

The Seventh Workshop on Interdisciplinary Sciences (WIS 2025)

WORKSHOP PROGRAM

Date: November 13–16, 2025

Venue (Hybrid): All times are JST (UTC+9)

On-site: Nov 13–14: Room 207, Open Learning Plaza Building (総合学習プラザ2階207室)
Ito Campus, Kyushu University

Nov 15–16: Kuju Joint Training Center, Oita, Japan

Online: Nov 13–14 via Microsoft Teams

No.	Title	Presenter	Japan Time
Opening remarks			Nov 13, 2025
1	Prof. Takahiro Kusakabe Dean, Faculty of Agriculture, Kyushu University, Japan		13:00 - 13:05
2	Prof. Ju-Kyong Lee Dean, College of Agriculture and Life Science, Kangwon National University, Republic of Korea		13:05 - 13:10
3	Assoc. Prof. Nguyen Duc Tung Vice Dean, Faculty of Agronomy, Vietnam National University of Agriculture, Vietnam		13:10 - 13:15
4	Group Photo	All participants	13:15 - 13:30
Session I (Chair: Assoc. Prof. Thorkil Casse)			Nov 13, 2025
1	Accelerating Molecular Discovery with Game AI methods and Supercomputers	Prof. Kazuki Yoshizoe Research Institute for Information Technology, Kyushu University, Japan	13:30 - 13:55
2	Insects as Biological Indicators of Biodiversity and Environment	Assoc. Prof. Ueno Takatoshi Faculty of Agriculture, Kyushu University, Japan	13:55 - 14:20
3	Ferric hydroxide desulfurized waste (FHDW) as a co-substrate in a sulfur-based denitrification system for efficient nutrient removal from waste water	Prof. Sang-Eun Oh Kangwon National University, Republic of Korea	14:20 - 14:45
4	Genetic Basis of <i>Erwinia amylovora</i> Persistence in the Honeybee Vector	Prof. Duck-Hwan Park Kangwon National University, Republic of Korea	14:45 - 15:10
Break			15:10 - 15:20
5	AI-based monitoring and robotic technologies for smart aquaculture	Assoc. Prof. Akinori Ozaki Institute of Tropical Agriculture, Kyushu University, Japan	15:20 - 15:45
6	Phylogenetic regression on networks: reticulate evolution and drought-response traits in sunflower	Prof. Dwueng-Chwuan Jhwueng Department of Statistics, Feng-Chia University, Taiwan	15:45 - 16:10
7	Observation-based estimation of urban-scale CO ₂ flux in the Chuncheon basin, South Korea	Assoc. Prof. Kyung-Hwan Kwak Kangwon National University, Chuncheon, Republic of Korea	16:10 - 16:35
8	Quantifying fish school fragmentation under predation using stochastic differential equations	Mr. Junyi Qi Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan	16:35 - 16:50
9	Mitigating methane emissions in rice by cultivar selection with microbial inoculant under reduced nitrogen	Mr. Vu Hoai Nam Vietnam National University of Agriculture, Vietnam	16:50 - 17:05
Session II (Chair: Dr. Nguyen Thi Ngoc Dinh and Dr. Nguyen Thi Ai Nghia)			Nov 14, 2025
Morning session			

