [2], Arunava Goswami [3*], Nilay Kanti Das [4]

[1] Biological Sciences Division, Indian Statistical Institute, 203 B. T. Road, Kolkata, 700108, India, subhadino@gmail.com; moumitasil20@gmail.com

[2] Calcutta Medical College and Hospital, Kolkata, India, drsilamrita@gmail.com

[3] Biological Sciences Division, Indian Statistical Institute, 203 B. T. Road, Kolkata, 700108, India, agoswami@isical.ac.in

[4] Department of Dermatology, College of Medicine and Sagar Dutta Hospital, Kolkata, West Bengal, India, drdasnilay@gmail.com

* **Correspondence:** subhadino@gmail.com; agoswami@isical.ac.in

Abstract: Dermatophytosis, a common superficial fungal infection of the skin, has become increasingly difficult to treat due to the emergence of recalcitrant infections and resistance to conventional antifungal agents. This highlights the need for novel therapeutic alternatives. In this study, the *in-vitro* antifungal activity of green-synthesized silver nanoparticles (AgNPs) and zinc oxide nanoparticles (ZNPs) was evaluated against the dermatophyte *Trichophyton rubrum*. The AgNPs were synthesized using $AgNO_3$ solution reduced by plant extracts, utilizing aqueous preparations from Ayurvedic churnas (*Phyllanthus emblica*, *Withania somnifera*) and ethanolic homeopathic mother tinctures (*Atropa belladonna*, *Strychnos nux-vomica*). The AgNPs were characterized using UV-vis, DLS, and TEM, and their antifungal activity was assessed by serial microdilution in 96-well plates. The ZNPs were commercially obtained, and their antifungal activity was evaluated using a method similar to that used for the AgNPs. The results indicated that the green-synthesized AgNPs exhibited antifungal activity. The best results were obtained for AgNPs synthesized using *P. emblica*, with MIC values ranging from 234.375 to 468.5 ppm and inhibition exceeding 94.5% at 937.5 ppm. The *A. belladonna*-AgNPs showed 61.05% inhibition at 937.5 ppm, while *W. somnifera*-AgNPs required 7500 ppm to achieve 69.35% inhibition of fungal growth. The *S. nux-vomica*-AgNPs did not exhibit meaningful antifungal activity under the conditions tested. In contrast, both lipophilic and hydrophobic ZNPs showed antifungal activity only at much higher concentrations (17.725% inhibition and 62.949% inhibition, respectively, both at 15625 ppm). Thus, the green-synthesized AgNPs, particularly those synthesized using *P. emblica*, demonstrate promising antifungal activity against *T. rubrum* and warrant further investigation into their toxicity and potential clinical applications.

Keywords: green synthesis; silver nanoparticles; *Trichophyton rubrum*; antifungal susceptibility; plant extracts

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Soil Matrix-on-a-Chip (SMaC): A Biomimetic Platform to Study Root Morphodynamics

Kaushal Agarwal [1,2]*, Pranab Kumar Mondal [1,2]

[1] School of Agro and Rural Technology, Indian Institute of Technology Guwahati, Guwahati- 781039, India

[2] Microfluidics and Microscale Transport Processes Laboratory, Department of Mechanical Engineering, Indian Institute of Technology Guwahati, Guwahati- 781039, India

* **Correspondence:** kaushal.agarwal@iitg.ac.in

Abstract: Soil structure plays an important role in root growth and overall plant development. However, direct observation of root-soil interactions is difficult because natural soil is opaque and highly heterogeneous. This limits systematic studies on how different soil textures affect early root growth. In this study, we present a transparent, low-cost, reusable, and biocompatible Soil Matrix-on-a-Chip (SMaC) platform for investigating root growth under different structural conditions. The SMaC platform consists of a 3D-printed cassette containing glass slides filled with a nutrient-rich hydrogel that serves as a soil analogue. Glass beads (2 mm diameter) were embedded at 0-2 mm spacings to create different soil-like textures and obstruction densities, including a hydrogel-only control. The materials are inexpensive, easy to replace, and suitable for repeated use without affecting plant growth. The transparent design of SMaC enables continuous, non-destructive imaging of root growth using a standard optical microscope. Root morphology, growth trajectory, and deformation are quantified through image analysis. Three-dimensional root geometries are reconstructed and used for numerical modelling, where the root segments are represented as beam elements to estimate bending loads and stresses caused by mechanical obstructions. The analysed root sections exhibited bending stresses of approximately 1.93-86.15 MPa, corresponding to calculated loads of 5.46×10^{-4}-1.82×10^{-1} N, demonstrating mechanical deformation induced by embedded obstacles. The results show that closely spaced obstacles increase root bending and alter the growth trajectory, whereas wider spacing allows straighter root growth. Additionally, increasing obstruction density reduced the nutrient-hydrogel volume, while the hydrogel had 99.2% water content. These observations help identify soil-like structures that support improved better root and shoot development. The proposed SMaC platform provides a simple and scalable approach for studying the mechanical effects of soil structure on roots, making it suitable for systematic studies on soil optimization and sustainable agricultural applications.

Keywords: soil matrix-on-a-chip; root growth; root mechanics; soil analogue; plant biomechanics

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Sustainable Plant Production and Agricultural Development in The Gambia

Jibbie Ann [1*]

[1] Agriculture Department, University of the Gambia, Faraba West Coast Region, Banjul, the Gambia

* **Correspondence:** sannabaldeh13@gmail.com

Abstract: Agriculture is a key sector in The Gambia, supporting most livelihoods but facing challenges such as climate change, poor soils, reliance on rainfall, and low productivity. These issues make traditional farming methods unsustainable for long-term development and food security. This study focuses on sustainable plant production and agricultural development in The Gambia. Its purpose is to explore strategies such as climate-smart agriculture, crop diversification, improved soil management, and agaric-processing to enhance productivity, strengthen food security, and improve rural incomes. The study evaluates sustainable farming approaches, including conservation agriculture, agroforestry, crop rotation, and the cultivation of climate-resilient crops. It further considers organic soil amendments, such as manure and compost, to enhance soil fertility, as well as irrigation technologies that support more reliable year-round crop production. In addition, agricultural processing is highlighted as a way to reduce losses and increase farmers' income. The findings show that unsustainable farming practices and reliance on rainfall have reduced productivity in The Gambia. However, adopting sustainable methods such as agroforestry, crop diversification, improved soil management, irrigation, and agro-food systems can improve yields, reduce losses, and increase farmers' incomes while strengthening food security and rural development. The study concludes that sustainable agricultural practices, improved resource management, and investment in modern farming technologies are essential for strengthening productivity, resilience, and food security in the Gambia. It finds that adopting sustainable practices such as agroforestry, crop diversification, irrigation, and agricultural processing is essential to improving productivity, strengthening resilience, and achieving long-term food security and rural development.

Keywords: sustainable agriculture; climate-smart agriculture; crop diversification

Growth and Phenological Responses of Bambara Groundnut (*Vigna subterranea (L.) Verdc.*) Accessions to Arbuscular Mycorrhizal Fungi Inoculation and Tillage Practices across Contrasting Agroecological Zones in Nigeria

Jimoh Muhammed [1]*, Zbyněk Polesný [1], Abberton Michael [2], Olaniyi Oyatomi [2]

[1] Department of Crop Sciences and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Czech Republic, muhammed@ftz.czu.cz; polesny@ftz.czu.cz.

[2] Genetic Resources Centre, International Institute of Tropical Agriculture, IITA, Ibadan, Nigeria, m.abberton@cgiar.org; o.oyatomi@cgiar.org.

* **Correspondence:** muhammed@ftz.czu.cz

Abstract: Bambara groundnut (*Vigna subterranea* (L.) Verdc.) is an underutilized African legume with considerable potential for sustainable food production because of its drought tolerance and adaptation to low-input environments. However, differences in genotype, environment, and agronomic management can influence its establishment and productivity. This study evaluated the effects of arbuscular mycorrhizal fungi (AMF) inoculation and tillage practices on the growth and phenological performance of six Bambara groundnut accessions across two contrasting agroecological zones in Nigeria. Field experiments were conducted at Ibadan and Mokwa using a split–split plot design involving three AMF treatments (non-inoculated control, *Rhizophagus irregularis*, and *Glomus mosseae*), two tillage practices (ridge and no ridge), six accessions, and three replications. Data on emergence, vegetative growth, and flowering were collected and subjected to analysis of variance. Agroecological location, accession, and tillage significantly influenced crop establishment, growth, and flowering ($p < 0.05$). Plants at Mokwa generally established better, produced greater vegetative growth, and flowered earlier than those at Ibadan, while ridge tillage improved establishment and growth. AMF inoculation had limited effects on most early-stage traits, although *R. irregularis* showed positive responses in some accessions. Significant accession × environment and accession × tillage interactions indicated genotype-specific responses, with TVSu-1635 and TVSu-515 showing consistently strong performance. Overall, the findings demonstrate the importance of genotype, agroecological environment, and tillage management in Bambara groundnut production and provide a basis for integrating AMF into location- and genotype-specific sustainable production strategies.

Keywords: bambara groundnut; arbuscular mycorrhizal fungi; agroecological intensification; phenology; plant growth

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Cultivation of Fast-Growing Trees on Marginal Lands for the Production of Composite Fuel Pellets

Anna Holovchenko [1]*, Olha Holovchenko [2], Valentin Holovchenko [3], Svitlana Sytnyk, [4], Mykola Kharytonov [5]

[1] Food Technologies, Agrarian Engineering, Dnipro State Agrarian and Economic University, anna17golovchenko@gmail.com

[2] Precision Agriculture, Agrarian Engineering, Dnipro State Agrarian and Economic University, helyasumyatina@gmail.com

[3] Engineering of Technical Systems, Agrarian Engineering, Dnipro State Agrarian and Economic University, golovchenkov@i.ua

[4] Laboratory of Forestry and Forest Management, Dnipro State Agrarian and Economic University, sytnyk.s.a@dsau.dp.ua

[5] Center of Nature Agriculture, Dnipro State Agrarian and Economic University, kharytonov.m.m@dsau.dp.ua

* **Correspondence:** kharytonov.m.m@dsau.dp.ua

Abstract: Forest stands located in combat zones (primarily in the country's southeast) have suffered damage from fires as well as from mines and artillery shells. Cultivating fast-growing crops and trees on marginal lands, with the introduction of non-traditional fertilizers (sewage sludge, biodigestate, etc.), can reduce overall production and transportation costs and energy for pellets and briquettes. Biomass samples were collected from fast-growing tree species (poplar, paulownia, black locust, etc.) during field experiments involving poplar and paulownia grown on technosols under drought conditions. Sewage sludge treated with flocculant (F) was introduced into the pits prepared for planting seedlings using a mechanized drilling the appropriate doses 20t/ha, 40t/ha, 60 and 80t/ha for growing of the black poplar hybrid Robusta (*Populus nigra var. plantierensis* × *Populus deltoides ssp. angulata Henry*) and *Paulownia Tomentosa*.These experiments tested various application rates of sewage sludge (0, 20, 40, 60, and 80 t/ha). In our case, the height of four year-old paulownia trees grown on loess-like loam with sewage sludge addition at doses of 40-80 t/ha did not exceed 2.4 m. Apparently, soil texture proved to be a limiting factor for *Paulownia Tomentosa* cultivation on this rock, even with high sewage sludge additions. Water is a second limiting factor. The results showed that poplar exhibited a higher growth rate and greater wood yield than paulownia when grown on technosols. Soil texture and dry conditions limit the prospects for growing *Paulownia Tomentosa* on marginal land. Acacia and poplar bark were used to produce composite pellets with high calorific value.

Keywords: wood trees biomass; marginal lands; biofuel.

Acknowledgement: This case study was conducted with the support of the Czech Development Cooperation and the Czech University of Life Sciences Prague.

Oxalate and Mineral Composition of Amoche (*Arisaema schimperianum*) as Influenced by Different Processing

Halabo Hazo [1]*, Gluham Hassan Shah [1], Mary Murimi [2]

[1] Department of food science and postharvest technology, Arba Minch University Ethiopia

[2] Department of Human Nutrition Texas Technical University, USA

* **Correspondence:** halaboazo@gmail.com

Abstract: Amoche (*Arisaema Schimperianum* Schott) is an herbaceous tuber crop in the Araceae family that serves as a vital food source in tropical and subtropical regions. However, members of this family contain oxalates, alkaloids, and other toxins. High oxalate levels bind essential minerals like calcium, magnesium, iron, and zinc, and form needle-like calcium oxalate raphides that cause oral acridity, inflammation, and burning. This study evaluated the effects of processing on the oxalate and mineral contents of amoche using High Performance Liquid Chromatography and Atomic Absorption Spectrophotometry. The treatments combined three heat levels (fresh, boiling, drying) with three soaking media (ginger juice, lemon juice, ethanol) against an unprocessed control. Processing significantly ($p < 0.05$) influenced oxalate and mineral levels. Fresh amoche presented high oxalate content as a major barrier to safe consumption. Boiling amoche after soaking in lemon juice yielded the maximum oxalate reduction of 72.39% (from 970.92 to 268 mg/100 g), though a slight reduction in mineral content occurred across all treatments relative to the control. Overall, boiling amoche after low-pH soaking effectively lowers oxalate levels. To remain within safe daily consumption thresholds (50–100 mg/100 g/2500 kcal/day), intake should be regulated around 268 mg/100 g of lemon juice–soaked and boiled amoche.

Keywords: amoche; heating; soaking; oxalate; minerals

Understanding Farmers' Decisions in Albania: Socioeconomic and Behavioral Influences on Conservation Agriculture Practices

Peter Maes [1]*, Mustapha Yakubu [1], Drini Imami [2], Miroslava Bavorova [1]

[1] Czech University of Life Sciences Prague, Faculty of Tropical Agrisciences, Department of Economic Development, Kamycka 129 Prague 16500, maes@ftz.czu.cz; yakubu_madaki@ftz.czu.cz; bavorova@ftz.czu.cz

[2] Agricultural University of Tirana, Faculty of Economics and Agribusiness, Department of Economics and Rural Development Policies, 1025 Pajsi Vodica Street, Koder Kamëz, Tirana, Albania, dimami@ubt.edu.al

* **Correspondence:** bavorova@ftz.czu.cz

Abstract: To address severe global soil degradation and high erosion rates specifically in the Balkans, Conservation Agriculture (CA) has emerged as a vital mitigation strategy. The purpose of this study is to move beyond standard demographics to identify the socio-economic, informational, and behavioral factors that influence smallholder farmers' adoption of full CA and its individual components in Albania. The study utilized a snowball sampling method to survey 242 farmers in central and western Albania. The data were analyzed using two models: a probit regression model to evaluate the drivers of full CA adoption, and a multivariate probit (MVP) regression model to analyze the simultaneous, "piecemeal" adoption of individual CA practices (crop rotation, cover cropping, and no/minimum tillage). Socio-economic characteristics (age, education) had a limited influence on full CA adoption. Instead, behavioral and informational factors were primary drivers: personal intuition and access to new technology positively influenced adoption, while traditional extension services and friends' opinions showed a negative correlation. Additionally, cost-reduction goals drove cover cropping and crop rotation, peer networks boosted crop rotation, and gender barriers significantly limited women's uptake of no-till practices. CA adoption in Albania is governed by a complex interplay of behavioral, institutional, and economic factors rather than farmer demographics. To improve adoption rates, policy interventions must reform traditional extension services, leverage peer-to-peer learning networks, address gender-specific barriers, provide targeted financial incentives, and promote CA as a comprehensive package rather than isolated practices.

Keywords: conservation agriculture; adoption; behavioral factors; extension services; Albania; smallholder farmers; gender

Acknowledgement: The authors would like to acknowledge the Czech University of Life Sciences Prague, to the Faculty of Tropical Agrisciences, and Drini Imami & Edvin Zhllima from the Agricultural University of Tirana.

Airborne Alder and Hazel Pollen: Meteorological Drivers, Surface Elements, and Allergy Responses

Uliana Semak [1]*, Halyna Melnychenko [1], Olena Bobrova [2], Viktor Husak [3]

[1] Department of Biology and Ecology, Vasyl Stefanyk Carpathian National University, 57 Shevchenka Street, Ivano-Frankivsk, 76018, Ukraine, uliana.semak@cnu.edu.ua; halyna.melnychenko@cnu.edu.ua

[2] Plant Physiology and Cryobiology Group, Department of Plant Genetics and Breeding, Czech Agrifood Research Center, Drnovská 507/73, 161 00 Prague 6, Czech Republic; olena.bobrova@carc.cz

[3] Department of Biochemistry and Biotechnology, Vasyl Stefanyk Carpathian National University, 57 Shevchenka Street, Ivano-Frankivsk, 76018, Ukraine, viktor.husak@cnu.edu.ua

* **Correspondence:** uliana.semak@cnu.edu.ua

Abstract: Alder and hazel are major early-season allergenic trees, yet integrated evidence linking pollen dynamics, surface characteristics, meteorology, and health responses remains limited in Ukraine. This study assessed airborne Alnus spp. and Corylus spp. pollen in Ivano-Frankivsk and their environmental-health relevance. During the 2026 season, airborne pollen was monitored with a Durham gravimetric sampler. Seasonal metrics were integrated with daily meteorological data, light microscopy and SEM-EDS characterization of representative pollen surfaces, allergist visits, and allergen-specific IgE records. Same-day and lagged associations were evaluated using rank correlations and complementary statistical analyses. Both pollen seasons lasted 64 days. Corylus peaked on 4 March, whereas Alnus peaked on 14 March. The Alnus seasonal pollen integral was 2505 grains m^{-3}, 62% higher than Corylus (1545 grains m^{-3}), with more high-pollen days. Mean temperature was negatively associated with daily concentrations of both taxa, with significant relationships persisting across preceding days. SEM-EDS revealed localized surface-associated particles and low-abundance inorganic elements. Total allergist visits correlated with combined pollen exposure (ϱ = 0.53), while allergic-rhinitis visits showed stronger associations with Alnus (ϱ = 0.80) and combined pollen (ϱ = 0.72), peaking at approximately ϱ = 0.89 two days after exposure. Specific IgE showed no statistically supported short-term exposure relationship. Early-spring alder and hazel pollen exposure was taxon-specific and temporally associated with allergy-related healthcare utilization. Integrating aerobiological, meteorological, physicochemical, and health indicators may strengthen local pollen-risk surveillance and preparedness.

Keywords: aerobiology; allergic rhinitis; SEM-EDS; meteorological drivers; environmental exposure.

Miscanthus Sinensis Responses to Rare Earth Element Stress

Viktoriia Zadarko [1]*, Viktor Husak [1], Olena Bobrova [2], Volodymyr Kotsiubynskyi [3], Yaroslava Hryhoriv [4], Andrew Kotsiubynskyi [5]

[1] Department of Biochemistry and Biotechnology, Vasyl Stefanyk Carpathian National University, Ivano-Frankivsk, Ukraine

[2] Czech Agrifood Research Center, Prague, Czech Republic

[3] Department of Applied Physics and Materials Science, Vasyl Stefanyk Carpathian National University, Ivano-Frankivsk, Ukraine

[4] Department of Forest and Agrarian Management, Vasyl Stefanyk Carpathian National University, Ivano-Frankivsk, Ukraine

[5] Department of Environmental Protection Technology and Occupational Safety, National Technical University of Oil and Gas

* **Correspondence:** viktoriia.zadarko.22@pnu.edu.ua

Abstract: Rare earth element (REE) contamination can alter plant growth, elemental homeostasis, tissue structure, and lignocellulosic biomass quality. This study evaluated dose-dependent responses of *Miscanthus sinensis* 'Zebrinus' to a soil-applied La–Ce–Pr–Nd–Sm mixture. Plants were grown at 0, 300, and 3000 mg REE kg^{-1} soil (n = 5 per treatment). Growth and biomass allocation were quantified; root and leaf elemental composition was assessed by EDS/XRF; leaf ultrastructure and Si distribution were examined by SEM–EDS; and biomass thermal behavior was characterized by TGA/DTG. REE exposure suppressed shoot growth but shifted biomass allocation belowground. Shoot length decreased by 13.8% and 20.0%, and fresh shoot mass by about 50%, whereas fresh root mass increased by 113% and 179% at 300 and 3000 mg kg^{-1}, respectively. Detectable REE signals occurred in roots only and increased with dose. Al and Fe increased mainly in roots, Ca increased in leaves but decreased moderately in roots, and Mn showed an organ-specific non-linear response. SEM revealed progressive tissue deformation, delamination, and fragmentation. At 3000 mg kg^{-1}, cell width decreased from 15.7 to 4.60 μm, cell area declined by about 90%, and intercellular gaps reached 23.3 μm. Si-positive structures became spatially denser, although this did not demonstrate an increase in total Si content. The thermal profile at 300 mg kg^{-1} remained close to the control, whereas at 3000 mg kg^{-1} the estimated cellulose component decreased to about 17% and high-temperature DTG peaks shifted. *Miscanthus sinensis* showed a strong stress-driven shift toward root biomass and belowground retention of detectable REEs, supporting its potential relevance for phytostabilization. However, severe REE loading compromised leaf structural integrity and lignocellulosic biomass quality, indicating that biomass quality and toxicity must be considered when using Miscanthus on REE-affected soils.

Keywords: *Miscanthus sinensis*; rare earth elements; phytostabilization; biomass allocation; SEM–EDS; thermogravimetric analysis.

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Fertilization and Plant Development Drive Fungal Community Assembly and Functional Succession in the Sorghum Rhizosphere

Ibrahim Ajadi [1]*, Ganiyu Shittu Olahan [1], Azeez Adebola Lateef [1]

[1] Department of Plant Biology, University of Ilorin, Ilorin, Nigeria. 16-55ei044pg@students.unilorin.edu.ng; Olahan.gs@unilorin.edu.ng; Lateef.aa@unilorin.edu.ng

* **Correspondence:** 16-55ei044pg@students.unilorin.edu.ng

Abstract: Fertilization affects both crop performance and soil microbial communities, but how different fertilizer types influence fungal communities in the rhizosphere as plants develop is not well understood. This study examined the effects of cow dung and NPK fertilization on fungal communities in the sorghum rhizosphere at the vegetative, reproductive transition, and physiological maturity stages. Rhizosphere soils from fertilized and unfertilized plots were analyzed using high-throughput ITS amplicon sequencing. Fungal diversity, community composition, taxonomy, and functional guilds were assessed using alpha and beta diversity analyses and FUNGuild. Sequencing produced 49,403–56,498 raw reads per sample and 5,487 ASVs after rarefaction. NPK increased fungal richness at the vegetative stage, while cow dung resulted in higher diversity and evenness at maturity. Fungal community composition varied significantly with fertilizer treatment and plant growth stage (ANOSIM $R = 0.17–0.59$, $P < 0.05$). Ascomycota was the dominant phylum across samples. NPK was associated with higher relative abundances of Eurotiomycetes and Hypocreales, whereas cow dung favored Basidiomycota and saprotrophic genera such as *Cladosporium*, *Fusarium*, *Cercophora*, and *Podospora*. Saprotrophic and symbiotrophic guilds were more prominent under cow dung, while pathotrophic guilds were relatively higher in NPK and control soils. These findings show that fertilizer type and plant development jointly influence fungal community structure and functional groups in the sorghum rhizosphere, with cow dung supporting a more diverse fungal community.

Keywords: sorghum; rhizosphere fungi; fertilization; ITS sequencing; fUNGuild

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Investigation of the Effects of Apple Pomace-Derived Preparations on the Digestion of Carbohydrates

Márta Vaczó [1]*, Judit Tormási [1]

[1] Department of Food Chemistry and Analytics, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, H-1118 Budapest, Hungary, Vaczo.Marta@stud.uni-mate.hu; Tormasi.Judit@uni-mate.hu

* **Correspondence:** Vaczo.Marta@stud.uni-mate.hu

Abstract: Industrial-scale apple processing generates large quantities of byproducts, which can be a potential source of dietary fiber, minerals, and bioactive compounds. Bioactive compounds have been reported to inhibit enzymes involved in starch digestion. The vast majority of apple pomace is typically disposed of through landfilling, incineration, or composting, or is used as low-quality animal feed. Out of the apple pomace that is produced, only a small fraction is recycled for pectin extraction, which results in a new byproduct. The aim of this study was to determine which fraction of apple pomace might reduce the glycaemic index of carbohydrates, and whether the order of extraction of the valuable components of apple pomace is a significant factor influencing digestibility. The extracts differed in their pectin and polyphenol content, as well as in the order of extraction. The digestion simulation was performed according to the hybrid Infogest protocol, during which samples were collected at multiple times (0–240 min). The total glucose content of each sample was determined using the GOPOD method. The results showed that three out of four treatments had a glycaemic response-reducing effect, with the pectin-reduced fraction performing the best. This was also the only fraction that achieved the same effect in the small intestine as well as in the stomach, in terms of glucose release. It was also found that the order of extraction of the polyphenol and pectin content of apple pomace has no effect on carbohydrate digestibility. The results support the presumed reducing effect of apple pomace on starch and propose recycling an industrial byproduct multiple times.

Keywords: apple pomace; starch digestion; in vitro digestion; glycaemic index

Acknowledgement: This work was supported by the NTP-SZKOLL-26-0029 project and the Institute of Food Science and Technology of the Hungarian University of Agriculture and Life Sciences.

