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WELCOME MESSAGE FROM THE CONFERENCE CONVENER

It is with great pleasure that I welcome you to the 7th International Conference on Agriculture, Food Security, and Food Safety (AgroFood 2026).

On behalf of the International Centre for Research (ICR), it is an honor to welcome you to this global forum dedicated to advancing scholarship and dialogue in Agriculture, Food security and Food Safety. Guided by this year's theme, "Strengthening Agri-Food Resilience: Technology, Safety and Sustainability in the Climate-Challenged World", the conference brings together diverse perspectives to foster collaboration, promote scientific innovation, and explore transformative approaches to sustainable agriculture, food technology, and resilient food systems in response to global challenges.

As the world faces growing challenges related to food security, sustainable agriculture, climate change, and nutrition, research and collaboration are essential for developing innovative and sustainable solutions. The AgroFood 2026 provides a multidisciplinary platform for researchers, academicians, industry experts, and policymakers to share knowledge, present cutting-edge research, and foster collaborations that advance agriculture, food science, and sustainable food systems.

I would also like to express my sincere appreciation to iConferences, the organizing body of this conference, for its dedication and professionalism in bringing together an outstanding international community of scholars and professionals. Through their commitment to excellence in conference management, participants from around the world are provided with an engaging platform for learning, collaboration, and networking.The abstracts presented in this volume reflect the breadth, diversity, and quality of contemporary research in agriculture, food technology and food safety. They demonstrate the collective commitment of our contributors to advancing knowledge, promoting inclusive dialogue, and generating evidence that informs policy, education, and practice across disciplines and communities.

I encourage you to actively participate in the keynote sessions, technical presentations, panel discussions, networking opportunities, and collaborative exchanges throughout the conference. May these interactions inspire new ideas, meaningful partnerships, and lasting contributions to the advancement of agriculture, food technology.Thank you for joining us and for contributing your expertise to AgroFood 2026. I wish you a rewarding, thought-provoking, and memorable conference experience.

Thulakshana Liyanage
Founder & Executive Director
International Centre for Research (ICR), USA
Founder & Director
iConferences , Sri Lanka

MESSAGE FROM THE CONFERENCE CHAIR AGROFOOD 2026

It is my great pleasure to welcome you to the 7th International Conference on Agriculture and Food (AgroFood 2026). Over the years, AgroFood has grown into a vibrant platform that brings together researchers, industry professionals, policymakers, and students to exchange knowledge, foster collaborations, and address the evolving challenges facing the agri-food sector. This year's theme, "Strengthening Agri-Food Resilience: Technology, Safety and Sustainability in the Climate-Challenged World," reflects our shared commitment to developing innovative and science-based solutions for resilient and sustainable food systems.
The increasing impacts of climate change, food insecurity, emerging food safety risks, and rapid technological advancements demand interdisciplinary collaboration and collective action. AgroFood 2026 provides an opportunity to showcase cutting-edge research, encourage meaningful dialogue, and strengthen partnerships that translate scientific discoveries into practical solutions for society.

I would like to express my sincere appreciation to our keynote speakers, presenters, reviewers, sponsors, organizing committee, academic partners, and all participants for their invaluable contributions and unwavering support. Your dedication continues to shape AgroFood into a dynamic international conference that promotes excellence in agricultural and food research.
I hope this conference inspires new ideas, meaningful collaborations, and lasting partnerships that will contribute to a more resilient, safe, and sustainable agri-food future.
I wish you a productive and rewarding conference.

Dr. Nor Khaizura Mahmud Ab Rashid,
Associate Professor,
Department of Food Science, Faculty of Food Science and Technology,
Universiti Putra Malaysia,
Malaysia

MESSAGE FROM THE PARTNERS AGROFOOD 2026 - CENTRE FOR RESEARCH IN BIOTECHNOLOGY FOR AGRICULTURE (CEBAR), UNIVERSITI MALAYA,MALYSIA

On behalf of the Centre for Research in Biotechnology for Agriculture (CEBAR), Universiti Malaya, Malaysia, we are delighted to be partnering with iConferences, Sri Lanka, for the 7th International Conference on Agriculture, Food Security, and Food Safety (AgroFood 2026).

CEBAR's core vision is to be a world-class research centre for agricultural biotechnology, dedicated to advancing a sustainable bioeconomy. This mandate aligns perfectly with this year's timely and critical conference theme for AgroFood 2026: "Strengthening Agri-Food Resilience: Technology, Safety and Sustainability in the Climate-Challenged World."

As we face unprecedented global climate disruptions, the vulnerability of our food systems has never been more apparent. At CEBAR, our research focuses on leveraging cutting-edge biotechnology to engineer climate-resilient crops, enhance food safety, and pioneer sustainable agricultural practices. We believe that modern biotechnology is not just a scientific tool, but a vital shield to protect global food security against environmental volatility.

Our partnership with AgroFood 2026 reflects a shared commitment to the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals). Addressing these complex global challenges requires breaking down silos. This conference serves as a premier platform for the cross-border sharing of knowledge, bringing together researchers, policymakers, and industry leaders to translate scientific discoveries into actionable, real-world solutions.

Through this collaboration, we hope to foster deep networks, inspire new joint research initiatives, and empower the next generation of agricultural innovators. We wish all the participants, presenters, and organizers a highly fruitful and inspiring conference. Together, let us cultivate a more resilient, safe, and sustainable future for global agriculture.

Associate Professor Dr Tan Boon Chin (Director),
Prof Jennifer Ann Harikrishna (Former Director)
Associate Professor Rosazlin Abdullah
Centre for Research in Biotechnology for Agriculture (CEBAR)
Universiti Malaya,
Malaysia

MESSAGE FROM THE PARTNERS AGROFOOD 2026 - UNIVERSITY OF AGRICULTURE FAISALABAD

A Shared Commitment to a Resilient Agri-Food Future On behalf of University of Agriculture Faisalabad Pakistan, I am delighted to extend our warmest greetings to all participants of the 7th International Conference on Agriculture, Food Security, and Food Safety 2026 (AgroFood 2026).

In an era marked by significant climate challenges, the theme of this year's conference, “Strengthening Agri-Food Resilience: Technology, Safety and Sustainability in the Climate-Challenged World,” is both timely and critical. The need for robust, sustainable, and technologically advanced food systems has never been more urgent. Events like AgroFood 2026 are invaluable platforms for fostering the international collaboration and knowledge exchange necessary to tackle these global issues.

As academics, researchers, and industry leaders convene in Kuala Lumpur and online, we are presented with a unique opportunity to share insights and forge partnerships that will shape the future of agriculture. We commend the organizers for bringing together such a distinguished panel of speakers and for providing strong publication opportunities that will amplify the impact of the research presented.

The University of Agriculture Faisalabad Pakistan is proud to support this important initiative. We look forward to the outcomes of the discussions and the innovative solutions that will emerge from this gathering, and we reaffirm our commitment to contributing to a more secure and sustainable agri-food landscape for all. Wishing you a successful and insightful conference.

Dr. Muhammad Azhar Ali
Department of Food Engineering
University of Agriculture Faisalabad
Pakistan.

Table of Contents Page No

ABSTRACTS OF ORAL SESSIONS

AGRICULTURAL BIOTECHNOLOGY, CROP IMPROVEMENT AND CLIMATE RESILIENCE

SUSTAINABILITY, ONE HEALTH AND AGRICULTURAL SYSTEMS

ARTIFICIAL INTELLIGENCE, DIGITAL AGRICULTURE AND AGRICULTURAL ANALYTICS

ABSTRACTS OF ORAL SESSIONS - VIRTUAL

FOOD SECURITY, FOOD SYSTEMS AND COMMUNITY RESILIENCE

AGRICULTURAL ECONOMICS, VALUE CHAINS AND SUSTAINABLE DEVELOPMENT

FOOD TECHNOLOGY, FUNCTIONAL FOODS AND PRODUCT INNOVATION

ABSTRACTS OF POSTER SESSIONS

.

ABSTRACTS OF ORAL SESSIONS

PAPER SESSION 1:

AGRICULTURAL BIOTECHNOLOGY, CROP IMPROVEMENT AND CLIMATE RESILIENCE

A1 **[01]**

BIOENGINEERING SOIL-DERIVED BACTERIAL EXOPOLYSACCHARIDES AS POTENTIAL NATIVE HYDRO-MATRICES FOR SUSTAINABLE AND RESILIENT AGRICULTURAL APPLICATION

Nasuha, A., Ali, M., Afrin, S. and Bhuiyan, M. N. I.

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Bacterial exopolysaccharides (EPS) are extracellular biopolymers that contribute to biofilm formation, protection against desiccation and oxidative stress, and microbial adaptation to environmental fluctuations. Due to their water-retention and stabilizing properties, EPS have attracted attention as sustainable biomaterials with potential agricultural and industrial applications. This study focused on systematic screening, molecular taxonomic identification, and physical-biochemical performance tracking of high-yielding exopolysaccharides producing bacterial strains, evaluate their biochemical and functional properties, and assess their potential relevance for moisture retention and sustainability-oriented agricultural applications. Soil samples from Dhaka city were evaluated for potential hydrogen levels, and aerobic heterotrophic bacterial loads were quantified using colony-forming units. Phenotypic screening was verified via Congo Red tests, followed by microscopic, biochemical, and sixteen-S ribosomal ribonucleic acid gene sequencing. Purified biopolymers were structurally mapped using Ultraviolet and Fourier-transform infrared spectroscopy, while functional properties, including water-holding capacity, oil-holding capacity, water solubility, emulsification activity, and antioxidant potential, were evaluated. The soils exhibited a neutral-to-slightly alkaline pH and high microbial abundance. Among twelve bacterial isolates, three EPS-producing strains were identified as *Bacillus subtilis*, *Bacillus velezensis*, and *Bacillus stercoris*. Optimisation studies revealed *B. stercoris* as the highest EPS producer. *Bacillus* species were considered promising candidates due to their high EPS productivity, environmental adaptability, and previously reported plant-associated benefits. The purified EPS demonstrated high water-holding capacity, favourable water solubility, strong emulsification performance, and notable free-radical scavenging activity. These properties suggest potential utility in applications requiring moisture retention and physicochemical Soil-derived *Bacillus* exopolysaccharides exhibited promising functional characteristics that may support their future development as bio-based hydro-matrix materials. Strategically deploying these native bacterial matrices is an effective intervention to mitigate topsoil moisture depletion and reduce reliance on synthetic agrochemicals. Future studies should evaluate the performance of these EPS materials in soil-based trials, including plant growth promotion, drought-stress mitigation, and moisture-retention assessments under field-relevant conditions. Such investigations will be essential to establish the practical applicability of these EPS materials in agricultural settings. For agro-biotechnology applications, these biopolymers represent a promising sustainable alternative that may contribute to improved soil health and ecological resilience. Nevertheless, further optimization of production processes and large-scale validation studies are required before commercial or field deployment.

