

Book of Abstracts

The 6th International Conference on Agriculture, Food Security and Safety (AgroFood 2025)

6-7th August 2025 | Kuala Lumpur, Malaysia

Committee of the AgroFood 2025

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Book of Abstracts of the 6th International Conference on Agriculture, Food Security, and Food Safety (2025)

Edited by Assoc. Prof. Dr. Norida Mazlan and Dr. Nor Khaizura Mahmud

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MESSAGE FROM THE CONFERENCE CHAIRPERSON AgroFood 2025



On behalf of organizing committee, it is my privilege and great delight to welcome all the esteemed delegates, partners, speakers and participants to the **6th International Conference on Agriculture, Food Security and Food Safety (AgroFood 2025)**, under the theme *“Feeding the World Sustainably: One Health, One World”*. This is gathering were important convergence of science and innovation to address the most pressing challenges of our time.

As we stand at the crossroads of rapidly changing world, our important mission is to nourish a growing global population which projected to reach 10 billion by 2050, while protecting the health of our planet and its inhabitants. This demands will indirectly related to transformation in how we produce, distribute and consume food.

Under the theme *“Feeding the World Sustainably: One Health, One World”*, we recognize that food security, environmental sustainability and global health are inextricably linked. Climate change intensifies droughts and floods, threatening agricultural productivity. The transboundary disease from zoonotic outbreaks to crop pandemics has highlight the fragility of our interconnected food system. And as we push for greater food production, we must ensure we do not exhaust the natural resource for future generations.

At this conference, we will address these challenges by focusing on the food security, Climate smart agriculture by scaling regenerative practices and building resilience against climate extreme. The One health in action that preventing disease transmission through trans-boundary collaboration, which strengthening global partnership to combat pest, pathogen and food supply disruptions. All this will need to include environmental stewardship that protect biodiversity, soil and water resource while meeting the rising food demand,

Through this conference, all expertise is vital in shaping a future where food systems sustain both people and planet. We hope everyone could engage, collaborate and drive the change to our world needs. Together we can achieve the “One Health, One World’ vision into reality.

I look forward to fruitful discussion during this conference and may our collective efforts could pave the way for a more sustainable and food-secure future.

Assoc. Prof. Dr Norida Mazlan
Chairman, AgroFood 2025

MESSAGE FROM THE CONFERENCE CO-CHAIR AgroFood 2025



It is with great pleasure and deep appreciation that I welcome all delegates, researchers, industry partners, and students to this year's AgroFood 2025 Conference, themed "Feeding the World Sustainably: One Health, One World." This theme speaks to the urgent need for integrated approaches in addressing global food security, public health, and environmental sustainability. As our food systems face unprecedented challenges, from antimicrobial resistance and climate change to emerging zoonotic threats, it is only through collaboration across disciplines, sectors, and borders that we can forge meaningful solutions. The One Health framework reminds us that the health of people, animals, and our shared environment is interconnected.

This conference brings together thought leaders and innovators to exchange knowledge, share cutting-edge research, and inspire action towards a more resilient and inclusive global food system. I am confident that the sessions and discussions will spark new ideas and foster impactful partnerships that extend beyond this event.

On behalf of the organizing committee, I thank you for your presence and active participation. May this conference serve as a platform not only for academic and professional growth, but also for a shared commitment to building a healthier, more sustainable world.

Warm regards,
Assoc. Prof. Dr. Nor Khaizura Mahmud Ab Rashid
Co-Chair, AgroFood 2025

MESSAGE FROM THE ACADEMIC PARTNER AgroFood 2025



On behalf of the Department of Agronomy and Horticulture, Faculty of Agriculture, Bogor Agricultural University (IPB), Indonesia, it is our distinct honour and pleasure to welcome you to the 6th International Conference on Agriculture, Food Security, and Safety (AgroFood 2025). We are proud to be the academic partner for this prestigious event, which will be held from 6th – 7th August 2025 in Kuala Lumpur, Malaysia, in both online and in-person formats. The theme for this year's conference, "Feeding the World Sustainably: One Health, One World," encapsulates the comprehensive approach needed to address the multifaceted challenges of global food systems.

This theme highlights the importance of integrating diverse perspectives and innovative practices across the entire agricultural spectrum—from sustainable farming and advanced biotechnology to food safety and nutrition security.