Chitinolytic Plant Growth Promoting Earthworm Gut Bacteria as Multifunctional Bioinoculants for Sustainable Chickpea Production

Moumita Parveen [1]*, Narayan Chandra Mandal [1]

[1] Mycology and Plant Pathology Laboratory, Department of Botany, Siksha Bhavana (Institute of Science), Visva-Bharati, Santiniketan – 731235, West Bengal, India.

* **Correspondence:** narayanchandra.mandal@visva-bharati.ac.in

Abstract: Earthworm gut constitutes a rich source of beneficial microorganisms due to their feeding habits which have potential applications in sustainable agriculture exclusively in biocontrol of phytopathogens and plant growth promotion. In this context, chitinase-producing bacteria were isolated from the gut of *Eisenia fetida* and evaluated for their plant growth-promoting (PGP) traits, biocontrol potential, genomic characteristics, and field performance in chickpea (*Cicer arietinum L.*). *Aeromonas sp. HCP8* (213.75 U ml^{-1}) and *Bacillus sp. EGI6* (135.08 U ml^{-1}) exhibited the highest chitinase producing activity along with multiple PGP phenotypes, including phosphate and potassium solubilization, phytohormone production, siderophore secretion, ammonia production, and ACC deaminase activity. Whole-genome sequencing further validates their genomic involvement in chitinase production, nutrient mobilization, phytohormone biosynthesis, and stress tolerance. Further, Vermicompost enriched with these selected bacterial strains was evaluated under field conditions following randomized block design. Bacteria enriched vermicompost treatments significantly enhanced the growth and yield attributes along with nutrient contents. These findings demonstrate that earthworm gut-derived chitinolytic bacteria possess strong potential as multifunctional bioinoculants for improving crop productivity while reducing dependence on chemical fertilizer, thereby contributing to environmentally sustainable agricultural practices.

Keywords: earthworm gut; bacteria; chitinase; biocontrol; plant growth promotion; vermicompost; sustainable agriculture

Can the BioCoupler® Temporary Immersion System be Adapted for Olive (*Olea europaea* L.) Micropropagation?

Pavla Přinosilová [1]*, Aleš Eichmeier [1]

[1] Mendeleum—Institute of Genetics, Faculty of Horticulture, Mendel University in Brno, Valtická 334, 691 44 Lednice, pavla.prinosilova@mendelu.cz; ales.eichmeier@mendelu.cz

* **Correspondence:** pavla.prinosilova@mendelu.cz

Abstract: Temporary immersion systems (TIS) use liquid media with periodic immersion of explants and represent a promising alternative to conventional semi-solid culture for in vitro plant propagation. Although several TIS platforms have been investigated for olive (*Olea europaea* L.) micropropagation, the BioCoupler® (Plant Cell Technology, Washington, DC, USA) TIS has not, to the best of our knowledge, been evaluated for this species. This study aimed to assess the suitability of the BioCoupler® system for olive micropropagation and determine key parameters for optimization. During three pilot experiments with cultivars Galega vulgar and Frantoio, preliminary observations suggested enhanced shoot development with meta-topolin and zeatin combined compared with zeatin alone. The pilots also identified immersion regime, vessel configuration, explant density and explant size as key parameters requiring optimization. Based on these observations, a subsequent experiment evaluated 1-, 3- and 5-min immersion once daily in Frantoio and Moraiolo, with semi-solid culture as a control. In Frantoio, 1-min immersion resulted in the highest total node production (4.85 ± 0.30 nodes per explant), significantly exceeding the semi-solid control (3.41 ± 0.65; $p = 0.046$) and 5-min treatment (2.98 ± 0.88; $p = 0.009$). In Moraiolo, no significant differences in total node production were observed among the treatments, although the highest mean value was recorded after 1-min immersion (7.05 ± 1.45 nodes per explant). These results suggest that the BioCoupler® system can support olive micropropagation, while responses to immersion duration are cultivar-dependent. Further work will focus on optimizing immersion frequency.

Keywords: BioCoupler®; *Olea europaea*; temporary immersion system; liquid culture; micropropagation

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Pre-War Imbalances and Post-War Recovery: Reimagining Ukraine's Countryside through Community-Centric Resilience

Olena Kotykova [1]*, Mykola Babych [2], Bohdan Babych [3]

[1] Chair of Growth Economics, Structural Change and Trade, University of Greifswald, Friedrich-Loeffler-Straße 70, 17489 Greifswald, Germany

[2] International Agricultural Policy and Environmental Governance, University of Kassel, Steinstraße 19, 37213 Witzenhausen, Germany

[3] Faculty of Social Sciences, Otto-Friedrich-University of Bamberg, Kapuzinerstraße 16, 96047 Bamberg, Germany

* **Correspondence:** olena.kotykova@uni-greifswald.de

Abstract: Wartime agricultural destruction in Ukraine revealed not only immediate war damages but also deep-seated pre-war structural distortions. Decades of prioritizing macroeconomic export records in grain and oilseeds masked severe socio-spatial decay, land monopolization, depopulation, and soil degradation. A descriptive-structural and socio-spatial analytical framework was utilized to assess pre-war statistical datasets (2000–2021), land control distribution, structural shifts between crop and livestock production, and the institutional outcomes of territorial decentralization reforms.The empirical analysis demonstrates an extractive agrarian dualism: 14% of corporate enterprises control 74% of arable land, capturing tax benefits while transferring value out of rural regions. Conversely, 17 million household farms operate on sub-hectare micro-plots without credit access, yet guarantee domestic food sovereignty by producing 97.7% of potatoes, 85.9% of vegetables, and 68.2% of milk. The contraction of livestock farming's share from 50.6% to 22.7% eroded year-round rural employment and soil organic balance. The decentralization reform (2015–2020) transferring state agricultural land to municipal hromada ownership provides the crucial institutional anchor for local wealth retention and spatial governance. Post-war reconstruction must avoid rebuilding the corporate status quo and execute a 4-pillar community-centric framework: 1) municipal land governance via the State Land Bank; 2) smallholder diversification and cooperative livestock/horticulture; 3) decentralized storage hubs and short supply chains; and 4) eco-remediation aligned with the EU Green Deal.

Keywords: agricultural resilience; community-centric reconstruction; land concentration; food sovereignty; hromada

Isolation, Functional Characterization and Molecular Identification of Rhizobacteria Associated with the Rhizosphere of *Solanum melongena* L. in Cooch Behar, West Bengal

Susamay Debnath[1], Srinjoy Ghosh[1,2], Krishnendu Pramanik[1]*

[1] Department of Botany, Cooch Behar Panchanan Barma University, Panchanan Nagar, Vivekananda Street, PIN – 736101, West Bengal, India

[2] Department of Biochemistry, Uttar Banga Krishi Viswavidyalaya, Pundibari, 736165, Cooch Behar, West Bengal, India

* **Correspondence:** krishnendu.cbpbu@gmail.com

Abstract: The rhizosphere is a biologically active soil zone where root-associated microorganisms contribute to nutrient cycling and plant growth. The present study investigated the physicochemical characteristics of rhizospheric soils associated with eggplant (*Solanum melongena* L.) and evaluated the functional attributes of culturable rhizobacteria from Cooch Behar district, West Bengal, India. Soil samples were collected from three agricultural sites at Ruerkuthi (26º19′28″ N, 89º27′24″; (26º13′08″ N, 89º30′31″; 26º12′59″ N, 89º30′25″) and subjected to physicochemical analysis. Rhizobacteria were isolated by serial dilution and streak plating, followed by purification and morphological characterization. Sixteen isolates were selected and evaluated by Gram staining, antibiotic susceptibility testing, lactose fermentation assay, and screening for nitrogen-fixing and phosphate-solubilizing activities. Molecular identification of the isolates was performed based on 16S rRNA gene sequencing. The isolates exhibited variation in colony morphology, Gram-staining reactions, and antibiotic susceptibility profiles. Among them, 10 isolates demonstrated potential nitrogen-fixing activity, while 14 exhibited phosphate-solubilizing activity. MacConkey agar analysis showed that four isolates exhibited no growth, whereas eight were unable to ferment lactose. Based on the combined functional assessment, isolates SD2-10 and SD1-13 were screened as promising candidates for further investigation. Molecular identification of SD2-10 revealed 99% query coverage and 97.91% sequence identity with the genus Staphylococcus. The sequence was deposited in NCBI GenBank under accession number PZ805087. Overall, the findings demonstrate the presence of culturable rhizobacteria with potentially phytobeneficial functional traits in the eggplant rhizosphere. Further studies are required to validate their plant growth-promoting efficacy, biosafety, and suitability for agricultural application.

Keywords: Culturable rhizobacteria; Edaphic characterization; Phytobeneficial traits; *Solanum melongena*; *Staphylococcus sp*

Antioxidant Enzymes in ROS and RNS Homeostasis: Molecular Regulation and Signalling in Higher Plants

Asma Sultana [1]*

[1] Department of Botany, J.K. College, Purulia-723101, West Bengal, India, asma.sultana44@gmail.com

* **Correspondence:** asma.sultana44@gmail.com

Abstract: The generation of reactive oxygen and nitrogen species (ROS and RNS, respectively) within the cell is the inevitable consequence of aerobic metabolism. ROS and RNS have diverse sites of origin and participate in a wide range of signalling processes. While both ROS and RNS can be accounted for, either individually or in concert, as participating in the regulation of both physiological and stress-related processes in plants, their potentially detrimental effects cannot be overlooked. Under unfavourable environmental conditions, excessive accumulation of ROS and RNS can become toxic due to the disruption of the cellular redox balance, resulting in oxidative and nitrosative stresses in plants. This damages essential biomolecules, which may ultimately lead to cell death. To counteract these destructive effects, plants have evolved sophisticated antioxidant defence systems comprising both enzymatic and non-enzymatic components. The enzymatic antioxidants have different levels of regulation to increase their sensitivity to any redox imbalance and harmful deviation in the immediate milieu, hence ensuring their effective functioning. The present study has focused on the molecular details of the network involving ROS and RNS signalling and on how antioxidants, especially enzymatic antioxidants, act in concert to maintain non-toxic levels of ROS and RNS under stress conditions, while preserving their essential signalling functions, thereby contributing to plant survival and adaptation.

Keywords: reactive oxygen species; reactive nitrogen species; antioxidant enzymes; stress biology

Biocontrol, Plant Growth-Promoting, and Bioremediation Potential of *Aeromonas Veronii* CMF from the Gut of *Chrysomya megacephala*

Sandipan Banerjee [1]*, Kunal Kumar Saha [2], Krishnendu Pramanik [3], Hynek Roubík [1], Narayan Chandra Mandal [2]

[1] Department of Food and Bioresource Technology, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamycka 129, Suchdol, Prague-06, Czech Republic banerjee@ftz.czu.cz; roubik@ftz.czu.cz

[2] Mycology and Plant Pathology Laboratory, Department of Botany, Visva-Bharati, Santiniketan, West Bengal, India, mandalnc@visva-bharati.ac.in

[3] Department of Botany, Cooch Behar Panchanan Barma University, Cooch Behar, West Bengal, India

* **Correspondence:** banerjee@ftz.czu.cz

Abstract: Gut system of chitinivorous insect *Chrysomya megacephala* was purpose fully targeted to find unexplored microbial resources based on the rationale of their usual food habits. A phytobeneficial bacterial strain *Aeromonas veronii* CMF was successfully isolated and characterized up to genomic approaches. Genomic-phenotypic characterization and validation were carried out. The gut isolate A. veronii CMF is a non-pathogenic strain, as proven by the negative results from the hemolysis and DNase tests. Antifungal enzyme production by the CMF exhibited 22.14 ± 2.12, 16.09 ± 0.476, and 1.89 ± 0.46 U/mL chitinase, protease, and β−1,3-glucanase production, respectively. Further, in vitro and in vivo studies also elucidate the effective utilization of such gut bacterial attributes against as many as nine plant pathogenic fungi, demonstrating plant growth-promoting (PGP) and root-colonizing activities with *Cicer arietinum* and *Oryza sativa* IR36, as well as heavy metal(loid)s (HMs) resistance, removal, and bioaccumulation potential. Hence, the current study revealed the potential of the gut symbiont CMF to respond against both the biotic and abiotic stresses with PGP attributes for sustainable agriculture.

Keywords: antifungal activity; chitinase, β-glucanase; protease; insect gut symbiont; heavy metal; plant-microbe interaction; root colonisation

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Decentralising Precision Agriculture: An Open-Source Application for Weed Detection and Density Estimation to Optimise Herbicide Use in Resource-Constrained Agricultural Context

Adam Hruška [1]*, Antoine Bercy [1]

[1] Department of Food and BioResource Technology, Czech University of Life Sciences Prague (CZU)

* **Correspondence:** hruskaa@ftz.czu.cz

Abstract: Weed infestations significantly reduce crop yields, particularly in resource-constrained farming systems where access to decision support tools is limited. This study addresses the need for accessible, offline weed management solutions by developing an open-source mobile system that integrates computer vision with agronomic decision rules. The system employs a lightweight YOLOv7-based detector with TensorFlow Lite for on-device inference. It was trained using 17,423 manually annotated smartphone images from maize fields, covering one crop and ten weed species. The application includes species-specific density estimation and economic threshold-based herbicide recommendations. The model achieved a precision of 0.926, recall of 0.847, and mAP@50 of 0.914 on the test set. After INT8 quantization, the model size reduced by approximately 3.9× with only ~1% loss in mAP, while maintaining inference speeds of 171–254 ms on mobile devices. The system converts detections into weed-density estimates and compares them with embedded economic thresholds to generate actionable management guidance. The study demonstrates the feasibility of deploying open, offline, on-device weed management systems that effectively combine computer vision and agronomic decision rules in a practical smartphone workflow for resource-limited agricultural contexts.

Keywords: weed detection; mobile system; economic threshold; computer vision; resource-constrained farming

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Institutional Arrangements and NUS Commercialisation in Nigeria: The Case of *Parkia Biglobosa* and *Solanum Aethiopicum*

Ibitayo Esther Adeniran [1]*, Jiří Hejkrlík [1]

[1] Department of Economics and Development, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, adeniran@ftz.czu.cz; hejkrlik@ftz.czu.cz

* **Correspondence:** hejkrlik@ftz.czu.cz

Abstract: The study focused specifically on the social network analysis component of a broader mixed-methods design. Data were collected from 400 actors engaged in the value chains of *Parkia biglobosa* and *Solanum aethiopicum* and were complemented by key informant interviews, focus group discussions, and field observations. The network analysis mapped relationships around information exchange, input sharing, marketing collaboration, and organisational support and examined network structure using measures of density, centrality, and brokerage. It is grounded in collective action theory. The analysis showed that commercialisation in both value chains was organised through hybrid institutional arrangements that combined formal associations with informal ties based on trust, reciprocity, and socially embedded exchange. In *Parkia biglobosa*, women occupied central positions in processing and trade, consistent with earlier evidence that locust bean marketing and processing are heavily feminised and often concentrated in local market networks. Network patterns indicated that a limited number of actors performed brokerage roles, linking otherwise weakly connected groups to market information and institutional support; such bridging positions are important for coordination but can also create dependence on a few central nodes The findings further showed that association membership alone did not guarantee better commercial outcomes, but associations functioned as important common spaces for information exchange and coordination across actors.

Keywords: institutional arrangements; value chains; market access; collective action; smallholder farmers

Synergistic Effects of Rice Straw Biochar and Titanium Dioxide Nanoparticles on Growth, Biomass, and Mineral Accumulation in *Amaranthus hybridus* L. Cultivated in Unstressed Soil

Najatullahi Ajoke Opeloyeru [1]*, Gabriel Kehinde Olawepo [1], Paul Ojo Fatoba [1]

[1] Department of Plant Biology, Faculty of Life sciences, University of Ilorin, Ilorin, Kwara state, Nigeria opeloyeru.na@unilorin.edu.ng; olawepo.gk@unilorin.edu.ng; pofatoba@unilorin.edu.ng

* **Correspondence:** opeloyeru.na@unilorin.edu.ng

Abstract: Biochar and nanoparticles are promising soil amendments for enhancing crop productivity, but their combined effects on leafy vegetables under non-stressed conditions remain unclear. This study evaluated the individual and combined effects of rice straw biochar (RSB) and titanium dioxide nanoparticles (TiO_2 NPs) on the growth, physiology, biomass, mineral accumulation, chlorophyll pigments and antioxidant enzyme activity of *Amaranthus hybridus* L. grown in non-stressed soil. A screen house pot experiment was conducted using a completely randomized design with three replicates. Ten treatments comprised a control, TiO_2 NPs (200, 400 and 600 mg per 2 kg soil), RSB (20, 40 and 80 g per 2 kg soil), and their combinations. Physiological traits were assessed weekly from 4–9 weeks after planting, while biomass, mineral composition, chlorophyll pigments and antioxidant enzymes were analysed at harvest. The combined application of 200 mg TiO_2 NPs and 20 g RSB produced the highest plant height (62.58 cm), shoot and root biomass, leaf nitrogen (4.44%) and carotene (3.24 mg/g). In contrast, 600 mg TiO_2 NPs alone resulted in the highest chlorophyll a (0.639 mg/g), chlorophyll b (0.304 mg/g) and total chlorophyll (9.454 mg/g). All treatments enhanced antioxidant enzyme activity relative to the control, suggesting mild oxidative stress. Low-dose TiO_2 NPs combined with RSB synergistically improved growth, biomass and nutritional quality of A. hybridus, demonstrating a sustainable approach for enhancing leafy vegetable production under non-stressed soil conditions.

Keywords: *Amaranthus hybridus*; rice straw biochar; titanium dioxide nanoparticles; chlorophyll; antioxidant enzymes.

Advancing Sustainable Agriculture Through Plant Science and Climate-Smart Innovation

Kaddijatou J Baldeh [1*]

[1] Management Development Institute, Kanifing Municipality, The Gambia

* **Correspondence:** basaikouminteh411@gmail.com

Abstract: Agriculture is fundamental to global food security, economic development, and environmental sustainability. However, climate change, population growth, land degradation, water scarcity, biodiversity loss, and declining soil fertility continue to threaten agricultural productivity and the resilience of food systems. Addressing these challenges requires sustainable, science-based, and interdisciplinary approaches that improve crop production while conserving natural resources. Advances in plant science and agricultural innovation have become essential for developing resilient farming systems capable of meeting current and future food demands. This study employed a comprehensive review of recent scientific literature on sustainable agriculture, plant science, crop improvement, and climate-smart technologies. It examined developments in plant biotechnology, precision agriculture, soil and water management, digital agriculture, artificial intelligence, and data-driven farming. The review assessed how these innovations contribute to improving agricultural productivity, resource-use efficiency, environmental sustainability, and resilience to climate-related stresses. The findings indicate that integrating climate-smart agricultural practices with modern technologies significantly improves crop yields, enhances resistance to pests, diseases, drought, and extreme weather conditions, while reducing environmental impacts. Precision agriculture and digital technologies optimise resource utilisation, improve farm management decisions, and minimise production costs. Biotechnology and improved crop varieties further strengthen food security by increasing productivity and enhancing resilience under changing climatic conditions. Plant science and technological innovation are key drivers of sustainable agricultural transformation. Strengthening collaboration among researchers, policymakers, extension services, and farming communities will accelerate the adoption of evidence-based practices. Continued investment in research, innovation, and capacity building is essential for achieving resilient agricultural systems, improved food security, environmental conservation, and sustainable rural development.

Keywords: sustainable agriculture; plant science; climate-smart agriculture

Botanical Characterisation and Productive Evaluation of Four Local Varieties of the Genus Xanthosoma (Araceae) in the San Martín region, Peru

Goldis Perry Davila [1]*, Robert Juda Rabanal Gonzales [2], Andrea Irene Bosmediano Oliveira [3], Lady Laura Tuisima Coral [4], Zbyněk Polesný [1]

[1] Department of Crop Science and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague; perry_davila@ftz.czu.cz; polesny@ftz.czu.cz

[2] Faculty of Agricultural Science, National University of San Martin, Jr. Maynas N° 177, Tarapoto - Peru; Rjrabanalg@alumno.unsm.edu.pe

[3] Department of Tropical Forest Ecology Engineering; Faculty of Forestry Sciences, National University of Peruvian Amazon, Carretera Zungarococha, Puerto Almendra 16000, Peru; andreabosmedianounap@gmail.com

[4] National University of Ucayali, Faculty of Forestry and enviromental Sciences; Carretera Federico Basadre Km. 6,200, Calleria, Coronel Portillo, Ucayali, Peru; lady_tuisima@unu.edu.pe

* **Correspondence:** perry_davila@ftz.czu.cz

Abstract: Peru harbours a rich diversity of native crops, including species of the genus Xanthosoma. In the San Martín region, however, these crops are rapidly declining. Many native Araceae are now scarcely known by younger generations, and their cultivation is gradually disappearing, remaining only in small plots for household consumption. As these crops have little commercial value, farmers have limited incentives to expand their cultivation. This study was conducted between July 2022 to December 2024. Vegetative propagules of four local Xanthosoma varieties were collected from five communities in the San Martín Region, Peru. The objective was to characterise the four varieties botanically and evaluate their productive performance under experimental field conditions. A total of 144 plants were evaluated. Three cormel colour types were identified: yellow, white, and orange. Cormel length ranged from 3 to 10 cm, while plants produced an average of two to four leaves measuring 25–60 cm. The local variety 'Witino Blanco' produced the heaviest cormels, with a mean weight of 503.75 g per plant, and the local variety 'Witino rojo 'has the longest leaves, averaging 58 cm in length. These native Xanthosoma varieties continue to be cultivated by local communities and represent valuable genetic resources. This study contributes to their conservation by providing scientific information that supports their sustainable cultivation and promotes the preservation of native crop diversity in the Peruvian Amazon

Keywords: Local varieties; Xanthosoma; on-farm conservation; Araceae; plant genetic resources

Acknowledgement: We express our gratitude for support to the Faculty of Tropical AgriScience – CZU, National University of Ucayali, National University of San Martin and National University of the Peruvian Amazon

Characteristics of Water Consumption and Yield Formation in Spring Barley Depending on the Use of Biological Products in Southern Ukraine

Andriy Dobrovolskyi [1]*, Yevgeny Honcharenko [1]

[1] Department of Plant Growing and Horticulture, Faculty of Agricultural Technology, Mykolaiv State Agrarian University, 54020, 9 Heorhii Honhadze Str., Mykolaiv, Ukraine

* **Correspondence:** dobrovolskiyav@mnau.edu.ua

Abstract: *Hordeum vulgare* L. is one of the major cereal crops in Ukraine due to its adaptability, early maturity, and wide range of uses. However, its productivity in southern Ukraine is largely constrained by limited soil moisture and frequent droughts, making efficient water use an important factor in sustainable crop production Field experiments were conducted during 2023–2025 at the Educational, Scientific and Practical Centre of Mykolaiv National Agrarian University It was found that spring barley plants of the Tamango variety consumed the least amount of moisture per 1 metric ton of grain when pre-sowing seed treatment with the biological product MycoFriend was used, combined with foliar fertilization at the beginning of the spring barley plants' stem elongation and heading stages using HELPROST® Universal – 528.8 m^3/t, which is 2.4–18.9% lower than in other experimental treatments. HELPROST® Universal provided the greatest increase in grain yield. On average over the years and considering the pre-sowing seed treatment factor, the grain yield of the Nadiinyi variety was 3.24 t ha^{-1}, and for the Tamango variety - 3.53 t ha^{-1}, which exceeded the figures for the control treatment and for crops fertilized with GumiFriend by 0.24–0.26 and 0.12–0.14 t ha^{-1}, respectively. In the southern regions of Ukraine, to make more efficient use of moisture and achieve higher yields of spring barley, it is recommended to grow the Tamango spring barley variety, treating its seeds with MycoFriend before sowing, and applying HELPROST® Universal as a fertilizer to the crops twice during the growing season

Keywords: spring barley; pre-sowing seed treatment; foliar fertilization of crops; water use efficiency; yield

Synergistic Effect of Biochar and Arbuscular Mycorrhizal Fungi on the Vitality of *Vitis vinifera* L.

Linda Holcova [1]*, Milan Špetík [1], Aleš Eichmeier [1]

[1] Mendeleum - Institute of Genetics, Mendel University in Brno, Valtická 334, 691 44 Lednice, Czech Republic, xholcova@mendelu.cz

* **Correspondence:** xholcova@mendelu.cz

Abstract: The grapevine trunk disease (GTD) complex represents a major challenge for viticulture worldwide, reducing vine vitality, causing premature grapevine death, and leading to significant economic losses. This study evaluated the synergistic effect of biochar and arbuscular mycorrhizal fungi (AMF) of the genus *Rhizophagus* on the vitality of grapevine seedlings (*Vitis vinifera* L.) and their response to infection by *Diplodia seriata*, one of major GTD pathogen Grapevine seedlings were treated with biochar in combination with *Rhizophagus intraradices* or *Rhizophagus irregularis*. Disease severity was evaluated by measuring the length of necrotic lesions. The combined application of biochar and AMF significantly reduced necrotic lesion development compared with untreated controls, indicating antifugal effects to biotic stress. While the average necrosis length reached approximately 10.6 cm in the control grapevines, the maximum lesion length was limited to 2 cm in grapevines treated with *R. intraradices*, whereas grapevines treated with *R. irregularis* exhibited an average lesion length of approximately 5 cm. No significant differences were observed in biomass or root system volume. These findings demonstrate that biochar promotes favorable conditions for mycorrhizal establishment, enhancing plant and AMF interactions, and contributing to improved grapevine health. The synergistic application of biochar and AMF represents a promising, environmentally strategy for sustainable viticulture.