Keywords: Exopolysaccharides, bioengineering, *Bacillus*, moisture retention, sustainable agriculture, hydro-matrix

A2 **[02]**

TRANSCRIPTOMIC RESPONSES OF *Musa acuminata* cv. BERANGAN TO DROUGHT: UNVEILING THE ROLE OF THE *MAMYB-86-LIKE* TRANSCRIPTION FACTOR

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[2]UM Agroforestry, Universiti Malaya, Malaysia

Banana is the fourth economically important crop worldwide, feeding over 500 million people. However, drought stress adversely affects the yield and productivity of bananas worldwide. To combat drought stress, bananas have developed complex resistance and adaptation mechanisms. However, there is still a lack of understanding regarding the molecular regulation of drought stress signalling in the Berangan cultivar. Hence, this study determined the drought responses of Berangan at the transcriptome level. This study hypothesized that drought stress could alter gene expression in Berangan and the MYB transcription factor could be activated. To test this hypothesis, RNA-sequencing analysis was performed on well-watered, drought-stressed for 7 days, or water-recovered leaf samples. In total, 767 and 542 differentially expressed genes (DEGs) were identified in drought-stressed and water-recovered samples, respectively, compared to their respective well-watered plants. Notably, 81 of these DEGs were transcription factors, with the highest in the MYB family. To validate the role of the MYB transcription factor, a highly differentially expressed gene, *MaMYB86-like*, was ectopically expressed in yeast, and analyzed for protein-protein interaction. The results showed that *MaMYB86-like*-expressing yeast enhanced drought and heat tolerance. These findings suggest that the *MaMYB86-like* may enhance the production of secondary metabolites to cope with drought stress.

Keywords: Banana, drought stress, transcription factor, MYBs, transcriptomic

A3 **[03]**

OIL PALM WOOD VINEGAR AS A FOLIAR BIOSTIMULANT IMPROVES DROUGHT STRESS TOLERANCE IN *Pandanus amaryllifolius*

Amnan, M.A.M, Teo, W.F.A, Aizat, W.M, Khaidizar, F.D, and Tan, B.C

Centre for Research in Biotechnology for Agriculture (CEBAR), Universiti Malaya, Malaysia

Drought stress poses a severe threat to plant growth, yield, and survival worldwide. Wood vinegar, a condensate derived from smoke generated during biochar production, has garnered increasing attention as a sustainable biostimulant capable of promoting plant growth and enhancing abiotic stress tolerance. This study aimed to evaluate the efficacy of oil palm wood vinegar in mitigating the adverse effects of drought stress on *Pandanus amaryllifolius*, and to determine its optimal application concentration and frequency. Optimal oil palm wood vinegar concentration and application frequency were established prior to drought imposition. Plants were subsequently subjected to drought stress and treated exogenously with oil palm wood vinegar to assess physiological, biochemical, and molecular responses. Drought stress significantly impaired plant growth; however, foliar application of oil palm wood vinegar at 1:500 dilution at 3-day intervals for 12 days substantially improved drought tolerance. Treated plants exhibited increased leaf relative water content, root-to-shoot ratio, stem circumference, chlorophyll content, and antioxidant enzyme activities, alongside reduced electrolyte leakage, hydrogen peroxide, proline, and malondialdehyde levels. Molecular analysis revealed upregulation of drought-responsive genes (*HSP70*, *GAPDH*, and *Thau*) with concurrent downregulation of *ENO* and *β-Fruc*. These biostimulatory effects are attributed to key bioactive compounds in OPWV, including anthranilic acid, syringol, guaiacol, and catechol. Oil palm wood vinegar demonstrates clear potential as a sustainable foliar biostimulant for alleviating drought stress in *P. amaryllifolius*, warranting further investigation across other economically important crop species.

Keywords: Drought stress, wood vinegar, oil palm waste, biostimulants, antioxidants enzymes, drought tolerance.

A4 **[04]**

EFFECT OF SOIL AND FOLIAR APPLICATION OF POTASSIUM AND ZINC ON HYBRID MAIZE (*Zea mays* L.) PRODUCTIVITY

Ali, A[1]., Safdar, M.E.[1], Nadeem, M.A.[1], Qamar, M.R.[1], Khoiriyah, N.[2]

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[2]Department of Agribusiness, Faculty of Agriculture, Universitas Islam Malang, Indonesia

The experiment was conducted at research area of Agronomy, University of Sargodha, Punjab, Pakistan to determine the effect of different levels and methods of potassium and zinc application on hybrid maize. The trial was in randomized complete block design with three replications having net plot size 4m × 3m. The treatments were comprised of , T_1 = Control, T_2 = K_2O = 0 kg ha^{-1} + $ZnSO_4$ = 15 kg ha^{-1} (At Soil), T_3 = K_2O = 0 kg ha^{-1} + $ZnSO_4$ = 0.15% (Foliar Spray), T_4 = K_2O = 75 kg ha^{-1} (At Soil) + $ZnSO_4$ = 0 kg ha^{-1}, T_5 = K_2O = 75 kg ha^{-1} (At Soil) + $ZnSO_4$ = 15 kg ha^{-1} (At Soil), T_6 = K_2O = 75 kg ha^{-1}(At Soil) + $ZnSO_4$ = 0.15% (Foliar Spray), T_7 = K_2O = 1.5% (Foliar Spray) + $ZnSO_4$ = 0 kg ha^{-1}, T_8 = K_2O = 1.5% (Foliar Spray) + $ZnSO_4$ = 15 kg ha^{-1} (At Soil), T_9 = K_2O = 1.5% (Foliar Spray) + $ZnSO_4$ = 0.15% (Foliar Spray). Yield components of maize had significant differences among all treatments. The maximum plant height (214.23 cm), cob length (21.56 cm), thousand-grains weight (417.10 g), grain yield (5262 kg ha^{-1}), crude protein and crude oil percentage was higher (9.34 %) and (6.43 %), was observed at potassium and zinc level (K_2O @ 1.5% (Foliar Spray) + ZnSO4 @ 0.15% (Foliar Spray). Maize (Zea mays L.) is an important cereal crop, but its productivity is limited due to nutrient deficiencies and improper fertilizer use, particularly potassium and zinc. This study aimed to evaluate the effect of soil and foliar application of potassium and zinc on growth, yield, and quality of hybrid maize. The experiment was conducted at Agronomic research area, University of Sargodha using a randomized complete block design with three replications. Nine treatments involving different combinations of potassium (K_2O) and zinc ($ZnSO_4$) were applied through soil and foliar methods. Data on growth, yield, and quality parameters were recorded and analyzed statistically using analysis of variance. Significant differences were observed among treatments. The highest plant height (214.23 cm), cob length (21.56 cm), grains per cob (415.27), thousand-grain weight (417.10 g), and grain yield (5262 kg ha^{-1}) were obtained with foliar application of potassium (1.5%) and zinc (0.15%). Similarly, maximum crude protein (9.34%) and crude oil (6.43%) contents were recorded under the same treatment. Foliar application of potassium and zinc proved more effective than soil application in improving growth, yield, and quality of maize. It is recommended to apply potassium (1.5%) and zinc (0.15%) as foliar spray for better productivity under semi-arid conditions.

Acknowledgment: The first author is grateful to Higher Education Commission of Pakistan for providing travel grant to attend the 7th International Conference on Agriculture, Food Security, and Safety (Agro Food -2026) for oral presentation of his research work.

Keywords: Components, cob, foliar, growth, quality, yield

A5 **[05]**

GREEN SYNTHESIS AND OPTIMIZATION OF SILVER NANOPARTICLES DERIVED FROM BENTONG GINGER (*Zingiber officinale*) EXTRACT

Jabar, A., N.A., Ismail, S.I., Loo, Y.Y., Chong, K.H., Padmanabhan, K., Nor-Khaizura, M.A.R.

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Foodborne illnesses are becoming a worldwide issue, and the conventional chemical preservatives used to control them raise concerns over residues, environmental pollution, and microbial resistance, which creates a need for safer and more environmentally friendly alternatives. Silver nanoparticles produced through a plant-mediated green route offer a promising option, yet the rhizome extract of Malaysian Bentong ginger remains underexplored as a reducing and stabilising agent. This study aimed to synthesise and optimise silver nanoparticles using Bentong ginger rhizome extract. Extracts were prepared from both self-dried rhizome and commercial ginger powder with distilled water, then mixed with silver nitrate solution to reduce the silver ions. A one-factor-at-a-time approach was applied to optimise three parameters: pH, silver nitrate concentration, and incubation time, while formation was monitored through a visible colour change and by ultraviolet-visible spectrophotometry. Successful synthesis was confirmed by a colour change from light yellow to dark brown and by a characteristic surface plasmon resonance peak at 450 nanometres. The most stable nanoparticles were obtained under alkaline conditions at an acidity of 11, a 1-millimolar silver nitrate concentration, and a 24-hour incubation, with both extract types yielding comparable results. Bentong ginger rhizome extract is therefore an effective green source for synthesising stable silver nanoparticles, providing an optimised foundation for their subsequent antimicrobial applications in food preservation.

Keywords: Green synthesis; silver nanoparticles; Bentong ginger; optimization; surface plasmon resonance

A6 **[06]**

GREEN-SYNTHESIZED ZINC OXIDE (ZNO) NANOPARTICLES ALLEVIATE DROUGHT STRESS IN ROUGH LEMON (*Citrus jambhiri L.*) ROOTSTOCK

Tehseen, M.[1], Khan, T.A.[1], Zang, X.[1], Cao, Z.[1], Hu, L.[1], Zhou, C.[1], Wang, L.[1,2]

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Drought stress is a significant abiotic stress that delays citrus production by limiting vegetative growth, affecting gas exchange, and causing oxidative damage due to excessive reactive oxygen species (ROS) production. The present study evaluated the potential of green-synthesized zinc oxide nanomaterials (ZnO NPs) derived from Calotropis gigantea leaf extract to mitigate drought-induced damage in rough lemon (*Citrus jambhiri* L.) rootstocks. A pot experiment was conducted using a completely randomized design with two irrigation regimes: well-watered and drought-stressed plants subjected to 15 days of irrigation withholding and five foliar ZnO NP levels (0, 50, 100, 150, and 200 ppm). Drought stress had marked negative effects on plant growth and gas-exchange traits. However, foliar application of ZnO NPs reduced the adverse effects. The 150 ppm treatment showed significant improvements in plant height, leaf development, total biomass, and relative chlorophyll content under both water-use regimes. Under drought stress, the application of 100 ppm ZnO NPs resulted in the most favorable net photosynthetic rate (Pn) and stomatal conductance, while enhancing antioxidant defense (i.e., peroxidase and catalase activities, DPPH radical-scavenging potential, and total phenols). These responses contributed to improved detoxification of reactive oxygen species and reduced oxidative stress. Overall, foliar application of green-synthesized ZnO NPs (100-150 ppm) can be a promising strategy for improving photosynthetic and antioxidant activity, and growth of citrus rootstocks under water-deficit conditions.