1	How do we explain different perceptions of nature conservation on a global scale?	Assoc. Prof. Thorkil Casse Roskilde University, Denmark Kyushu University, Japan	09:00 - 09:25
2	Two perspectives on factor analysis: penalized maximum likelihood and algebraic approaches	Prof. Kei Hirose Kyushu University, Japan	09:25 - 09:50
3	Vietnam's coffee sector in the digital era: harnessing AI across the robusta value chain	Dr. Nguyen Viet Tru Western Highlands Agriculture and Forestry Science Institute, Vietnam	09:50 - 10:15
4	High-throughput 3D reconstruction method for plants and its application to traits feature extraction	Dr. Pham Thanh Dong Faculty of Agriculture, Kyushu University, Japan	10:15 - 10:35
5	Real-time IoT-based monitoring of methane emissions in rice production under water and fertilizer management	Dr. Nguyen Thi Ngoc Dinh Vietnam National University of Agriculture, Vietnam	10:35 - 11:00
6	Integrating multi-sensor remote sensing and machine learning for coffee production mapping in the Dak Lak region, Vietnam	Mr. Nguyen Trung Duc Graduate School of Bioresource and Bioenvironmental Sciences, Kyushu University, Japan	11:00 - 11:15
7	Asymptotic dynamics of a transboundary fishery model and the impact of fishing costs under cooperative and non-cooperative scenarios	Mr. Tran Anh Minh Vietnam National University, Vietnam	11:15 - 11:30
Lunch time			11:30 - 13:00
Session III (Chair: Dr. Pham Hung Cuong)			Nov 14, 2025
Afternoon session			
1	The <i>Diadegma fenestrata</i> Ichnovirus (DfIV): roles and genomic interactions in a complex parasitoid-host relationship	Assoc. Prof. Juil Kim Kangwon National University, Republic of Korea	13:00 - 13:25
2	Earth observation for crop monitoring in Vietnam	Dr. Nguyen Thi Thu Ha Vietnam National University of Agriculture, Vietnam	13:25 - 13:50
3	Characterization of transcriptomic and physiological properties of <i>Ligularia stenocephala</i> in response to deep seawater fertilization	Ms. Azeez Bimpe Suliyat Kangwon National University, Republic of Korea	13:50 - 14:05
4	A comparative study on the effect of contract farming on rice farmers' income and yield: a case study in Vietnam	Ms. Le Thi Dieu Hien Kangwon National University, Republic of Korea	14:05 - 14:20
5	The analysis of emergent behavior in flocks with visual field	Mr. Yujie Gao The University of Tokyo, Japan	14:20 - 14:35
Break			14:35 - 14:50
Session IV (Chair: Assoc. Prof. Juil Kim)			Nov 14, 2025
1	Rainfall variability and nutrient dynamics driving fishery decline in Kafuri bay	Assist. Prof. Toshinori Tabata Faculty of Agriculture, Kyushu University, Japan	14:50 - 15:15
2	Effects of co-composting of chicken manure and biochar on growth and yield of Malabar spinach (<i>Basella alba</i>)	Dr. Nguyen Thi Ai Nghia Vietnam National University of Agriculture, Vietnam	15:15 - 15:35
3	Effects of biochar and fertilizer application on growth, yield and N ₂ O emissions of kohlrabi	Dr. Nguyen Hong Hanh Vietnam National University of Agriculture, Vietnam	15:35 - 15:55
4	Dynamics in variety and seed choices: the case of pumpkin farmers in northern Vietnam	Ms. Nguyen Thi Phuong Wageningen University & Research, Wageningen, The Netherlands	15:55 - 16:15

Closing Remarks		
1	Assoc. Prof. Kyung-Hwan Kwak Vice Dean, College of Agriculture and Life Science, Kangwon National University, Republic of Korea	16:15 - 16:30
Brainstorming at Kuju Joint Training Center, Oita, Japan		Nov 15– 16, 2025

**THE SEVENTH WORKSHOP ON
INTERDISCIPLINARY SCIENCES 2025**

ABSTRACT

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1 **Ferric hydroxide desulfurized waste (FHDW) as a co-substrate in a sulfur-based**
2 **denitrification system for efficient nutrient removal from wastewater**

3 **Sang-Eun Oh^{1,*}, Sandesh Pandey¹, Anup Gurung¹, Suleman Shahzad¹, Fida**
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6 University, Republic of Korea

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8 **Abstract**

9 An iron-rich waste derived from acid mine drainage (AMD) sludge was repurposed as
10 a co-electron donor in elemental sulfur (S⁰) autotrophic denitrification, forming a
11 combined sulfur–iron system termed SADNIP (sulfur autotrophic denitrification with
12 iron processes). Three up-flow packed bed columns were operated with varying S⁰ to
13 iron-waste ratios (100:0, 75:25, and 50:50) over 60 days to evaluate nitrate (NO₃⁻-N)
14 and phosphate (PO₄³⁻-P) removal from hydroponic wastewater under different empty
15 bed contact times (EBCTs). The mixed S⁰–iron waste media dramatically improved
16 denitrification: at an EBCT of 6 h, the 50:50 (S⁰:waste) column achieved nearly 97%
17 NO₃⁻-N removal, far outperforming the sulfur-only column (29% removal). Even at a
18 short 4 h EBCT, the 50:50 column maintained nearly 75% nitrate removal with minimal
19 nitrite accumulation. Phosphate removal was enhanced by the iron waste addition –
20 the 50:50 column consistently removed 80–90% PO₄³⁻-P during early phases, versus
21 <25% in the sulfur-only system. High-throughput 16S rRNA gene sequencing revealed
22 that the sulfur–iron system enriched sulfur-oxidizing denitrifiers (e.g. *Thiobacillus* and
23 *Acidihalobacter*) while sulfur only column contained primarily heterotrophic non
24 denitrifying bacterial population with *Neobacillus* acting as a major denitrifying
25 bacterium.