Keywords: GTD complex; *Diplodia seriata*; biochar; AMF; *Rhizophagus*

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Sustainable Plants and Agriculture for Global Food Security

Saikou Jabbie [1]*

[1] University of the Gambia, Faraba, Gambia

* **Correspondence:** mamadisowe24@gmail.com

Abstract: Plants are the foundation of agriculture and human civilisation, providing food, oxygen, fibre, medicine, and ecosystem services essential for life. Agriculture has evolved from traditional subsistence farming to modern, technology-driven production systems that support more than eight billion people worldwide. However, climate change, population growth, declining soil fertility, biodiversity loss, and limited natural resources increasingly threaten agricultural productivity and global food security. Sustainable agricultural practices are therefore essential to balance increased food production with environmental conservation. This study reviews current literature on sustainable plant science and agriculture, focusing on advances in crop breeding, biotechnology, precision agriculture, climate-smart farming, integrated pest management, and agroecological practices. Information from recent scientific publications was synthesised to evaluate strategies that improve crop productivity, resilience, and resource-use efficiency while minimising environmental impacts. The review demonstrates that combining improved crop varieties with sustainable management practices significantly enhances agricultural productivity and resilience. Climate-smart crops with improved tolerance to drought, heat, pests, and diseases increase yield stability under changing environmental conditions. Precision agriculture, crop rotation, cover cropping, conservation tillage, and efficient irrigation reduce water use, chemical inputs, greenhouse gas emissions, and soil degradation. Furthermore, policy support, farmer education, and improved post-harvest management strengthen food security and promote sustainable agricultural development. Integrating innovations in plant science with sustainable agricultural practices offers an effective pathway toward resilient food systems. Continued investment in research, technology, and inclusive agricultural policies will be essential to ensuring global food security, conserving biodiversity, protecting natural resources, and achieving the United Nations Sustainable Development Goals.

Keywords: plant science; sustainable agriculture and food security; climate-smart agriculture

Breaking Fertilizer Dependency: Seed Diffusion Networks and Soil Fertility Management of Nitrogen Fixing Trees in Malawi

Katherine Jacobs [1]*, Miroslave Bavarova [2], Joyce Njoloma [3]

[1] Food and BioResource Technology, Faculty of Tropical AgriSciences, Czech University of Life Sciences, Kamýcká 129, 165 00 Praha-Suchdol, Czechia, xjack004@studenti.czu.cz

[2] Economics and Development, Faculty of Tropical AgriSciences, Czech University of Life Sciences, Kamýcká 129, 165 00 Praha-Suchdol, Czechia, bavorova@ftz.czu.cz

[3] Forestry, Faculty of Natural Resources, Lilongwe University of Agriculture and Natural Resources, Bunda Campus, Lilongwe, Malawi, jnjoloma@luanar.ac.mw

* **Correspondence:** xjack004@studenti.czu.cz

Abstract: Global conflict has contributed to volatile prices for nitrogen fertilizers. This poses a severe threat to food security in many sub-Saharan African countries, where smallholders rely on imported fertilizers to sustain yields. Nitrogen-fixing trees (NFTs) provide a low-cost alternative by improving soil fertility through biological nitrogen fixation while reducing erosion and supplying fuelwood and fodder. Despite promotion in Malawi, adoption remains limited possibly due to limited awareness and seed access. A cross-sectional survey was conducted among approximately 280 farming households in Dowa East, Malawi, including both adopters and non-adopters. Villages were cluster sampled and households in the village were randomly selected. Data on nitrogen fixing tree awareness, seed access, fertilizer use, and household characteristics was collected using Kobo Toolbox questionnaires. Data collection is finished on August 2026. Analyses are expected to identify seed distribution networks, compare of seed security and awareness as barriers to NFT adoption, and assess whether NFT adoption is associated with reduced inorganic fertilizer use. A kernel density estimation map will visualizs seed access, logistic regression will compare adoption constraints, and an inverse probability weighted regression adjustment will compare inorganic fertilizer use. With an anticipated spike in inorganic fertilizer prices in 2026, this research provides timely insight on how to scale NFT adoption to improve food security and soil health for millions of African smallholder farmers.

Keywords: agroforestry; nitrogen fixing trees; seed security; soil health; Malawi

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Synergistic Co-Digestion of Indian Jujube Waste and Cow Dung Enhances Methane Recovery: Optimization of Feedstock Ratio in Batch Anaerobic Digestion

Manvendra Kumar [1]*, Viktoriia Chubur [1], Hynek Roubík [1]

[1] Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Prague, Czech Republic, kumarm@ftz.czu.cz; chubur@ftz.czu.cz; roubik@ftz.czu.cz

* **Correspondence:** kumarm@ftz.czu.cz

Abstract: Fruit processing waste can create environmental problems if it is not managed properly, while anaerobic digestion can convert this waste into renewable energy. However, fruit waste alone may cause rapid acidification and low process stability. Therefore, this study examined whether co-digestion of Indian jujube (*Ziziphus mauritiana*) waste with cow dung could improve methane production and identify the most suitable mixing ratio. A 25 day batch anaerobic digestion experiment was conducted in triplicate. The treatments included an inoculum blank, cow dung and jujube mono digestion, and jujube dung mixtures of 50:50, 70:30, and 90:10 based on total solids. Biogas was measured daily, methane yield was calculated per kilogram of volatile solids, synergy was assessed using a synergy index, and methane kinetics were evaluated using the modified Gompertz model. Co-digestion improved methane production compared with the mono digestion treatments. Among the tested ratios, the 70:30 jujube to cow dung mixture showed the best performance, producing 271 $L \cdot kgVS^{-1}$ of biogas and 122 $L \cdot kgVS^{-1}$ of methane. Its methane yield was approximately 2.7 times higher than that of jujube mono-digestion. The 50:50 and 90:10 mixtures produced 59 and 88 $L \cdot kgVS^{-1}$ of methane, respectively. All co-digestion ratios showed positive synergistic effects, while the highest synergy index of 3.27 was obtained from the 70:30 mixture. The modified Gompertz model showed a strong fit to the experimental data, with R^2 values of at least 0.96. Co-digestion with cow dung clearly improved the anaerobic conversion of Indian jujube waste. The 70:30 ratio was the most effective and offers a promising option for renewable energy recovery and sustainable waste management.

Keywords: indian jujube; anaerobic co-digestion; methane production; cow dung; synergistic effect

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Effects of Cultivar and Fertilization on Winter Wheat Productivity and Grain Quality under the Conditions of the Southern Steppe of Ukraine

Antonina Panfilova [1]*, Peter Verbitskyi [1]

[1] Department of Plant Growing and Horticulture, Faculty of Agricultural Technology, Mykolaiv State Agrarian University, 54020, 9 Heorhii Honhadze Str., Mykolaiv, Ukraine

* **Correspondence:** panfilovaantonina@ukr.net

Abstract: Winter wheat (*Triticum aestivum* L.) is one of the major cereal crops in Ukraine, and its productivity depends on weather conditions, cultivar characteristics, and mineral nutrition. Optimizing cultivar selection and fertilizer application is essential for improving grain yield and quality under the arid conditions of the Southern Steppe of Ukraine. The aim of this study was to evaluate the effects of weather conditions, cultivar, and fertilization on winter wheat productivity and grain quality during. Field experiments were conducted during 2022–2025 at the Educational, Scientific, and Practical Center of Mykolaiv National Agrarian University using standard field and laboratory methods. Two winter wheat cultivars were evaluated with Duofertil 30, Duofertil 38, and Eurocereal 34. Grain yield and the main technological quality indicators were determined. On average, the cultivar Pokrovska produced the highest grain yield (5.54 t ha^{-1}), exceeding Duma Odeska by 5.3%, indicating better adaptation to dry conditions. Compared with the control, Duofertil 30 increased grain yield by 0.22 t ha^{-1}, Duofertil 38 by 0.31 t ha^{-1}, and Eurocereal 34 by 0.42 t ha^{-1}. Fertilizer application also improved grain quality. Eurocereal 34 produced the highest protein content (14.2–14.4%), crude gluten content (26.1–26.5%), and test weight (793–795 g L^{-1}). Pokrovska consistently showed superior grain quality compared with Duma Odeska. Cultivating the winter wheat cultivar Pokrovska with Eurocereal 34 was the most effective strategy under the conditions of the Southern Steppe of Ukraine, providing the highest grain yield and improved technological grain quality.

Keywords: winter wheat; cultivar; mineral fertilizers; grain yield; grain quality

Symbiotic Activity of Pea Under the Conditions of Southern Ukraine

Antonina Panfilova [1]*, Oleksandr Mytnyk [1], Andrii Brahin [1]

[1] Department of Plant Growing and Horticulture, Faculty of Agricultural Technology, Mykolaiv State Agrarian University, 54020, 9 Heorhii Honhadze Str., Mykolaiv, Ukraine

* **Correspondence:** panfilovaantonina@ukr.net

Abstract: The relevance of studying the symbiotic activity of pea crops in southern Ukraine is driven by the need to improve crop productivity under climate change, increasing drought, and insufficient rainfall. Optimising biological nitrogen fixation is an effective approach to enhancing plant adaptation and ensuring stable yields under adverse environmental conditions. Field experiments were conducted during 2024–2025 at the Educational, Scientific and Practical Centre of Mykolaiv National Agrarian University to evaluate the symbiotic activity and productivity of different pea varieties. The results demonstrated a close relationship between symbiotic activity and crop productivity. The formation of nitrogen-fixing nodules varied according to plant growth stages and directly influenced yield formation. The highest symbiotic activity was observed during the seed-filling stage, when both the number and mass of active nodules reached their maximum values, particularly in the Darunok Stepu and Kozachok varieties. Among the studied varieties, Kozachok produced the highest average grain yield over 2024–2025 (3.12 t/ha), followed by Darunok Stepu (2.85 t/ha), while Kruiz showed the lowest productivity (1.95 t/ha). These findings confirm that varietal characteristics and the efficiency of the legume-rhizobia symbiosis play a crucial role in achieving high and stable yields. The superior symbiotic potential of the Darunok Stepu and Kozachok varieties contributed to their greater productivity under the weather conditions of southern Ukraine. The practical significance of the research lies in identifying pea varieties best adapted to the climatic conditions of southern Ukraine. Darunok Stepu and Kozachok are recommended for cultivation by farmers and agricultural producers seeking stable grain yields under changing climate conditions.

Keywords: pea; symbiotic potential; variety; yield

From Genes to Habitat conservation: Multi-omics approach deciphering molecular pathway, genetic resource, and ecological architecture of *Fritillaria roylei*, critically endangered medicinal plant of Indian Himalayas

Balraj Sharma [1]*, Romit Seth [1], Sapna Thakur [1]

[1] Department of Biotechnology, CSIR - Institute of Himalayan Bioresource Technology, Palampur, Kangra, Himachal Pradesh, India, balrajsharma196@gmail.com, balraj.ihbt21a@acsir.res.in

* **Correspondence:** rksharmaa.ihbt@gmail.com

Abstract: Medicinal plants produce valuable specialised metabolites, yet the genetic and ecological drivers of their diversity remain poorly understood. This study integrates transcriptomics, population genetics, phytochemical profiling, and ecological niche modelling to elucidate alkaloid diversity in the endangered Himalayan species *Fritillaria roylei*, informing conservation, elite chemotype identification, and climate-resilient management. An integrative multi-omics approach combined organ-specific transcriptomics, transcriptome-derived microsatellite molecular marker analysis, UHPLC-based phytochemical profiling, and ecological niche modelling to investigate *F. roylei*. These analyses linked alkaloid biosynthesis, genetic diversity, population structure, metabolite variation, and habitat suitability to identify priority populations and climate-resilient conservation refugia. Organ-specific transcriptome sequencing generated 408.44 million paired-end reads, yielding 113,909 non-redundant transcripts (82,848 unigenes and 31,061 isoforms). Differential expression identified 4,638 transcripts, with the bulb emerging as the primary metabolic organ enriched for steroid backbone, terpenoid, sesquiterpenoid, triterpenoid, and phenylpropanoid biosynthesis. Key MVA pathway genes, cytochrome P450s, UDP-glycosyltransferases, ABC transporters, aquaporins, and regulatory transcription factors formed interconnected networks governing isosteroidal alkaloid biosynthesis. Population genomic analyses resolved significant genetic diversity and structure, while UHPLC-based metabolite profiling identified elite alkaloid-rich chemotypes. Ecological niche modelling predicted climate-resilient refugia and priority conservation areas, integrating genomic, biochemical, and environmental evidence to guide conservation and sustainable utilisation of F. roylei. Isosteroidal alkaloid biosynthesis in *F. roylei* showed enrichment of cholesterol, terpenoid, and isopentenyl diphosphate pathways. Transcriptome-derived molecular markers and metabolite characterisation revealed genetic diversity, population structure, and identification of elite genotypes and chemotypes, respectively. These findings provide genomic resources and molecular targets for metabolic engineering and conservation of this endangered species.

Keywords: *Fritillaria roylei*; isosteroidal alkaloids; transcriptomics; genetic diversity; ecological niche modeling; conservation genomics

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Fungi for the Restoration of War-Damaged Soils: Main Types and Methods of Application

Yurii Spychak [1]*

[1] Department of Plant Protection, Faculty of Agrotechnology and Environmental Management, Sumy National Agrarian University, University address: Sumy National Agrarian University, 160 Gerasym Kondratiev St., Sumy, 40000, University email: admin@snau.edu.ua

* **Correspondence:** yuriispychak@gmail.com

Abstract: Military activities significantly contaminate soils with explosive compounds (TNT, RDX, HMX), petroleum hydrocarbons, and heavy metals. Such contamination poses serious long-term risks to the environment and human health in affected regions. Fungi have considerable potential for the bioremediation of such soils, both through direct application (mycoremediation) and via the use of spent mushroom substrate. They can degrade complex pollutants, accumulate heavy metals, and improve soil structure. For the restoration of war-damaged soils, fungi are applied in two main ways: 1. Direct mycoremediation — the introduction of live fungal cultures directly into contaminated soil. White-rot basidiomycetes are widely used for their ability to produce powerful ligninolytic enzymes (laccases and peroxidases). 2. Application of spent mushroom substrate — incorporation of residual substrate from mushroom cultivation. SMS acts as a biological activator, enriching the soil with organic matter and nutrients, and stimulating the activity of beneficial soil microorganisms. White-rot fungi such as *Phanerochaete chrysosporium*, *Trametes versicolor*, and *Pleurotus ostreatus* effectively degrade explosive compounds due to their strong enzymatic systems. For example, in field trials, TNT concentrations decreased from approximately 194 mg/kg to 3 mg/kg within 62 days when fungi were combined with organic substrates. Spent substrate from mushrooms such as *Agaricus bisporus*, *Pleurotus eryngii*, *Pleurotus ostreatus*, and *Lentinula edodes* significantly accelerates the degradation of petroleum hydrocarbons (C10–C35) and polycyclic aromatic hydrocarbons, while also stimulating native hydrocarbon-degrading bacteria. Certain fungal species, including *Telephora penicillata*, demonstrate hyperaccumulation of heavy metals and metalloids (As, Cd, Cu, Zn). The application of SMS also improves the physical and chemical properties of soil by increasing pH, organic matter content, nutrient availability, and promoting better plant growth. This enables effective integration of mycoremediation with phytoremediation. White-rot fungi and spent substrate from common edible mushrooms represent a cost-effective and environmentally friendly tool for the restoration of soil contaminated by military activities. The best results are achieved through the combined application of fungi, native microorganisms, and plants.

Keywords: microremediation; remediation; post-war soil; explosive compounds; petroleum hydrocarbons; bioaccumulation of heavy metals

Phytochemical Analysis and Investigation of Antioxidant and Anti-Inflammatory Activities of Selected Ethiopian Traditional Medicinal Plant

Juhar Zemede [1]*, Belay Melese [2], Tegenu Mekuria [2], Gui-Lin Chen [2], Guang-Wan Hu [2]

[1] Ethiopian Biodiversity Institute, Ethiopia

[2] CAS Key Laboratory of Plant Germplasm and Speciality Agriculture, Wuhan Botanical Garden, Chinese Academy of Sciences, China

* **Correspondence:** glchen@wbgcas.cn

Abstract: Research on the isolation, characterisation, and biological testing of bioactive compounds from medicinal plants remains limited. This study primarily explores the secondary bioactive metabolites and the pharmacological potential of four medicinal plants from Ethiopia. The study aimed to screen phytochemical constituents and investigate their antioxidant and anti-inflammatory potential. The ethanolic extracts of Clerodendrum myricoides (Hochst.) R.Br. ex Vatke, Millettia ferruginea (Hochst.) Hochst. ex Baker, Vepris dainellii (Pic.Serm.) Kokwaro, and Fuerstia africana T.C.E.Fr. r. leaves were subjected to Ultra Performance Liquid Chromatography-Quadrupole Time-of-Flight Mass Spectrometry (UPLC- QTOF-MS)/MS for phytochemical analysis and assays, including anti-oxidant (2,2-diphenyl-1-picrylhydrazyl [DPPH], ferric reducing-ion reducing power [FRAP]), Cyclooxygenase 2 (COX-2) inhibition for anti-inflammatory, and Folin–Ciocalteu for phenolic contents determination. The total phenolic contents of *C. myricoides*, *M. Ferruginea*, *V. dainellii*, and *F. africana* were 125.68 ± 0.82 mg, 54.97 ± 0.94, 113.57 ± 0.99 and 66.40 ± 1.14 mg GAE/g, while flavonoid contents were 236.25 ± 1.85, 78.12 ± 0.96, 51.148 ± 1.09 and 60.79 ± 0.47 mg RE/g, respectively. *C. myricoides* and *F. africana* have higher DPPH scavenging rates with IC 50: 1.10 ± 0.12, 2.09 ± 0.14 mg/ml. *C. myricoides* and F. africana displayed the highest FRAP values with 33.30 ± 0.92 and 23.87 ± 1.42 mM Fe2, respectively, and anti-inflammatory activities with COX-2 inhibition at IC_{50} /g. F. africana exerted the highest of 1.82 ± 0.04 μg/ml. About 61 bioactive metabolites have been identified. Alkaloids, phenolic, flavonoids, and terpenoids were the dominant class of identified compounds. The pharmacological tests have validated the therapeutic uses of traditional medicinal plants. Bioactive metabolites play a crucial role in the potential therapeutic applications of plants.

Keywords: medicinal plants; traditional use; antioxidants; anti-inflammatory; phytochemistry

Acknowledgement: We thank the Key R&D Program of Hubei Jiangxia Laboratory, the National Natural Science Foundation of China, the Natural Science Foundation of Hubei Province, the Hubei Provincial Science and Technology Innovation Talent and Service Program, and the Sino-Africa Joint Research Centre, CAS, for supporting this work financially. Our thanks extend to the Ethiopian Biodiversity Institute for their cooperation and support. Finally, we would like to thank the ANSO scholarship for the Young Talents Program for covering our study costs.

Animals & Ecology

Scientific Session



Population Status of the Philippine Warty Pig (*Sus philippensis* Nehring, 1886) and Risks Associated with African Swine Fever in Aliwagwag Protected Landscape, Cateel, Davao Oriental, Philippines

Mark Kevin L. Camposo [1, 2*], Mary Fil M. Bauyot [3], Ricksterlie C. Verzosa [4, 5], Francisco Ceacero [6], Jhonnel P. Villegas [4, 6]

[1] Eastern Mindanao Biodiversity Corridor Project, Davao Oriental State University, City of Mati, 8200 Philippines

[2] Research, Innovation, and Extension, Davao Oriental State University, City of Mati, 8200 Philippines

[3] Faculty of Humanities and Social Sciences, Davao Oriental State University, City of Mati, 8200 Philippines

[4] Faculty of Agriculture and Life Sciences, Davao Oriental State University, City of Mati, Davao Oriental, 8200 Philippines

[5] Faculty of Advanced and International Studies, Davao Oriental State University, City of Mati, Davao Oriental, 8200 Philippines

[6] Department of Wildlife and Animal Sciences, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 16500 Praha – Suchdol, Czech Republic

* **Correspondence:** markkevin.camposo@dorsu.edu.ph

Abstract: The Philippine warty pig (*Sus philippensis*) population in the Aliwagwag Protected Landscape faces severe threats from African Swine Fever (ASF), habitat disturbance, and human activities. This study examined the population status of the species, identified risks associated with ASF, and explored the local knowledge and perspective on the biorisk mitigation strategies within the protected landscape. The study used camera trapping to measure relative abundance and archival research to gather three-year local ASF data. Geographic mapping combined species detections and disease occurrences to create an ASF spillover risk map. Additionally, qualitative data from key informant interviews and focus group discussions were evaluated through thematic analysis and causal layered analysis to assess conservation factors. Camera trapping revealed a low relative abundance index (RAI = 0.80) for the Philippine warty pig. Spatial mapping showed high African Swine Fever (ASF) spillover risks due to overlapping habitats and domestic cases. Thematic analysis identified key local ecological insights, while causal layered analysis linked immediate threats like hunting and ASF to structural issues, complicated by mixed community views. The Philippine warty pig population in Aliwagwag exhibits low relative abundance and faces severe African swine fever spillover risks driven by human access, activity, and poor biosecurity. Immediate hazards, hunting, disease, and habitat loss reflect deeper systemic issues. Safeguarding the species requires community-integrated planning, improved biosecurity protocols, stronger enforcement, and collaborative disease management addressing both local livelihoods and surveillance gaps.

Keywords: wild pig; diseases; camera trapping; conservation; protected landscape

Acknowledgement: The authors are grateful to Davao Oriental State University; the Eastern Mindanao Biodiversity Corridor Project (EMBC); PH ENDEERMENT; the Biology Teachers Association of the Philippines - Davao Chapter; rrreefs; the Tropical Genomics and Invertebrate Research Laboratory (TRoGenIR); the Faculty of Advanced and International Studies (FAIS); the University Research Ethics Board (UREB); USAID INSPIRE; DENR Region XI; DENR-CENRO Baganga; LGU Cateel; Barangay Aliwagwag; and the Mandaya Indigenous Community.

Immunocastration as Welfare-Friendly Alternative to Castration in Farmed Fallow Deer (*Dama dama*)

Thoniso Chitambala [1]*, Veit Ny [1,2], Francisco Ceacero [1], Luděk Bartoň [2], Tersia Kokošková [1]

[1] Department of Wildlife and Animal Sciences, Faculty of Tropical Agrisciences, Czech University of Life Sciences, Prague, Kamýcka 129, Prague – Suchdol, 165 00, Czech Republic; chitambala@ftz.czu.cz; ceacero@ftz.czu.cz

[2] Department of Cattle Breeding, Institute of Animal Science, Přátelství 815, 104 00 Prague, Czech Republic, barton.ludek@vuzv.cz

* **Correspondence:** kokoskova@ftz.czu.cz

Abstract: Immunocastration is a welfare-friendly alternative to castration for controlling reproductive function in farmed deer. This study evaluated the effects of immunocastration on testicular development, sperm quality, and histological characteristics in yearling fallow deer (*Dama dama*). Forty-four bucks (10 months old) were assigned to treatment groups that either received three doses of the GnRH vaccine Improvac® or remained intact. Animals were managed under a broader experimental design that also included nutritional supplementation. At slaughter (weeks 37–39), testes colour, morphometry, sperm quality, and histological traits were assessed. Immunocastration significantly suppressed reproductive function, resulting in seminiferous tubule atrophy, reduced sperm viability, and a lower proportion of morphologically normal sperm compared with intact animals. Histological examination revealed impaired spermatogenesis and degeneration of testicular tissue, confirming the effectiveness of GnRH vaccination in inhibiting reproductive activity. Despite these marked microscopic changes, differences in testes size were limited, indicating that gross morphometric measurements alone may not accurately reflect immunocastration success. Immunocastrated animals also exhibited reduced testes redness, suggesting decreased vascularisation associated with reproductive suppression. Positive relationships were observed between testes development, body growth, and antler characteristics in intact bucks, highlighting the role of reproductive hormones in overall male development. The findings demonstrate that immunocastration effectively suppresses reproductive function in yearling fallow deer and therefore shows potential as a practical, welfare-oriented reproductive management strategy for farmed venison production systems.