Keywords: Antioxidant enzymes, citrus rootstocks, drought stress tolerance, gas exchange, green synthesis; nanobiotechnology, *Citrus jambhiri*; zinc oxide nanoparticles

PAPER SESSION 2:

SUSTAINABILITY, ONE HEALTH AND AGRICULTURAL SYSTEMS

B1 **[07]**

OLIVE: INNOVATION IN VALUE ADDITION AND EXPANSION IN OMAN

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College of Agricultural and Marine Sciences, Sultan Qaboos University, Oman.

Olive: Innovation in Value Addition and Expansion in Oman is a strategic research initiative that examines the sustainable expansion of olive cultivation in the Sultanate of Oman while advancing value-added uses of olives and their byproducts. Omani farmers of the high-altitude mountains, such as Al Jabal Al Akhdar, have recently been introduced to olive as a new crop. Since its introduction over the past decade, olive production has experienced a surge in popularity and potential. Exploring locally-produced olives for innovative, value-added food and functional products. The research is structured around the following practical goals that will be assessed using various methods: (1) assessing the current status of olive cultivation, including cultivars, productivity, and potential for vertical and horizontal expansion using various crops assessment and yield methods; (2) analyzing the physical and chemical qualities of Omani olives and oils to enhance the competitiveness of extra virgin and pomace oils. The analysis will include various olive oil quality and quantity parameters that compare different chemical and physical properties.; (3) identifying optimal agronomic conditions climate, soil health, water efficiency, and management practices—for suitable olive varieties using crop chilling requirement modelling and Maximum Entropy models; and (4) exploring value addition through byproducts, including nutraceuticals, cosmetics, and beverages. Although an oil crop, olives also show strong potential as a functional food and beverage crop. Olive leaves, rich in oleuropein and hydroxytyrosol, can be processed into teas, powders, or ready-to-drink extracts with cardiovascular and immune benefits. Olive fruits and residues may be converted into fermented juices, probiotic drinks, or antioxidant blends, while hydroxytyrosol-rich pomace and wastewater may be used in sports and wellness beverages. These innovations add economic value while promoting sustainability, which will ultimately enhance the value of niche olive production in Oman, located in a climate- and water–challenged region.

Keywords: Oman, olives, value-addition, *Olea europaea*, functional food

B2 **[08]**

COMPARATIVE METHODOLOGICAL CHALLENGES IN AGRICULTURAL SUSTAINABILITY ASSESSMENT UNDER THE LOW-CARBON TRANSITION

Streimikis, J.

Vytautas Magnus University, Lithuania

Agricultural sustainability assessment increasingly requires the simultaneous consideration of economic, environmental, and social objectives, particularly under the low-carbon transition. Multi-criteria decision-making (MCDM) methods provide useful tools for addressing such multidimensional problems, but the diversity of available approaches creates an important methodological challenge: selecting a method that is appropriate for a specific assessment task. This study presents a comparative methodological analysis of eight widely used MCDM approaches: AHP, BWM, Fuzzy-BWM, TOPSIS, VIKOR, PROMETHEE, ELECTRE, and MULTIMOORA. The methods are compared according to their analytical functions, treatment of uncertainty, expert involvement, strengths, limitations, and typical applications. The analysis demonstrates that MCDM methods should not be regarded as interchangeable, as they perform different functions including criteria weighting, alternative ranking, and analysis of conflicting objectives. Based on these differences, a task-oriented framework for method selection is proposed. The study concludes that method selection should follow the analytical objective of the assessment, while hybrid approaches can combine complementary methodological functions where necessary.

Keywords: Agricultural sustainability, sustainability assessment, multi-criteria decision-making, low-carbon transition.

B3 **[09]**

EFFECT OF MALTODEXTRIN ON FLOWABILITY AND COMPACTION OF FREEZE-DRIED AMBARELLA AND KEY LIME POWDERS

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The conversion of fruit pulps into powder form enhances their shelf life and expands their applications in food and nutraceutical products; however, their utilization is often limited by poor flowability, stickiness, and weak compaction behavior. This study investigated the effect of maltodextrin (DE5) at 0, 10, and 20% (w/w) on the physicochemical, flow, and compaction properties of freeze-dried Ambarella (Spondias cytherea) and Key Lime (Citrus aurantifolia) powders. Fruit pulps were homogenized with maltodextrin, freeze-dried, and milled into powders, which were then characterized for moisture content, particle size, density, glass transition temperature (Tg), flowability, and tablet tensile strength. Results showed that increasing maltodextrin significantly reduced particle size (from 257 to 80 µm in Ambarella and from 225 to 90 µm in Key Lime) and increased bulk density. Flowability improved notably in Ambarella powders at higher maltodextrin levels, whereas Key Lime powders exhibited increased cohesion at 20% maltodextrin. In terms of compaction behavior, Ambarella powders without maltodextrin produced the strongest tablets (up to 2.51 MPa), while Key Lime powders showed lower tensile strength overall (1.21–1.87 MPa). The glass transition temperature remained low for all samples due to high sugar and acid content. Overall, maltodextrin improved powder handling properties, although its effects were fruit dependent. The findings highlight the importance of optimizing carrier concentration to achieve desirable flow and compaction characteristics in fruit powder applications.

Keywords: Ambarella, compaction, flowability, freeze drying, key lime, maltodextrin, powder, tablet formation

B4 **[10]**

AMR AT THE POULTRY–ENVIRONMENT INTERFACE: EVIDENCE OF UNDETECTED TRANSMISSION IN A ONE HEALTH COMMERCIAL INTENSIVE BROILER FARM

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This study investigated antimicrobial resistance (AMR) in Escherichia coli at the poultry–environment interface within a One Health framework in a commercial intensive broiler farm in Qatar. A total of 426 cloacal and environmental samples (dust, feed, litter, boot swabs, and water) were analyzed using standard microbiological methods, antimicrobial susceptibility testing against 15 antibiotics, and whole-genome sequencing for selected isolates. E. coli was widely detected across all sample types, with high resistance to ciprofloxacin, tetracycline, ampicillin, and trimethoprim–sulfamethoxazole, while all isolates remained susceptible to carbapenems. Multidrug-resistant strains were highly prevalent, and a strong association between poultry and environmental resistance profiles ($p < 0.0001$) suggested undetected transmission within the farm ecosystem, with higher resistance levels observed during summer. Overall, the study demonstrates circulation of antimicrobial-resistant E. coli between poultry and the environment, highlighting broiler farms as important reservoirs of MDR bacteria, with implications for One Health surveillance, biosecurity, and food safety to potential human exposure through the poultry production chain.

Keywords: *Escherichia coli*, AMR, multidrug resistance, poultry, one health.

B5 **[11]**

STRENGTHENING CERTIFICATION SYSTEM IN ORGANIC RICE GOVERNANCE: AN INSTITUTIONAL ECONOMICS VALUE CHAIN UPGRADING STRATEGIES

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Organic certification plays a strategic role in upgrading the organic rice value chain by enhancing product credibility, expanding market access, and strengthening farmers' bargaining position. The abstract credibility, expanding market access, and strengthening farmers' bargaining position. However, the certification process often involves complex procedures, administrative burdens, and high transaction costs that constrain smallholder participation. This study aims to explore the business processes of the organic rice certification system, identify the bottlenecks, and formulate institutional strategies to improve efficiency and support institution-value chain upgrading. The study was conducted in organic rice production centers in Central Java Province. A qualitative approach was applied through in-depth interviews with value chain actors, including farmer champions, heads of farmer groups, certification facilitators, extension officer, traders, processors, and government representatives. Using an institutional economics perspective, this study examines the interaction between formal institutions, such as certification standards, inspection procedures, and documentation requirements, and informal institutions, including trust, collective action, leadership, and farmer group norms. The findings reveal that high compliance cost, weak documentation capacity, limited internal control systems, facilitator dependency and fragmented coordination are key bottlenecks. Strengthening farmer institutions, certification cost financing, collective certification, internal control systems, and government support is recommended.

Keywords: Organic certification, institutional economic, governance, rice, cost, value chain

PAPER SESSION 3:

ARTIFICIAL INTELLIGENCE, DIGITAL AGRICULTURE AND AGRICULTURAL ANALYTICS

C1 **[12]**

HYPERSPECTRAL IMAGING AND ARTIFICIAL INTELLIGENCE FOR PRECISION QUALITY MAPPING OF MANGOES

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This study aims to develop a non-destructive approach for spatial prediction of mango internal quality, specifically soluble solids content and titratable acidity, using hyperspectral imaging and artificial intelligence. A total of N hyperspectral images of mango samples was acquired in the visible and near-infrared range, and corresponding reference measurements (n = N samples) were obtained using standard laboratory methods. Spectral data were preprocessed through reflectance correction, normalization, smoothing, and derivative transformation to enhance informative features. Partial least squares regression was employed as a baseline model, while deep neural network models were developed to capture nonlinear relationships between spectral data and quality attributes. The results showed that the deep learning models achieved superior predictive performance, with coefficients of determination reaching R^2 = 0.89 (SSC) and 0.61 (TA), with corresponding root mean square errors of RMSE =1.06 and 0.09, respectively, outperforming the regression approach. Furthermore, pixel-level prediction enabled the generation of spatial distribution maps of sugar and acidity across mango surfaces, revealing internal heterogeneity that cannot be captured by conventional point-based measurements. Overall, the proposed framework demonstrates strong potential for precise, automated, and nondestructive fruit quality assessment in intelligent agriculture and postharvest grading applications.

Keywords: Hyperspectral imaging, mango quality assessment, soluble solids content, titratable acidity, non-destructive evaluation, precision agriculture

C2 **[13]**

BUILDING AND VALIDATING EXPERT-GROUNDED QUESTION-ANSWER DATASETS FOR PRECISION AGRICULTURE ADVISORIES IN LOW-RESOURCE SETTINGS

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Precision agriculture for smallholder farmers in low-resource settings requires advisory systems that are not only feasible but also trustworthy, locally relevant, and easy to understand. However, most farmer-facing artificial intelligence systems are discussed at the surface layer, with limited attention to how the underlying advisory knowledge is authored, curated, structured, validated, and made safe for deployment. This paper presents *AgriVaani,* an Indian agriculture domain-specific language model to deliver context-aware, expert-aligned, and actionable advisories across agriculture and allied sectors, as a case study in program-led curation of an expert-grounded agricultural question-answer corpus for a personalised advisory model in India. The objective of the study is to document a practical framework for building high-quality agricultural advisory datasets from affiliated sources and scientific literature ready to use by the Indian farmers. The methodology involved selecting 30 major crops, 6 allied sectors and advisory domains (10-12) with around 150+ subcategories based on the needs of smallholder farmers and designing structured templates for question-answer authoring, along with curating advisory content from around 250+ authoritative published sources, and validating the corpus through an iterative review process by agricultural experts. The system architecture separates the curated knowledge layer from the application layer, where multilingual access is facilitated through translation APIs. The resulting framework offers a replicable and scalable approach for developing grounded, expert-verified, and accessible agriculture advisory datasets for artificial intelligence systems. The study concludes that knowledge curation is a critical but underexamined component in enhancing the reliability and effectiveness of precision agriculture interventions.