AgroFood 2025 brings together participants from all over the world, including distinguished scholars, industry leaders, and dedicated professionals. This gathering provides a unique platform to exchange ideas, share cutting-edge research, and develop strategies that will shape the future of agriculture and food security.

We extend our heartfelt gratitude to all speakers, sponsors, and attendees for their contributions. Your presence and input are invaluable to the success of AgroFood 2025. Together, let us embark on this journey of knowledge-sharing and innovation to create a sustainable and food-secure future.

Welcome to AgroFood 2025!

Prof Edi Santosa,
Head of the Department,
Department of Agronomy and Horticulture, Faculty of Agriculture,
Bogor Agricultural University (IPB),
Indonesia

MESSAGE FROM THE ACADEMIC PARTNER AgroFood 2025



It is my distinct honour and pleasure to welcome you to the 6th International Conference on Agriculture, Food Security, and Food Safety (Agro Food 2025). As an academic partner, we are thrilled to continue our collaboration on this prestigious platform that brings together eminent scholars, industry leaders, and passionate professionals from around the globe.

This conference serves as a pivotal forum for sharing cutting-edge research, exploring innovative solutions, and promoting sustainable practices that address the critical challenges facing our global food systems today. In a world where agriculture and food security remain central to the well-being of societies, Agro Food 2025 offers a unique opportunity to delve into the latest advancements and emerging trends in agricultural technology, food production, and safety protocols.

We are particularly excited about the diverse range of topics to be explored this year — from sustainable farming methods and biotechnology innovations to global food safety standards and strategies for nutrition security. The insights gained from these sessions will not only enrich academic discourse but also inform practical applications for policymakers, practitioners, and communities around the world.

Moreover, the networking opportunities provided by this conference will foster meaningful collaborations and professional relationships that will extend well beyond these sessions, enhancing our collective ability to address complex agricultural and food security challenges.

We extend our sincere gratitude to all the distinguished speakers, generous sponsors, and dedicated participants for their invaluable contributions to Agro Food 2025. Your presence and engagement are essential to the continued success of this event.

Together, let us embrace this opportunity to share knowledge, spark innovation, and chart a path toward a more sustainable and food-secure future.

Welcome to Agro Food 2025!

University of Agriculture Faisalabad, Pakistan

ABSTRACTS OF KEYNOTE ADDRESSES - AgroFood 2025

- | | | |
|----|---|----|
| 01 | Biotech Tools for Sustainable Crop Production: From Microorganisms to microRNA | 02 |
| | <i>Harikrishna, J.A.</i> | |
| 02 | Sing Nanotechnology for Ameliorating Herbicidal Activity of Different Active Ingredients with The Various Mechanisms of Actions | 03 |
| | <i>Zargar, M., Bayat, M.</i> | |

ABSTRACTS OF ORAL PRESENTATIONS - AgroFood 2025

PRECISION AGRICULTURE (A)

- | | | | |
|----|----|---|----|
| A1 | 03 | Development and Validation of a CFD Thermal Model for Small-Scale Naturally Ventilated Greenhouse Under Semi-Arid Conditions of Botswana | 05 |
| | | <i>Thipe, E.L., Hoffmann, J.E., Sebitosi, A.B., Kempen, E., Teke, G.</i> | |
| A2 | 04 | Ai-Driven Climate Change Mitigation for Food Security: A Quantitative Analysis Using Satellite Data | 06 |
| | | <i>Kollipara, Y.V.P., El-Gayar, O.</i> | |
| A3 | 05 | Impact of Conservation and Precision Agriculture Management Practices on Production of Cereals in Greece | 07 |
| | | <i>Kosti, M., Moraitis, M., Karamoutis, C., Kyparissis, A., Cavalaris, C., Zamidis, A., Lampropoulos, C., Solomos, T., Balafoutis, A.T.</i> | |
| A4 | 06 | The Use of Remote Sensing Technology in Smart Irrigation and Its Role in Water Rationing | 08 |
| | | <i>Yassen, H.T., Al-Badri, S.B.S.</i> | |