Keywords: animal welfare; venison production; fallow deer, reproduction

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Histological Evaluation of Ex Vivo Intestinal Explant Culture Standardization in Common Carp (*Cyprinus carpio*)

Natália Chomová [1]*, Zuzana Kiššová [2], Marek Ratvaj [1], Dagmar Mudroňová [1], Peter Popelka [3]

[1] Department of Microbiology and Immunology, University of Veterinary Medicine and Pharmacy, Komenského 73, 04181, Košice, Slovakia, natalia.chomova@uvlf.sk; marek.ratvaj@uvlf.sk; dagmar.mudronova@uvlf.sk

[2] Department of Morphological Disciplines, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, 04181, Košice, Slovakia, zuzana.kissova@uvlf.sk

[5] Department of food hygiene, technology and safety, University of Veterinary Medicine and Pharmacy, Komenského 73, 04181, Košice, Slovakia, peter.popelka@uvlf.sk

* **Correspondence:** natalia.chomova@uvlf.sk

Abstract: This study aimed to standardize a protocol for ex vivo intestinal tissue explants from common carp (*Cyprinus carpio*) to reduce the number of experimental animals in accordance with the 3Rs principles, while maintaining the validity of research outcomes. A common carp weighing approximately 3 kilograms underwent an abdominal incision, and the posterior intestine was excised. After cleaning and rinsing in a mixed antibiotic solution, the intestine was opened longitudinally, and explants were obtained using a 4-mm-diameter biopsy punch. The explants were then placed epithelium-side up in a suitable medium in a 96-well plate for incubation. At specified time points, the explants were collected and processed for histological staining with Hematoxylin and Eosin, Periodic acid–Schiff, and Alcian blue. Microscopic examination revealed an intact architecture of the intestinal layers immediately after sampling. In samples taken after 6 hours, partial epithelial damage, tissue swelling, and epithelial exfoliation were observed. After 8 hours, tissue integrity was clearly compromised, and tissue degeneration was evident. These alterations were consistently observed across all staining methods. Other tested parameters also correlated with these histological findings. Histological observations corroborated the results of other assays and demonstrated that this model is suitable for time-limited testing of immunomodulators affecting the fish intestine over a six- to eight-hour period. Furthermore, the study demonstrated that the number of experimental animals required to obtain robust results can be minimized.

Keywords: common carp; immunology; aquaculture; explant tissue culture; histology

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Incidence of Aflatoxins in Horse Feed

Michaela Harčárová [1]*, Lukáš Bujňák [1], Alena Hreško Šamudovská [1], Alica Tvrdá [1]

[1] Department of Animal Nutrition and Husbandry, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, 041 81 Košice, Slovak Republic, michaela.harcarova@uvlf.sk; lukas.bujnak@uvlf.sk; Alena.HreskoSamudovska@uvlf.sk; alica.tvrda@student.uvlf.sk

* **Correspondence:** michaela.harcarova@uvlf.sk

Abstract: The presence of aflatoxins has been reported in a wide range of feedstuffs (cereals, peanuts, soybeans, cottonseed), and various products derived from these commodities. The primary producers of aflatoxins are *Aspergillus flavus* and *Aspergillus parasiticus*. In general, aflatoxins exert hepatotoxic, immunosuppressive, mutagenic, teratogenic, and carcinogenic effects in animals. In horses, aflatoxicosis is characterized by reduced feed intake, weight loss, liver damage, centrilobular hepatic necrosis, and damage to the brain, kidneys, and heart. Regular monitoring of mycotoxin concentrations in feed should constitute an integral part of preventive measures aimed at minimizing the risk of health complications caused by mycotoxicoses. Sample preparation and analysis were performed according to the Veratox® for Aflatoxin protocol (Neogen Corporation, Lansing, MI, USA). Aflatoxin concentrations in 19 horse feed samples were quantified using an enzyme-linked immunosorbent assay (ELISA) at a wavelength of 450 nm using an ELISA reader (Dynex Technologies, Inc., Chantilly, USA). Total aflatoxins were detected in 7 of the 19 examined horse feed samples, representing an incidence rate of 36.84%. The concentrations of aflatoxins in the samples ranged from 0.301 ppb to 6.840 ppb, with a mean concentration of 1.069 ppb. Directive 2002/32/EC of the European Parliament and of the Council of 7 May 2002 on undesirable substances in animal feed, as regards aflatoxins, specifies only the maximum permissible content of aflatoxin B1 (mg/kg of feed) at 12% moisture, i.e. 0.01 ppm (10 ppb). We conclude that the examined horse feed samples do not pose a risk of acute intoxication in horses. In future research, in addition to determining the total aflatoxin content, it would be appropriate to investigate other mycotoxins that are toxic to horses.

Keywords: aflatoxins; horse**;** feed safety; mycotoxins; nutrition

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Chronic Exposure to Wastewater Effluent Reshapes Brain-Gonad-Sperm Neurochemistry

Gayani Rajakaruna Kapukotuwa [1]*, Serhii Boryshpolets [1], Vitaliy Kholodnyy [1], Jan Turek [1], Ganna Fedorova [1]

[1] Faculty of Fisheries and Protection of Water, South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocenoses, University of South Bohemia in České Budějovice, Zátiší 728/II, CZ-389 25 Vodňany, Czech Republic; rajakaruna@frov.jcu.cz; sboryshpolets@frov.jcu.cz; vkholodnyy@frov.jcu.cz; turek@frov.jcu.cz; gfedorova@frov.jcu.cz"

* **Correspondence:** rajakaruna@frov.jcu.cz

Abstract: Treated wastewater effluents release complex mixtures of biologically active pharmaceuticals into surface waters, yet their long-term effects on neurochemistry in wild fish remain poorly understood. Here, we combined targeted Liquid Chromatography–High-Resolution Mass Spectrometry (LC-HRMS) with brain-gonad-sperm neurotransmitter profiling in European perch (Perca fluviatilis) inhabiting an effluent-fed pond (n = 35) and a reference pond (n = 35) over 2 years. Forty-one pharmaceuticals were detected in water, with significantly higher richness and concentrations in the effluent-fed pond (Generalized Linear Model, Gamma; $p < 0.0001$). Fish from this pond exhibited progressive, tissue-specific bioaccumulation, with the highest Bioaccumulation Factors (dry weight) (BAFd.w) in the brain and gonad, and detectable burdens in sperm. Neuroactive, weakly basic drugs (e.g., sertraline, citalopram, trazodone, donepezil) showed increasing brain and gonadal BAFd.w. over time. Thirty neurotransmitters, precursors, and metabolites were measured in the brain, gonad, and sperm. Across the tested tissues, effluent exposure altered key monoamine and amino acid neurotransmitter levels (e.g., serotonin, dopamine, GABA, glutamate), accompanied by accumulation of precursors (tryptophan, phenylalanine, glutamine) and extensive rewiring of intra- and inter-tissue neurotransmitter correlation networks. Cross-tissue analyses revealed persistent disruption of coordinated signaling along the brain-gonad-sperm axis. These findings demonstrate that chronic, environmentally relevant effluent exposure drives pharmaceutical bioaccumulation and neurochemical dysregulation in wild fish, potentially impairing the central nervous system's regulatory control of reproduction and affecting population-level fitness.

Keywords: anthropogenic contaminants; aquatic organisms; LC-HRMS; neurotransmission system; pharmaceutical compounds

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Are Floating Macrophytes Tolerant to Ibuprofen? A Comparative Study

Hanna Kornacka [1]*, Mirela Wolf-Baca [1]

[1] Faculty of Environmental Engineering; Wroclaw University of Science and Technology; Wybrzeże Stanisława Wyspiańskiego 27, 50-370 Wrocław, Poland; hanna.kornacka@pwr.edu.pl; mirela.wolf-baca@pwr.edu.pl

* **Correspondence:** hanna.kornacka@pwr.edu.pl

Abstract: Ibuprofen (IBU) is one of the most frequently detected pharmaceuticals in aquatic environments due to its widespread consumption and incomplete removal during conventional wastewater treatment. However, its effects on aquatic macrophytes remain insufficiently studied. Our previous research demonstrated contrasting responses of floating and submerged macrophytes to IBU, with Lemna minor showing the highest tolerance. Therefore, the present study investigates whether other floating macrophytes exhibit similar tolerance to IBU-induced stress. Three floating macrophytes, *Hydrocharis morsus-ranae*, *Salvinia natans*, and *Spirodela polyrhiza*, were cultivated in a controlled laboratory environment and exposed to increasing concentrations of IBU. Physiological and morphological responses were evaluated throughout the exposure period. Chlorophyll fluorescence was monitored to assess photosynthetic performance and detect early physiological stress. Plant growth, biomass, leaf area, and visible symptoms of phytotoxicity were also assessed. The study provides a comparative assessment of IBU sensitivity among selected floating macrophytes. Physiological and morphological responses revealed differences in plant sensitivity to IBU exposure. Changes in photosynthetic performance and plant development were used to characterize the effects of increasing IBU concentrations on individual species. The findings contribute to a better understanding of the phytotoxic effects of IBU on aquatic macrophytes and provide a basis for identifying species with higher tolerance to pharmaceutical exposure. The selection of tolerant macrophytes may support further studies evaluating their potential for the phytoremediation of IBU-contaminated waters.

Keywords: ibuprofen; aquatic macrophytes; phytotoxicity

Plant Science for Sustainable Agriculture: Advances in Crop Resilience, Biodiversity, and Food Security

Ebrima Kuruma [1*]

[1] Gambia Collage, Brikama, Brikama Area Council, Gambia

* **Correspondence:** saulmendy4@gmail.com

Abstract: Plant science is fundamental to sustainable agriculture and global food security. Climate change, soil degradation, biodiversity loss, and increasing food demand require innovative approaches that improve crop productivity while protecting natural resources. Advances in plant science offer practical solutions for enhancing agricultural resilience and environmental sustainability. This study reviews current scientific evidence on sustainable agricultural practices, focusing on plant genetics and breeding, biodiversity and soil health, plant-based biostimulants, and propagation techniques. A structured literature review was conducted using **Google Scholar** to identify relevant scientific studies published between **2024 and 2026**. Articles were selected based on their relevance to plant science, sustainable agriculture, crop productivity, resilience, biodiversity, soil health, biostimulants, and food security. Titles, abstracts, and full texts were assessed for relevance and eligibility. A total of **85 scientific articles** were included and analyzed thematically to identify major findings and evaluate their contributions to sustainable farming systems. The review found that improved breeding technologies enhance crop tolerance to drought, salinity, pests, and diseases while maintaining high yields. Increased plant biodiversity supports healthier soil microbial communities, improves nutrient cycling, and reduces dependence on synthetic fertilizers. Plant-based biostimulants promote plant growth and provide environmentally friendly alternatives for improving crop performance. Furthermore, effective propagation methods and high-quality seeds strengthen agricultural resilience and contribute to food and nutrition security. Integrating advanced breeding, biodiversity conservation, natural biostimulants, and quality propagation techniques is essential for developing resilient and sustainable agricultural systems. These approaches can increase productivity, conserve natural resources, reduce environmental impacts, and contribute to long-term food security and sustainable farmer livelihoods.

Keywords: plant science; sustainable agriculture; crop resilience

Evaluation of Colostral Nutrition in Calves

Petra Timkovičová Lacková [1]*, Iveta Maskaľová [1], Tomáš Mihok [1], Michaela Harčárová [1]

[1] Department of Animal Nutrition and Husbandry, University of Veterinary Medicine and Pharmacy in Košice, Komenského 78, 041 81 Košice, Slovak Republic; petra.timkovicova@uvlf.sk; iveta.maskalova@uvlf.sk; tomas.mihok@uvlf.sk; michaela.harcarova@uvlf.sk

* **Correspondence:** petra.timkovicova@uvlf.sk

Abstract: Colostrum, the first mammary secretion after parturition, is a key source of passive immunity and essential nutrients for newborn calves. Due to the epitheliochorial placenta, calves are born without maternal antibodies, making colostrum essential for immune protection during early life. Therefore, the experiment was conducted to evaluate changes in total serum protein concentration in calves during the first month of life as an indicator of successful passive immunity transfer from colostrum. We hypothesized that total serum protein concentration would be highest shortly after birth and would decrease with increasing age of the calves. The experiment was conducted in a group of 18 calves. Blood samples were collected from the coccygeal vein on days 2, 14, and 30 of age. After centrifugation, total serum protein concentrations (g/L) were determined using a digital refractometer. Results are presented as the mean ± standard deviation (SD). On the second day after birth, the mean total serum protein concentration in calves was 61.00 ± 16.63 g/L. A significant decrease ($P < 0.05$) in total serum protein concentration was observed with increasing age, reaching 54.07 ± 5.81 g/L on day 14 and 49.33 ± 7.67 g/L on day 30 after birth. According to Šlosárková et al. (2017), the cut-off value for total serum protein concentration in calves is 52.0 g/L. In 18 calves, the highest total serum protein concentration was observed on the second day after birth, and it decreased with increasing age. These results indicate sufficient passive immunity transfer from colostrum, providing protection against pathogens.

Keywords: calves; colostrum; immunity

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Friendly Bonds in Semiferal Exmoor Ponies in Milovice Nature Reserve, Czech Republic

Anežka Malá [1]*, Francisco Ceacero [1], Martina Komárková [1]

[1] Department of Wildlife and Animal Sciences, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Praha-Suchdol, malaanezka@ftz.czu.cz; ceacero@ftz.czu.cz; komarkova@ftz.czu.cz

* **Correspondence:** malaanezka@ftz.czu.cz

Abstract: Social bonds are an important component of equid societies, influencing group cohesion, social stability and individual welfare. However, the structure and persistence of these relationships in semi-feral populations remain insufficiently understood. This study investigated preferred social relationships in a herd of semi-feral Exmoor ponies living in the Milovice Nature Reserve, Czech Republic. Twenty semi-feral Exmoor ponies were observed between April and October 2021. Behavioural data were collected during 99.25 hours of direct observation using ad libitum sampling and 15-minute scan sampling. Nearest-neighbour associations, affiliative interactions, and agonistic interactions were recorded. Social network analyses, association indices, cluster analyses, and dominance hierarchy were used to evaluate social relationships within the herd. A total of 4,282 nearest-neighbour observations and 1,022 social interactions were recorded. Preliminary analyses suggest that social associations were not randomly distributed within the herd. Grooming was the most frequent affiliative behaviour (n = 205), while biting (n = 332) and head threats (n = 168) were the most common agonistic interactions. Initial analyses indicate the presence of preferred partners and stable social clusters. Ongoing analyses will further evaluate the stability of these relationships and their links to age, kinship and social status. Preliminary findings support the existence of stable social relationships in semi-feral Exmoor ponies and highlight the importance of preferred partners in herd social structure. Further analyses will help translate behavioural research into practical conservation actions, contributing to the resilience and long-term sustainability of free-ranging equid populations in a rapidly changing world.

Keywords: equids; friendship; social bonds; preferred companion; positive interactions

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MaxEnt Model-based Prediction of the Collared Mongoose (*Urva semitorquata*) Distribution in Mainland Palawan, Philippines

Adrian Raphael Mallorca [1]*, Desamarie Antonette P. Fernandez [1]

[1] Animal Biology Division, Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los-Banos

* **Correspondence:** aamallorca@up.edu.ph

Abstract: The collared mongooses (*Urva semitorquata*) are one of the most severely understudied carnivores occurring in the Philippines only in Palawan. Information regarding the species' ecology, particularly its local distribution and habitat suitability, is limited. The Maximum Entropy (MaxEnt) Algorithm approach was used to determine the relationship between species presence and various environmental variables in its prediction of the suitable habitats. The best model (AUC=0.881) revealed that the potential distribution of the collared mongooses in Palawan is highly fragmented and restricted to the central mountains of the main island. Habitat suitability was most strongly influenced by Precipitation of the Driest Month and Slope Percentage, suggesting a dependence on stable sources of moisture and water in heterogenous habitat. Response curves demonstrated a strict requirement for proximity to inland waterways, possibly attributed to prey availability. The species is also estimated to be widespread across open forests more than other habitat types. Highly suitable habitats were concentrated within Cleopatra's Needle Critical Habitat (CNCH), with approximately 0.675 km2 of highly suitable habitat across mainland Palawan with highest density in Barangay San Caruray, Taytay. The Victoria-Anepa'an Mountain Range (VAMR) is among the best candidates for future study areas targeting the species. Mainland Palawan exhibited relative unsuitability (74.45%) in terms of land area, suggesting relative specific habitat and microclimatic requirements influencing the detectability in camera trap surveys.

Keywords: collared mongoose; Maximum Entropy (MaxEnt); Species distribution modelling (SDM); Palawan

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Melodious Melancholia: Analysing the Effect of Anthropogenic Noise on the Bird's Social Communication

Swapnanil Mondal [1]*, Chayan Munshi [1]

[1] Ethophilia Research Foundation, Santiniketan, 731235, India, ethophiliaresearchfoundation@gmail.com

* **Correspondence:** chayan.munshi@ethophilia.com

Abstract: Birds rely heavily on their auditory perception for essential behaviours such as communication, foraging, predator avoidance, and social interaction. Vocalisation plays a central role in these functions and is closely linked to their sensory ecology. However, the increasing anthropogenic noise is transforming natural soundscapes, interfering with bird's ability to perceive and produce acoustic signals. This research examines how varying levels of human disturbance affect vocal communication in birds across contrasting ecosystems. Acoustic data were collected using high-sensitivity recording systems from multiple sampling points representing a gradient of urbanisation and were analysed using specific codes in Python Spyder (V6.0). Geographic Information System (GIS) tools were used to integrate landscape features. Preliminary findings substantiate our hypothesis and suggest that bird vocal communication frequencies are significantly affected by human-made artificial sounds. However, it is a fact that collective bird calling can be considered a behavioural marker of migration from extreme to moderate to less urban areas. The results imply a high potential for acoustic masking in urbanised environments, where anthropogenic noise may interfere with bird's ability to perceive and transmit vocal signals effectively. However, to substantiate this kind of hypothesis, it is important to have a long-term study on the collective vocalising intricacies in birds. The frequency- and amplitude-dependent variation in bird calling supports our hypothesis that the urban mechanical soundscape disrupts avian communication, or bird collective calling, in the changing ecosystem.

Keywords: bird vocal communication; anthropogenic noise; collective vocalisation; social behaviour

Behavioural Ecology of the Endangered Wild Camel (*Camelus ferus*): Understanding Behaviour to Support Conservation and Resilience

Martina Sihelská [1]*, Anna Bernátková [2], Adiya Yadamsuren [3], Tamara Fedorova [1], Martina Komárková [1, 2]

[1] Department of Wildlife and Animal Sciences, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 16500 Praha – Suchdol, Czech Republic, martinesihelska@gmail.com; fedorova@ftz.czu.cz

[2] Prague Zoo, U Trojského zámku 120/3, Prague, Czech Republic, anna.bernatkova@zoopraha.cz

[3] Wild Camel Protection Foundation Mongolia, Jukov avenue, Bayanzurkh District, Ulaanbaatar 13343, Mongolia, adiya@wildcamels.mn

* **Correspondence:** martinesihelska@gmail.com

Abstract: The wild camel (*Camelus ferus*) is a critically endangered species and the only extant truly wild representative of Old World camels, surviving in small, fragmented populations in the Mongolian and Chinese Gobi. Despite its conservation significance, its behavioural ecology remains poorly quantified, with no previous structured behavioural description available. This study aimed to provide the first quantitative assessment of activity budgets, vigilance and social behaviour in wild camels under semi-natural conditions. Using systematic scan sampling, we observed a herd of 21 individuals at the Zakhyn Us Wild Camel Breeding Centre over 15 days (88.5 observation hours). Vigilance was modelled against herd size using generalized linear mixed-effects models (GLMMs), and social interactions were analysed by age–sex class. Feeding (29%) and resting (28.7%) dominated the activity budget in a bimodal daily pattern. Vigilance decreased significantly with increasing herd size ($\beta = -0.88 \pm 0.35$ SE, $p = 0.013$), supporting antipredator explanations and representing the first structured description of vigilance behaviour in Old World camelids. Social interactions were strongly male-biased, with agonistic behaviour concentrated among males and affiliative behaviour more frequent in females and mixed-age groups. Play was observed exclusively in subadult males, representing one of the first structured descriptions of play in Old World camelids. A complete parturition event and subsequent early maternal behaviour were also recorded, providing rare first-hand documentation of birth and mother–offspring interactions in this species. These results provide the first behavioural baseline for *C. ferus*, essential for informed conservation management and for supporting the species' long-term resilience. The findings also inform welfare-oriented husbandry of domestic camels (*C. dromedarius*, *C. bactrianus*), supporting evidence-based welfare improvements and bridging wild and domestic camel management.

Keywords: *Camelus ferus*; antipredator behaviour; play behaviour; animal welfare

RNAi Silencing of Isoprenyl Diphosphate Synthase (IDS) for Sustainable Control of Ips typographus

Jaroslav Strádal [1]*, Rajarajan Ramakrishnan [1], Jiří Synek [1], Anna Jirošová [1]

[1] Department of Forest Protection and Entomology, Czech University of Life Sciences Prague, Prague, Czech Republic

* **Correspondence:** stradalj@fld.czu.cz

Abstract: The European spruce bark beetle, *Ips typographus*, is a major forest pest with limited options for sustainable control. RNA interference (RNAi) offers a species-specific alternative to conventional insecticides. We investigated the role of isoprenyl diphosphate synthase (IDS) in aggregation pheromone biosynthesis and evaluated its potential as an RNAi target for environmentally friendly control of *I. typographus*. Male *Ips typographus* beetles were injected with double-stranded RNA (dsRNA) targeting IDS1 and IDS2 genes. Gene silencing efficiency was evaluated by quantitative real-time PCR (qRT-PCR). The effect of IDS silencing on aggregation pheromone biosynthesis was assessed by measuring 2-methyl-3-buten-2-ol (MBO) production using solid-phase microextraction coupled with gas chromatography–mass spectrometry (SPME; GC–MS). Pheromone production was induced by feeding on fresh spruce logs. The RNAi silencing experiment targeting the IDS genes demonstrated that the introduction of specific dsRNA successfully reduced IDS1 and IDS2 gene expressions. RNAi-based gene silencing has been demonstrated as an effective tool for reducing the expression of target genes. In Ips typographus, this approach could potentially be used to target genes involved in pheromone biosynthesis, such as IDS1 and IDS2, which may reduce aggregation behavior and limit population growth without directly killing the insects. This strategy could provide a more specific and environmentally friendly alternative for future bark beetle management. However, further research is needed to evaluate the effectiveness and ecological impacts of RNAi-based control methods under natural conditions.

Keywords: RNAi silencing; *Ips typographus*; pheromone biosynthesis

Environmental Safety of Decentralised Drinking Water Sources and Environmental Risks in Rural Communities during Military Conflict: the Case of the Sumy Territorial Community, Ukraine

Zhanna Sylchenko [1]*, Serhii Lutsenko [1], Anatolii Kornus [1], Olesia Kornus [1], Kostiantyn Lytvyn [1]

[1] Department of General & Regional Geography, Faculty of Natural Sciences & Geography, Sumy State Pedagogical University named after A.S. Makarenko, Ukraine, 40002, Sumy, Romenska St., 87, zhannasilch999@gmail.com; sluccc88@gmail.com; kornus@sspu.edu.ua; zavgeogr@sspu.edu.ua; konstantinlit500@gmail.com

* **Correspondence:** sluccc88@gmail.com

Abstract: The relevance of the study is due to damage to critical infrastructure and prolonged disruptions in the operation of centralized water supply systems, which increases the risks to the water security of the population. The aim is to assess the ecological condition of decentralised water intakes by determining their hydrochemical composition and to evaluate the potential for using decentralised water intakes of the Sumy territorial community as alternative sources of drinking water supply during military actions. Research methods: field investigations (visual inspection of decentralised water supply sources); statistical analysis and the comparative geographical research method; atomic absorption analysis; potentiometric method; photometric analysis; colorimetric method. Analyzed water mine wells, and individual wells, assessing their spatial accessibility to the population and their sanitary and ecological status. In shaft wells exceedances of the regulatory limits established by DSanPiN 2.2.4-171-10 were identified for the following parameters: total hardness (22.1 mmol/dm^3), total iron (0.38 mg/dm^3), and nitrates (54.5 mg/dm^3). Water from the borehole demonstrated better quality indicators, however, it also failed to fully comply with the regulatory requirements due to elevated values of total hardness (18 mmol/dm^3) and total iron (0.35 mg/dm^3). We concluded that drinking water from shaft wells is partially contaminated and unsuitable for long-term consumption. Exceedances of the regulatory limits established by DSanPiN 2.2.4-171-10 were identified for the following parameters: total hardness, total iron, nitrates. Water from the borehole demonstrated better quality indicators, however, it also failed to fully comply with the regulatory requirements due to elevated values of total hardness and total iron.

Keywords: Sumy; drinking water; well; geochemical analysis; risks

Geoecological Assessment of the Quality of Surface Waters of Lake Chekha in the Context of Its Use in Recreational Activities in the City of Sumy

Zhanna Sylchenko [1]*, Kostiantyn Lytvyn [1], Olena Danylchenko [1], Olena Korol [1], Serhii Lutsenko [1]

[1] Department of General & Regional Geography, Faculty of Natural Sciences & Geography, Sumy State Pedagogical University named after A.S. Makarenko, Ukraine, 40002, Sumy, Romenska St., 87, zhannasilch999@gmail.com; konstantinlit500@gmail.com; o.danylchenko@sspu.edu.ua; o.korol@sspu.edu.ua; s.lutsenko@sspu.edu.ua

* **Correspondence:** s.lutsenko@sspu.edu.ua

Abstract: Urban lakes play a crucial role in maintaining ecological balance, supporting biodiversity, and providing recreational opportunities for local communities. However, increasing anthropogenic pressures associated with urbanisation, recreational activities, and environmental pollution often degrade water quality and aquatic ecosystems. Ensuring the ecological and sanitary conditions of Lake Chekha (Sumy, Ukraine) are essential for environmental sustainability and public well-being. Therefore, the aim of this study was to assess the current ecological state of Lake Chekha using rapid field assessment methods. Visual colour assessment; organoleptic assessment; Secchi disk method; colourimetric rapid test; depth sounding; field visual assessment. The study of the ecological condition of the lake was conducted in 3 key areas: 1 - the central beach of the lake, 2 - near the tennis courts, and 3 - near Kharkivska Street. Water temperature in the lake: 7.8 °C. pH: point 1 – 5.5; point 2 – 6.5; point 3 – 7. Colour, odour, and transparency of the water: 1 – light yellow, odourless, transparent; 2 – light yellow, odourless, translucent; 3 – light greenish, slightly marshy-rotten, translucent. Also at point 3, clogging of the coastal protective strip and the water surface of the lake was detected. The ecological state of the lake varies across different control points. At point 3 - the worst indicators, this can be explained by the significant anthropogenic and urban load on the site. This site is not suitable for recreational use. The other two sites are in satisfactory condition and can be used for recreational purposes of the city.