Keywords: Precision agriculture, smallholder farmers, agricultural advisory systems, data curation, expert validation, farmer-facing artificial intelligence, low-resource settings, India

C3 **[14]**

AN AI-BASED THERMAL IMAGING SYSTEM FOR REAL-TIME PIGLET MONITORING AND EARLY HYPOTHERMIA WARNING IN FARROWING PENS

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Labor shortages in the swine industry drive the need for automated monitoring in farrowing pens. This study proposes an AI-based thermal imaging system for real-time piglet monitoring and early hypothermia warning. A thermal camera (1280 × 960) was used to collect 2,602 images, annotated into piglets, ear, and foot classes. A YOLOv4 model was trained (70%) and tested (30%) for object detection. Temperature values were extracted from detected piglet regions, and noise filtering was applied to improve reliability. The model achieved stable training with a total loss of 2.6202. Results show the system can accurately detect piglets and estimate their thermal conditions in real time, supporting early hypothermia detection and reducing manual workload.

Keywords: Thermal imaging, piglet detection, hypothermia warning, precision livestock farming, precision agriculture.

C4 **[15]**

ESTIMATING THE TECHNICAL EFFICIENCY OF AGRICULTURAL INFORMATION ADOPTER FARMERS OF MAIZE CROP IN INDIA

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The present study analyses the impact of agricultural information adoption on the technical efficiency of maize farmers in India across 2002, 2012, and 2018 using a stochastic frontier analysis (SFA) production model. Propensity Score Matching (PSM) was used to obtain the information adopter and non-adopter farmers. Results show a consistent decrease in technical efficiency over time, with mean TE decreasing for adopters (0.48 to 0.35) and non-adopters (0.47 to 0.35). A shift towards lower efficiency classes and leftward kernel densities indicates system-wide deterioration. Despite this trend, agricultural information adopters have higher average TE and significant inefficiency reductions in 2012 and 2018. Higher inefficiency persists among SC/ST households and farmers in northern and western and centra regions of India due to socio-economic and spatial disparities. High γ values (o.87-0.96) indicate that inefficiency, not noise, causes most output variation. The study emphasizes the importance of enhanced extension services, input access, and region-specific support to boost efficiency and technological information adoption.

Keywords: Information adoption, maize, propensity score matching, situation assessment survey

C5 **[16]**

CYBERSECURITY AND SYSTEM INTEGRATION AS DETERMINANTS OF EXPORT COMPETITIVENESS IN FLORICULTURE

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Flower marketing in Colombia faces the challenge of articulating digital processes that guarantee operational efficiency, traceability and protection of information in increasingly interconnected environments. Given this, system integration and cybersecurity emerge as technologies to help the competitiveness and environmental sustainability of the export sector by minimizing physical logistics related flower waste. To validate a model that explains the interdependence between cybersecurity technologies and systems integration in order to optimize flower marketing. Through a sample of 72 surveys collected in the savannah of Cundinamarca in Colombia, a quantitative approach was studied through exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and structural equation modeling (SEM). The validated model explained 67.59 % of the total variance, confirming that system integration and cybersecurity operate as multidimensional strategic factors. Psychometric properties showed robust reliability ($\alpha > 0.87$; AVE > 0.67; IFC > 0.91) and adequate goodness of-fit indices (CFI > 0.91; IFI > 0.92; RMSEA = 0.14), according to academic literature. In the cybersecurity dimension, the protection of sensitive data and reputational risk analysis presented the highest factor load ($\lambda = 0.901$), while in the integration dimension, the connection between internal management (ERP) and transport ($\lambda = 0.906$) stood out. The results suggest that system integration drives, rather than just complements, the implementation of cybersecurity measures. The structural correlation ($r = 0.785$) shows that producers with greater interoperability are better positioned to adopt advanced protection protocols, fostering a more competitive, sustainable and secure industry.

Keywords: Cybersecurity; system integration; export competitiveness; floriculture; structural equation modeling.

C6 **[17]**

ANALYSING RICE PRODUCTION EFFICIENCY USING WINDOW DEA AND FRACTIONAL REGRESSION MODEL: EVIDENCE FROM INDIA

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In the present study we investigate dynamic efficiency of rice production in Indian states using a window Data Envelopment Analysis (DEA) approach over a ten-year period. The window DEA results reveal considerable differences in efficiency levels across states in different crops over time, indicating the presence of substantial heterogeneity in resource use patterns. While some states show consistently high efficiency and remain near the efficiency frontier, others exhibit persistent inefficiencies. To understand what factors, affect efficiency of rice production, we perform a second stage analysis using Fractional Regression Models (FRM). We find a positive and significant impact of electricity use, rural road density and proportion of irrigated to sown area on crops production efficiency. Among the factors, electricity consumption for irrigating crops has the most significant impact. We also find a negative impact of deviation in rainfall on rice production efficiency. The study has important implications for improving consistency in cereal production in India, encouraging efficient use of resources and aligning agricultural productivity with the long-term goal of food security and environmental sustainability.

Keywords: Window DEA, FRM, efficiency, food security, rice, India

PAPER SESSION 4:
FOOD PROCESSING, PRODUCT DEVELOPMENT AND CROP HEALTH

D1 **[18]**

SPECIES DIVERSITY, PHYLOGENETIC RELATIONSHIPS, AND PATHOGENICITY OF *COLLETOTRICHUM* SPP. CAUSING APPLE ANTHRACNOSE IN TROPICAL HIGHLAND ORCHARDS OF INDONESIA

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Apple anthracnose caused by *Colletotrichum* species is a major constraint to tropical highland apple production in Indonesia, yet information on pathogen diversity remains limited. This study investigated the species diversity, phylogenetic relationships, and pathogenicity of *Colletotrichum* isolates associated with apple anthracnose in East Java. Five representative isolates collected from four major apple-producing regions were characterized using morphological observations and internal transcribed spacer sequence analysis. Species identification was considered preliminary based on sequence similarity and phylogenetic inference. Pathogenicity was evaluated using wounded and non-wounded inoculation methods on apple fruits. The isolates were closely related to *Colletotrichum gloeosporioides*, *C. siamense*, *C. nymphaeae*, and *C. aenigma*, with sequence similarities ranging from 99.48% to 100%. All isolates caused anthracnose, producing lesion diameters of 1.6–2.3 cm, with the *C. gloeosporioides* isolate showing the greatest aggressiveness.These findings improve understanding of *Colletotrichum* diversity in tropical apples and support more accurate disease diagnosis, pathogen surveillance, and targeted disease management. However, identification based solely on the internal transcribed spacer region provides limited taxonomic resolution for species within the *Colletotrichum gloeosporioides* species complex. Therefore, future studies employing multilocus phylogenetic analyses are recommended to confirm species identity and clarify evolutionary relationships among the isolates.

Keywords: Apple anthracnose; disease diagnosis; *colletotrichum*; pathogenicity; phylogenetic analysis; species diversity.

D2 **[19]**

EFFECTS OF FERMENTATION CONDITIONS ON THE PHYSICOCHEMICAL AND MICROBIOLOGICAL PROPERTIES OF PROBIOTIC-FERMENTED TOMATO JUICE

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Probiotic-fermented tomato juice is a promising non-dairy matrix, and this study evaluated the influence of sucrose concentration and fermentation time on its physicochemical and microbiological properties. Tomato juice was inoculated with 1% (w/w) of a mixed probiotic culture containing *Lactobacillus acidophilus* LA5 and *Bifidobacterium lactis* BB12 and fermented at 42°C for 0, 2, 4, and 6 h using sucrose concentrations of 0, 0.5, 1.0, 1.5, and 2.0%. The initial pH (4.625) decreased significantly over time in all treatments, with the 2.0% sucrose juice reaching 4.321 at 6 h compared with 4.494 in the control, indicating greater acidification under higher sucrose supplementation. Titratable acidity remained within the range of 0.466–0.573% lactic acid and did not differ significantly among treatments ($p > 0.05$). Total soluble solids decreased during fermentation, from 8.9% to 7.2% in the 2.0% sucrose treatment and from 8.6% to 7.4% in the 1.5% sucrose treatment, reflecting sucrose utilisation by the probiotic cultures. Colour parameters (L*, a*, and b*) varied with sucrose concentration and fermentation time. The a* value ranged from 15.49 to 31.40, with the 2.0% sucrose treatment at 6 h exhibiting the highest redness (a* = 31.40), suggesting enhanced lycopene-associated colour intensity. Microbiological analysis showed that lactic acid bacteria counts remained above approximately 4.3 log CFU/mL throughout fermentation, with the 1.5% sucrose treatment maintaining relatively stable viability (5.23–5.14 log CFU/mL from 0 to 6 h), while the 2.0% sucrose treatment recovered to 5.05 log CFU/mL at 6 h. Overall, sucrose concentrations of 1.5–2.0% combined with 6 h of fermentation provided favourable conditions for balancing acidification, sugar utilisation, colour development, and probiotic viability in fermented tomato juice.

Keywords: Probiotic viability; physicochemical characteristics; acidification; sugar utilization; non-dairy matrix.