A5	07	Spatio-Temporal Characteristics of Drought and its Impact on Local Food Security: The Case of Libokemkem and Ebinat District, Northwestern Ethiopia	09
		<i>Getaneh M., Victor J., Janneke E., Derege M.</i>	
A6	08	Assembling and Testing a Smart Electronic System for Measuring Tractor-Implement Performance Indicators using Internet of Things Technologies (IoT)	10
		<i>Rashid, O.M., Al-Aani, F.</i>	
A7	09	Overview of Air-Based Sensors for Efficient Farming Under the Challenges of Climate Variability in Southern Africa	11
		<i>Sikhuni, W., W, Mncwabe, B, Kese, Z, Matshikwe, A, Sakha, P, Mzilikazi, F, Mayekiso, A. and Tafeni, N.V.</i>	

BUSINESS AND EXTENSIONS (B)

B1	10	Household Survey on Livelihoods of Communities in Nipah Industry in Sarawak - A Baseline Study	13
		<i>Mohamad, R.A.</i>	
B2	11	Barriers to The Utilisation of Digital Technologies by Smallholder Farmers in The Eastern Cape Province, South Africa	14
		<i>Tafeni, N.V., Gwala, L., Mayekiso, A.</i>	
B3	12	Socio-Economic Factors Influencing the Adoption of Tractor-Traction by Smallholder Maize Farmers in Mbashe Local Municipality, South Africa	15
		<i>Sawulisi, A., Toko, A., Khoza, A., Mphana, Z., Skhephu, A., Mayekiso, A.</i>	

- B4 13 Impact of Drought and Floods Disasters on Communal Livestock Farmers and Their Adaptative Capacity in The Eastern Cape Province South Africa 16

Gwala, L., Bontsa-Tafeni, N.V., Mayekiso, A.

- B5 14 Understanding Gender Gaps in the Adoption of Agriculture Technologies in Malawi: The Case of Vibangalala Extension Planning Area (EPA) in Mzimba 17

Munthali, G.N.C., Puming, H., Banda, L.O., Mzumara T.

SUSTAINABILITY AND ENVIRONMENT (C)

- C1 15 The Pumpkin Potential: Comprehensive Utilization of Pumpkin Plant for Sustainable Food Systems 19

Sritharan, S., Arampath, P.C.

- C2 16 Rhizosphere Bioengineering: Biochar-Immobilized *Bacillus Consortium* Modulate *Elaeis Guineensis* – Soil Interactions for an Improved Survival Under Reduced Chemical Fertilization 20

Ajeng, A.A., Abdullah, R., Ling, T.C., Harikrishna, J.A.

- C3 17 Evaluation of Indigenous Microbial Isolates for Growth Promotion and Biocontrol of Bacterial Panicle Blight in Rice 21

Yakubu, A.I, Mazlan, N., Zulperi, D.M, Jaafar, N.M

- C4 18 Biochar as a Green Solution for Remediating Contaminated Soil 22

Abu-Sari, N., Yong, S. K., Abdullah, R.

- C5 19 Evaluation of Rice Farming Sustainability in Pali District: Income Analysis and Farmers' Perceptions of Social, Economic, and Environmental Aspects 23

Jhoni, A., Yamin, M., Budianta, D., Lifianthi

C6	20	Effects of Compost Amendments on Soil Structural Stability	24
		<i>Askri, A., Alkaabi, B., Alketbi, S., Alnaqbi, M., Aldhanhani, A., Ahmed, Z.F.</i>	
C7	21	Design and Performance Assessment of a Hybrid Indirect Solar Dryer with Various Absorber Plate Configurations	25
		<i>A. S. Abd., Dr. L. A. Zeinaldeen</i>	
C8	22	Evaluating Environmental Performance of Apple Production Systems in Japan: Pathways Toward Sustainable Agriculture	26
		<i>Oo, M.T., Tomasi, L., Silvestri, S., Noguchi, R.</i>	
C9	23	Carbon Budget Analysis of Fresh Fruit Bunch and Oil Palm Seed Production Using Life Cycle Assessment: A Comparative Approach for Sustainable Palm Industry Practices	27
		<i>Agusta, H., Pardede, A.S., Jesika, R., Rosalina, Y.</i>	
C10	24	Exploring Gender Difference in Adoption of Sustainable Agricultural Practices in Southwestern Ethiopia	28
		<i>Engura, T.T., Bekele T.L., Gemedo, D.O.</i>	
C11	25	AI-Driven Innovations in Farming: A Systematic Literature Review on Advancing Sustainable Agriculture	29
		<i>Kollipara, Y.V.P., El-Gayar, O.</i>	
C12	26	Farmers' Perceptions of Conservation Agriculture Benefits and Adoption in Mopani District, South Africa	30
		<i>Mnisi, M.A., Van Niekerk, J.A.</i>	