26 **Keywords:** *iron waste, acid mine drainage, nitrate removal, phosphate removal, low*
27 *C/N wastewater*

Genetic Basis of *Erwinia amylovora* Persistence in the Honeybee Vector

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Abstract

Fire blight, a severe bacterial disease caused by *Erwinia amylovora* (Ea), poses a significant threat to the pome fruit industry in South Korea. While the honeybee (*Apis mellifera*) is a known vector, the mechanisms underlying its persistence within the bee are poorly understood. This study investigated the persistence of Ea in honeybees and identified key genetic factors contributing to this process. Using quantitative methods, we found that Ea can persist for up to 3 days and 15 days post-acquisition in the honeybee gut and on the exterior of honeybee body, respectively. To unravel the genetic basis of this persistence, we generated several Ea mutants with disruption in genes associated with adherence, colonization, and virulence. Our results demonstrated that the disruption of the *waaL* gene, responsible for lipopolysaccharide (LPS) O-antigen synthesis, significantly reduced Ea persistence in the honeybee gut. The loss of O-antigen and mobility reduction in $\Delta waaL$ mutant may explain their decreased ability to persist. Interestingly, a high titer of Ea ($> 10^8$ CFU) was consistently observed in several dead bees, while continuously declining in live ones, suggesting that it proliferates upon host death or a weakened state. These findings establish a foundation for understanding the intricate persistence of Ea in its vector and shed light on the impact of this pathogen on honeybee health.

Keywords:

AI-based Monitoring and Robotic Technologies for Smart Aquaculture

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Abstract

Efficient and sustainable aquaculture requires not only water quality management but also continuous monitoring and improvement of bottom conditions. However, conventional methods relying on manual inspection are labor-intensive and often fail to capture the spatial variability of pond environments. This study aims to develop a comprehensive technology platform for smart aquaculture that enhances productivity and reduces labor through visualization, automation, and environmental control. An autonomous boat equipped with an underwater camera system was developed to acquire bottom footage of shrimp ponds. Using deep learning, the collected images were classified into four representative categories—gravel, residual feed, white fungal growth, and sludge—to visualize the spatial distribution of degraded bottom areas. The visualization results serve as a foundation for adaptive feeding control and maintenance planning. Furthermore, robotic technologies for water-bottom cleaning and feeding automation are being explored to achieve an integrated system that connects monitoring, decision-making, and action. This research demonstrates the potential of combining AI-based image analysis and autonomous robotics to realize a sustainable and intelligent aquaculture system that supports both productivity improvement and environmental conservation.

Keywords:

Phylogenetic Regression on Networks: Reticulate Evolution and Drought-Response Traits in Sunflower

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Abstract

Reticulation (hybridization, introgression) is common in plants and challenges tree-based comparative methods. I present a phylogenetic network regression that integrates reticulate edges directly into the variance–covariance (VCV) structure for continuous traits. Starting from an eNewick network, we construct the descendant–ancestor incidence and edge-weight matrices to assemble a Brownian-motion VCV under inheritance probabilities along hybrid edges, yielding closed-form generalized least squares for regression on ecological covariates. Maximum likelihood is used for branch-scale rate and mixing parameters, with profile likelihood and condition-number checks for identifiability. Simulations benchmark bias and coverage against tree-based baselines under varying reticulation depth and edge weights. As a case study, we analyze *Helianthus annuus* traits related to drought tolerance (e.g., leaf, root, and allocation metrics) and environmental covariates. Network models recover stronger and more biologically coherent associations than tree models when reticulation is present, while collapsing to tree behavior in its absence. The workflow is compatible with standard PCM pipelines (design matrices, contrasts, diagnostics) and is readily extensible to Gaussian-type processes. I conclude with guidance on when networks materially change inference and practical tips for robust estimation on empirical datasets.

Keywords: *phylogenetic regression, reticulate evolution, eNewick, variance–covariance matrix, Brownian motion, drought tolerance, Helianthus annuus*

Observation-based estimation of urban-scale CO₂ flux in the Chuncheon basin, South Korea

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Abstract

Carbon dioxide (CO₂) flux represents the transport and exchange of carbon between the atmosphere and the surface per unit area, and in urban regions it exhibits strong spatiotemporal variability driven by traffic, industrial activities, and meteorological conditions. Vertical CO₂ flux near the surface is largely influenced by turbulent mixing, requiring a sound understanding of atmospheric diffusion processes for accurate quantification. Although the eddy covariance (EC) technique has been widely employed, it relies on the assumption of homogeneous surfaces, which limits its applicability in complex urban settings. In this study, we explored alternative observation-based approaches to estimate urban-scale CO₂ fluxes in Chuncheon, South Korea. First, we used a UAV-based flux-gradient (FG) method, in which a hexacopter equipped with a sonic anemometer (FT-742), a CO₂ sensor (GMP252), and a temperature–pressure sensor (Imet-X4) conducted vertical profiles from 0 to 250 m a.g.l. (above ground level). Turbulent diffusion coefficients were derived from wind data and the von Kármán constant, while atmospheric stability was assessed using the Bulk Richardson number. The FG method successfully revealed diurnal variations of vertical CO₂ fluxes, reflecting characteristic urban surface emissions. Next, we also applied a Two-layer box model using continuous CO₂ concentration data from LI-850 sensors deployed at two fixed sites: KNU (100 m a.s.l.; above sea level) and KBM (500 m a.s.l.), separated by 7 km from each other. CO₂ fluxes were estimated from layer thickness and temporal concentration changes at the two fixed sites. The analysis captured daytime negative fluxes due to photosynthesis and nighttime positive fluxes driven by respiration and emissions, with distinct seasonal patterns. These results demonstrate the feasibility of combining UAV observations and fixed monitoring networks for reliable urban-scale CO₂ flux quantification, highlighting pathways to improve accuracy by accounting for horizontal transport, mixing processes, and boundary layer dynamics.