D3 **[20]**

PARTIAL SUBSTITUTION OF WHEAT FLOUR WITH HEAT-MOISTURE-TREATMENT MODIFIED COWPEA FLOUR AFFECTED PHYSICOCHEMICAL AND SENSORY PROPERTIES OF STRAIGHT-DOUGH PREPARED PAN BREAD

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Wheat, one of pan-bread's raw materials, must be imported since Indonesia cannot grow it. Flour from imported wheat is used to prepare pan bread in Indonesia. This food security issue might be lessened by utilizing local food sources e.g., cowpea (*Vigna unguiculata*), to partially substitute wheat flour in pan-bread preparation. Objectives were to determine effect of adjusted moisture content (AMC), temperature, and time of heat moisture treatment (HMT) on cowpea-flour swelling power, solubility, lightness, to select best treatment, and to determine effect of substitution ratios of wheat flour to HMT-modified cowpea flour on pan-bread physicochemical and sensory characteristics. Cowpea flour was modified using HMT with AMC (20, 25, 30%), temperatures (75, 80, 85°C), and time (2, 4, 6 hours). Pan bread was then prepared by partially substituting wheat flour with selected HMT-modified cowpea flour (ratios: 100:0 [control], 95:5, 90:10, 85:15, 80:20, 75:25, 70:30). AMC, HMT temperature and time interactions significantly affected ($p \leq 0.05$) modified cowpea flour swelling power and solubility with best treatments at 25% AMC, 80°C, 6 hours, i.e. highest swelling power (6.36±0.04 g/g). Pan bread (95:5 substitution ratio) exhibited highest ($p \leq 0.05$) volume overall (785.00±7.07 cc), acceptable hardness (238.86±0.04 g) similar to control and higher than other treatments, plus with control having highest overall hedonic acceptance (5.75±0.02 of 7-point scale). Therefore, pan bread with the 95:5 ratio was selected since it exhibited best observed physicochemical and sensory characteristics with either similar to, or higher than control. Taken together, it could be recommended as an alternative for commercial pan bread productions.

Keywords: Cowpea flour, heat moisture treatment (HMT), pan bread, partial substitution, wheat flour

D4 **[21]**

GUAR GUM COATING IMPROVES PRE-STORAGE QUALITY OF BER FRUIT CULTIVARS

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Ber (*Ziziphus mauritiana* L.) is a highly perishable fruit with a limited shelf life, primarily due to its elevated respiration rate, which intensifies physiological changes. Guar gum (GG) is an eco-safe edible coating used to enhance the shelf life of horticultural products by regulating membrane permeability and fruit senescence. Therefore, the current study was conducted to analyze the potential effects of using GG-coating at different concentrations [control, 0.5%, 1%, and 1.5% (w/v)] to control and manage disease incidence, oxidative stress, and preserve the physicochemical characteristics to improve the shelf life of the ber fruit during ambient storage. Results exhibited that pre-storage 1.5% GG-coating considerably reduced the increasing trend of weight loss, disease incidence, synthesis of oxidative stress markers such as electrolyte leakage, malondialdehyde, hydrogen peroxide, browning enzyme activity, i.e., polyphenol peroxidase, as well as inhibited fruit softening by reducing the polygalacturonase and cellulase activities compared to uncoated fruit. However, GG-coated ber fruit showed a considerable reduction in soluble solids content and ripening index, while maintaining the highest values of titratable acidity, ascorbic acid, total phenolic content, and antioxidant scavenging activity. GG-coating enhanced antioxidant enzymes (SOD, POD, CAT, APX), maintained cellular integrity, and is an eco-friendly technique to improve ber fruit.

Keywords: *Ziziphus mauritiana*, guar gum, polygalacturonase, polyphenol peroxidase, oxidative markers, total phenolic content

ABSTRACTS OF ORAL SESSIONS-VIRTUAL

PAPER SESSION 5:

FOOD SECURITY, FOOD SYSTEMS AND COMMUNITY RESILIENCE

E1 **[22]**

GROUNDWATER QUALITY ASSESSMENT FOR SUSTAINABLE AGRICULTURE IN KALPITIYA, SRI LANKA

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Groundwater is the primary water source for agriculture in Kalpitiya, Sri Lanka. However, intensive farming and excessive agrochemical use have raised serious concerns about water quality and long-term sustainability. This study aims to evaluate the physicochemical quality of groundwater and assess its suitability for sustainable agricultural use, with a focus on identifying key risks to soil and crop productivity. Groundwater samples were collected from 10 agricultural wells across the Kalpitiya area to capture spatial variation. Samples were analyzed for pH, electrical conductivity (EC), total hardness, nitrate, free ammonia, and phosphate using standard laboratory methods. The results were compared with the World Health Organization (WHO) and Food and Agriculture Organization (FAO) guideline limits for irrigation water quality. The results showed that pH values ranged from 4.0 to 5.0, which is below the recommended range (6.5–8.5), indicating highly acidic conditions unsuitable for most crops. EC values ranged from 1500 to 2000 µS/cm, exceeding the FAO threshold for salinity hazard, which can negatively affect crop yield. Total hardness ranged from 500 to 1000 mg/L, classifying the water as very hard. Nitrate concentrations (35–50 mg/L) approached or exceeded the WHO limit of 50 mg/L, while free ammonia (1–2 mg/L) and phosphate (3–6 mg/L) levels indicated nutrient contamination likely linked to agricultural activities. These findings mention important risks to soil health, crop productivity, and long-term agricultural sustainability. This study is situated in the site-specific coastal dry-zone groundwater under intensive farming pressure, and provides practical insights for similar regions. Improved water management practices, including controlled fertilizer use and regular monitoring, are recommended to protect groundwater resources and support sustainable agriculture.

Keywords: Groundwater quality, sustainable agriculture, well water, irrigation suitability, environmental sustainability

E2 **[23]**

POST-HARVEST TOMATO LOSSES, COPING STRATEGIES, AND FOOD SECURITY AMONG VALUE CHAIN ACTORS IN NIGERIA

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Post-harvest losses (PHL) undermine incomes and food security in Nigeria's tomato sector, yet remained under-quantified for northern Nigeria. This study examined PHL and food security among producers and marketers in Kano and Kaduna States, Nigeria via five objective-specific tools: descriptive statistics (socioeconomic profiling), the Post-Harvest Loss Index (PHLI: loss levels per node), Tobit regression (loss determinants), the US-HFSSM (food security status), and Ordered Logit Regression (PHL's effect on food security). A four-stage procedure was used: purposive selection of four LGAs per state by production intensity, two villages per LGA via key-information identification, enumeration of farmers and marketers through registers and snowballing, and proportionate random sampling, yielding 308 producers and 35 marketers. The PHLI revealed that 51.3% of producers with moderate losses (mean 15%) linked to handling, rough handling, storage, and knowledge gaps, while marketers recorded lower losses (mean 6%) but faced pest infestation and poor transport. Tobit results showed post-harvest training significantly reduces losses for producers ($\beta=-0.048$, $p<0.01$) and marketers ($\beta=-0.013$, $p<0.01$), and extension contact ($\beta=-0.032/-0.052$, $p<0.05$) significantly reduces losses while transportation costs increased losses for both groups. US-HFSSM revealed 68.6% of marketers were very low food secure (VLFS), the worst outcome across the value chain compared to 39.3% of producers. OLR confirmed higher PHL reduced food security among producers ($\beta = -1.044$, $p<0.01$; marginal effect=0.073) and, more strongly, marketers ($\beta=-8.903$, $p<0.05$), while storage access improved producer's food security (AME=+0.013, $p<0.01$). Targeted post-harvest training, cold storage investment, and credit access are critical for improving food security among tomato producers and marketers in northern Nigeria.

Keywords: Post-harvest losses, food security, tomato value chain, tobit regression, ordered logit regression,Nigeria

E3 **[24]**

THE NEMETON: A CLIMATE-INDEPENDENT, SELF-SUFFICIENT FOOD SOLUTION

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The Nemeton is a climate-independent, self-sufficient, specialised geo-thermal greenhouse system designed to tackle a nexus of deeply intertwined global problems, including the climate crisis, hunger, eutrophication, soil degradation, carbon emissions, food security, and the accumulation of micro-plastics and per- and poly- fluoroalkyl substances. The system achieves its goals by integrating numerous existing scientific innovations and technologies within a novel framework that maximises the synergies of these techniques and produces a higher output and increased environmental benefits than currently occur in the same geospatial footprint. Its methods include mycology, multiple farming techniques, soil innovation, carbon-neutral regenerative agriculture processes, and year-round access to production. The aim is to create a global network of these scalable greenhouses that restores the planet's mycelia concentration while providing year-round food access and climate crisis mitigation. The expected outcomes of this system are the ability to reverse atmospheric carbon loading, eliminate eutrophication, produce food and economic opportunities, repair the planet, foster food sovereignty, and enable increased alignment with the United Nation's Sustainable Development Goals.

Keywords: Regenerative agriculture, food security, food sovereignty, climate change, scalable solutions

E4 **[25]**

STRENGTHENING AGRI-FOOD RESILIENCE AGAINST DOUBLE BURDEN OF FOOD INSECURITY AND MALNUTRITION: A SUSTAINABLE FOOD SYSTEMS ANALYSIS OF MASHISHIMALE, SOUTH AFRICA

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Rural food systems in Sub-Saharan Africa face severe, interconnected pressures from both environmental degradation and structural socio-economic transformations. This paper examines the baseline prevalence of food insecurity and the double burden of malnutrition, which is the co-existence of undernutrition and overnutrition, within the rural community of Mashishimale, located in the Ba-Phalaborwa Municipality of the Mopani District, Limpopo Province. An integrated food systems framework was employed to empirically evaluate how intensive soil tillage, fragile, localized water infrastructure, poor market-access roads, and unequal household gender dynamics interact to disrupt key dimensions of food security, including availability, access, utilization, and stability. The analysis reveals that while smallholder backyard production of staple crops such as maize, cowpeas, and groundnuts serves as an essential survival mechanism, it is severely undermined by high seasonal temperatures of 28°C to 40°C, soil structural decline from intensive inversion tillage, and severe post-harvest handling losses. Furthermore, traditional food preparation practices often result in an unequal intrahousehold distribution of caloric and micronutrient intake, leaving women and young children disproportionately vulnerable to wasting and micronutrient deficiencies, while household heads exhibit indicators of overnutrition. To address these systemic vulnerabilities, this paper proposes a coordinated suite of large-scale, nutrition-sensitive agricultural interventions. These include promoting conservation agriculture (CA), expanding localized agro-processing and solar-powered cold storage, providing community-wide nutritional education, and actively empowering women within the agricultural value chain.

Keywords: Food systems; double burden of malnutrition; conservation agriculture; nutrition-sensitive interventions; mopani district.

E5 **[26]**

EXPLORING THE IMPACT OF A GOVERNMENT FOOD SUBSIDY PROGRAM ON FOOD SECURITY WITHIN REMOTE FIRST NATION COMMUNITIES IN NORTHERN CANADA

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Food insecurity in Canada is disproportionately experienced by indigenous people and has been identified by the federal government as a serious public health crisis in northern First Nations communities. The prevalence of food insecurity within First Nations communities has been found to be three times the national average and largely attributed to historical and contemporary colonial policies and legislation. The primary aims of our research were to determine the impact of a northern food subsidy program introduced by the government of Canada on five northern remote First Nations communities in Ontario Canada and create culturally appropriate definitions of food in/security and healthy nutrition. Utilizing an Indigenous community-based research approach, we held community engagement sessions where members shared their experiences and visions regarding food security and Indigenous sovereignty. A survey was also conducted through semi-structured one-on-one interviews. The findings revealed moderate to severe food insecurity in all five communities despite the government food subsidy program. Complicating high rates of food insecurity, community members shared extreme challenges they faced accessing potable water and managing chronic health conditions. Water insecurity is widespread and directly impacts the ability to manage chronic health conditions, such as diabetes, hypertension, and arthritis. Challenges pertaining to the impacts of imposed settler colonial systems including health, wellness, housing, income, and food, are all interconnected. Any solution(s) must be tailored to the unique local contexts and needs and meaningfully include First Nations communities in the design, implementation and evaluation of strategies.