Keywords: lake; recreational activities; ecological condition; point; rapid assessment methods.

A Pleasant Surprise? Conservation Insights on the Re-emergence of an Endangered Species in Social Media Discourse

Jhonnel Villegas [1, 2]*, Diether Montejo [3], Imelda Diaz [4], Francisco Ceacero [1, 2]

[1] Department of Wildlife and Animal Science, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, 16500 Praha-Suchdol, Czech Republic

[2] Faculty of Agriculture and Life Sciences, Davao Oriental State University, City of Mati, Davao Oriental 8200, the Philippines

[3] Center for Research and Development, Holy Cross of Davao College, 8000 Davao City, Davao del Sur, Philippines

[4] Department of Environment and Natural Resources – MIMAROPA Regional Office, 1701 Parañaque City, Philippines

* **Correspondence:** jhonnel.villegas@dorsu.edu.ph

Abstract: Social media are repositories of ecological and conservation-relevant insights into threatened wildlife, particularly the Philippine brown deer (*Rusa marianna* Desmarest, 1822). In Marinduque, Philippines, this animal was previously thought to be locally extinct, but recent sightings received widespread public attention on social media, driven by posts from government agencies and major news outlets. We analysed social media comments to examine public sentiment, emotional responses, and opinions regarding the re-emergence of the brown deer, focusing on how these discourses reflect environmental-psychological processes. Five highly engaged posts were purposively selected, yielding a total of 4,006 comments. After manual screening, 69.52% (N= 2,785) of relevant comments were retained and analysed. Our thematic analysis revealed humans as the primary threat (n = 754), conservation anxiety and protective sentiment (n = 646), calls for action and environmental governance (n = 639), knowledge contestation and species identification (n = 524), and symbolic value and ecotourism (n = 222). Public sentiments framed the brown deer as a threatened mammal and a culturally significant, emotionally charged symbol of environmental recovery, local identity, and governance concerns. Drawing on Connectedness to Nature Theory (CNT), these expressions can be interpreted as reflections of perceived affective and cognitive bonds with the natural world. This connectedness influences how people respond to wildlife conservation issues. Integrating species knowledge, social media sentiment, and environmental governance expectations, we provide evidence that naturally occurring digital discourse can inform conservation planning. We show how managers and policymakers can use social media sentiments to refine communication strategies and design community-based interventions for the brown deer. While social media data are constrained by platform biases and uneven participation, they offer a complementary source of conservation-relevant insight in data-limited settings.

Keywords: cervidae; conservation culturomics; environmental governance; integrative conservation; *Rusa Marianna*; tropical ecology

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Assessing the Knowledge, Attitudes, Practices of Antibiotics Use in Broiler production in Takeo Province, Cambodia

Sona Sareoun [1]*, Raksmey Phoeurk [2], Kimchhin Sok [2], Sophea Nhean [3]

[1] Economic and Development Management, Faculty of Agricultural Economics and Rural Development, Royal University of Agriculture, Sangkat/Khan Dangkor, Phnom Penh, Cambodia, sonasareoun35@gmail.com

[2] Faculty of Agricultural Economics and Rural Development, Royal University of Agriculture, Sangkat/Khan Dangkor, Phnom Penh, Cambodia, praksmey@rua.edu.kh; sokkimchhin@rua.edu.kh

[3] General Directorate of Rubber (GDR), Ministry of Agriculture, Forestry and Fisheries, Phnom Penh, Cambodia, nheansophea@gmail.com

* **Correspondence:** sonasareoun35@gmail.com

Abstract: In Cambodia, broiler farming provides a significant contribution to rural income and food security. Nevertheless, broiler farmers in Takeo Province persist in experiencing issues due to inadequate biosecurity, limited technical knowledge and support, and inappropriate antibiotic use leading to a surge of resistance to antimicrobials (AMR). This exploratory mixed-methods study was conducted in Takeo, Cambodia. Field observation and key informant interviews (KIIs) were conducted with 13 key stakeholders in production (5) and in health inspection (8). Semi-structured questionnaire was used with topics including antibiotic use practices, veterinary services, biosecurity, and production challenges. As a result, the most common poultry diseases are Newcastle (50%), Avian Influenza (25%), Coccidiosis (12.50%), and Fowl Cholera (12.50%). These results indicate that various types of infections occur in Takeo. Oxytetracycline, amoxicillin, enrofloxacin, and doxycycline were the most prescribed antibiotics, mainly for suspected respiratory and gastrointestinal bacterial infections. Farmers' knowledge of antibiotic use is poor, as reported by KIs, based on knowledge score of 48% while they are attitude reported at the moderate level, average score 68.4%. Individual attitude of withdraw period seems to be paid more attention by famers (scores of 82.5%) due to public and individual health concerns. The overall practice reported at the moderate level (score of 65%) among farmers, mainly due to incomplete treatment courses, mixing different antibiotics, and inadequate record-keeping. Overall, the findings highlight the need to strengthen farmer training, improve veterinary advisory services, enhance farm biosecurity, and promote prudent antibiotic use to reduce the risk of antimicrobial resistance in broiler production.

Keywords: broiler production; antibiotic use; antimicrobial resistance (AMR); KAP; Cambodia

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Social Stress and Rumination Disruption: Dairy Cow Responses to Milking Parlour Position and Management Changes

Adéla Višová [1]*

[1] Department of Animal Science, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences, visovaadela@gmail.com

* **Correspondence:** visovaadela@gmail.com

Abstract: Social stress is a major welfare concern in dairy cattle, and the milking parlour is a setting where cows routinely experience such stressors, including group changes, altered milking order, or contact with unfamiliar staff, which activate hormonal stress pathways that suppress rumination and reduce milk production. This study investigated whether dairy cows have preferred positions in a herringbone milking parlour and whether being displaced from that preferred position affects their daily milk yield. Data were collected from a commercial dairy farm using electronic milking sensors and collar-based rumination monitors. Each cow's most frequently visited parlour stall was identified as her preferred position. Milk yield was then compared across five categories of spatial displacement from this preference, using a mixed statistical model that accounted for individual cow differences. Results showed that cows milked in their exact preferred stall produced the highest milk yield (22.15 kg/day). Even small displacements to adjacent stalls reduced yield significantly (−0.09 kg, $p = 0.013$). Larger displacements, particularly to the opposite side of the parlour, caused reductions of up to −0.51 kg per milking ($p < 0.0001$). While these differences appear small, they accumulate to a potential loss of 27 to 156 kg of milk per cow over a full lactation. These findings suggest that respecting individual cow preferences in parlour management, alongside minimising unnecessary group changes, can support both animal welfare and farm productivity.

Keywords: dairy cows; milk yield; social stress; milking parlour; animal welfare

Oregano Essential Oils as an Alternative Approach to the Control of *Salmonella* spp. in Poultry Production

Zuzana Kiššová [1]*, Natália Chomová [2], Ilias Giannenas [3], Viera Karaffová [1]

[1] Department of Morphological Disciplines, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, 041 81 Košice, Slovakia

[2] Department of Microbiology and Immunology, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, 041 81 Košice, Slovakia

[3] Laboratory of Animal Nutrition, Faculty of Veterinary Medicine, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece.

* **Correspondence:** zuzana.kissova@uvlf.sk

Abstract: The increasing prevalence of antimicrobial-resistant *Salmonella* spp. in poultry industry, together with the global efforts to reduce the use of antibiotics in food-producing animals, has accelerated the search for effective natural alternatives. Among these, essential oils (EOs) have attracted considerable interest due to their antimicrobial, antioxidant, anti-inflammatory, and antiparasitic properties. Although their antibacterial activity against *Salmonella* spp. has been demonstrated in previous *in vitro* and *in vivo* studies, their effects on intestinal tissue during infection remain insufficiently understood. The aim of this study was to evaluate the effects of oregano essential oil using an *ex vivo* chicken intestinal model experimentally infected with *Salmonella* Enteritidis. For this *ex vivo* study, ileal explants (overal 60 replicates) were obtained from three broiler chickens (Ross 308) following necropsy. Tissue viability was assessed by metabolic activity assay kit (MTS assay), while the expression of selected genes associated with intestinal barrier integrity was analysed using quantitative real-time PCR (qPCR). In addition, bacterial adhesion to the intestinal tissue was determined. Treatment with 0,5% EOs maintained the intestinal tissue viability and proliferative capacity compared with the control group. Moreover, oregano essential oil upregulated the expression of tight junction-related genes, including VILL, CK18 and CLDN, indicating improved preservation of intestinal barrier function. A significant reduction in *Salmonella* adhesion to the intestinal tissue was also observed following EO treatment. These findings demonstrate the potential of oregano EOs as a natural strategy to reduce intestinal colonisation by *Salmonella* spp. while preserving epithelial integrity, highlighting its promise as an alternative approach for improving gut health and controlling Salmonella infections in poultry production.

Keywords: poultry; explant; Salmonella; MTS; qPCR.

Acknowledgement: This work was funded by the Internal Grant Agency of the University of Veterinary Medicine and Pharmacy in Košice (UVMP Košice), Project No. 06/2026, and by the scientific grant agency of the Ministry of Education, Research, Development, and Youth of the Slovak Republic and the Slovak Academy of Sciences [VEGA 1/0010/26].

The Museum Wildlife Collection of the Natural Science Museum (Mindanao State University - Iligan Institute of Technology): 50 Years of Perseverance of Wildlife Conservation Amidst the Socio-Political Conflict in Mindanao, Philippines

Larkspur Alforque [1]*

[1] Graduate School, University of the Philippines Los Baños, College, Los Baños, Laguna, lcalforque@up.edu.ph

* **Correspondence:** lcalforque@up.edu.ph

Abstract: Natural history museums in socio-politically conflicted areas have always strived to promote the wildlife in their region through conservation, education, and public awareness. The wildlife collections at the Natural Science Museum (NSM) of Mindanao State University - Iligan Institute of Technology's (MSU-IIT) showcase the distribution, diversity, and endemicity for both dry and wet collections of amphibians, reptiles, birds, and mammals. Assessing the intrinsic value of the collection and its representativeness in the country's mammalian fauna, an International and National Criteria will be used. And highlight the linkages between sociopolitical conflicts and the collection and conservation efforts of the museum during those years. The collection has 586 specimens, from 2 orders and 8 families from Class: Amphibia, 2 orders and 13 families from Class: Reptilia, 17 orders and 34 families from Class: Aves, and 10 orders and 19 families from Class: Mammalia, of which 53.58% are endemic to the Philippines. Around 10.22% of the species within these groups are of conservation concern according to both national and international conventions, primarily based on the IUCN and Philippine Red List Criteria, as well as the CITES and CMS appendices. Crisis mapping and selective biodiversity assessment and collection in certain areas to continue wildlife conservation. The collection reflects the influence of cultural, ethical, economic, ecological and legal factors on the species distribution and endemicity, providing insights into the variability observed in museum collections amidst the sociopolitical crisis present.

Keywords: natural history museums; intrinsic value; conservation; socio-political conflict

Acknowledgement: I would like to thank Dr. Anna Pauline de Guia and Dr. Juan Carlos Gonzalez for their teachings and support to this paper used from my WLDL 292 (Curatorship for Wildlife Collections) course. I would also thank my classmates, Cielo and Rain, for their moral support. I would like to thank Mr. Emerito Batara, the Laboratory Technician of the Natural Science Museum of MSU-IIT for his contribute in letting me access their collections.

Feed Intake and *In Vitro* Dry Matter Digestibility in Dairy Cows Fed Different Levels of Dried Moringa oleifera Leaves and Medicago sativa Hay as a Supplement to *Chloris Gayana* Hay

Omolara Alarape [1]*, Perminus Migwi [1], James Ondiek [1]

[1] Department of Animal Sciences, Faculty of Agriculture, Egerton University, P.O. Box 536-20115, Njoro, Kenya

* **Correspondence:** omolaral.alarape@gmail.com

Abstract: Inadequate quality and availability of protein-rich feed resources can limit feed intake and nutrient utilization in dairy cattle, particularly when animals are fed low-quality basal forages. Dried *Moringa oleifera* leaves and Lucerne (*Medicago sativa*) hay are potential protein supplements that may improve the utilization of low-quality diets. Therefore, this study evaluated the effect of supplementing Rhodes grass hay with different levels of dried Moringa leaves and Lucerne hay on feed intake and *in vitro* digestibility in lactating dairy cows. Nine lactating Holstein-Friesian cows with an initial body weight of 444±39.7 kg were randomly assigned to three experimental treatments using a Randomized Complete Block Design (RCBD). Rhodes grass hay was fed ad libitum while Moringa leaves and Lucerne hay were supplemented at ratios of 0:10 in T1, 5:5 in T2 and 10:0 in T3, respectively. Moringa supplementation increased ($p<0.05$) the DM intake of the basal diet (13.7 kg DM/day) and total DM intake (15.3 kg DM/day). The Moringa-supplemented treatment (T3) produced the highest gas production (8.93 ml/200 mg DM) at 24 h, the highest SCFA (0.19 ml/200 mg DM) and ME (6.86 MJ/kg DM), but the lowest organic matter digestibility (20.7%) compared with the control. The results showed that the use of dried Moringa leaves as a protein supplement to low-quality diets improved DM intake and digestibility, which may contribute to increased dairy productivity.

Keywords: fermentation; gas production; lucerne; moringa; short-chain fatty acids

Usutu Virus Detected in Mosquitoes Collected at Numerous Localities in the Czech Republic

Jana Blažková [1]*, Jiří Černý [1]

[1] Department of Animal Science and Food Processing, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, Praha – Suchdol, 165 00, Czechia, janablazkova2@gmail.com; jiricerny@ftz.czu.cz

* **Correspondence:** janablazkova2@gmail.com

Abstract: Usutu virus (USUV) is a mosquito-borne flavivirus that causes mass mortality in blackbirds and occasionally neurological disease in humans. In Czech mosquitoes, USUV had previously been detected only in South Moravia and South Bohemia. We screened *Culex mosquitoes* from six Czech regions for USUV RNA in the 2024 and 2025 seasons. In total 111,151 mosquitoes were collected in reed-bed pond habitats. Female *Culex modestus* and *Culex pipiens* s.l. were tested in pools by reverse transcription quantitative polymerase chain reaction (RT-qPCR). In 2024, 106 of 255 individually tested pools were positive, and USUV RNA was detected in both species. Positive pools came from South Moravia and, for the first time in Czech mosquito surveillance, from North Moravia and North Bohemia. Minimum infection rates in North and South Moravia were 3.7 and 3.6 per 1,000 Culex mosquitoes. North Bohemia had only 0.19 per 1,000. In contrast, none of the 84 superpools tested in 2025 were positive. USUV detection thus varied markedly between the two seasons, from multiple positive pools to no positive samples, coinciding with the warm conditions in 2024 and the cooler 2025. This contrast is in line with the temperature dependence of USUV transmission. Our findings extend the previously documented distribution of USUV in Czech mosquitoes, with the highest detection rates observed in Moravian reed-bed wetlands.

Keywords: usutu virus; culex modestus; culex pipiens s.l.; mosquito surveillance; rt-qpcr

Evolutionary Adaptation of Dengue Virus Serotype 4: Comparative Analysis of Codon Usage Bias in Sylvatic and Urban Genotypes

Panhavoan Ky [1]*

[1] Department of Wildlife and Animal Sciences, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6, Suchdol, Czech Republic.

* **Correspondence:** kypanhavoan@ftz.czu.cz

Abstract: Dengue virus (DENV) is an important arboviral pathogen with expanding geographic distribution and substantial public health impact. Although four serotypes (DENV-1–4) are recognized, DENV-4 remains comparatively understudied. This study investigates the evolutionary adaptation of DENV-4 across urban and sylvatic ecologies using a total of 1050 genomic sequences from the NCBI GenBank database. Codon usage bias and codon adaptation patterns are analyzed to identify signatures of host-associated evolutionary constraints and their potential determinants, providing insights into the molecular evolution and ecological adaptation of DENV-4. No significant differences in nucleotide composition were observed between urban and sylvatic genotypes. However, the highest C+G content was detected at the first codon position, suggesting non-random codon usage potentially associated with host-driven selective pressures, including tRNA availability. Relative synonymous codon usage (RSCU) analysis identified seven highly preferred codons, with AGA (Arg) showing the highest usage, whereas CGU (Arg) was rarely used. Correspondence analysis revealed distinct clustering patterns that were associated with the geographic distribution of the viral sequences, suggesting a potential geographical signature in DENV-4 codon usage. Codon usage analysis of DENV-4 revealed a pronounced compositional bias, with adenine being the most prevalent nucleotide and a higher C+G content at the first codon position (CG1) than at the second (CG2), indicating non-random codon usage potentially shaped by host-associated selective pressures. Both urban and sylvatic strains shared seven preferred codons (RSCU > 1.6), with AGA (Arg) exhibiting the highest usage, suggesting preferential retention of specific synonymous codons. Correspondence analysis revealed distinct clustering according to geographic lineages, indicating a potential geographical signature in codon usage. Although ENC–GC3s analysis suggested that mutational pressure was the predominant determinant of codon bias, the slightly lower ENC value in sylvatic strains (50.91 ± 0.07) than in urban strains (51.05 ± 0.20) indicates marginally stronger codon bias, potentially reflecting differences in ecological or host–vector selective pressures.

Keywords: DENV-4; codon usage bias; urban vs. sylvatic genotypes; evolutionary adaptation; geographic clustering; mutational.

Acknowledgement: This research is conducted as part of the PhD study at the Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague.

Effect of Dietary Humic Substance Preparations on Nutrient Digestibility in Growing Pigs

Stanislav Hreško [1]*, Alena Hreško Šamudovská [2], Michaela Harčárová [3], Tomáš Mihok [4], Lukáš Bujňák [5]

[1] Department of Animal Nutrition and Husbandry, University of Veterinary Medicine and Pharmacy in Košice, Komenského 73, 041 81 Košice, Slovakia, stanislav.hresko@uvlf.sk; alena.hreskosamudovska@uvlf.sk; michaela.harcarova@uvlf.sk; tomas.mihok@uvlf.sk; lukas.bujnak@uvlf.sk

* **Correspondence:** stanislav.hresko@uvlf.sk

Abstract: Humic substances used as feed additives in livestock nutrition can have a supportive effect on the digestive system and thus influence nutrient digestibility, feed conversion and animal production. This study aimed to compare the effect of feeding diets with the addition of two different preparations of humic substances on the digestibility of dry matter and nitrogen substances and on the content of dry matter and nitrogen substances in faeces. A total of 18 crossbred pigs (Slovak White Pig x Landrace) were divided into three groups: control and two experimental. For eight weeks, experimental groups were fed feed mixtures with the addition of two different preparations of humic substances in an amount of 6 g/kg: HUMAC® Natur AFM (group HN) and HUMAC® Natur AFM MycotoxiSorb (group HNM). Faecal samples were collected to determine the content of dry matter and crude protein, and to determine the apparent total tract digestibility of nutrients in the diets. Digestibility was expressed through digestibility coefficients, which were calculated based on diets and faecal analysis. None of the preparations used had a significant effect on the digestibility of dry matter, organic matter and nitrogenous substances. The nitrogenous substance content in the dry matter of the faeces of both experimental groups was not significantly affected. In the HN group, a significantly higher dry matter content in the faeces of pigs was found in comparison to the control ($p < 0.05$). The addition of humic substances led to a reduction in the water content of the droppings, which may contribute to a reduction in the overall humidity in the breeding premises, thereby potentially limiting the risk of spreading infections and improving the hygienic conditions of animal husbandry.

Keywords: additive; humic substances; pig; excretion

Acknowledgement: This study was carried out with the support of the Scientific Grant Agency of the Ministry of Education, Research, Development and Youth of the Slovak Republic and the Slovak Academy of Sciences, project VEGA No. 1/0698/24.

Using Spectral Indices as Early Warning Systems for Forest Fires in Syria: A Case Study from the Cedar and Fir Reserve

Ranim Ahmad [1]*

[1] Department Forestry and Environment, Faculty of Agriculture Engineering, Latakia University, Latakia, Syria

* **Correspondence:** Ranim.d.ahmad@gmail.com

Abstract: This study aims to analyze the spectral response of forest systems in the Cedar and Fir Reserve to forest fires and the severe climate fluctuations over the past decade. Using a time series of Sentinel-2 imagery (10m resolution) via Google Earth Engine, the research extracted indicators for Normalized Difference Vegetation Index (NDVI), Normalized Burn Ratio (NBR), and the Difference Normalized Burn Ratio (dNBR) to understand recovery dynamics across eight forest patterns, including: (pure stands of Lebanese cedar (Cedrus libani), Cilician Fir (Abies cilicica), broadleaf forests (Quercus sp.) and Maquis. The results revealed that the 2020 fire intensity was primarily driven by the fuel load accumulation resulting from peak biomass (NDVI 0.54) followed by drought. While dNBR assessment showed high vulnerability in broadleaf forests and maquis, Cedar forests demonstrated higher resistance despite prior thermal stress. The year 2021 proved critical, as severe drought and declining vitality (NDVI < 0.40) hindered spontaneous regeneration. The study concluded that mixed forests exhibit greater ecological resilience than pure stands. It further recommends implementing Adaptive Fuel Management practices and employing satellite-derived spectral indices as early warning tools to monitor vegetation desiccation in Syria.

Keywords: forest fires; Difference Normalized Burn Ratio; ecological resilience; fuel load; Cedar and Fir reserve

Sustainable Use of Olive Oil Residues in Ruminant Diets for Methane Reduction and Product Quality

Shraddha Dhamore [1]*, Goran Kis [1]

[1] Faculty of Agriculture, University of Zagreb, Croatia; shraddhadhamore16@gmail.com

* **Correspondence:** shraddhadhamore16@gmail.com

Abstract: Methane emissions from enteric fermentation in ruminants are a major contributor to agricultural greenhouse gas emissions. At the same time, the olive oil industry generates large quantities of by-products, including olive pomace, olive cake, pits, and olive mill wastewater, which are often underutilized despite being rich in polyphenols and residual lipids. This study evaluates the potential of these olive oil residues as sustainable feed ingredients to reduce methane emissions while maintaining or improving animal productivity and product quality. A review of published in vitro and in vivo studies was conducted to assess the effects of olive oil industry residues when included in ruminant diets. The studies examined methane emissions, rumen fermentation characteristics, animal performance, and the quality of milk and meat. The reviewed studies indicate that incorporating olive oil residues into ruminant diets can reduce methane emissions without negatively affecting animal performance. Methane reduction is mainly attributed to the antimicrobial activity of polyphenols against methanogenic microorganisms and protozoa, as well as the effects of fatty acids on rumen fermentation pathways. Additionally, improvements in the fatty acid profile of milk and meat have been reported. Olive oil industry residues represent a promising sustainable feed resource that can mitigate enteric methane emissions, enhance the nutritional quality of animal products, and promote the valorization of agro-industrial waste, contributing to more environmentally sustainable livestock production.

Keywords: olive oil residues, methane emissions, ruminant nutrition, sustainable agriculture

SREBP1a Induced PINK1-Parkin Mediated Mitophagy Facilitates Ovarian Cancer Progression

Sk. Eashayan Tanbir[1,2]*, Sib Sankar Roy [2,3]

[1] Centre for Environment, Indian Institute of Technology, Guwahati, India

[2] Cell Biology and Physiology Division, CSIR-Indian Institute of Chemical Biology, 4 Raja S. C. Mullick Road, Kolkata, 700032, India

[3] Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, 201002, India

* **Correspondence:** eashayan.cmb@gmail.com; sibsankar@iicb.ac.in

Abstract: Sterol regulatory element-binding protein 1 (SREBP1) is the master regulator of lipid metabolism. However, the contribution of SREBP1 to mitochondrial regulation and ovarian cancer progression remains incompletely defined. This study investigated whether SREBP1 promotes ovarian cancer progression through altered mitochondrial dynamics and mitophagy. SREBP1a was overexpressed and/or SREBP1 was silenced in ovarian cancer cell lines, followed by assessment of proliferation, migration, invasion, mitochondrial morphology, and bioenergetics using MTT, wound-healing, Matrigel invasion, confocal microscopy, and Seahorse extracellular flux analyses. DRP1 and PINK1 regulation was examined by qRT-PCR, western blotting, flow cytometry, chromatin immunoprecipitation, and promoter luciferase assays. PINK1 silencing and the SREBP1 pathway inhibitor Fatostatin were used for functional validation, including in a SKOV3 xenograft mouse model. SREBP1a expression was elevated in ovarian cancer tissue samples and cell lines and increased proliferation, migration, and invasion were observed. SREBP1a enhanced glycolysis, oxidative phosphorylation, ATP production, and mitochondrial fragmentation, accompanied by increased DRP1 expression, Ser616 phosphorylation, and mitochondrial recruitment. SREBP1 bound the DNM1L promoter and increased its activity. SREBP1 also increased PINK1-Parkin recruitment to mitochondria and mitophagy, while PINK1 silencing reduced mitochondrial remodelling, bioenergetics, proliferation, and invasion. Fatostatin reduced mitochondrial fission, mitophagy, cellular bioenergetics, malignant phenotypes, and xenograft tumor growth. The findings identify SREBP1a as a transcriptional regulator linking DRP1-dependent mitochondrial fission and PINK1-Parkin mitophagy to ovarian cancer progression and provide preclinical evidence supporting SREBP1 pathway inhibition as a potential therapeutic strategy.