FOOD SAFETY AND FOOD WASTE (D)

D1	27	Food Standardization and Authentication; A Legal Study with Special Reference to The Gi Agriculture Goods in India <i>Kushwaha, B.K., Kumar, A.</i>	32
D2	28	Control and Pareto Chart to Prolong Shelf Life of Fruits and Vegetables <i>AL-Badri, S.B.S.</i>	33
D3	29	Errors Associated with Mycotoxin Analysis Due to Heterogeneity of Mycotoxin Accumulation and Related Sampling Problems <i>Samarajeewa, U.</i>	34
D4	30	Evaluation of Agronomic Traits, Yield, and Nutritional Quality of Seven Quinoa Varieties Under Arid Environmental Conditions in Saudi Arabia <i>Shaihaldein, H.O., Alsubaie, Q.D., Saad, M.A.O, Akasha, M.</i>	35

POSTER SESSION

P1	31	Plant Growth-Promoting Effects of <i>Phialocephala Fortinii</i> <i>Udaakbayar, J., Takeshi, T.</i>	37
P2	32	Correlations Between Microbial Community and Volatile Compounds in Berbassa, A Unique Sudanese Fermented Milk Starter <i>Eltayeb, M.M., Eltigani, S.A., Taniguchi, T., Ishihara I, A., Arima, J., Elgasim, E.E.</i>	38

P3	33	Variation in Root Traits and Root-Endophyte Interactions in Primary Synthetic Wheat Derived from <i>Aegilops Tauschii</i> Collected from Diverse Soil Types	39
		<i>Mohammedali, A.K.H., Kamal, N.M. Gorafi, Y.S.A., Tahir, I.S.A., Tsujimoto, H., Taniguchi, T.</i>	
P4	34	Technical Evaluation and Calibration of Drone Sprayers for Pest and Disease Control in Oil Palm Plantations	40
		<i>Priyanandana M.K.K.C., Kumari D.R.L., Menike, A.M.G.C.P., Kumari W.S.M., Weerasekara A.A.C.M., Upeksha S.H.D., Warnakulasooriya S.S.P.</i>	
P5	35	Biochemical Analysis of Mature Date Palm Fruit Astringency: Toward Fruit Quality Improvement	41
		<i>Pullaniyil, J., Francis, D., Kaur, N., El Mahi, M., Ahmed, Z.</i>	
P6	36	Evaluation of Alternatives to Sulfur Dioxide for Microbiological Control in Winemaking	42
		<i>López-Alfaro, I., Santamaría, A.P., Gutiérrez, V.A.R., Esteban, T. A., Ojeda, G.S., Benito, C.A., González-Arenzana, L.</i>	
P7	37	Multi-Purpose Forages Potential to Enhancing Mixed Smallholder Farming Productivity and Food Security in Malawi	43
		<i>Bekele, R., Joseph, H., Kee – Tui, S.H., Mwendia, S., An, N.</i>	
P8	38	Socioeconomic Factors Affecting Smallholder Farmers' Access to Formal Financial Credit in Selected Rural Areas of Alice Town, South Africa	44
		<i>Moeketsi, T., Mayekiso, A., Toko, A.</i>	
P9	40	Willingness to Pay for Fodder Seed Technology: Price Sensitivity and Adoption Barriers Among Small-Scale Livestock Farmers in or Tambo District Municipality, South Africa	45
		<i>Toko, A., Mayekiso. A., Mamabolo. M., Tjelele. T.J., Kau, J., Mkhize, N.R.</i>	

ABSTRACTS OF KEYNOTE ADDRESSES

[01]

BIOTECH TOOLS FOR SUSTAINABLE CROP PRODUCTION: FROM MICROORGANISMS TO microRNA

Harikrishna, J.A.