Keywords: Food security, indigenous, remote, northern

PAPER SESSION 6:

AGRICULTURAL ECONOMICS, VALUE CHAINS AND SUSTAINABLE DEVELOPMENT

F1 **[27]**

GENOTYPIC VARIATION IN GROWTH AND YIELD RESPONSES TO THERMAL TIME AND PHOTOPERIOD IN RAINFED RICE UNDER DELAYED TRANSPLANTING

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Delayed monsoon transplanting exposes rice to temperature and photoperiod shifts, disrupting phenology and reducing yields. This study evaluates these climatic impacts on development and identifies tolerant varieties to sustain productivity in rainfed ecosystems. Five rice varieties (Binadhan-17, -20, -22, BINA dhan26, and BR-22) were evaluated under three transplanting dates using a split-plot design with three replications. Linear mixed models integrated with weather data revealed significant effects of transplanting date, variety, and their interaction on phenology, plant height, and grain yield. BINA dhan26 and BR-22 showed significant reductions in days to panicle initiation (DPI), varying from 71 to 59 days and 74 to 56 days, respectively, while it varied from 67 to 56 days for Binadhan-20. For Binadhan-17 and Binadhan-22, DPI varied from 61 to 53 days and 57 to 51 days, respectively. Similarly, days to flowering for BINA dhan26 and BR-22 decreased from 98 to 85 days and 92 to 81 days, while it varied from 91 to 86 days for Binadhan-20, 82 to 77 days for Binadhan-17, and 81 to 78 days for Binadhan-22. Plant height significantly decreased, particularly in BR-22 (133 to 99 cm) and Binadhan-20 (129 to 100 cm). Grain yield of BINA dhan26 remained most consistent (5.9 to 4.7 t/ha) compared to BR-22 (6.7 to 4.3 t/ha) and Binadhan-20 (6.1 to 4.0 t/ha). In contrast, Binadhan-17 (4.4 to 2.8 t/ha) and Binadhan-22 (4.6 to 2.2 t/ha) showed severe reductions as cumulative Growing Degree Days (GDD) decreased from 2221 to 1914°C day. BINA dhan26 and BR-22 showed superior adaptability and yield stability, serving as key genetic resources for breeding climate-resilient rice to mitigate late-transplanting penalties in rainfed ecosystems.

Keywords: Rice, delayed transplanting, phenology, temperature, photoperiod, yield stability

F2 **[28]**

MODELING AGRICULTURAL LAND CONVERSION USING LOGARITHMIC REGRESSION: EVIDENCE FROM MAROS REGENCY, INDONESIA

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Agricultural land conversion has become a critical issue in rapidly developing peri-urban regions, where population growth and economic expansion increase pressure on land resources. In Gowa Regency, this process has intensified over the period 2014–2024, raising concerns about the sustainability of agricultural land and regional food security. Understanding the driving factors behind this conversion is essential for effective land-use management. This study aims to analyze the influence of economic growth, population, and policy factors on agricultural land conversion. A logarithmic regression model is applied to capture the elasticity of land changes in response to these variables. Secondary data on Gross Domestic Product (GDP) and population are obtained from Indonesian Central Statistics Agency, while land-use change data are derived from Geographic Information System (GIS) analysis over the 2014–2024 period. A policy index is constructed to represent regulatory influence on land-use control. The results show that GDP and population have negative relationships with agricultural land area, indicating that increases in economic activity and population are associated with a reduction in agricultural land. Specifically, a 1% increase in GDP and population leads to small but consistent decreases in land area, suggesting gradual but continuous land conversion. Meanwhile, the policy index shows a positive relationship, indicating that stronger policy interventions contribute to preserving agricultural land, although the effect remains relatively limited. In conclusion, economic and demographic pressures are key drivers of land conversion in Gowa Regency, while policy plays a moderating role. It is recommended that local governments strengthen land-use regulations, improve policy enforcement, and integrate spatial planning with sustainable development strategies to better control agricultural land conversion.

Keywords: Agricultural land conversion; logarithmic regression; land-use policy

F3 **[29]**

PROFILING OF VALUE CHAIN ACTORS FOR SMALLHOLDER BROILER FARMING IN BUFFALO CITY MUNICIPALITY, SOUTH AFRICA: A SWOT ANALYSIS APPROACH

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The sustainability of smallholder broiler farming is said to be threatened due to challenges that are linked to the smallholder broiler value chain (VC), which include rising input costs (day-old chicks, feed, veterinary services, equipment), limited access to markets, and poor infrastructure. Some of these somehow trigger unstable profitability and may, in the long run, hinder development within the broiler sector. Therefore, there is a need to improve the productivity and sustainability of smallholder broiler farmers by analyzing their VC through its actors using the SWOT analysis. Consequently, the study aimed to profile value chain actors for Smallholder Broiler Farmers in Buffalo City Municipality, South Africa, using a SWOT Analysis approach. This study employed a cross-sectional research design and a quantitative research approach. A sample size of 125 Smallholder broiler farmers, drawn using Cochran's formula, was used for this. Broiler farmers were sampled using non-probability sampling methods such as purposive and snowballing, in which primary data were collected from within BCM through surveys using in-person interviews. The SWOT (strengths, weaknesses, opportunities, threats) analysis is frequently used among the scientific techniques that evaluate possible factors acting as bottlenecks or opportunities for prioritizing developmental strategies. Therefore, the SWOT analysis matrix was used to analyze the value chain of smallholder broiler farmers. The findings of the study revealed that the value chain of smallholder broiler farmers consists of several actors. Such actors included input markets, consumers, extension officers, government institutions, and financial institutions. Also, the study found that despite opportunities like free access to extension officers and strengths like free services offered by the government. Smallholder broiler farmers in BCM are vulnerable to threats such as high production and transport costs, long distances to market and input suppliers, and a lack of storage facilities. Also, these farmers are characterized by weaknesses such as high mortality rates, poor housing facilities, and a failure to meet consumer preferences. Therefore, strategies aimed at the development of broiler farmers, to minimize threats and weaknesses experienced by most Smallholder broiler farmers, need to be implemented through both government and private institutions to reduce failures along the value chain.

Keywords: Value Chain, broiler value Chain analysis, smallholder broiler farmers, SWOT analysis

F4 **[30]**

EVALUATING FACTORS INFLUENCING THE ADOPTION OF CLIMATE-SMART PRACTICES FOR ENHANCED CLIMATE RESILIENCE AMONG SMALLHOLDER FARMERS IN EASTERN CAPE, SOUTH AFRICA

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Climate change poses a severe threat to agriculture and food security in Sub-Saharan Africa, where production is predominantly rain-fed. The Eastern Cape Province, South Africa, is particularly vulnerable due to its high dependence on smallholder farming and limited adaptive capacity. The study aimed to; assess the level of awareness and access to Climate-Smart Practices [CSP] among smallholder farmers and evaluate the socio-economic and institutional factors influencing the adoption of CSP for enhanced climate resilience. A quantitative cross-sectional design was adopted. A snowball sampling technique was used to select 115 smallholder farmers. Data was collected using semi-structured questionnaires complemented by 5-point Likert scale statements on perceptions and barriers. Analysis followed a two-stage analytical approach; descriptive statistics were used to profile awareness and access levels, while Principal Component Analysis [PCA] was employed to reduce and identify the underlying latent dimensions of socio-economic and institutional factors influencing adoption. PCA revealed that five principal factors - access to information, language barrier, education level, farm size, and financial resources - significantly constrain adoption. Analytically, the study exposes a critical awareness-access gap; 89.04% of farmers reported no awareness of specific CSP for hedging against floods, drought, and extreme temperatures, while 82% reported limited access to training and extension services, despite perceiving their potential benefits through media exposure. Inferential analysis showed a significant positive relationship between influencing factors and access to CSP, indicating that systemic barriers, not farmer apathy, drive low adoption of technologies such as drought-resistant varieties and precision agriculture. The study concludes that low adoption is driven by structural and informational exclusion rather than lack of interest. It recommends a proactive, localized capacity-building drive that integrates mass and social media, uses indigenous languages, and provides practical, pre-disaster training on CSP. This aligns with SDG 13 on urgent climate action and climate resilience.

Keywords: Climate-smart practices, adoption factors, awareness, smallholder farmers, climate resilience, eastern cape

F5 **[31]**

WHO CAPTURES THE PRICE? BUYER POWER, REGULATORY DESIGN, AND THE STRUCTURAL REDISTRIBUTION OF VALUE IN GLOBAL AGRI-FOOD CHAINS

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Buyer power concentration within global Agri-food value chains has resulted in a persistent imbalance in food price margin distribution, with primary producers capturing less than 24 percent of final consumer expenditure. This outcome is not explained by differences in productivity or efficiency, but by structural features of the food chain that allocate price risk, working capital pressure, and compliance costs upstream while allowing margin extraction downstream. The economic consequences include sustained margin compression at the farm gate, reduced investment, declining domestic production, and increased dependence on imports, with implications for supply resilience and self-sufficiency.

This study examines how governments can influence food price margin outcomes through regulatory design rather than price intervention. The analysis advances a governance-based approach centred on mandated Environmental Social and Governance transparency, treating the food chain as an integrated upstream and downstream economic system. The methodology combines the Country and Region as Publicly Traded Company valuation framework with quasi experimental evidence from food chain regulation, including the EU Unfair Trading Practices Directive, the UK Groceries Supply Code of Practice, and related international measures. Parliamentary and regulatory scrutiny of fair value in the food chain between 2020 and 2025 is used to triangulate findings.

The results indicate that introducing disclosure and conduct obligations ahead of price formation materially alters bargaining dynamics. The study concludes that applying a Publicly Traded Company disclosure model at jurisdiction level provides a scalable policy framework for improving food price margin distribution, strengthening producer viability, domestic supply capacity, and food system resilience.