Keywords:

Quantifying fish school fragmentation under predation using stochastic differential equations

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Abstract

This study builds upon our previously proposed stochastic differential equation (SDE)-based model to further investigate fish school fragmentation under predation. Specifically, we explore structural dynamics by incorporating graph-theoretic metrics—namely, the number of connected components—to quantify changes in prey school organization. Two quantitative indicators, first split time and final component count, are introduced to assess the timing and extent of group disintegration. Sensitivity analyses are performed on key parameters to evaluate their influence on group stability under nearest attack and center attack strategies. We independently examine the effect of environmental noise on fish school cohesion. Simulation results show that parameter changes impact fish school fragmentation differently under the two predation strategies. High environmental noise also makes it difficult for the school to stay cohesive. This framework provides a structured and quantitative basis for assessing how fish schools respond to different predation strategies and environmental noise levels.

Keywords:

Mitigating methane emissions in rice by cultivar selection with microbial inoculant under reduced nitrogen

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Abstract

This study evaluated an integrated agronomic approach to mitigate methane (CH₄) emissions in rice by combining reduced nitrogen (N) input with a root-associated microbial inoculant (RS). Two experiments were conducted: (1) a greenhouse trial assessing four rice cultivars (VNR20, BT7, TBR225, KD18) under RS application, and (2) a field trial with three N regimes (100% N, 50% N, 50% N + RS) on the most responsive cultivar, VNR20. In the greenhouse, VNR20 showed the greatest improvements in growth, chlorophyll content, and root development under RS. In the field, the 50% N + RS treatment reduced CH₄ concentration from 45 ppm in the 100% N treatment to 32 ppm at maximum tillering, while maintaining grain yield close to 6.1 t ha⁻¹ compared with 6.25 t ha⁻¹ in the 100% N treatment. These results indicate that integrating cultivar-specific responses with microbial biostimulants can reduce CH₄ emissions without yield loss. Long-term and multi-location trials are recommended to validate these findings.

Keywords: methane (CH₄) emissions, nitrogen reduction, microbial inoculant (RS), genotype-specific response, climate-smart agriculture

How do we explain different perceptions of nature conservation on a global scale?

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Abstract

Recent decades have seen a wave of conservation commitments worldwide, with countries pledging to protect global biodiversity through new terrestrial and marine protected areas. While the nature and extent of these commitments have been closely scrutinized, less attention has been paid to questions of their implementation. The latter question is particularly relevant in countries that face limitations in the capacity of state agencies; in many cases, previously established protected areas have been the sites of incursions and degradation. One model that has shown some promise entails elevating the governance roles of non-state entities—including national and transnational NGOs, local civil society organizations, and private contractors. In Africa, where the government is often absent in remote areas, a private contractor, African Parks, is now managing protected areas, including those in Chad and the Central African Republic (Financial Times, 5 July 2024). Typically, private actors inevitably operate within a context defined by the state, but in certain situations, private operators or even state national parks work beyond their limited mandate to provide public services (schooling, health clinics, Casse et al., 2022). In the United States, the U.S. Forest Service increasingly relies on partners in the NGO sector and at other governmental levels to implement forest policy in a contested and policy-layered context (Cowan 2022). In Central America, numerous protected areas have been degraded by outside influences—including by drug cartels (McSweeney et al. 2014)—but a strong involvement of international NGOs has been determinative in the successful implementation in some areas (McGinley and Cabbage 2011). In Asia, national parks and private tour operators compete for income from a booming tourism industry (Malaysia, New Straits Times, 2025). In this paper, we theorize the variety of situations in which governments call upon non-state actors in conservation implementation, describe the motivations for doing so, and provide a set of hypotheses for the determinants of success or failure of this model of co-governance.

Keywords:

Two perspectives on factor analysis: penalized maximum likelihood and algebraic approaches

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Abstract

Factor analysis is a classical yet useful tool for understanding the latent structure behind multivariate observed variables. In this talk, we present two complementary perspectives on factor analysis. The first is penalized maximum likelihood factor analysis. Hirose and Yamamoto (2015) showed that penalized maximum likelihood estimation is a generalization of the traditional two-step procedure, in which the model is first estimated by maximum likelihood and then the loading matrix is rotated with some criterion. This perspective implies that penalized maximum likelihood methods can yield sparser solutions than the rotation technique. Moreover, any rotation criterion can be incorporated as a penalty in the penalization procedure. In Hirose and Terada (2023), we proposed the prenet (product-based elastic net) penalty, which is based on the product of pairs of factor loadings within each row of the loading matrix. This novel penalty not only produces sparse solutions but also leads to a simple structure. The second topic is the algebraic approach to factor analysis. Here, we focus on how algebraic methods can be used to investigate improper solutions in maximum likelihood factor analysis. By treating the likelihood equations as a system of algebraic equations, we can compute exact solutions and gain new insights into the stability of the estimation problem.