Keywords: SREBP1a; Ovarian cancer; Mitochondrial dynamics; PINK1-Parkin mitophagy; DRP1

Sustaining Mutualisms: Evaluating Floral Architecture and Specialised Pollinator Networks of *Leucas nutans* (Lamiaceae)

Satyajit Oraon [1]*, Subrata Mondal [1]

[1] Department of Botany, Visva-Bharati, Santiniketan 731235, West Bengal, India, satyajitoraon2@gmail.com; submondal@rediffmail.com

* **Correspondence:** satyajitoraon2@gmail.com

Abstract: Floral phenotypic specialisation can promote the interactions between plants and pollinators that reflect the selection of pollinator types by plants. Floral traits, including morphology, rewards, and other attractants, can enhance the specialisation of plants towards the utilisation of specific groups of animals as their pollinators. Variations in floral morphology and their correlation to sexual reproductive strategies can determine pollination success and seed production. The present study revealed the floral architecture, phenology, breeding system, and role of bees in the pollination of *Leucas nutans* (Roth) Spreng. belongs to the family Lamiaceae. The relationship between the depth of the floral resources in the corolla tube and the proboscis length of the pollinators can determine the efficiency of a pollinator during pollen transfer. The zygomorphic flowers with bilabiate corolla produced sugar-rich nectar that acted as a classic reward for bee pollination, usually flowering during August to November. The floral architecture and behaviour of bees made them specialised pollinators, with A. dorsata playing a major role in pollination due to consistent visitation patterns. The plant exhibited relatively self-incompatible behaviour, and xenogamous hand pollination resulted in higher fruit set than natural open pollination. Low reproductive success was also observed in autogamy and geitonogamy, suggesting that the species' mixed breeding system may be a potential alternative for ensuring reproductive success and supporting bee-plant interactions in bee management.

Keywords: breeding behaviour; plant-bee interactions; pollination.

The last deer in North Africa: Human dimensions of Barbary stag (*Cervus elaphus barbarus*) conservation in Beni Salah, Algeria

Ayyoub Mouadna [1], Francisco Ceacero Herrador [1, 2]*, Johnnel P Villegas [1, 2], Sadek Atoussi [3], Rabah Zebsa [3]

[1] Department of Wildlife and Animal Science, Faculty of Tropical Agrisciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague, Czech Republic

[2] Faculty of Agriculture and Life Sciences, Davao Oriental State University, 8200 Mati, Davao Oriental, Philippines

[3] Laboratoire de Recherche Biologie, Eau et Environnement, Université 8 Mai 1945, Guelma 24000, Algeria

* **Correspondence:** ceacero@ftz.czu.cz

Abstract: What is the standpoint and knowledge of the local communities and institutions surrounding and responsible for the conservation of the Barbary deer? We conducted a thematic analysis following the six-step framework developed by Braun and Clarke (2006, 2019). Because the original interviews were conducted in Arabic, the transcripts were translated into English before analysis. The English transcripts were then carefully reviewed and analysed through the following stages: familiarisation with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. To enhance the rigour of the analysis and ensure intercoder reliability, JPV and AM independently coded and analysed the data. Any differences in coding or interpretation were then discussed until consensus was reached. Our findings demonstrate that conservation knowledge extends beyond ecological observations to encompass governance, social participation, and institutional challenges. They also highlight the value of integrating practitioner knowledge into evidence-based management, strengthening surveillance and community engagement, and fostering collaboration among researchers, conservation agencies, and neighbouring countries. By documenting the human dimensions of conserving Africa's last native deer, this study provides a foundation for adaptive conservation planning and offers insights applicable to managing other threatened large mammals across North Africa.

Keywords: biodiversity; cervids; conservation; human-wildlife interactions

Hydrogen sulfide and sulfur-containing phytocompounds as potential modulators of *Strongyloides* larval viability

Olexandra Boyko[1*], Victor Brygadyrenko[2], Yelizaveta Chernysh[3,4], Viktoriia Chubur[3], Hynek Roubík[3]

[1] Department of Parasitology, Veterinary and Sanitary Expertise, Faculty of Veterinary Medicine, Dnipro State Agrarian and Economic University, Sergiy Efremov St., 25, Dnipro, 49000, Ukraine, boikoalexandra1982@gmail.com

[2] Department of Zoology and Ecology, Oles Honchar Dnipro National University, Gagarin av., 72, Dnipro, 49010, Ukraine, brigad@ua.fm

[3] Department of Food and BioResource Technology, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, 16500 Prague, Czech Republic, chernysh@ftz.czu.cz, chuburv@ftz.czu.cz; roubik@ftz.czu.cz

[4] Sumy State University, Kharkivska st. 116, Sumy, 40007, Ukraine, y.chernysh@ecolog.sumdu.edu.ua

* **Correspondence:** boiko.o.o@dsau.dp.ua

Abstract: Anaerobic digestion is an effective technology for organic waste treatment, combining renewable energy production with substrate sanitisation. During the process, hydrogen sulfide (H_2S) is generated and has been reported to contribute to the inactivation of parasitic nematodes, including Trichuris suis Schrank, 1788 eggs. At the same time, the effect of H_2S and natural sulfur-containing phytocompounds, particularly compounds of garlic and onion, on the viability of nematode eggs and larvae remains insufficiently studied. Investigating their effect on Strongyloides larvae is relevant for revealing potential mechanisms of parasite inactivation and substantiating new approaches to increasing the efficiency of anaerobic digestion as a technology for producing disinfected organic fertilisers. A review of the biological role of hydrogen sulfide and the antiparasitic activity of sulfur-containing compounds was conducted using data from the Scopus, Web of Science, and Crossref databases. Based on the data synthesis, a hypothesis was formulated regarding the effects of exogenous H_2S and allicin on the viability of parasitic nematode larvae. Based on a review of the scientific literature, a set of mechanisms underlying the effects of sulfur-containing compounds was identified as a theoretical basis for further experimental studies to justify the dose-dependent effects of exogenous H_2S and allicin on nematode larval viability. The potential of hydrogen sulfide and natural sulfur-containing phytocompounds as agents for the biological control of parasitic contamination has been determined. Assessing their effect on nematode larvae may contribute to understanding the role of hydrogen sulfide in parasite inactivation during anaerobic digestion and to optimising technologies for producing safe organic fertilisers.

Keywords: breeding behaviour; plant-bee interactions; pollination.

Society & Culture

Scientific Session



Social Life Cycle Assessment of Commercial Biogas Production in Cambodia

Chhorth Chhiengputheavy [1]*

[1] Department of Food and Biotechnology, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague 6, Suchdol, Czech Republic

* **Correspondence:** chhorth@ftz.czu.cz

Abstract: Commercial biogas production has been promoted in Cambodia to improve renewable energy production and organic waste management. Most previous studies focused on technical performance and environmental benefits, while the social aspects received much less attention. This study aims to apply the Social Life Cycle Assessment (S-LCA) framework to evaluate the social sustainability of commercial biogas production. The study focuses on workers, local communities, value chain actors, and society to better understand the social impacts of this technology. The research will follow the UNEP Guidelines for Social Life Cycle Assessment and ISO 14040 framework. Data will be collected through literature review, questionnaires, interviews, and on-site observations. Commercial pig farms operating biogas systems in Cambodia will be selected as case studies. Stakeholder analysis and GIS-based mapping will also be applied to identify potential social hotspots and their geographical distribution. The study is currently in the research design stage, and data collection has not yet started. The expected outcome is the identification of important social indicators related to employment, working conditions, health and safety, and community well-being. The study is also expected to identify potential social hotspots associated with commercial biogas production in Cambodia. This research is expected to provide useful information on the social sustainability of commercial biogas production in Cambodia. The findings may support future policy development, improve stakeholder well-being, and encourage more socially responsible biogas implementation. The study will also contribute to the application of S-LCA in the renewable energy sector.

Keywords: anaerobic digestion; bioenergy; stakeholder assessment; sustainability; rural development

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Teaching Geography to Learners on the Autism Spectrum in Inclusive Classrooms: Methodological Approaches and Educational Practices

Karyna Deineka [2], Olena Korol [1]*, Olena Danylchenko [1], Olesia Kornus [1], Yurii Kosenko [2]

[1] Department of General and Regional Geography, Faculty of Natural Sciences and Geography, Sumy State Pedagogical University named after A.S. Makarenko, Ukraine, 40002, Sumy, Romenska St., 87, tarasnikolaienko7@gmail.com; 87,korolelena1976@gmail.com; olena_danylchenko@ukr.net

[2] Department of Special and Inclusive Education, Institute of Pedagogy and Psychology, Sumy State Pedagogical University named after A.S. Makarenko, Ukraine, 40002, Sumy, Romenska St., 87, karinadejneka6@gmail.com; kosenko75@gmail.com

* **Correspondence:** korolelena1976@gmail.com

Abstract: Inclusive education has become one of the key priorities of the Ukrainian educational system, requiring teachers to implement effective instructional strategies that address the diverse educational needs of learners on autism spectrum disorder (ASD). Geography, as a subject integrating spatial thinking, visual perception, and analytical reasoning, provides significant opportunities for the cognitive and social development of learners on ASD. At the same time, the abstract nature of many geographical concepts, the necessity to interpret maps and the integration of multiple information sources create considerable learning challenges for these students. The study aims to substantiate methodological approaches to teaching geography to learners on ASD in inclusive classrooms by considering their cognitive, communicative, and sensory characteristics. The research is based on the analysis of contemporary scientific literature, educational legislation, psychological and pedagogical studies, and methodological approaches to inclusive education. The research identifies the most effective instructional approaches for geography education, including visual teaching methods, structured learning, step-by-step task organization, adaptation of educational materials, practical learning activities, and the use of alternative visual communication tools such as ~~PECS~~ ASD cards, simplified maps, infographics, visual schedules, and algorithmic instructions. The proposed methodological framework emphasizes the importance of individualized instruction through Individual Development Programs, interdisciplinary collaboration among teachers, assistants, psychologists, and parents, and the creation of a predictable and supportive educational environment. The findings demonstrate that adapting geography instruction to the specific learning characteristics of learners on ASD enhances educational accessibility, promotes successful social integration, and contributes to the development of key competencies within inclusive education.

Keywords: ASD; inclusive education; geography education; teaching methods; Individual Development Program

Military Tourism in the Sumy Region: Significance, Preservation and Promotion

Olena Korol [1]*, Ihor Sakhnenko [1], Serhii Lutsenko [1], Anatolii Kornus [1], Andrii Pryhodchenko [1]

[1] Department of General and Regional Geography, Faculty of Natural Sciences and Geography, Sumy State Pedagogical University named after A.S. Makarenko, Ukraine, 40002, Sumy, Romenska St., 87, korolelena1976@gmail.com; zsakhneko@gmail.com; sluccc88@gmail.com; a_kornus@ukr.net; 69ca@ukr.net

* **Correspondence:** korolelena1976@gmail.com

Abstract: Military tourism has become one of the new directions of tourism development in Ukraine under the conditions of the Russian-Ukrainian war. The Sumy region, as a border territory with a long military history, possesses considerable potential for the development of military tourism based on Cossack heritage, World War II memorials, Afghan War monuments, and sites related to the current Russian-Ukrainian war. The study aims to analyse military tourism resources in the Sumy region, determine their historical, memorial, educational and tourism significance, and substantiate approaches to their preservation and promotion. The research is based on historical and documentary analysis, field observations, comparative analysis, cartographic methods and modern GIS technologies, including Google My Maps, ArcGIS Online and ArcGIS Field Maps. Military tourism sites were systematised according to historical periods and their functional significance was classified into historical-documentary, memorial-psychological, educational, social-identification, and tourism-economic categories. Particular attention is paid to the emergence of a new type of military heritage represented by destroyed civilian infrastructure, which has become an important documentary source of contemporary history. The study identifies the main challenges related to the preservation of military heritage, including physical destruction, insufficient funding, safety issues and ethical aspects of interpretation. The proposed development strategy includes thematic tourist routes, digital mapping, QR-code information systems, virtual tours and the integration of military tourism into educational programmes. The obtained results demonstrate that military tourism can become an important component of preserving historical memory, strengthening regional identity and supporting the post-war recovery of the Sumy region.

Keywords: war-related heritage; tourism development; Northeastern Ukraine; historical memory; GIS technologies; post-war recovery

Invisible Diaspora Networks: Transnational Ties of Czech Community Leaders in Spain

Alice Navrátilová [1]*

[1] Department of Sociology, Andragogy and Cultural Anthropology, Faculty of Arts, Palacký University in Olomouc, Křižkovského 8 779 00 Olomouc, alice.navratilova@upol.cz

* **Correspondence:** alice.navratilova@upol.cz

Abstract: This abstract examines previously neglected aspects of Czech migration to Spain. Unlike conventional studies focusing on macro-structural integration, this research targets an unexplored micro-dimension: the formation of social networks and transnational ties among diaspora community leaders. The primary objective is to analyze and typologize the structure, intensity, and dynamics of these professional and personal ties, which fundamentally influence the internal organization of the Czech diaspora across Spanish regions and in relation to Czechia. The study combines qualitative and quantitative methods, primarily employing egocentric structural social network analysis (SNA) following Wasserman and Faust (1994), integrated with in-depth interviews with selected diaspora representatives. Additionally, data visualization via advanced network maps and geographical cartograms illustrates the spatial distribution and territorial dispersion of these communities. The main output is an analytical model of the transnational activities and network capital of diaspora leaders. By focusing on the micro-dynamics of key actors, the paper demonstrates how the relational networks of a few individuals shape entire compatriot communities and define their geographic structure, offering a fresh theoretical perspective on transnational ties. This model contributes to migration studies and Czech cultural diplomacy, demonstrating that modern diaspora resilience relies primarily on the social ties maintained by its leaders.

Keywords: migration; mixed-methods research; network maps; cartograms; interpersonal ties

Perceptions of an Ideal Leader in Ukraine's Agricultural Sector

Inna Balahurovska [1]*

[1] Department of Economics, Entrepreneurship, and Business Administration, Sumy State University, 2, Rymskogo-Korsakova St., 40007 Sumy, Ukraine; i.balahurovska@management.sumdu.edu.ua

* **Correspondence:** i.balahurovska@management.sumdu.edu.ua

Abstract: In the context of socio-economic instability and the transformation of management practices, the study of values and behavioral guidelines that determine leadership standards acquires particular importance. The purpose of the study is to determine how ideas about a reference leader influence the formation of leadership style and interaction with followers in Ukrainian organizations of the agrarian sector. The research is pilot and exploratory in nature and employs a qualitative approach based on semi-structured interviews with four representatives of Ukraine's agricultural sector. Given the small sample size, the findings are exploratory and cannot be generalized to the agricultural sector of Ukraine as a whole. Special attention was paid to the question "Who is your ideal leader?" The data were analyzed using qualitative content analysis and the author's classification according to four criteria: purpose, which determines the leader's strategic direction; role, which reflects expected behavioral manifestations associated with an organizational position; type of decision, which identifies managerial choices as strategic, tactical, or operational; and function, which refers to managerial actions aimed at achieving organizational goals. The results showed that respondents associate an ideal leader with humanism, fairness, responsibility, strategic vision, innovativeness, the ability to inspire, and effective communication. Different configurations of these characteristics form distinct patterns of leadership behavior, supporting the hypothesis that individual leadership styles are unique. The findings indicate that value orientations and perceptions of an ideal leader influence leadership style and interactions with employees.

Keywords: leadership; leadership style; agricultural sector; qualitative research

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How Young Consumers Perceive Luxury Fashion Brands and Their Strategies on Social Media

Coen Allan Bensley [1], Alisa Selianskaia [1], Emel Yarimoglu [1]*

[1] School of Business, Anglo-American University, Letenska 5, 118 00, Prague 1, Czech Republic, coen.bensley@aauni.edu, alisa.selianskaia@aauni.edu, emel.yarimoglu@aauni.edu

* **Correspondence:** emel.yarimoglu@aauni.edu

Abstract: Consumers interact with brands on social media, which affects brand attitudes, purchase intention, and future buying behaviors. The aim of the research is to analyze young consumers' perceptions of luxury fashion brands and their social media platforms. A quantitative method was employed, and the questionnaire included one construct with nine items. Survey collected from 51 university students aged 18-22 by convenience sampling between April 24th and May 10th, 2026. Participants included 34 females, 16 males, and 1 non-binary consumer. Most respondents (80.4%) stated they purchase fast fashion products more due to economic conditions. Findings showed 45.1% of respondents respect luxury fashion brands' social media platforms though they are not consumers of these brands. Conversely, 47.1% provided negative insight regarding the honesty of luxury brands' social media content, highlighting respect for luxury brands does not necessarily mean consumers perceive social media communication as honest and genuine. Almost half of the respondents (49.1%) think luxury brands lead fashion trends. Limitations of research include (1) small sample by convenience sampling from a single university, limiting generalizability, and (2) frequency analyses used in data analysis, showing the absence of significance testing. In conclusion, consumers believe luxury brands lead trends first and continue to shape trend direction, which in turn is mass adapted by fast fashion. Luxury brands should prioritize genuine communication to support customer admiration. This increases consumer engagement, turning into long-term brand attachment over time.

Keywords: luxury product; social media marketing; perception; university students

Waste in genes: Sensory Illusions and Latent Consumer Behavior in Institutional Food Services

Balázs Ferenc Boncsarovszki [1]*, Diána Tünde Fejes [1], Lili Jázmin Lénárt [1], Viktória Dóczi [1], Attila Gere [1]

[1] Department of Postharvest, Commerce, Supply Chain and Sensory Science; Institute of Food Science and Technology; Hungarian University of Agriculture and Life Sciences; 1118 Budapest, Villányi Str. 29-43; boncsarovszki.ferenc.balazs@phd.uni-mate.hu; fejes.diana.tunde@stud.uni-mate.hu; lenart.lili.jazmin@stud.uni-mate.hu; doczi.viktoria@stud.uni-mate.hu; gere.attila@uni-mate.hu

* **Correspondence:** boncsarovszki.ferenc.balazs@phd.uni-mate.hu

Abstract: Food waste in public catering is a major sustainability and economic challenge, driven by a dissonance between providers and consumer preferences. This research maps waste habits across demographics—from nursery children to the elderly—especially in Northern Hungary. The objective is to quantify the gap between planned and actual nutrient intake, revealing economic and nutritional losses while exploring how socio-cultural backgrounds influence waste. The study longitudinally tracked 700 to 1,000 daily food portions over a four-month period using data triangulation. The methodology integrated the rigorous analysis of kitchen documentation (menus, ingredient allocations, and temperature logs) with empirical physical waste measurements. To accurately capture consumer behavior, age-specific observational tools were paired with comprehensive household and educator questionnaires. Results highlight the critical role of the home environment, underlining that early exposure to new ingredients and hands-on food-preparation education significantly boost food acceptance. Sensory rejections are prevalent, as consumers frequently reject foods with unfamiliar textures or appearances. Actual consumption is further hindered by these familiarities and strictly limited eating timeframes (approximately 15 minutes). Overall, participants strongly prefer creamier, bite-sized textures and require highly hygienic dining environments. By matching ingredient data with actual consumer behavior, this study accurately calculates financial and nutritional losses. These findings provide catering providers with practical, age-specific recommendations—such as adjusting visual presentation, serving temperatures, and textures—to drastically reduce food and economic waste.

Keywords: food waste; institutional catering; consumer preferences; sensory science; sustainability.

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Cybersecurity and International Security Challenges in Contemporary Global Politics

Khaoula Bouchebka [1*]

[1] International Security Analyst; Policy Fellow (ISEST), International Society of Engineering

* **Correspondence:** khaoulabouchebka@gmail.com

Abstract: International security is undergoing significant transformation due to globalization, technological advancement, and the rise of non-traditional threats such as cyberattacks and hybrid warfare, which increasingly challenge existing security frameworks and international institutions. This study employs a qualitative approach based on a systematic literature review of academic articles, policy papers, and reports from international organizations, combined with a comparative case study method examining recent security incidents and institutional responses. By cross-referencing these cases against existing institutional frameworks, the study builds a comparative matrix of threat types, actor behavior, and institutional adaptation, revealing recurring structural gaps such as attribution delays and fragmented information-sharing. The findings show that cyberattacks and hybrid warfare, combining military, informational, cyber, and economic tools, have become defining features of contemporary security, complicating detection, attribution, and response, while globalization amplifies both interdependence and cross-border vulnerability. Although international cooperation mechanisms exist, they remain fragmented and often lack the speed, coordination, and enforcement capacity needed to address fast-evolving risks. The study concludes that international security requires frameworks that move beyond a state-centric, military lens to incorporate technological, informational, economic, and societal dimensions, and proposes three recommendations: establishing a standardized cross-border attribution protocol for cyber incidents, creating a permanent real-time information-sharing mechanism among security bodies, and integrating hybrid-threat indicators into early-warning and crisis-response systems.

Keywords: international security; cybersecurity; hybrid warfare; geopolitics; global governance

Conservation and Local Realities in Mountain Protected Areas of the Western Balkans

Taulant Doli [1]*

[1] Department of Social Geography and Regional Development, Faculty of Science, Charles University, Albertov 2038/6128 00 Nové Město, taulant.doli@natur.cuni.cz

* **Correspondence:** taulant.doli@natur.cuni.cz

Abstract: Protected mountain areas on the borders of Albania, Kosovo and Montenegro, which together form the southern extension of the Dinaric Alps, contain unique and ecologically valuable landscapes. Historically, these areas have been considered isolated and remote, leaving them outside the priorities of regional development. These areas were considered suitable for designation as national parks (NP) and in recent decades three national parks have been established, namely the Albanian Alps, the Bjeshkët e Nemuna and the Prokletije. The main objective is proclaimed to preserve nature, but also to promote the economic development of the area through sustainable tourism and cross-border cooperation. However, these designations were based primarily on ecological criteria, ignoring local socio-cultural dynamics and the needs of local communities in the area. This study employs a qualitative approach based on preliminary data from 21 semi-structured interviews conducted in the Albanian Alps NP and Bjeshkët e Nemuna NP. The interviews involved local community members, park management staff, and regional authorities, while further interviews are planned as part of ongoing fieldwork. The data are analyzed through the Coupled Human-Environment framework to examine the dynamic interplay between centralized conservation policies, and local human practices. Preliminary findings reveal that rigid top-down governance, lack of funds and staff hinder park management. Concerns about pasture using in Kosovo's NP, where areas traditionally used for grazing are now mostly used for building recreational facilities, as well as ownership issues in Albania's NP, create tensions between local communities and conservation institutions. These issues can reduce trust and legitimacy of the conservation institutions in area. Effective conservation in the Western Balkans requires moving beyond rigid top-down frameworks to recognize mountain parks as landscapes shaped by both natural and human practices. Integrating bottom-up, community-based approaches with institutional management is essential to align conservation goals with local realities and ensure long-term regional sustainability.

Keywords: dinaric mountains; mountain protected areas; landscape governance; community participation

International Project Partnerships as a Factor in the Sustainability of Modern Education: A Case Study of a School Participating in the MURP Program

Yaryna Kravchylo [1]*, Svitlana Lutsenko [2], Galina Efremova [2]

[1] Management and Administration of Department of Pedagogy, Special Education, and Management Municipal institution Sumy Regional Institute of Postgraduate Pedagogical Education, Ukraine, 40007, 5 Mykola Sumtsov St., arinakravcilo@gmail.com

[2] Department of Pedagogy, Special Education, and Management Municipal institution Sumy Regional Institute of Postgraduate Pedagogical Education, Ukraine, 40007, 5 Mykola Sumtsov St., svitlana.lutsenko@soippo.edu.ua; angelgala@ukr.net

* **Correspondence:** svitlana.lutsenko@soippo.edu.ua

Abstract. This study examines the experience of Trostyanets Lyceum No. 1 in the Sumy region, which participated in the "Multi-Year Sustainability Program" (MURP) implemented by the NGO "DOCCU." The aim is to determine how social innovations, professional support, psychosocial practices, and inclusive management contribute to educational sustainability and cooperation with the local community. The study uses comparative analysis and a case study of management practices implemented during the project from October 2024 to March 2026, involving 700 students, teachers, and parents. Data were collected through interviews, questionnaires, document analysis, and observations and analyzed using qualitative content analysis and comparison of indicators before and after the interventions. Educational resilience was defined as the ability to maintain the continuity and quality of learning, ensure psychosocial well-being, and adapt educational and management practices to crisis conditions. The findings indicate that the program contributed to modernization of the educational process, teacher professional development, psychosocial support, and the creation of a new learning environment. Flexible learning models, social-emotional learning, coaching, and digital technologies supported educational continuity, teacher development, participant well-being, and community collaboration. These practices demonstrate potential for strengthening educational resilience and creating conditions for further development. However, the study does not allow conclusions about the long-term impact on community resilience because it focuses on a single institution and a limited observation period. Overall, the findings suggest that internationally supported educational initiatives can transform lyceums into resilient community hubs that promote educational continuity and sustainable development.