Keywords: Supermarket oligopoly, structural exploitation, political failure, income transfer

PAPER SESSION 7:

DIGITAL AGRICULTURE, AI AND CLIMATE-SMART FARMING

G1 **[32]**

THE IMPACT OF DIGITAL TECHNOLOGIES ON SMALLHOLDER FARMERS' WELFARE OUTCOMES IN THE EASTERN CAPE, SOUTH AFRICA

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The study aimed to evaluate the impact of digital technologies on smallholder farmers' welfare outcomes related to income, employment, and food security. It used a cross-sectional survey design and a quantitative approach. Non-probability purposive sampling was employed to select 250 smallholder farmers, and a semi-structured questionnaire was used as the data collection instrument in the OR Tambo District Municipality. Data analysis was conducted using descriptive statistics with the Statistical Package for Social Sciences (SPSS) version 24. The findings revealed that the adoption of digital technology among smallholder farmers in the OR Tambo district is slow, mainly due to barriers such as poor infrastructure, limited access to financial resources, and low digital literacy. Despite this slow adoption, a majority (73%) of farmers believed that digital technologies could help improve income and food security. This highlights the strong recognition of the potential benefits of digital technologies amongst smallholder farmers. Furthermore, the results revealed that 27% of respondents were concerned about the potential decrease in employment opportunities due to automation. The study concludes that addressing these barriers is essential for enhancing the welfare of smallholder farmers. In addition, the study recommends that infrastructure must be improved, financial support must be provided, digital literacy must be enhanced, and policies that encourage technology adoption must be developed.

Keywords: Digital literacy, or tambo district municipality, smallholder farmers, welfare

G2 **[33]**

FARMPULSE AI: PULSE PRICE PREDICTION USING RANDOM FOREST, ARIMA, AND LSTM

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Pulse crop prices in India are highly volatile due to seasonal demand, weather conditions, supply chain disruptions, and government policies. Farmers often rely on intermediaries and historical market observations, leading to poor selling decisions and financial losses. Existing agricultural platforms primarily provide historical price information and lack predictive intelligence to support decision-making. The objective of this study is to develop an intelligent agricultural forecasting system capable of predicting future pulse crop prices using machine learning and deep learning techniques. The system aims to improve farmer profitability, reduce market uncertainty, and support data-driven agricultural decision-making. Historical market data for pulse crops, including Toor Dal, Moong Dal, and Chana Dal, along with seasonal trends and Minimum Support Price (MSP) information, were collected from agricultural datasets. Data preprocessing techniques such as missing value handling, outlier removal, normalization, and feature engineering were applied. Random Forest, ARIMA, LSTM, XGBoost, GRU, and Prophet models were trained and integrated using ensemble forecasting techniques to generate accurate price predictions. The proposed Farm Pulse AI framework demonstrated effective forecasting performance under varying agricultural market conditions. Ensemble forecasting produced more stable and reliable predictions than individual models. The system successfully identified seasonal trends, generated MSP-aware alerts, and provided profit estimation capabilities. Experimental observations indicated improved forecasting stability, efficient market trend detection, and effective real-time prediction support. FarmPulse AI provides an intelligent and scalable solution for pulse crop price forecasting. By integrating statistical, machine learning, and deep learning models, the system helps farmers make informed selling decisions and reduce financial risks caused by market fluctuations. Future enhancements may include weather data integration, multilingual support, mobile applications, and advanced transformer-based forecasting models to further improve prediction accuracy and accessibility.

Keywords: Agricultural price prediction, machine learning, deep learning, random forest, arima, lstm, ensemble learning, msp, smart farming, agricultural analytics.

G3 [34]

USE OF DIGITAL TOOLS AND CROP RESIDUES FOR IMPROVED AGRICULTURALPRACTICES AND CLIMATE CHANGE ADAPTATION -A FOCUS ON COMMUNAL FARMERS IN EASTERN CAPE, SOUTH AFRICA

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Agricultural production is the primary livelihood source for households in the Eastern Cape Province, South Africa, after social grants. Communal farmers [CFs] rely predominantly on indigenous crop and livestock production practices, making them highly vulnerable to climate change. While digital tools such as drones, artificial intelligence, IoT sensors, and satellite imaging offer significant potential to enhance climate resilience and sustainable agriculture, their adoption remains slow in rural communal areas due to cost, infrastructural deficits, and low digital literacy. This study aimed to examine existing agricultural practices, specifically crop residue management and the awareness and use of digital tools among CFs; assess structural and socio-economic barriers to accessing and utilizing digital tools; and analyze the association between crop residue management practices and digital tool adoption for climate change adaptation. The study adopted a quantitative cross-sectional design targeting hard-to-reach communal farming households. A snowball sampling technique was employed to select 75 CFs with active crop and livestock experience. Data was collected using semi-structured questionnaires and analyzed through a two-stage analytical framework. First, descriptive statistics were used to profile farming systems and digital tool awareness. Second, inferential analysis using cross-tabulation and Chi-square test of association was applied to determine the relationship between crop residue use and awareness of digital agricultural practices, thereby moving beyond mere description to explanatory insight. The analysis reveals a dual subsistence system: 89% of CFs keep cattle and goats, while maize and potatoes are cultivated mainly for household consumption and animal feed, with only 3% selling surplus locally. Analytically, crop residue recycling is a dominant indigenous adaptation strategy, with 87% using stalks, leaves and roots to improve soil fertility. However, this strategy is proving ineffective, as farmers reported progressive soil degradation exacerbated by recurrent floods and droughts. A critical digital divide was identified: although 32% are aware of technologies such as drones, mobile agricultural apps, and livestock monitoring systems, their use is limited to weather forecasting on mobile phones, with no application to precision farming. Lack of financial support, limited information, and inadequate technical training emerged as significant determinants inhibiting adoption. Inferential results indicate a statistically significant association [$p<0.05$] between crop residue utilization and awareness of digital tools, suggesting that farmers who innovate in traditional practices are more predisposed to digital adoption, but are constrained by systemic barriers.The study concludes that while indigenous residue management demonstrates adaptive intent, its efficacy is eroded by intensifying climate shocks. The near-absence of functional digital tool use underscores a missed opportunity for climate-smart agriculture. The study recommends targeted capacitation and training programs aligned with SDG 9 [Industry, Innovation and Infrastructure], to enhance digital inclusion and integrated crop waste management for improved food security [SDG 2], climate resilience [SDG 13] and sustainable land management [SDG 15].

Keywords: Digital tools, communal farmers, crop residue management, climate change adaptation, climate resilience

G4 [35]

CONTRIBUTION OF DIGITAL PLATFORMS ON CROP INSURANCE ACCESSIBILITY FOR SMALLHOLDER FARMERS IN THE EASTERN CAPE, SOUTH AFRICA.

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The study aimed to evaluate the contribution of digital platforms to the accessibility of crop insurance amongst smallholder farmers. The study used a cross-sectional survey design and a quantitative approach. Non-probability purposive sampling was employed to select 100 smallholder farmers, and a semi-structured questionnaire was used as the data collection instrument in the OR Tambo District Municipality. Data analysis was conducted using descriptive statistics with the Statistical Package for Social Sciences (SPSS) version 24. The findings revealed that digital platforms, particularly mobile-based apps, are improving crop insurance accessibility for Eastern Cape smallholder farmers by providing relevant information. The results, however, revealed that the adoption of advanced technologies among smallholder farmers in the Eastern Cape province is low; instead, the majority (84%) of smallholder farmers prefer low-tech digital tools such as SMS and weather apps to enhance their decision-making processes. Despite the potential of advanced technologies to transform agricultural insurance by offering tailored risk assessments and streamlined claims processes, many (73%) of farmers remain reliant on more familiar tools that they can easily understand and trust. Factors such as limited access to the internet and smartphones, concerns about cost, and digital illiteracy contribute to poor adoption of advanced digital platforms. The study concludes that there is a pressing need to enhance the accessibility and usability of digital platforms for smallholder farmers. The study recommends the training of smallholder farmers on digital platforms, focusing on high-tech tools. The study further recommends creating hybrid systems that combine low-tech and advanced digital solutions.

Keywords: Digital illiteracy, eastern cape, low-tech digital platforms, smallholder farmers

PAPER SESSION 8:

FOOD TECHNOLOGY, FUNCTIONAL FOODS AND PRODUCT INNOVATION

H1 **[36]**

THE QUEST FOR ORGANIC LABELLING IN AUSTRALIA

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The Australian organic food industry is anticipating policy reforms in response to widespread concerns about greenwashing. These reforms arise amid historically high levels of consumer distrust, as organic certification is not legally required for a product to be labelled "organic" in Australia. This study examines the question: how have political and market interests interacted to facilitate or hinder organic labelling policy reforms in Australia? Drawing on a pressure–state–response framework, it analyses political dynamics and industry influence in the development of the proposed National Organic Standard Bill. The study employs a two-pronged approach to critical policy analysis: (a) review of publicly available secondary data on organic producers and (b) thematic analysis of (i) stakeholder inputs (n=26) from the parliamentary inquiry on organic labelling, (ii) the Ag2030 Strategy, (iii) the Australian Agricultural Sustainability Framework, and (iv) the two export and import standards on organic produce. Despite recognition of the need for regulation since the 1990s, Australia remains the only OECD country without a legal definition of "organic." Findings indicate that of the 6,300 organic operators in Australia, one-third operate without certification. The Ag2030 Strategy prioritises agribusiness growth over environmental sustainability, and the collapse of a key certification entity in 2025 underscores the urgent need for a robust national accreditation system. With the proposed Bill still in political limbo (as of January 2026), consumers remain vulnerable to greenwashing. Expedited political action is needed to improve consumer confidence in organic labelling both domestically and internationally, and to strengthen regulatory compliance and enforcement.

Keywords: Agriculture, critical policy analysis, greenwashing, pressure-state-response, regulation, sustainability

H2 **[37]**

FORMULATION AND EVALUATION OF PHYSICOCHEMICAL AND STORAGE STABILITY OF MICROENCAPSULATED VEGETABLE OIL POWDER-BASED COOKIES

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The increased demand for healthier bakery products has generated interest in extending their shelf life and oxidative stability. The objective of this study was to develop cookies using freeze-dried microencapsulated vegetable oil powder and to evaluate their physicochemical, sensory, and storage stability. Three different microencapsulated vegetable oil formulations were prepared using fixed oil blends consisting of 6.31 mL sunflower oil and 6.18 mL sesame oil per formulation as the core materials. The oils were encapsulated with various combinations of wall materials with different ratios (w/w): (T1) maltodextrin, whey protein, and pectin in 6:3:1, (T2) maltodextrin and whey protein in 7:3, and (T3) maltodextrin alone (10:0). Cookies made with non-encapsulated oil were considered as the control (T0). Results revealed that the T1 formulation had the lowest moisture content (2.30%) and peroxide value (0.62 ± 0.01 meq O_2/kg oil), representing an enhanced oxidative stability. The cookies made from the T1 formulation showed comparatively lower moisture content (3.24%) and water activity (0.42) than the other samples. Sensory evaluation using a 5-point hedonic scale indicated that cookies prepared with the T1 formulation received the highest overall acceptability score, with significantly higher ratings for appearance, aroma, taste, texture, and mouthfeel. Under accelerated storage conditions (40°C, 80% relative humidity), cookies containing microencapsulated oil demonstrated lower moisture absorption, slower pH reduction, reduced darkening, and delayed lipid oxidation compared to the control. Thus, it can be concluded that freeze-dried microencapsulation of sunflower and sesame oil with maltodextrin, whey protein, and pectin, with the ratio of 6:3:1 as wall materials, contributed to enhancing the oxidative stability, sensory quality, and shelf life of cookies, showcasing its potential as a healthier fat alternative in bakery products.