Centre for Research in Biotechnology for Agriculture (CEBAR), Professor, Microbiology & Molecular Genetics, Faculty of Science, University of Malaya, Malaysia

Food crop production is increasingly challenged by biotic and abiotic factors ranging from climate change to disease. This leads to the increased use of agricultural inputs that may reduce environmental sustainability. Fortunately, biology is also a source of solutions that have potential to replace or reduce some of the less sustainable agricultural practices. This presentation will use examples from research at the University of Malaya that demonstrate the use of halo tolerant rhizobacteria from a mangrove forest to alleviate biotic and abiotic stress in banana and how the use of a natural gene regulatory system, based on microRNA, can be adapted to produce RNA bio-fertilizers for crop protection.

Keywords: Sustainable agriculture, crop protection, biological solutions, microRNA, RNA biofertilizers

[02]

USING NANOTECHNOLOGY FOR AMELIORATING HERBICIDAL ACTIVITY OF DIFFERENT ACTIVE INGREDIENTS WITH THE VARIOUS MECHANISMS OF ACTIONS

Zargar, M., Bayat, M.

Department of Agrobiotechnology, Agrarian Institute Technological, RUDN University, Moscow, Russia

Nano formulations involving nanoemulsions, nanocapsules, nanospheres, and organic materials protect the herbicides from degradation and enable their herbicidal activity, enhance leaf absorption and facilitate the penetration into plant tissues while at the same time decreasing the off-target efficacy. The objective of this study was to develop Nano herbicides with the different sites of action and investigating their herbicidal activities on problematic weeds. The experiment was conducted during 2023 and 2024 at the experimental area of the state farm in southern Russia, Zardian investigated developing nanoparticles by the herbicides including (carfentrazone/bromoxynil + tribenuron- methyl, carfentrazone/bromoxynil + clodinafop-propargyl/cloquintocet- methyl, tribenuron- methyl + clodinafop-propargyl/cloquintocet-methyl) and (carfentrazone/bromoxynil + tribenuron- methyl + clodinafop-propargyl/cloquintocet- methyl) with the various mechanisms of action and evaluating their weed control activities on weeds in wheat cultivation system. Nanoformulated herbicides caused significant reduction percentage >95% on weed numbers and dry weight. The greatest weed control percent was observed for mixture of nano formulations of tribenuron-methyl plus propargyl/cloquintocet-methyl by 99% reduction, all nanoformulated herbicide combinations had better weed population reduction compared to conventional herbicides. The lowest weed biomass was attained for use of nano formulated tribenuron-methyl and combination of nano-carfentrazone/bromoxynil plus nano-tribenuron-methyl respectively. In all cases, nanostructured herbicides caused a significant increase in weed control compared to the control plots three weeks after treatment. Hence, research communities are recommended nano-based biodegradable herbicides to ensure global food security.

Keywords: Wheat, weeds, nanotechnology, herbicide

PRECISION AGRICULTURE

A1

[03]

**DEVELOPMENT AND VALIDATION OF A CFD THERMAL MODEL FOR
SMALL-SCALE NATURALLY VENTILATED GREENHOUSE UNDER SEMI-ARID
CONDITIONS OF BOTSWANA**

Thipe, E.L., Hoffmann, J.E., Sebitosi, A.B., Kempen, E., Teke, G.

Stellenbosch University, South Africa

Greenhouses are employed globally to circumvent open field cultivation while increasing the resilience of production systems for high-value crops under challenging environmental conditions, such as in semi-arid Botswana. However, most greenhouses are imported from regions with mild climates (Europe and China) and do not adapt well under the Botswana climate, where high solar radiation, extremely high summer temperatures, and low air humidity limit their productivity. In this study, a computational fluid dynamics thermal model was developed using ANSYS Fluent 2023, to predict the performance of greenhouses in Botswana and ultimately adapt standard greenhouse designs to the country's climate. The computational domain consisted of an empty plastic tunnel and its external environment. The discrete ordinate method was used to compute the effect of solar radiation, and the standard k-epsilon model for turbulence. The impact of external wind on the internal environment was simulated using velocity vector components. The model was validated against diurnal air temperature and velocity data from a small-scale naturally ventilated plastic-covered greenhouse in Stellenbosch, South Africa, for a select period in summer. There was good agreement between the simulated and experimental results, evaluated using percentage error and root mean square error. The average percentage error was 2.8-11.8%, and the root mean square error was 1.2-12.5 °C. Comparison between three vent configurations demonstrated that the model can be used to optimize the vent configuration for local conditions. The project's next phase will expand the model to crop evapotranspiration effects on the tunnel thermal performance and physical designs under local conditions.