Keywords: social innovations; project-based education management; international educational projects; educational sustainability.

Assessing the Impacts of Tourism Growth on Sustainable Development in Cox's Bazar, Bangladesh

Jannatul Ferdous Samira [1], Md. Hasan [2*]

[1] Bachelor of Business Administration (BBA), Business Administration, IUBAT— International University of Business Agriculture and Technology Dhaka, Bangladesh, 22302055@iubat.edu

[2] Department of Civil Engineering, IUBAT— International University of Business Agriculture and Technology Dhaka, Bangladesh, 21306026@iubat.edu

* **Correspondence:** 21306026@iubat.edu

Abstract: Tourism is an important contributor to the economies of many countries, including Bangladesh, where it generates income, employment, and investment opportunities. Cox's Bazar, home to the world's longest unbroken natural sea beach, is one of the most significant tourist destinations in Bangladesh, attracting large numbers of domestic and international tourists, particularly during the peak season from November to March. While tourism expansion brings substantial economic benefits, it also creates significant socio-cultural and environmental challenges for the local community and ecosystem. This study examines the impacts of tourism development on the sustainable development of Cox's Bazar, focusing on socio-economic and environmental dimensions. Both positive and negative effects are analyzed, including employment generation, income opportunities, inflation, social inequality, cultural changes, and environmental degradation. Primary data were collected through a structured survey of local residents and key stakeholders using questionnaires and open-ended questions to capture perceptions of tourism impacts. One-way ANOVA and independent samples t-tests were used to examine statistically significant differences in the dependent variables across five independent variables. The findings indicate that while residents strongly recognize the economic benefits of tourism, they have mixed perceptions regarding its social and environmental consequences. Major negative impacts identified include increased crime, social division, moral concerns, deforestation, and unplanned coastal development. The study concludes that sustainable tourism practices are essential to balance economic growth with environmental protection and social well-being. It recommends stronger policy enforcement, promotion of ecotourism, and increased community participation in tourism planning to ensure long-term sustainable development in Cox's Bazar.

Keywords: sustainable tourism; Cox's Bazar; socio-economic impact; environmental degradation; community participation

Determinants of Cultural Spending by Rural Municipalities: Evidence from the Czech Republic, 2014–2024

Petr Jenik [1]*, Alexander Shemetev [2], Martin Pělucha [3]

[1] Department of Finances and Accounting, Faculty of Social and Economic Studies, Jan Evangelista Purkyně University, Ústí nad Labem, Czech Republic, posta@petrjenik.cz

[2] Department of Economics and Management, Faculty of Social and Economic Studies, Jan Evangelista Purkyně University, Ústí nad Labem, Czech Republic, alexandershemetev@gmail.com

[3] Department of Regional Studies, Faculty of Economics, Prague University of Economics and Business, Prague, Czech Republic, pelucha@ireas.cz

* **Correspondence:** posta@petrjenik.cz

Abstract: Cultural activities are widely regarded as important for the vitality of communities, social cohesion and the attractiveness of local areas, particularly in rural areas that are facing demographic and economic challenges. Despite the growing interest in the role of culture in local development, there is still limited empirical evidence on the factors that influence municipal cultural spending. This study examines cultural expenditure patterns in rural municipalities in the Czech Republic (2014-2024). The analysis combines detailed municipal financial records with demographic and socio-economic indicators for municipalities with fewer than 2,000 inhabitants (median:378; mean:520). The balanced panel comprises 60,951 municipality-year observations. The study focuses on actual current cultural expenditure and its relationship with migration dynamics, personnel expenditure, unemployment, municipal indebtedness, population size and regional characteristics. Fixed-effects panel regressions employed to account for unobserved municipal heterogeneity and common time shocks. The results reveal a statistically significant decline in the proportion of municipal expenditure allocated to culture over time. Municipal indebtedness is consistently associated with lower cultural spending, indicating fiscal constraints on discretionary budgets. Conversely, higher personnel expenditure is associated with a larger cultural expenditure share. Unemployment shows weak and inconsistent effects. There is no evidence that cultural spending affects migration or that structurally affected regions allocate lower shares once fiscal conditions are considered. Larger municipalities devote a higher proportion of their budget to culture. Overall, fiscal capacity and administrative scale are stronger determinants of cultural expenditure than demographic pressure or regional disadvantage. The study provides novel evidence from a post-socialist context.

Keywords: municipal finance; cultural expenditure; local government; rural municipalities; fiscal policy

Development of Social Infrastructure in Territorial Communities of Sumy Region, Ukraine

Olesia Kornus [1]*, Vitaliy Omelyanenko [1], Anatolii Kornus [1], Olena Omelyanenko [1]

[1] Department of General and Regional Geography, Faculty of Natural Sciences and Geography, Sumy State Pedagogical University named after A.S. Makarenko, Ukraine, 40002, Sumy, Romenska St., 87, zavgeogr@sspu.edu.ua; omvitaliy@gmail.com; a_kornus@ukr.net; omvitaliy@gmail.com

* **Correspondence:** zavgeogr@sspu.edu.ua

Abstract: The war has affected the functioning of territorial communities in Ukraine, particularly in border regions. Sumy region, located in northeastern Ukraine along the border with Russia, has experienced infrastructural damage, population displacement, and increasing pressure on public services. This study examines the current state of social infrastructure in the communities of Sumy region and identifies the key issues influencing its development. The analysis draws on a sociological survey conducted among 259 residents from 22 communities between July and August 2024. Data were collected via an online questionnaire and analysed using both quantitative and qualitative methods. Particular attention was paid to healthcare, education, housing and communal services, cultural services, tourism and the effects of wartime conditions on their operation. Survey results revealed that 67% of respondents consider the existing level of social infrastructure inadequate for meeting local needs. The most negative assessments were of housing and communal services, with more than 60% of respondents expressing dissatisfaction with the quality and reliability of these services. In healthcare, respondents most frequently cited shortages of qualified personnel, outdated equipment and limited access to specialised medical services. Nearly half of the participants reported damage to social infrastructure facilities resulting from military actions. The obtained results highlight the importance of improving access to essential services and strengthening the role of local stakeholders in planning recovery measures. These steps are crucial for enhancing community resilience and supporting balanced local development in wartime and post-war conditions.

Keywords: social infrastructure; regional development; resilience; Ukraine

A Quantitative Cross-Sectional Study on Religious Coping and Post-Traumatic Stress Disorder Among Syrian Immigrants in Hungary

Mania Mekhel [1]*, Katalin Csigó [2]

[1] 1Department of Public Health and Epidemiology, Doctoral school of Medicine and Health Sciences, University of Debrecen, mekhailmania@gmail.com

[2] Institute of Psychology, Pázmány Péter Catholic University, csigo.katalin@btk.ppke.hu

* **Correspondence:** mekhailmania@gmail.com

Abstract: Syrian immigrants in Hungary constitute a distinctive population characterized by educational mobility within a restrictive migration policy context, yet no empirical research has examined post-traumatic stress disorder (PTSD) and religious coping in this group. This cross-sectional study surveyed 226 Syrian adults residing in Hungary between March and November 2025. PTSD symptoms were assessed using the PTSD Symptom Scale (PSS) and religious coping was measured with the Brief Arab Religious Coping Scale (BARCS). Analyses included Spearman's rank correlations, multiple regression, and moderated serial mediation using Hayes' PROCESS macro. The mean PSS score was 12.24 (SD = 9.73), with 8.85% of participants reporting severe PTSD symptoms, while the mean BARCS score was 19.11 (SD = 11.04). Bivariate analyses revealed significant associations between PTSD symptoms and female gender, younger current age, lower Hungarian language proficiency, and poorer psychological health. Multivariate analyses indicated that older age at immigration predicted greater religious coping utilization, whereas higher education predicted lower religious coping. No demographic variables significantly predicted PTSD symptoms, and mediation analyses revealed no significant indirect effects of immigration characteristics on PTSD or of psychological health on religious coping through demographic mediators. These findings challenge acculturative timeline assumptions, suggesting that PTSD symptoms are not mediated by temporal or demographic variables and that religious coping functions as a direct, gender-sensitive resource rather than a psychological mediator. Clinical interventions should prioritize immediate, duration-independent mental health screening and gender-sensitive religious coping support.

Keywords: Syrian immigrants; PTSD; religious coping; Hungary; mental health

From Peatland Concern to Civic Resilience: A Case of Non-Government-Led Digital Democratic Innovation in Indonesia

Nurul Dwi Purwanti [1*]

[1] Governance & Technology, Campus Fryslân, University of Groningen, Wirdumerdijk 34 8911 CE Leeuwarden - The Netherlands, n.d.purwanti@rug.nl

* **Correspondence:** n.d.purwanti@rug.nl

Abstract: Everyday environmental concerns shape how citizens engage with democratic accountability beyond government-led participation platforms. This study examines Pantau Gambut Indonesia as a non-government-led digital democratic innovation (NGL-DDI), focusing on how peatland-related concerns may contribute to civic resilience through democratic knowledge and public accountability. This study combines a purposive literature review with qualitative content analysis of publicly available materials. The review establishes the conceptual framework for discussing NGL DDI, civil society, everyday democracy, environmental concern, and knowledge circulation. The content analysis examines selected website materials content from Pantau Gambut Indonesia. Reliance on these organisational materials limits conclusions about participants' experiences and direct initiative's effects on civic resilience. The analysis is grounded in constructive skepticism as a democratic role, showing how NGL-DDI can support public questioning, evidence-based accountability, and critical engagement with environmental governance. In the case of Pantau Gambut, these roles are reflected through peatland monitoring, restoration pledge tracking, access of information, digital environmental literacy, and community-based environmental advocacy. The Pantau Gambut case in Indonesia demonstrates how bottom-up digital initiatives can contribute to environmental governance beyond formal participation channels. The study argues that NGL-DDI should be understood not only as technological participation, but also as civic resilience-building that sustains democratic knowledge, public accountability, and everyday democracy advocacy within environmental concern. Future research could triangulate these findings with interviews and participant observation to examine how documented practices are enacted and experienced, and whether they contribute to civic resilience.

Keywords: non-government-led digital democratic innovation; everyday democracy; environmental governance; civic resilience; peatland governance

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Development of the Social Welfare System in Sumy Region in the Twentieth Century

Mariana Sholudko [1]*, Alla Ryzhanova [1]

[1] Department of Social Work and Management of Socio-Cultural Activities, Educational and Scientific Institute of Pedagogy and Psychology, Sumy State Pedagogical University named after A.S. Makarenko, Romenska st., 87, Sumy, 40002, Ukraine, author: h_maryanka@ukr.net; a.ryzhanova@sspu.edu.ua

* **Correspondence:** h_maryanka@ukr.net

Abstract: The study aims to identify development trends in social welfare within the Sumy Region in the 20th century to outline prospects for its enhancement. The study utilizes historical-legal analysis, source criticism, and the generalization of the experience of the Sumy region patrons' charity work. Historically, during the pre-revolutionary era, social welfare in the Sumy region remained localized and selective as the state did not provide a full-fledged system of universal social guarantees. Under the Soviet regime, social welfare was a monopoly function of the state and depended on its attitude toward certain categories of the population. Following the 1990s, a transition began toward the legal model of social protection in independent Ukraine, within which state guarantees were gradually combined with municipal institutions, local programs, and public initiative. The historical experience of the Kharytonenko and Tereshchenko entrepreneurial families demonstrated that private capital could be directed toward establishing hospitals, educational institutions, shelters, cultural and educational facilities, and medico-social infrastructure. This ensured support for children, people with illnesses, people living in poverty, workers, urban populations, and local communities. The prospect for improving contemporary social welfare in the Sumy region lies in local communities stimulating the charitable initiatives of wealthy citizens within a social partnership involving the state and public organizations, drawing on the example of the Kharytonenkos' St. Zinaida Hospital.

Keywords: social welfare; Sumy Region; 20th century

Non-Govermental Organisations and Their Contribution to the Development of Gender-Sensitive Social Work in the Context of War in Ukraine

Daryna Usyk [1]*, Olena Honcharenko [1]

[1] Department of Social Work and Management of Socio-Cultural Activities, Educational and Scientific Institute of Pedagogy and Psychology, Sumy State Pedagogical University named after A.S. Makarenko, Romenska st., 87, Sumy, 40002, Ukraine daryna.usyk22@gmail.com

* **Correspondence:** daryna.usyk22@gmail.com

Abstract: Women's non-governmental organizations (NGOs) are a driving force in achieving gender equality, working to ensure equal opportunities, overcome discrimination, and protect vulnerable women. This study employs systemic, comparative, and descriptive research methods, alongside the analysis of academic literature, legal frameworks, and NGO analytical reports. The research highlights the core activities of women's public organizations and analyzes their contribution to developing gender-sensitive social work aimed at establishing gender equality. This review focuses on the activities of such NGOs as "La Strada-Ukraine", "Women's Consortium of Ukraine", "Girls", "League of Modern Women", and others. Operating at both national and regional levels, these organizations implement social, human rights, psychological, and educational initiatives for Ukrainian women. Specifically, they accept women's requests for assistance, provide initial counseling, and, when necessary, refer them to social service centers, healthcare institutions, law enforcement agencies, and other state authorities. In cases of domestic and gender-based violence, these NGOs offer psychological counseling, legal assistance, information on available public services, and support for survivors when contacting the relevant authorities. They also deploy mobile teams to crisis-affected areas and operate psychological support hotlines for vulnerable populations. In crisis situations—where state institutions lack sufficient resources or necessary services are unavailable locally—women's NGOs provide them independently, funded by attracted donor resources. It is concluded that the contribution of women's NGOs to the overall system of social work is strategically important for overcoming the consequences of humanitarian crises and systematically embedding the principles of gender equality in Ukrainian society.

Keywords: NGOs; gender equality; gender-sensitive social work

Battling Online Misinformation: The Effectiveness and Limitations of Accuracy Prompts

Vojtěch Vaněček [1]*

[1] Fakulta Sociálně Ekonomická, Univerzita Jana Evangelisty Purkyně, Czech Republic

* **Correspondence:** vvojtch@gmail.com

Abstract: Information is frequently shared online without sufficient consideration of its accuracy, which may contribute to the spread of misinformation and disinformation. Accuracy prompts have therefore been proposed as a simple behavioural intervention that encourages users to consider whether information is true before deciding to share it. This paper synthesizes findings from peer-reviewed experimental and meta-analytic studies on the effects of accuracy prompts on online information sharing, with particular attention to intervention design, outcome measurement, and research context. It also considers the implications of the available evidence for the design of future experimental research. The available evidence suggests that accuracy prompts can make users more selective when deciding what to share, primarily by reducing their willingness to share inaccurate content.The strength and consistency of this effect nevertheless vary across prompt formats and experimental designs, which limits straightforward comparison between studies. The literature also indicates that conclusions are often based on short-term online experiments and self-reported intentions rather than observed behaviour. These limitations suggest a need for more controlled and methodologically integrated research. Accuracy prompts can therefore be regarded as a promising but context-dependent approach to reducing the circulation of misleading content. Future research should compare alternative prompt formats more systematically, distinguish stated sharing intentions from observed behaviour, and examine their effects in more realistic online information environments.

Keywords: misinformation; accuracy prompts; online information sharing; behavioural interventions; sharing intentions

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Rehabilitation Potential of Tourism for Internally Displaced Persons and War Veterans in the Lebedyn Territorial Community, Ukraine

Anastasiia Volynska [1]*, Olesia Kornus [1], Olena Korol [1], Anatolii Kornus [1,2], Valentyna Kholodok [3]

[1] Department of General and Regional Geography, Faculty of Natural Sciences and Geography, Sumy State Pedagogical University named after A.S. Makarenko, Ukraine, 40002, Sumy, Romenska St., 87, volynska.anastasia7@gmail.com; olesyakornus@gmail.com; korolelena1976@gmail.com; a_kornus@ukr.net

[2] Department of Ecology and Environmental Protection Technologies,. Sumy State University,. Ukraine, 40007, 116, Kharkivska st.,. a_kornus@ukr.net

[3] Regional Communal Institution «Kharkiv Organizational and Methodological Center of Tourism», Ukraine, 61022, 5 Svobody Square, Derzhprom, 9th entrance, 1st floor, Kharkiv, Hvd_kult@ukr.net

* **Correspondence:** olesyakornus@gmail.com

Abstract: The full-scale war in Ukraine has increased the need for effective approaches to the rehabilitation and social integration of internally displaced persons (IDPs) and war veterans. Tourism and recreation are increasingly recognised as complementary elements of rehabilitation and social integration programmes. This research examines the rehabilitation potential of tourism resources in the Lebedyn territorial community of Sumy region, a near-frontline area that has retained significant natural and cultural assets. The study is based on a combination of quantitative and qualitative methods. Empirical data were collected through a survey of 150 respondents, including 85 IDPs and 65 veterans. The analysis was supplemented by expert interviews with representatives of local authorities, social services, and tourism businesses, as well as an assessment of local tourism and recreational resources. Survey responses revealed strong interest among both groups in tourism and recreational activities that support psychological recovery and social interaction. Most respondents reported a need for opportunities conducive to psychological recovery, communication, and recreation in natural settings. Financial limitations, accessibility issues and security concerns remain the main barriers to participation. At the same time, the Lebedyn community possesses diverse natural and cultural resources and demonstrates institutional readiness to support rehabilitation initiatives. The findings highlight the potential of tourism to contribute to psychosocial rehabilitation in war-affected regions when linked to local development policies and social support programmes. Community-based tourism initiatives may strengthen social cohesion, improve well-being and support the recovery of vulnerable population groups.

Keywords: rehabilitation tourism; internally displaced persons; war veterans; social integration; community resilience.

Socio-Pedagogical Conditions of Adolescents' Creative Development by Means of Sociocultural Activity Under the Challenges of Martial Law

Valeriia Smirnova [1*]

[1] Management of Sociocultural Activity, Department of Social Work and Management of Sociocultural Activity, Sumy State Pedagogical University named after A.S. Makarenko

* **Correspondence:** s.v.d.050605@gmail.com

Abstract: Abstract: Profound transformations caused by the full-scale war have rendered adolescents a vulnerable group. This study analyzes the creative development of adolescents under martial law conditions with the aim of developing a sociocultural program to foster social resilience. The approach employed combines a theoretical analysis of pedagogical and sociocultural literature, modeling and design methods, and empirical online assessment of the adolescents' psycho-emotional state and creative needs. It is argued that sociocultural activity serves as an effective open system for overcoming crisis states. The socio-pedagogical conditions for creative development were identified as follows: a safe space, subject-to-subject interaction, diversity of content, and the integration of outcomes into community life. A proprietary program titled "Art-Resilience" was developed for public libraries, aiming to transform adolescents into active agents of creativity through art therapy methods. A system of quantitative and qualitative criteria for evaluating results was established. The target group consisted of 138 individuals. The program spanned three months. Event formats included art picnics, interactive art exhibitions, art therapy workshops, an online quiz, and a "Art as a Way of Life" quiz. Implementation of the program resulted in increased adolescent engagement in creative interaction with peers. Thus, fostering the creative development of adolescents through sociocultural activities is a crucial factor in building social resilience in the face of external challenges.

Keywords: adolescents; sociocultural activity; creative development; resilience.

Digital Biocultural Heritage as a Tool for Socio-Environmental Communication and Community Resilience

Oksana Shcherbak [1]*, Olha Kruhliak [2], Svitlana Kovtun [1]

[1] Laboratory of Animal Reproductive Biotechnology, Institute of Animal Breeding and Genetics nd. a. M.V.Zubets, National Academy of Agrarian Sciences of Ukraine, Chubynske village, Boryspil district, Kyiv region, 08321, Ukraine, ov19792006@gmail.com; kovtun_si@i.ua

[2] Laboratory of Scientific Information Support, Economics and Innovation Marketing, Institute of Animal Breeding and Genetics nd. a. M.V.Zubets, National Academy of Agrarian Sciences of Ukraine, Chubynske village, Boryspil district, Kyiv region, 08321, Ukraine, ovokrug@gmail.com

* **Correspondence:** ov19792006@gmail.com

Abstract: In the context of the European Green Deal and the EU Biodiversity Strategy to 2030, scientific institutions contribute to environmental awareness and inclusive models of environmental education. A key direction is the integration of biocultural heritage into socio-environmental communication linking conservation, cultural identity, and education. The study employs an interdisciplinary framework integrating place-based learning, citizen science, and digital science communication to transform local biocultural heritage into an accessible educational and communicative resource. Within this framework, place-based learning grounds ecological knowledge in local heritage, citizen science supports community participation in documenting and interpreting the site, and digital science communication scales these insights into accessible educational outcomes. The empirical basis is the "Chubynsky Farmstead" landscape reserve (Ukraine) as local biocultural heritage. A digital nature conservation exhibition – "Ancient Oaks of Chubynske: Living Biocultural Heritage of the Middle Dnipro Forest-Steppe" – was developed, integrating visual landscape documentation with scientific interpretation of ecological and historical-cultural dimensions. The findings demonstrate that digital representation of biocultural landscapes expands the spatial and social reach of environmental knowledge, transforming a locally embedded heritage site into an accessible educational and communicative resource. This shift supports the reinterpretation of veteran oak ecosystems as both ecological structures and carriers of collective memory, fostering place-based environmental awareness beyond the local scale. The model illustrates how research institutions can act as mediators of socio-environmental knowledge through digital platforms, enabling scalable forms of environmental communication. This approach aligns with European open science and sustainability frameworks and supports new forms of community-oriented environmental engagement.

Keywords: biocultural heritage; environmental education; science communication; digital platforms; sustainable development

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Preparing Future Educators to Deliver Quality Education: Experiences from Teaching Practice Amid Wartime Risks

Nataliia Osmuk [1*]

[1] Department of Pedagogy, Scientific and Educational Institute of Pedagogy and Psychology, Sumy State Pedagogical University named after A.S. Makarenko, 87 Romenska Street, Sumy, Sumy Region, 40000, Ukraine; vlasnata17@gmail.com

* **Correspondence:** vlasnata17@gmail.com

Abstract: The preparation of future teachers in Ukraine takes place amid war-related challenges and educational changes. Teaching practice provides opportunities to develop skills, resilience, and readiness for challenging conditions. The aim was to examine the role of teaching practice in developing professional competencies and readiness for quality education in crisis conditions. The study was conducted during a two-week extracurricular education teaching practice (60 hours) involving 19 bachelor's students majoring in English and another foreign language. Students worked with secondary school pupils in a mixed educational format. Each student observed and analysed four lessons conducted by teachers and independently conducted two lessons of their own, followed by self-reflection. The study used pedagogical observation, analysis of teaching activities, student self-reflection, and a final group discussion. The findings showed that teaching practice provided experience in lesson planning, teaching, communication, and adaptation to educational conditions. At the final conference, at least 10 students positively assessed their experience. They reported overcoming the fear of public teaching, discovering communication models, and gaining satisfaction from teaching and from interacting with pupils and teachers. Five students reported uncertainty and fear of making mistakes when presenting educational material, as well as considerable anxiety related to war-related risks. Four students experienced significant difficulties because their lessons could only be conducted online. Teaching practice creates opportunities to develop pedagogical communication, professional self-confidence, flexibility, and reflective awareness. The findings also indicate the need for further support in crisis-response skills, emotional resilience, and online teaching competence.

Keywords: future teachers; teaching practice; self-reflection

Program for Social-Pedagogical Prophylaxis of Cruel Treatment of Women under Wartime Conditions by Civic Organization

Diana Viunnyk [1]*, Alla Ryzhanova [1]

[1] Department of Social Work and Management of Socio-Cultural Activities, Educational and Scientific Institute of Pedagogy and Psychology, Sumy State Pedagogical University named after A.S. Makarenko, Romenska st., 87, Sumy, 40002, Ukraine, authors: dianavyunnik24@gmail.com; allaar@ukr.net, a.ryzhanova@sspu.edu.ua

* **Correspondence:** dianavyunnik24@gmail.com

Abstract: Under wartime conditions of violence normalisation, the level of violent treatment of women increases, which shakes society's social strength from within. The study aims to substantiate the program to improve the pedagogical prevention of this issue in a civic organisation. Analysis, generalising foreign and domestic experience, systemising the experience of the "Women's perspective" Centre over a year, and diagnostics of the actual level of women's social protection. Contemporary social-pedagogical prophylaxis is organised on the basis of a social partnership between civic organisations (domestic and international) and local self-governance institutions; however, it primarily serves adult women, who are more likely to request assistance. A high level of social protection was observed: women aged 56 and older – 100%; 46-56 – 87%; a low protection level among women aged 16-25 – 66,7%. A program aimed at girls aged 18-25, students, workers or child caretakers was substantiated, as they are often at a higher risk of psychological, economic, and physical violence due to a lack of life experience, fear of losing a partnership, underestimating the value of personal dignity, etc. Social-pedagogical prophylaxis is aimed at the territorial community, affirming intolerance towards the cruel treatment of women and girls, the development of dignity, self-defence skills, and safe behaviour, and involving them in preventive activities in real and virtual spaces.