Keywords:

Earth observation for crop monitoring in Vietnam

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Abstract

The application of remote sensing for crop monitoring and yield estimation is well established in many regions around the world. In Vietnam, its use in agriculture is diverse - ranging from mapping arable land and analyzing land use/land cover to distinguishing annual crops from perennial ones. Rice and coffee, the country's two major export commodities, are cultivated across vast areas. As climate change increasingly affects Vietnam's agricultural systems, its negative impacts are becoming more evident, particularly on rice and coffee farms. This calls for more efficient field monitoring and management practices. Optical remote sensors aboard Earth-orbiting satellites, capable of capturing surface data up to twice daily due to their high temporal resolution, have demonstrated strong potential for near-real-time monitoring of crop health and growth conditions. This data collected is then analyzed to recommend the most effective field and cropping management strategies - ensuring both economic profitability and ecological sustainability.

Keywords:

Vietnam's coffee sector in the Digital Era: Harnessing Artificial Intelligence across the Robusta value chain

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Abstract

Vietnam stands as the world's leading producer and exporter of Robusta coffee, playing a vital role in sustaining rural livelihoods and contributing substantially to the national economy. However, the sector is increasingly constrained by climate variability, soil fertility decline, fluctuating quality standards, and stricter global requirements for sustainability and traceability. This study examines the transformative potential of Artificial Intelligence (AI) across the Vietnamese coffee value chain. Three critical domains are explored: (i) smart cultivation practices through AI-enabled nutrient diagnostics, precision irrigation, disease forecasting, and soil health assessment; (ii) processing and post-harvest innovation using AI-driven fermentation control, drying optimization, roasting management, and sensory profiling; and (iii) trade and export advancements via AI-powered market prediction, blockchain-based traceability, and logistics optimization. The paper highlights the central role of the Western Highlands Agriculture and Forestry Science Institute (WASI) in driving digital transformation, standardizing data systems, and fostering collaboration with international technology partners. By harnessing AI, Vietnam can elevate the quality and competitiveness of its Robusta coffee, reinforce sustainability commitments, and secure a stronger position in the global market.

Keywords: *Robusta coffee, Artificial Intelligence, smart agriculture, processing innovation, traceability, WASI, Vietnam*

High-throughput 3D reconstruction method for plants and its application to traits feature extraction

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Abstract

Monitoring plant growth with 2D images is common, yet this method fails to adequately capture the intricate, three-dimensional nature of plant canopies. This limitation highlights the need for advanced 3D monitoring within plant phenotyping systems. This study introduces a high-throughput phenotyping system that generates 3D plant models from a series of 2D images captured from multiple camera poses. A camera was employed to systematically gather video data from various angles, ensuring complete coverage of the plant canopy. The resulting image dataset served as the foundation for training and evaluating photorealistic 3D reconstruction techniques, specifically Neural Radiance Fields (NeRF) and 3D Gaussian Splatting. The reconstructed models were evaluated for quality using PSNR, SSIM, and LPIPS metrics. The results showed that 3D Gaussian Splatting significantly outperformed NeRF in both reconstruction fidelity and processing speed. Moreover, this study investigated the application of these 3D models for quantitative analysis. By leveraging 3D data processing, we were able to extract true-to-scale plant trait information, suggesting a viable, non-invasive method for detailed phenotype extraction from visual data.

Keywords: *Plant phenotyping, Neural Radiance Fields (NeRF), Gaussian Splatting, spatial data, data-driven agriculture*

Real-time IoT-based monitoring of methane emissions in rice production under water and fertilizer management

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Abstract

Rice cultivation is one of the largest anthropogenic sources of methane (CH₄), contributing about 11% of global emissions. Sustainable water and fertilizer management are therefore essential to mitigate greenhouse gas (GHG) emissions while ensuring rice productivity. Conventional CH₄ measurement methods rely on gas sampling and laboratory analysis, which hinder real-time monitoring and increase costs. To address this, an IoT-based monitoring system was developed, consisting of power supply, sensing (CH₄, temperature, humidity), and communication modules, enabling real-time data collection and wireless transmission. A split-plot experiment was conducted at the rice experimental field of the Faculty of Agronomy, Vietnam National University of Agriculture, with two water regimes (continuous flooding, CF, and alternate wetting and drying, AWD) and five fertilizer treatments (100% chemical, 50% chemical + 50% organic, 100% organic, slow-release biochar, and nano-Fe). Results showed that water regimes and their interaction with fertilizers significantly affected rice growth, yield, and CH₄ emissions. AWD improved tillering, photosynthesis, dry matter accumulation, and yield (+20%) while reducing CH₄ emissions by 70–78% compared with CF. Fertilizer effects were more pronounced on CH₄ emissions, with 100% organic fertilizer producing the highest CH₄ concentrations. In contrast, AWD combined with slow-release biochar achieved the highest yield (6.1 t/ha) with the lowest CH₄ emissions (2.1–11.8 ppm), reducing emissions by 65–68%. These findings highlight AWD irrigation and biochar fertilization as a sustainable strategy to balance rice productivity and environmental benefits.