Keywords: Computational fluid dynamics, modelling, greenhouse tunnel, temperature and velocity, naturally ventilated

A2

[04]

AI-DRIVEN CLIMATE CHANGE MITIGATION FOR FOOD SECURITY: A QUANTITATIVE ANALYSIS USING SATELLITE DATA

Kollipara, Y.V.P., El-Gayar, O.

Dakota State University, USA

Climate change has emerged as one of the most pressing challenges to global food security, with rising temperatures, erratic rainfall patterns, and frequent extreme weather events significantly affecting agricultural productivity. This study proposes an artificial intelligence-driven framework that integrates satellite remote sensing data, climatic observations, and soil information to evaluate the impact of climate variability on crop performance and to identify actionable mitigation strategies. Leveraging the Kaggle Agri Yield: Predict Crop Yield from Soil, Weather | Kaggle, which combines field-level maize yield data with vegetation indices such as NDVI and EVI, alongside detailed weather and soil parameters, the research emphasises quantitative modelling to capture complex relationships between climate conditions and crop outcomes. Preprocessing includes temporal alignment of multi-source datasets, normalisation of environmental variables, and cloudmasking of satellite imagery to enhance data quality. Machine learning and deep learning techniques are explored to generate predictive insights and to identify the most influential factors contributing to yield fluctuations under climate stress. The outcomes of this study aim to inform precision agriculture interventions, including adaptive planting schedules and resource-efficient irrigation, thereby enhancing resilience to climate impacts. By linking satellite-based analytics with AI-driven decision support, this research contributes to sustainable food production strategies and supports evidence-based planning for farmers, policymakers, and food security initiatives.

Keywords: Climate change mitigation, satellite remote sensing, AI modelling, crop yield prediction, food security

A3

[05]

IMPACT OF CONSERVATION AND PRECISION AGRICULTURE MANAGEMENT PRACTICES ON PRODUCTION OF CEREALS IN GREECE

Kosti, M.¹, Moraitis, M.¹, Karamoutis, C.², Kyparissis, A.², Cavalaris, C.³, Zamidis, A.⁴,
Lampropoulos, C.⁵, Solomos, T.⁶, Balafoutis, A.T.¹

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Greek agriculture confronts significant problems in terms of soil degradation, compression from the destruction of soil structure, nitrate pollution, increased fuel consumption and the corresponding greenhouse gas emissions. In this work, an alternative cereals cultivation scheme which incorporated methods of Conservation Agriculture and Precision Agriculture was evaluated under real production conditions in two regions of Greece, where the risk of agricultural land degradations is high. Pilot applications included Conservation Agriculture methods (minimum and no-tillage, permanent soil cover (mulching) and cereals' crop rotation); and Precision Agriculture (variable rate nutrient application). In each region, two pilot fields have been selected and divided into 4 plots to cover the management practices combinations, including the conventional farming techniques (as a control). The results varied per pilot region, field and specific management practice. In summary, the trials showed that Conservation Agriculture techniques improved the crop yield up to 16.48%, while Precision Agriculture techniques and the combination of the two techniques improved it by 4.43% and 7.09% respectively. These findings depended on a multitude of external factors such as weather conditions and soil fertility, which were monitored during experiments. In conclusion, after two growing seasons (2022-2023 and 2023-2024), results indicated that the combination of precision and conservation agriculture methods had the best results. This combination maintained or enhanced crop yields and improved resource management and sustainability. The results of this work will be enriched based on data from the current growing season (2024-2025).

Keywords: Conservation agriculture, precision agriculture, no-tillage, variable rate nutrient application, cereals.