Keywords: mistreatment of women; socio-pedagogical prevention; non-governmental organisation

Gendered Entry and Leadership Barriers in Agricultural Cooperatives: Evidence from Ghana

Bernice Adu-Boahen [1]*, Ebenezer Donkor [1], Jana Mazancová [1], Dadson Awunyo-Vitor [2]

[1] Department of Food and BioResource Technology, Faculty of Tropical AgriScience, Czech University of Life Sciences, Prague, Kamycka 129, 165 21 Prague 6 – Suchdol, Czech Republic, adu-boahen@ftz.czu.cz; donkorebenezer44@gmail.com; mazan@ftz.czu.cz

[2] Department of Agricultural Economics, Agribusiness and Extension, Faculty of Agriculture, Kwame Nkrumah University of Science and Technology, Kumasi-Ghana, PMB, KUST Post Office, Kumasi, awunyovitor@gmail.com

* **Correspondence:** mazan@ftz.czu.cz

Abstract: Agricultural cooperatives play a key role in enhancing smallholder farmers' livelihoods by improving access to credit, markets, and extension services. However, women's participation in these cooperatives, especially in leadership roles, remains limited. This study examined gender-specific barriers to cooperative entry and leadership among smallholder cocoa farmers in the Ashanti Region of Ghana. A mixed-methods design was employed, combining a survey of 319 farmers with 50 semi-structured interviews, four gender-segregated focus group discussions and four key informant interviews with cooperative leaders. Quantitative data were analysed using descriptive statistics, Principal Component Analysis (PCA), propensity score matching (PSM), endogenous treatment regression and linear regression, while qualitative data were analysed thematically through the lens of Feminist Institutionalism. The findings reveal that women face significantly greater barriers to entry and leadership than men. Entry barriers were associated with membership costs, limited access to land and information, and restrictive socio-cultural norms, whereas leadership barriers were driven by male-dominated cooperative governance structures, domestic responsibilities, cultural expectations, and limited participation and decision-making. Although cooperative membership improved women's access to credit and extension services, it did not substantially reduce leadership barriers, indicating that institutional and socio-cultural constraints persist beyond economic inclusion. The study concludes that achieving gender equality requires reforms that address both formal institutional arrangements and informal socio-cultural norms through gender-responsive governance, inclusive leadership development and policies that strengthen women's participation and representation in cooperative decision-making.

Keywords: agricultural cooperatives; gender; leadership barriers; feminist institutionalism; Ghana

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Artificial Intelligence and Digital Educational Ecosystems as Drivers of Educational Resilience in a Risk-Prone World

Pinchuk Andrii [1]*, Pinchuk Diana [2], Honcharenko Liubov [3]

[1] Computer Sciences, Informatics, Sumy State University, 40007, 116 Kharkivska St., Sumy, Ukraine, pinchuk.andryusha310212@gmail.com

[2] Municipal institution Sumy Regional Institute of Postgraduate Pedagogical Education, Ukraine, 40007, 5 Mykola Sumtsov St., diana.pinchuk@soippo.edu.ua

[3] Kherson Institute of Private Joint-Stock Company «Higher Educational Institution «Interregional Academy of Personnel Management», 73034, Kherson, 200th Anniversary of Kherson Avenue, 23/49, lubagoncharenko@gmail.com

* **Correspondence:** diana.pinchuk@soippo.edu.ua

Abstract: The rapid development of artificial intelligence (AI) and digital technologies is transforming educational systems by reshaping pedagogical approaches, institutional governance, and educational innovation. Amid armed conflicts, cyber threats, global uncertainty, and accelerating technological change, strengthening educational resilience has become essential for ensuring the continuity, accessibility, inclusiveness, and quality of education. This study examines the role of AI-enabled digital educational ecosystems in enhancing educational resilience and identifies conditions for their effective implementation. A qualitative research design was employed, combining a systematic review of recent scholarly literature, comparative analysis of international policy documents, and conceptual synthesis of current practices in AI and digital transformation. The analysis identified key components of AI-enabled digital educational ecosystems, including personalized learning, adaptive assessment, learning analytics, evidence-informed management, and digital collaboration. These components can enhance the adaptability of educational systems to changing conditions. However, their effectiveness depends on institutional readiness, educators' digital competencies, ethical AI governance, and sustainable digital infrastructure. Based on the synthesized evidence, a conceptual framework linking AI integration, digital educational ecosystems, and educational resilience was developed. The findings indicate that AI-enabled digital educational ecosystems can contribute to more resilient and sustainable education when supported by coherent institutional strategies, responsible governance, and continuous professional development. The framework provides a theoretical basis for future empirical research and evidence-informed educational policies.

Keywords: artificial intelligence; digital educational ecosystems; educational resilience; digital transformation; sustainable education.

On Both Sides of the Plate: Managing the Communication Gap Between Catering Standards and Consumer Preferences

Lili Jázmin Lénárt [1]*, Balázs Ferenc Boncsarovszki [1], Diána Tünde Fejes [1], Viktória Dóczi [1], Gere Attila [1]

[1] Department of Postharvest, Commerce, Supply Chain and Sensory Science; Institute of Food Science and Technology; Hungarian University of Agriculture and Life Sciences; 1118 Budapest, Villányi Str. 29-43; lenart.lili.jazmin@stud.uni-mate.hu; boncsarovszki.ferenc.balazs@phd.uni-mate.hu; fejes.diana.tunde@stud.uni-mate.hu; doczi.viktoria@stud.uni-mate.hu; gere.attila@uni-mate.hu

* **Correspondence:** lenart.lili.jazmin@gmail.com

Abstract: Food waste in public catering is not merely a gastronomic or logistical issue, but a complex policy dilemma. This study examines the political economy of public catering, focusing on the structural tension between strict nutritional regulations and actual consumer preferences, specifically targeting nurseries and lower primary school grades. The research explores how to resolve conflicts of interest between parental expectations, institutional standards, and low meal acceptance rates using empirical data. The investigation analyzes decision-making processes from policy and communication perspectives. Utilizing a qualitative approach combined with the quantitative evaluation of a large-sample dataset, we analyzed validated questionnaires from parents and children in nurseries and lower primary grades. Following rigorous data cleaning, this reliable dataset was used to examine menu planning protocols and conflicts of interest between catering providers and institutional stakeholders. The research maps decision-making mechanisms where rigid adherence to nutritional guidelines leads to lower meal acceptance and increased food waste among young consumers. The findings highlight that a significant source of waste is a lack of effective communication: during menu planning, regulatory compliance often overrides target age groups' taste preferences. The study identifies a "standard vs. preference" conflict, where decision-makers prioritize nutritional maximization over food attractiveness. This gap, substantiated by questionnaire feedback, frequently results in menus with predictably low consumption rates. The solution lies in establishing a direct communication channel between the kitchen, parents, and children to align future offerings, minimize discarded food. The research proposes implementing an integrated communication, planning framework that balances policy requirements with practical meal acceptance.

Keywords: public catering; public policy; conflict of interest; consumer expectations; communication gap

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Does Cooperative Membership Empower Rural Women? Causal Evidence from Agricultural Cooperatives in Ogun State, Nigeria

Suliat Anuoluwapo Ogunneye [1]*, Gospel Iyioku[1], Ilesanmi Ayodeji Amoran[1], Jana Mazancova [1]

[1] The Department of Food and BioResource Technology, Faculty of Tropical of Agricultural Sciences, Faculty of Tropical AgriSciences, Kamycka 129 165 00 Praha 6 - Suchdol Czech Republic, mazan@ftz.czu.cz

* **Correspondence:** aanuoluwapoazeez@gmail.com

Abstract: Agricultural cooperatives are widely promoted as instruments of rural women's empowerment across Sub-Saharan Africa, yet many evaluations compare members with non-members without adequately accounting for selection into membership. This study examines the effect of agricultural cooperative membership on women's multidimensional empowerment in Ogun State, Nigeria. Cross-sectional data were collected from 716 respondents, comprising 358 cooperative members and 358 non-members across 20 cooperatives in ten Local Government Areas. A probit model was first used to identify the socioeconomic and institutional determinants of membership among women and men. The analysis then focused on 456 female respondents, using propensity score matching to estimate the average treatment effect on the treated, complemented by endogenous switching regression to assess selection on unobservables. Empowerment was measured across five A-WEAI domains: production, resources, income, leadership, and time and care burden. Access to credit and extension contact emerged as the main determinants of cooperative membership, with no statistically significant gender difference in these determinants. Cooperative membership was associated with a significant increase in women's overall empowerment, with estimated treatment effects ranging from 0.18 to 0.20. The largest gains occurred in the leadership and resources domains, while no significant improvement was observed in the time and care-burden domain. Evidence on whether women-only cooperatives generated greater empowerment gains than mixed-gender cooperatives were inconclusive across identification strategies. The endogenous switching regression produced results consistent in direction and magnitude with the matching estimates. The findings suggest that cooperative participation can strengthen women's empowerment, particularly through improved access to resources and leadership opportunities, while additional interventions are needed to address persistent time poverty.

Keywords: agricultural cooperatives; women's empowerment; propensity score matching; endogenous switching regression; A-WEAI; Nigeria

The Actual Group of People Who Live Together in a Specific Geographic Area

Juma Luis [1]*

[1] Gambia Collage Department of Arts and Culture

* **Correspondence:** ousmansarr7854@gmail.com

Abstract: Society and culture are fundamental dimensions of human life that collectively shape patterns of behaviour, social interaction, identity, and community development. Society encompasses the organised structures and institutions through which individuals and groups coexist, including family, government, education, and the economy, while culture comprises shared values, beliefs, norms, traditions, language, and practices that give meaning to social life. This study examines the relationship between society and culture, with particular emphasis on their distinctions, interdependence, and influence on human behaviour and social relationships. A qualitative and descriptive approach was adopted through a review of relevant literature, observations, interviews, surveys, and analysis of existing documents and texts. The analysis indicates that society provides the structural framework within which individuals interact, whereas culture influences the beliefs, attitudes, values, and behaviours expressed within that framework. The findings further demonstrate that society and culture are mutually reinforcing: culture shapes social institutions and interactions, while society provides the context through which cultural practices are developed, maintained, transmitted, and transformed over time. The study concludes that society and culture are inseparable and mutually dependent forces that contribute significantly to the formation of human identity, social cohesion, and community organisation.

Keywords: society; culture; human behavior

Impact of Agribusiness Cooperatives on Digital and Financial Inclusion of Women Farmers in Ghana

Edwin Zu-Cudjoe [1]*

[1] Czech University of Life Sciences Prague, Prague, Department of Agri-Cooperatives, execdir@seghana.net

* **Correspondence:** execdir@seghana.net

Abstract: Rural women smallholder farmers have joined agri-cooperatives to access inputs, credits, and access markets. Over the period, many agribusiness cooperatives have provided training in good agronomic practices, provided inputs and technical training and organised various events in a bid to promote trade and sales of farm produce. This study seeks to research on if these supports and offerings from agribusiness cooperatives in Ghana have improved access to inclusive digital and financial services to women smallholder farmers especially in rural communities. The study contributes to understanding ways to develop better systems to deliver improved services to rural smallholder farmers in Ghana. The study would rely on World Bank Data on Ghana on 2022 using random sampling and convenience sampling of women smallholder farmers in Ghana who belong to agribusiness cooperatives, and determine the impact of variables of membership on digital inclusion and financial inclusion using Endogeneous Treatment Regression Models to show the relationship between membership of agribusiness cooperatives and financial and digital inclusion. Initial findings indicate that membership in agri-cooperatives has a significant impact on opening bank accounts for business, applying for loans, accessing government grants and making payments using MoMo to vendors and suppliers. Agri-cooperatives have a huge role to play in promoting inclusive services, promoting sustainable development in rural communities and ensuring women's economic empowerment. Ghana's agribusiness cooperatives have been a pivotal tool for promoting empowerment and sustainable development in rural communities. Research and academic studies is necessary to provide new insights on best practices for agri-cooperatives to promote economic empowerment.

Keywords: Women Smallholder farmers; Agri-Cooperatives; Inclusive Financial; Financial Services

If We Don’t Know It, We Won’t Eat It: How Household Habits Shape Canteen Plate Waste

Diána Tünde Fejes [1]*, Balázs Ferenc Boncsarovszki [1], Attila Gere [1]

[1] Department of Postharvest, Commerce, Supply Chain and Sensory Science; Institute of Food Science and Technology; Hungarian University of Agriculture and Life Sciences; 1118 Budapest, Villányi Str. 29-43; fejes.diana.tunde@stud.uni-mate.hu; boncsarovszki.ferenc.balazs@phd.uni-mate.hu; gere.attila@uni-mate.hu

* **Correspondence:** fejes.diana.tunde@stud.uni-mate.hu

Abstract: In institutional food services, effectively reducing food waste begins with understanding the difference between well-developed, sustainable institutional menus and traditional household eating habits. In Hungary, more than 50,000,000 kg of plate-waste causes serious economic and nutritional problems not only for the service provider but also for the 1.6–1.8 million consumers. This study examines how the phenomena of “food rejection” is linked to a lack of familiarity with diverse or healthy ingredients at home, and what direct impact this has on the refusal of meals served in the canteens. A multi-purpose survey was conducted involving 120 households (parents and their children) in the northern region of Hungary. In addition to household food-related habits, the questionnaire assessed the consumption of traditional and alternative ingredients, the pickiness of children, and the general perceived quality of school canteens. The results reveal that while the majority of households consume traditional staples (such as potatoes, rice, and dried pasta) on a weekly basis, healthier alternatives are largely unknown: many households have never consumed nutritious pseudo-grains (such as amaranth, quinoa, and buckwheat) and are not open enough to try ingredients that are new to them. This lack of knowledge further contributes to children’s picky eating behaviors and their rejection of strictly regulated institutional meals. The study concludes that food waste in institutional catering arises not from poor food quality, but from a lack of prior sensory experiences. Effective waste reduction strategies should prioritize interactive sensory education and familiarization with ingredients before introducing institutional menus.

Keywords: food rejection; institutional catering; food waste reduction; consumer preferences; household food education

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Trait Resilience and Attentional Function: Objective and Self-Reported Measures

Victoria Manzato [1]*, Amanda Elton [1,2]

[1] Department of Psychiatry, College of Liberal Arts and Sciences, University of Florida, victoriamanzato@ufl.edu

[2] Department of Psychology and Neuroscience University of North Carolina at Chapel Hill, amandaelton@ufl.edu

* **Correspondence:** manzatovictoria@gmail.com

Abstract: Trait resilience promotes adaptive responses to stress and adversity and is consistently linked to attentional function. However, this literature relies almost entirely on self-report, leaving open whether resilience also relates to objective attentional capacity. Data from 396 participants aged 18–19 were analyzed. Objective attention was assessed with the Sustained Attention to Response Task (SART; d-prime, reaction time, and error indices), self-reported attention with the Conners' Adult ADHD Rating Scales (CAARS) DSM-Inattention Scale and the Barratt Impulsiveness Scale (BIS), and resilience with the 10-item Connor-Davidson Resilience Scale (CD-RISC-10) and the Child and Youth Resilience Measure (CYRM). Spearman correlations and Mann-Whitney tests were computed with Benjamini-Hochberg correction within measure families. All twelve self-reported attention–resilience associations were significant and negative (rho = −.257 to −.379, all $p < .001$). Objective SART indices showed no association with resilience (d-prime with CD-RISC-10, rho = .002), except reaction time variability with the CYRM (rho = .134–.148). Objective and self-reported attention were unrelated across all twenty-one pairings ($|rho| < .078$). Sex differences emerged in SART speed, variability, commission errors ($|$rank-biserial r$|$ = .15–.25), and CD-RISC-10 (r = .19, males higher). SART performance showed the expected speed–accuracy tradeoff and adequate d-prime variability. Resilience was associated with self-reported, but not task-based, performance, and the two classes of measure were mutually unrelated. These findings suggest that self-report and behavioral measures may capture distinct aspects of attention, with resilience more closely related to perceived than objective attentional functioning, highlighting the importance of measurement choice in resilience research.

Keywords: resilience; sustained attention; sex differences



ORGANISING COMMITTEE

Dear MCYR 2026 participant, we sincerely thank you for participating in this year's event. Your active engagement, insightful discussions, and contributions made the conference both meaningful and impactful.

Under the theme "Research Innovation to Action: Pathways Toward Resilience in a Risk-Prone World," MCYR 2026 aimed to inspire collaboration across disciplines and highlight the innovative work of emerging researchers. The energy and curiosity you brought to each session truly shaped the success of this year's conference.

We hope the experience was valuable, both intellectually and personally, and that the connections you built will continue to foster new ideas and collaborations. We look forward to welcoming you to MCYR 2027 and seeing how your research continues to grow, create impact, and make a difference.

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BioResources & Technology





ČZU Faculty of Tropical AgriSciences



ABOUT THE FACULTY OF TROPICAL AGRISCIENCES

The **Faculty of Tropical AgriSciences** (FTZ) at the Czech University of Life Sciences Prague (CZU) is a unique institution in the Czech Republic, boasting over fifty years of tradition in tropical agriculture, rural development, and the sustainable management of natural resources in the tropics.

Mission

The mission of the faculty is to provide higher education to foreign and Czech students in the fields of tropical agriculture, rural development, and the sustainable management of natural and energy resources in the tropics. An integral part of our mission is Research and Development in the field of tropical life sciences, with a focus on applying R&D results to the specific conditions of tropical and/or developing countries.

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To be a leading institution in the Czech Republic dedicated to excellence in tropical agri-sciences, fostering the transfer of cutting-edge knowledge and technology between the Czech Republic, the EU, and tropical regions, while respecting the traditions, values, and socio-economic realities of local communities in the developing world.

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ABOUT THE BIORESOURCES & TECHNOLOGY DIVISION

The BioResources and Technology (BRT) is a research division in the **Faculty of Tropical AgriScience** (FTZ) at the **Czech University of Life Sciences Prague** (CZU). The BRT is dedicated to advancing sustainable solutions through rigorous research, innovative technology, and interdisciplinary collaboration.

BRT research and innovation research activities encompass a wide range of thematic areas, from the determination of the real impact of small biogas plants (both in developing and developed countries) on the environment, climate change and society to bioresources technologies, including bioenergy, environmental aspects, food security, waste management, biotechnologies and more.

The global shift towards renewable energy and sustainable practices has reinforced the importance of holistic approaches to resource management. This underscores our commitment to fostering collaboration across these disciplines, enhancing our ability to address complex sustainability challenges. Interdisciplinary research is at the core of the BRT. Our team comprises environmental science, engineering, agriculture, and social sciences expertise.

BioResources & Technology

http://biores.tech/





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AgriSci-UA

Strengthening AgriSciences in Ukraine: AgriSci-UA



siris

Open Science to Increase Reproducibility In Science



MWAZACO
MINE WATER ATLAS ZAMBIA COPPERBELT

Mine Water Atlas of the Zambian Copperbelt



bio capital

Mobilising investments for protecting and restoring biodiversity by harnessing innovative financial solutions and advanced geospatial analytics



Adapt Fin

Unlocking Private Sector Finance for Climate Adaptation



unicom

UNICOM: Universities – Communities: strengthening cooperation



deSalSea

Novel Sustainable Forward-Osmosis Seawater Desalination Process

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AgriSci-UA

agrisci-ua.com

AgriSciences Platform for Scientific Enhancement of HEIs in Ukraine

The platform aims to enhance the capabilities and collaboration among universities in the area of AgriSciences and to improve the scientific capacities of young educators, researchers, and postgraduate students at select Ukrainian universities. This will be accomplished through the continued development of the AgriSciences Platform, which focuses on increasing expertise in key areas of agrarian sciences, crucial for Ukraine's post-war development.

Beyond traditional AgriSciences topics, the project addresses urgent issues specific to present-day Ukraine, including the environmental and social impacts of the war. Furthermore, the project will also foster the formation of multidisciplinary research teams and offer grant opportunities to address these emerging challenges. These initiatives are critical for addressing Ukraine's needs during and after the conflict.

AgriSci-UA project is supported by Czech Republic Development Cooperation via Ministry of Foreign Affairs of the Czech Republic.

MCYR 2026 PARTNERS

osiris4r.eu

Open Science to Increase Reproducibility in Science

Reproducibility is crucial to the progress and impact of Research and Innovation (R&I) as it confirms or corrects the outcomes of single studies, resulting in higher quality research, more reliable and implementable outcomes, and a reduction of research costs. Embedding reproducibility in the strategy and design of research should thus be regarded as a key precondition to research quality.

OSIRIS aims to facilitate this shift by systematically gathering knowledge on the underlying drivers, testing effective evidence-based solutions, identifying incentives for reproducibility by stakeholders, and embedding reproducibility in research design. The project involves a unique combination of expertise in Open Science (OS), reproducibility, implementation, and data sharing, along with a range of committed stakeholders.

The OSIRIS project is funded by the European Union's Horizon Europe research and innovation programme under grant agreement No. 101094725.

MCYR 2026 PARTNERS

MWAZACO

MINE WATER ATLAS ZAMBIA COPPERBELT

www.frda.org/mwazaco/

Mine Water Atlas of the Zambian Copperbelt

The MWAZACO project aims to improve water resource management and environmental protection in Zambia's Copperbelt Province by addressing contamination from mining and metallurgical activities. Through the development of an open-access, geo-referenced digital platform, the project will map pollution sources, assess environmental risks, and identify opportunities for mine water treatment and reuse.

MWAZACO will also establish a pilot water treatment system, a demonstration farm, and a Centre of Excellence at Copperbelt University to strengthen local research, technical capacity, and sustainable water management practices. By combining scientific research, innovative technologies, and community engagement, the project will contribute to safer water use and long-term environmental resilience, laying the foundation for a nationwide Mine Water Atlas of Zambia (MWAZA).

The MWAZACO project is supported by the Czech Development Agency (CzechAid) under the Czech Development Cooperation programme.

MCYR 2026 PARTNERS

bio capital

bio-capital.eu

Mobilising investments for protecting and restoring biodiversity by harnessing innovative financial solutions and advanced geospatial analytics

BIO-CAPITAL is an innovative project dedicated to addressing the critical challenge of biodiversity protection and restoration. By integrating technological advances within the field of geospatial analytics with sustainable financing solutions, the project aims to bridge the gap between ecological preservation and the need for increased private investment in conservation efforts.

The project adopts an interdisciplinary approach, combining expertise in biodiversity protection, the development of biodiversity-friendly financing mechanisms, and the application of advanced space technologies. These elements are brought together to create transformative solutions that enhance financial flows for biodiversity protection, restoration and sustainable utilisation.

This project has received funding from the European Union's Horizon Research and Innovation Programme under grant agreement No. 101135150.

MCYR 2026 PARTNERS

https://adapt-fin.eu/

Unlocking Private Sector Finance for Climate Adaptation

The ADAPT-FIN project aims to mobilise private-sector investment in climate adaptation by strengthening the economic and financial case for resilience measures. By combining macroeconomic modelling with investment-level analysis, the project will develop an advanced cost–benefit assessment approach to quantify the economic value of adaptation, including avoided climate damages, ecosystem services, and broader resilience benefits.

ADAPT-FIN will test and validate its approach through nine real-world case studies across six European countries, working closely with businesses, investors, financial institutions, and public authorities. Through the development of investment roadmaps, practical tools, and policy recommendations, the project seeks to overcome financial barriers, support investment-ready adaptation solutions, and contribute to closing Europe's climate adaptation finance gap.

The ADAPT-FIN project is funded by the European Union’s Horizon Europe research and innovation programme under Grant Agreement No. 101295821.

MCYR 2026 PARTNERS

https://unicom.community/en/unicom-home/

Universities – Communities: strengthening cooperation

The general objective of the project is to enhance universities' social role through boosting university-community engagement, leading to the elaboration of state policy on supporting the third mission of universities for ensuring social cohesion, resilience, sustainability and prosperity in Ukraine.

The UNICOM project aims to foster cooperation between Ukrainian universities and their surrounding communities by incorporating best practices from EU states such as Italy, Germany, Sweden, Latvia and Czech Republic. The project activities include developing policies to enhance the third mission of universities, analyzing the needs of communities and universities across Ukraine, and capacity-building for university staff through exchange programs focused on resilience, sustainability, inclusion, entrepreneurship, environment, public health, and social cohesion.

The project is a promising step towards promoting the third mission of universities in Ukraine and strengthening university-community cooperation.

MCYR 2026 PARTNERS

deSalSea

https://desalsea.eu/

Novel Sustainable Forward-Osmosis Seawater Desalination Process

The deSalSea project aims to develop a sustainable and energy-efficient seawater desalination process based on forward osmosis. By combining biomimetic membranes with stimuli-responsive draw solutions, the project seeks to reduce energy consumption, minimise environmental impacts, and improve the sustainability of freshwater production.

The project brings together research partners from Spain, France, and the Czech Republic to develop advanced membrane materials, optimise osmotic performance, and enable energy-efficient regeneration of draw solutions. These innovations aim to improve the efficiency and feasibility of freshwater production while reducing dependence on fossil-based materials.
Through environmental, energy, economic, and social assessments, deSalSea will evaluate the sustainability and practical potential of the proposed technology, contributing to more resource-efficient desalination and long-term water security.

The deSalSea project is supported under the M-ERA.NET 3 Joint Call 2024, with funding from participating national agencies and European Union co-funding.

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