Keywords: *AWD, Methane emissions, Slow-release biochar fertilizer, Rice*

Integrating multi-sensor remote sensing and machine learning for coffee production mapping in the Dak Lak region, Vietnam

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Abstract

Coffee, mainly Arabica (*Coffea arabica*) and Robusta (*Coffea canephora*), is one of the world's most valuable agricultural commodities, supporting farmers in over 50 developing countries. Vietnam ranks as the second-largest exporter, and since the early 2000s, Dak Lak Province in the Central Highlands has become the country's primary production area, dominated by Robusta cultivation. However, production in Dak Lak now faces growing pressures from irregular rainfall, declining soil quality, and the intensification of cultivation driven by market demand. Reliable, high-resolution maps of smallholder coffee are needed for land-use planning, certification, and climate-smart management. Yet, distinguishing coffee from other perennial crops remains challenging due to intercropping, variable shade, and frequent cloud cover in the region. To overcome these limitations, we built an integrated workflow that combines multi-temporal optical imagery (Sentinel-2 and Landsat) with radar data (Sentinel-1) and ancillary information. We then tested three machine learning classifiers, *viz.*, Random Forest, Gradient Boosted Trees, and Support Vector Machines, on both single-sensor and fused datasets. The results indicate that fusing multi-sensor data improves mapping accuracy compared with single-sensor inputs. Random Forest achieved the best performance on the fused dataset, with an overall accuracy of 91.8% and an F1-score of 0.91 for the coffee classification. In contrast to earlier studies that relied on single sensors or covered smaller areas, our approach integrates complementary datasets at 10-m resolution. This allowed us to more reliably separate coffee from other vegetation types, even in smallholder landscapes characterized by intercropping and variable shade. The 2024 coffee map of Dak Lak provides a reliable baseline for monitoring Vietnam's production systems. By making the methods reproducible and openly available, this study contributes to sustainable agriculture, informs climate adaptation, and enhances sustainability in global coffee supply chains.

Keywords: *climate-smart agriculture, coffee, machine learning, remote sensing, random forest*

Asymptotic dynamics of a transboundary fishery model and the impact of fishing costs under cooperative and non-cooperative scenarios

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Abstract

This study proposes a system of differential equations describing the interactions among fishing effort, fish biomass, and market price across the three Exclusive Economic Zones (EEZs) of Vietnam, Thailand, and Cambodia in the Gulf of Thailand. Two models are developed. The first considers a non-cooperative scenario, where fleets cannot move between EEZs, and fishing costs differ by region. The second represents a cooperative scenario, allowing fleet movement at a rate determined by environmental conditions and assuming equalized costs. Both models consist of seven equations describing biomass growth, regional fishing effort, and price dynamics via supply-demand interactions. Using a two-time scale approach (fast for fleet movement and price adjustment, slow for biomass and effort growth) the system is reduced by the aggregation method to focus on total biomass. In the non-cooperative case, regions with higher carrying capacity, larger area, or lower costs tend to monopolize the fishery, eliminating effort elsewhere. Coexistence of fishing effort in all three regions requires a strict equality condition on environmental parameters, which is rarely satisfied. Multiple equilibria may arise, including extinction equilibria with residual effort, saddle-type equilibria, and coexistence of stable extinction and positive equilibria. In the cooperative case, monopolization does not occur, and four equilibrium structures emerge, including asymptotically stable extinction states, saddle-positive coexistence, and multiple stable positive equilibria. We place particular emphasis on analyzing how the fishing cost parameter shapes the system's asymptotic behavior, as it strongly influences the qualitative dynamics. Unlike carrying capacity or area, fishing cost is policy-controllable, providing a practical tool for fisheries management and cooperative governance among nations in the Gulf of Thailand.

Keywords:

The *Diadegma fenestrale* Ichnovirus (DfIV): roles and genomic interactions in a complex parasitoid-host relationship

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Abstract

Polydnaviruses (PDVs) exhibit highly specific mutualistic relationships with endoparasitoid wasps, diversifying into bracoviruses and ichnoviruses through independent evolutionary trajectories. As obligate symbionts, PDVs encode genes that are crucial for successful parasitism, often including factors that disrupt host immunity, thereby ensuring parasitoid survival within lepidopteran larvae. However, the expression of these genes must be tightly regulated to avoid detrimental effects on the parasitoid itself. The *Diadegma fenestrale* Ichnovirus (DfIV), a well-characterized PDV, possesses a genome comprised of 62 non-overlapping circular DNA segments, totaling approximately 240 kb. Our prior investigations have revealed differential expression of DfIV genes across distinct hosts and developmental stages, even within the same host species. Furthermore, we have demonstrated the integration of DfIV segments into the host genome, suggesting a mechanism for accelerated co-evolution. Here, I will explore the evolutionary implications of these findings, focusing on the intricate interplay between DfIV gene regulation, host specificity, and the co-evolutionary dynamics shaping this complex tripartite interaction.