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Keywords: Bakery products, lipid oxidation, peroxide value, sesame oil, sunflower oil

H3 **[38]**

FORMULATION OPTIMIZATION AND FUNCTIONAL CHARACTERIZATION OF A PLANT-BASED SPREAD PRODUCT CONTAINING BANANA PEEL, WATERMELON AND OLEASTER SEEDS

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The sustainable utilization of agro-industrial by-products offers a promising approach for developing value-added functional foods while reducing food waste. In this context, the present study aimed to develop a novel plant-based functional spread product utilizing banana peel together with watermelon and oleaster seeds. The optimal ingredient proportions were determined using a D-optimal mixture design comprising 16 different formulations by targeting the most suitable textural and color properties. The physicochemical, rheological and bioactive analyses were performed on the optimized spread stored at 25 °C and 4 °C over 14 days. The optimum formulation was determined as 63.4% banana peel puree, 8.2% watermelon seed and 8.4% oleaster seed, which yielded a L* value of 41.09 and a viscosity of 8,000 mPa·s. The total dry matter and mineral contents did not change significantly. On the other hand, the pH value, emulsion capacity, total phenolic content and antioxidant capacity values decreased during storage up to 37.6%, 61.9%, 90.3% and 44.2%, respectively, while the viscosity and total color difference values increased significantly ($P < 0.05$). Additionally, the spread stored at 4 °C exhibited better quality preservation than that stored at 25 °C except for pH, indicating improved stability under refrigerated storage. In conclusion, this study provides valuable insights into the development and storage stability of a plant-based spread produced through the valorization of food by-products.

Acknowledgment: This study was financially supported by The Scientific and Technological Research Council of Türkiye (TÜBİTAK; 2209–A program).

Keywords: Functional food spread, agro-industrial by-product, D-optimal mixture design, waste valorization

H4 **[39]**

CIRCULAR FOOD SYSTEM APPROACH FOR FOOD SECURITY: DEVELOPMENT OF NUTRIENT-ENRICHED Black WHEAT–WHEY INSTANT *Idli* MIX

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The underutilization of anthocyanin-rich black wheat and the disposal of dairy whey as waste represent significant nutritional, environmental, and economic challenges. Valorization of these resources through functional food development offers an opportunity to enhance nutritional security while supporting sustainable food systems. To develop and optimize black wheat instant *idli* mixes fortified with paneer whey, cheese whey, and whey protein concentrate (WPC-80), and to evaluate their nutritional, physicochemical, structural, shelf-life, and health-promoting properties. Formulations were optimized using Response Surface Methodology (RSM) and validated through Artificial Neural Network (ANN) modelling. Comprehensive characterization included proximate composition, ICP-MS mineral profiling, RVA, FTIR, XRD, DSC, SEM, ^{1}H NMR spectroscopy, in vitro protein digestibility, multivariate analysis, and a 120-day shelf-life study under ambient storage with and without nitrogen flushing. Health effects were assessed using a 28-day Wistar rat feeding trial. Whey fortification increased protein content by 47%, water absorption by 22%, and in vitro protein digestibility by 14%. Iron, zinc, and manganese contents increased by up to 6.3-, 4.1-, and 11.5-fold, respectively, while heavy metals remained within FSSAI limits. BWWPC exhibited 87% lower peak viscosity, 99% lower breakdown viscosity, and 70% lower setback viscosity than BWI, indicating enhanced paste stability. Nitrogen flushing extended shelf life by 40% (75 to 105 days). In vivo studies showed reductions of 37% in SGOT, 25% in SGPT, and 24% in blood glucose levels. PCA explained 86.6% of the total variance and clearly differentiated whey-fortified formulations. Black wheat–whey instant idli mix is a safe, nutrient-dense, and shelf-stable functional food with demonstrated nutritional and health benefits. Future studies should focus on large-scale consumer acceptance, clinical validation of health effects, and commercialization strategies to support sustainable utilization of underexploited cereals and dairy by-products.

Keywords: Black wheat, whey fortification, functional foods, food security, sustainable nutrition, dairy by-products, protein enrichment, shelf-life extension, circular economy

POSTER SESSION

P1 **[40]**

RECONNECTING PRODUCTION AND CONSUMPTION TO IMPROVE NUTRITIONAL SECURITY

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In recent years, food consumption patterns have increasingly shifted toward packaged and externally sourced products, including staples such as flour, rice, and spices. These products often rely on chemical preservatives and extended processing to increase shelf life, which can reduce nutritional density, alter calorific quality, and distance consumers from fresh, locally produced food. This transition has weakened local supply chains, reduced dietary diversity, and constrained income realization for smallholder farmers, while rising consumption of processed foods, particularly among children, has further compromised household nutrition. This study examines whether reconnecting local production and consumption through democratic economy principles can improve nutritional security. Democratic economic principles in this context refer to localized ownership of food systems, collective decision-making by producers, equitable value distribution, and community control over processing, pricing, and distribution. The intervention was implemented between 2019 and 2023 in selected rural and semi-urban areas of Madhya Pradesh, India, where farmers were organized into producer collectives to enable local aggregation, processing, and hyper-local distribution of grains, vegetables, spices, and soy-based foods. A mixed-methods baseline-endline design was used, combining household dietary surveys and qualitative interviews. Results show a shift away from reliance on externally packaged foods toward locally processed alternatives, with household dietary diversity increasing from 5.2 to 6.5 food groups. Consumption of fruits rose from 45% to 62%, vegetables and dairy reached over 80% coverage, and soy-based food consumption increased from 32% to 48%. The study concludes that community-controlled, hyper-local food systems can enhance dietary diversity, strengthen farmer livelihoods, and reduce dependence on nutritionally diluted packaged foods, offering scalable insights for sustainable and nutrition-sensitive food system design.

Keywords: Nutritional security, dietary diversity, food habits, household nutrition

P2 **[41]**

PERFORMANCE OF *Asparagus officinalis* L.VARIETIES UNDER SHADE STRUCTURE AND OPEN FIELD CONDITIONS IN A FARMER FIELD TRIAL IN BARIO, SARAWAK

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Asparagus (*Asparagus officinalis L.*) cultivation in tropical highland regions such as Bario, Sarawak remains limited, particularly among smallholder farmers due to variable environmental conditions and production practices. This study evaluated the performance of two asparagus varieties under two contrasting production systems: shade structure and open field, through a community-based farmer field trial. The experiment was arranged in a 2 × 2 factorial Randomized Complete Block Design (RCBD) with six replications, involving a total of 1,440 plants. Treatments consisted of two asparagus varieties grown under shade structure providing approximately 50% shading and open-field conditions. Growth and yield parameters, including germination rate, plant height, spear diameter, spear length, and total yield were recorded throughout the production cycle. During germination, the 'Hybrid High Rise F1 136' variety exhibited a higher germination rate (90%) compared to 'Apollo AP11' variety (71%). From the observation, plants cultivated under shade structure showed weaker stem strength and higher plant mortality than those grown in the open field. Accordingly, higher yields were obtained under open-field conditions for both varieties. Across both production systems, 'Hybrid High Rise F1 136' consistently produced higher yields than 'Apollo AP11'. These findings suggest that open-field cultivation using suitable varieties is more appropriate for asparagus production in the Bario highland.

Keywords: Tropical highland, production systems, asparagus varieties, growth, yield.

P3 **[42]**

OPTIMISING FLOWERING INDUCTION FOR SARAWAK GOLD (SG1) PINEAPPLE AGRONOMIC PRACTICES

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The Sarawak Gold 1 (SG1) pineapple is a new and premium variety planted in Sarawak that is known for its sweetness, juiciness and edible core. SG1 pineapple is characterised by its unique golden-orange flesh and very short period from planting to harvesting. It holds great potential and can transform the country's pineapple industry. Farmers can plant this pineapple twice in two years, which makes the turnover rate of SG1 pineapple plants faster than other pineapples. Nonetheless, specific research focused on SG1 pineapple performance in Sarawak is lacking. Therefore, studying the management practices, particularly the timing of flowering induction, is crucial for assisting farmers in the industry. This research aimed to determine the most suitable time for flowering induction using the recommended concentration rate of hormone used for the flowering of SG1 pineapple. Agronomic parameters evaluated included weight, length and circumference of the fruit. Statistical analysis was carried out to determine the significant differences among treatments. A two-factorial analysis of variance (ANOVA) result showed significant effects of flowering induction timing and hormone concentration on fruit length, while only hormone concentration significantly affected fruit circumference ($p < 0.05$). However, no significant difference was observed in fruit weight. The research demonstrated the importance of suitable timing for flower induction with the recommended concentration rate of flowering hormone to obtain a better fruit yield. Thus, this study was able to enhance the productivity and profitability for farmers.

Keywords: Sarawak gold 1, sg1 pineapple, hormone, flowering, fruit development

P4 **[43]**

PURIFICATION OF ADAN SEDERHANA SEEDS FOR QUALITY BARIO RICE PRODUCTION IN SARAWAK, MALAYSIA

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Bario rice, particularly the Adan variety, is a premium rice produced in Sarawak, Malaysia and was registered under Geographical Indication certification in 2008 due to its superior quality and traditional cultivation practices. However, concerns regarding seed impurity and seed mixture among farmer-sourced planting materials may affect rice quality and authenticity. Therefore, this study was conducted to purify *Adan Sederhana* seeds for quality Bario rice seed production. The study was carried out in Bario Highland, Sarawak, Malaysia using selected local farmers seed lines. The experiment was arranged in a randomized complete block design with four seed lines and four replications. Agronomic parameters evaluated included plant height, number of tillers, 1000-grain weight and length of pannicle. Statistical analysis was carried out to determine significant differences among treatments. ANOVA results obtained in year 2023 and 2024 showed no significant differences among the evaluated seed lines for all parameters observed ($p = 0.01$) indicating that the selected seed lines possessed relatively uniform agronomic characteristics. The study demonstrated the importance of seed purification in maintaining varietal characteristics and improving seed quality for Bario rice production. This project is expected to support the availability of high-purity foundation seeds for sustainable and high-quality rice production in Bario, Sarawak, Malaysia.

Keywords: Bario, adan rice, seed purification