A4

[06]

THE USE OF REMOTE SENSING TECHNOLOGY IN SMART IRRIGATION AND ITS ROLE IN WATER RATIONING

Yassen, H.T., *Al-Badri, S.B.S.*

Department of Agricultural Machines and Equipment, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq

This review uniquely synthesizes recent advancement in remote sensing technologies and their applications in smart irrigation, identifying gaps in current research and proposing future direction. The increasing global demand for water, driven by population growth and climate change, necessitates innovative solutions for sustainable water management. This study explores the integration of remote sensing technology within smart irrigation systems to optimize water usage in agriculture. Effective water resource management is crucial, particularly in arid regions where groundwater depletion poses significant challenges. The research highlights how remote sensing can enhance irrigation efficiency by utilizing sensors that monitor soil moisture levels and environmental conditions, enabling precise irrigation scheduling. By employing the Internet of Things (IoT), these systems facilitate real-time data transmission, allowing for timely adjustments based on plant water needs and weather forecasts. This approach not only conserves water but also reduces operational costs and labor efforts associated with traditional irrigation methods. The findings suggest that smart irrigation systems can significantly mitigate water wastage while improving agricultural productivity. Furthermore, the study emphasizes the importance of balancing technological advancements with sustainable practices to ensure equitable water distribution and safeguard groundwater resources against pollution and over-extraction. Overall, the research underscores the potential of remote sensing and smart technologies in revolutionizing irrigation practices, contributing to sustainable agricultural development in the face of growing water scarcity challenges.

Keywords: Water rationing, smart irrigation, sensors, IOT, remote sensing

A5

[07]

SPATIO-TEMPORAL CHARACTERISTICS OF DROUGHT AND ITS IMPACT ON LOCAL FOOD SECURITY: THE CASE OF LIBOKEMKEM AND EBINAT DISTRICT, NORTHWESTERN ETHIOPIA

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Drought is often considered the most costly and widespread hazard, profoundly impacting global socioeconomic growth. The spatiotemporal distribution of drought severity is less evident in northwestern Ethiopia's highlands. This study was conducted in north-western Ethiopia's food-insecure and drought-prone Libokemkem and Ebinat districts. Based on satellite data and socioeconomic indicators, we employed an integrated approach to understand the characteristics of drought and its impact on local food security. The vegetation condition index (VCI), the standard precipitation evaporation index (SPEI), rainfall deviation, the start and end of the growing season, and socioeconomic indicators based on farmers' practice data were analysed to understand the impact of rainfall inconsistency on food availability, vegetation, and drought characteristics. The result revealed a significant drought impact during the growing season over the study periods (2000-2022). As indicated by the Standardized Precipitation Evaporation index, severe (< -1.5) and moderate (> -1.49) drought were observed in approximately 39 and 30% and 17 and 21% of the growing season in Libokemkem and Ebinat districts, respectively. During eight out of 23 years, the vegetation was affected by stress. Ebinat district experienced extreme drought when severe drought captured over Libokemkem, while both districts experienced enhanced local food insecurity differently. Our study shows that identifying drought during the growing season is crucial as it impacts vegetation; thus, local food insecurity is complex. This study highlights the need for an integrated approach to monitor the spatiotemporal distribution of drought and vegetation characteristics to allow for timely and continuous intervention to reduce local food insecurity.

Keywords: Drought, SPEI, VCI, local food insecurity, precipitation

A6

[08]

**ASSEMBLING AND TESTING A SMART ELECTRONIC SYSTEM FOR
MEASURING TRACTOR-IMPLEMENT PERFORMANCE INDICATORS USING
INTERNET OF THINGS TECHNOLOGIES (IoT)**