Keywords: *Polydnavirus, koinobiont, campopleginae, coevolution, host adaptation*

Characterization of transcriptomic and physiological properties of *Ligularia stenocephala* in response to deep seawater fertilization

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Abstract

Deep seawater (DSW) shows promise as a sustainable biofertilizer that can meet both the nutritional and water needs of *Ligularia stenocephala*, a lesser-studied leafy vegetable and folk medicine. This study evaluated the effects of DSW at 0% (NT), 5% (DSW5), and 10% (DSW10), as well as its diluted derivatives (SWF500 and SWF1000), on soil chemistry, plant physiology, antioxidant activity, and stress-responsive gene expression under high salinity conditions. SWF500 improved soil fertility, recording the highest total nitrogen (0.15%), P₂O₅ (363.63 mg.kg⁻¹), SiO₂ (199.25%), and organic matter (23.23 g.kg⁻¹), while DSW10 elevated electrical conductivity (1.30 dS.m⁻¹), cation exchange capacity (10.56 cmol.kg⁻¹), and salinity (1.1%). Careful assessment of crop responses, such as leaf nutrient content, reflected these trends, with SWF500 enhancing nitrogen (5.127%), carbon (46.007%), sulfur (0.583%), and phosphorus (0.881%) levels, and DSW zones showing increasing sodium levels. Antioxidant activities diverged across treatments, with DSW5 maximizing TPC and ABTS activity, while SWF500 enhanced DPPH. Notably, DSW10 promoted leaf expansion at the first 4 weeks of growth and reduced postharvest weight loss to more than 71% after 9 days. Transcriptomic analysis revealed strong induction of ROS-scavenging and osmotic stress responsive genes, including *HPPD*, *ROMT*, and *HPT1*. These findings unveil the physiological and molecular mechanisms of diluted deep seawater and its derivatives in enhancing soil fertility, activating antioxidant activities, and reprogramming stress-responsive pathways, highlighting their potential as sustainable inputs for organic agriculture.

Keywords:

A comparative study on the effect of contract farming on rice farmers' income and yield: a case study in Vietnam

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Abstract

The Vietnamese government has been promoting an enabling environment for vertical integration in the rice value chain through contract farming (CF) to enhance value chain upgrading, product quality, and farmers' incomes. While previous studies have examined the effects of CF participation versus non-participation, evidence on the differential impacts of specific CF models remains limited. This study investigated the effects of two CF models: Indirect contract farming (CF-I) and direct contract farming (CF-D), on rice farmers' income and yield in the Mekong Delta region of Vietnam. Using primary data from 437 rice farmers across Can Tho, An Giang, and Hau Giang provinces, this study used propensity score matching (PSM) to address selection bias. The findings showed that farmers participating in the CF-I model achieved higher incomes and yields than non-CF farmers, with income increases ranging from 7.48 to 8.99 million VND/ha and yield increases from 0.44 to 0.76 tons/ha. Farmers engaging in the CF-D model had income increases ranging from 5.04 to 5.54 million VND/ha, while the change in yield was not statistically significant. Moreover, the findings showed that farmers engaging in the CF-I model had higher income and yield than those in the CF-D model. This study contributed comparative evidence on the effect of different CF models in the rice sector. This study suggested that scaling up CF models, especially the CF-I model, can be an effective strategy to improve both farmers' income and yield.

Keywords: *Contract farming, PSM, income, yield, rice farmers*

The analysis of emergent behavior in flocks with visual field

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Abstract

We propose an extension of the classical Cucker--Smale model by introducing a visual field into the interaction mechanism through the characteristic function, which captures directional and asymmetric perception among agents. For both discrete and continuous time systems, we derive sufficient conditions for flocking, showing that convergence emerges under suitable assumptions on the initial configuration and system parameters only. We further show that these conditions recover the classical Cucker-Smale results in the limiting case which means the angle of visual field turns to 2π under some cases. Numerical simulations are provided to illustrate and validate the theoretical findings.

Keywords:

Rainfall variability and nutrient dynamics driving fishery decline in Kafuri bay

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Abstract

Kafuri Bay in Itoshima City, a shallow coastal ecosystem supporting aquaculture and small-scale fisheries, has experienced a marked decline in catches in recent years. To investigate the underlying drivers, long-term water quality data (April 2010–December 2023) were analyzed using Principal Component Analysis (PCA). Nine parameters (temperature, salinity, COD, DO, NH₄-N, NO₃-N, NO₂-N, PO₄-P, chlorophyll-a) were examined at both surface and bottom layers. PCA extracted three main components at each layer: surface phytoplankton activity, nutrient concentrations, and winter oxygen at the surface; winter nutrient input, organic matter supply, and bottom phytoplankton proliferation at the bottom. Time-series comparison revealed that peaks in surface phytoplankton and nutrient indices often coincided with heavy rainfall, indicating terrestrial runoff as a dominant nutrient source. Aquaculture yields were strongly associated with surface nutrient availability, while boat fisheries depended more on bottom phytoplankton. However, reduced catches in 2020 despite elevated phytoplankton indices highlighted the critical role of organic matter supply. These results suggest that rainfall variability, intensified by climate change, disrupts nutrient inflow and destabilizes coastal productivity, thereby undermining fisheries. Adaptive management strategies must therefore account for rainfall-induced shifts in nutrient supply to sustain fisheries under a changing climate.

Keywords:

Effects of co-composting of chicken manure and biochar on growth and yield of Malabar spinach (*Basella alba*)

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Abstract

The experiment aims to study the effects of co-composted products of chicken manure and biochar on growth and yield of Malabar spinach (*Basella alba*). The experiment was arranged in a randomized complete block design (RCBD), including 4 co-composted fertilizer treatments of chicken manure co-composted with 0, 5, 10 and 20% biochar. The results showed that chicken manure co-composted with biochar gave the higher plant height, leaves number, SPAD index and yield than treatment with chicken manure compost, the highest was treatment with 20% biochar. Co-composted product also increased Brix value and reduced nitrate residue in vegetable. The study concludes that co-composted product could increase the growth and yield of Malabar spinach while making the most use of locally available raw materials.

Keywords: *co-composting, chicken manure, biochar, Malabar spinach, yield*

Effects of biochar and fertilizer application on growth, yield and N₂O emissions of kohlrabi

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Abstract

This study investigated the effects of biochar (B) and different fertilizer types (F) application on the growth, yield, quality, and N₂O emissions of kohlrabi (*Brassica oleracea* var. *caulorapa*) cultivated on upland field at the Faculty of Agronomy, Vietnam National University of Agriculture (VNUA), Hanoi, Vietnam in autumn-winter season 2025. The 2 factors field experiment included two biochar treatments: B0 (no biochar) and B1 (with biochar); three fertilizer treatments: F1 (100% chemical fertilizer), F2 (50% chemical fertilizer + 50% compost), and F3 (100% composted manure). The results indicated Biochar application did not significantly affect growth, yield, or quality, but it reduced N₂O emissions by 18.9% in comparison to no biochar. There were no significant differences in growth characteristics among fertilizer types. However, the F2 treatment (50% chemical + 50% manure) produced the highest average individual kohlrabi weight (0.48 kg/root) and yield (40.4 tons/ha). The combination of F2 and B1 resulted in the highest leaf number, leaf area index, average head weight, and actual yield (41.65 tons/ha), though these were not significantly different from the F2 and B0. The lowest N₂O emission (0.68 ppm) was recorded in the combination of 100% composted manure with biochar (F3B1). These findings highlight the potential role of integrating organic and inorganic fertilizers with biochar in enhancing kohlrabi yield and mitigating greenhouse gas emissions. Further research is recommended to assess the long-term impacts and economic feasibility under practical field conditions.

Keywords: *biochar, fertilizer, kohlrabi, N₂O emission*

Dynamics in variety and seed choices: the case of pumpkin farmers in northern Vietnam

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Abstract

Smallholder farmers' variety and seed choices are critical to agro-biodiversity and livelihood sustainability. Existing studies often overlooked the dynamic, context-specific nature of such choices. We explored how introductions of hybrid pumpkin varieties affected farmers' choices across spatial and temporal contexts. We interviewed 72 stakeholders and 178 households of 3 ethnic groups in 15 villages at 2 altitudes in northern Vietnam. We assessed farmers' encounter and experimentation with introduced pumpkin types, and their motivations for growing different types. Farmers were grouped according to dynamics in their choices. In Mai Son (700 m a.s.l.), four groups were present: (i) farmers who abandoned local types and only grew introduced types, (ii) farmers who grew traditional and introduced types, (iii) farmers who only grew traditional types after experimenting with introduced types, and (iv) farmers who exclusively grew traditional types without trying introduced types. In Sa Pa (1600 m a.s.l.), the first group was absent. Variety adoption was driven by agronomic performance and by how introduced varieties fitted within broader livelihood systems co-influenced by market access, land and labor allocation, and food and feed needs. These factors played out differently across altitudes. We showed for the first time how dynamics in variety use was shaped by a whole range of changes, not static decisions. Simple adoption models are not useful for designing interventions that enhance use of introduced pumpkins or conservation of traditional pumpkin types: variety choice proved to be an ongoing, dynamic, contextualized process.

Keywords: *Varietal diversity, seed source, hybrid pumpkin, traditional pumpkin, agrobiodiversity*