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A developed smart electronic system operating based on Internet of Things technologies (IoT) was assembled and tested for measuring some tractor-implement performance indicators. The measured indicators included pulling force, slip ratio, and fuel consumption. The developed system was assembled and installed on a *Massey Ferguson Xtra 470*, a four-wheel drive tractor. The system was tested in the field for ploughing and harrowing the soil to determine the system's efficiency. A moldboard plough and an offset disc harrow were used for preparing the soil. Two operating speeds were used, 3.84 and 4.81 km.h⁻¹ for the ploughing, and 4.74 and 6.75 km.h⁻¹ for the harrowing. The obtained results from the developed system were compared with conventional measuring methods. The study confirmed the possibility of using the developed system as an alternative to conventional measurement methods due to its high measurement efficiency and ease of use. The results showed no significant differences between the developed systems when compared to conventional measurement methods, as the performance efficiency of the developed system for ploughing and harrowing operations reached 96.81% and 96.58% for pulling force, 97.35% and 97.05% for slip ratio, and 98.39% and 98.3% for fuel consumption, respectively. Also, the obtained results showed that the increase of operating speed for both ploughing and harrowing operations led to an increase in pulling force and slip ratio, but a decrease in fuel consumption. The highest recorded pulling force was 22.43 KN obtained when using the moldboard plough at 4.81 km.h⁻¹, while the lowest pulling force was 16.81 KN when using the disc harrow at 4.74 km.h⁻¹. The highest recorded slip ratio was 14.82% obtained when using the moldboard plough at 4.81 km.h⁻¹, while the lowest slip ratio was 10.38% using the disc harrow at 4.74 km.h⁻¹. The highest recorded fuel consumption was 35.81 L. ha⁻¹ obtained when using the moldboard plough at 3.84 km.h⁻¹, while the lowest fuel consumption was 10.50 L. ha⁻¹ using the disc harrow at 6.75 km.h⁻¹. Moreover, two performance properties, including pulling and field efficiency, were studied. The study showed no significant difference between the results obtained from the two measuring methods. However, the results indicated significant differences in pulling and field efficiency while increasing the operation speed. Increasing the ploughing speed from 3.84 to 4.81 km.h⁻¹ led to a decrease in the pulling efficiency from 78.43% to 75.29% and in the field efficiency from 68.87% to 67.27%. Similarly, increasing the harrowing speed from 4.74 to 6.75 km.h⁻¹ led to a decrease in the pulling efficiency from 70.75% to 69.40% and in the field efficiency from 71.60% to 70.66%.

Keywords: Sensors, tractor performance, draft force, slip ratio, fuel consumption, IoT

A7

[09]

OVERVIEW OF AIR-BASED SENSORS FOR EFFICIENT FARMING UNDER THE CHALLENGES OF CLIMATE VARIABILITY IN SOUTHERN AFRICA

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Agriculture in Southern Africa is increasingly affected by climate variability, including erratic rainfall, rising temperatures, and frequent droughts. These challenges threaten food security and agricultural sustainability, especially for small-scale farmers. Precision agricultural tools, particularly air-based sensors, offer innovative solutions to detect, monitor and manage these impacts. This study critically evaluates the role and effectiveness of air-based sensors in enhancing productivity and resilience. This study employed a systematic literature review approach, secondary data was used to collect literature on previous studies and adapted a Prisma framework, and bibliometrics analysis was done on the downloaded SCOPUS CSV file. A rigorous search of the Scopus database yielded 375 studies from 2001 to 2025, narrowing to 99 high-quality articles after screening and eligibility assessment. Bibliometric analysis reveals a growing scholarly focus on remote sensing technologies, including UAVs, satellites, which provide real-time, high-resolution data critical for precision agriculture and climate adaptation. This study highlighted that developed countries dominate research output and international collaborations and are increasingly integrating these technologies for precise farm management. Despite promising benefits such as enhanced resource use efficiency and improved resilience to climate variability, widespread adoption is impeded by high costs, limited technical skills, infrastructure challenges. The review underscores the need for targeted policies, capacity building, and regional cooperation to harness the full potential of air-based sensing technologies for sustainable agriculture and food security in Southern Africa.

Keywords: Air-based sensor, efficient farming, Southern Africa, climate variability

BUSINESS AND EXTENSIONS

B1

[10]

**HOUSEHOLD SURVEY ON LIVELIHOODS OF COMMUNITIES IN NIPAH
INDUSTRY IN SARAWAK - A BASELINE STUDY**

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This report presents the findings of a baseline study on the Nipah palm (*Nypa fruticans*) industry in Sarawak, with a focus on communities engaged in harvesting, processing and commercialization activities. The study aimed to map the Nipah value chain, identify key stakeholders, evaluate the scale and distribution of community involvement and analyze livelihood strategies, assets and outcomes. Utilizing the Sustainable Livelihoods Framework and a snowball sampling approach, surveys were conducted with 452 harvesters and processors, 91 traders and 218 food and beverage operators across selected divisions in Sarawak. The results indicate that most Nipah-related activities are small-scale and community-based, serving as an essential source of income and employment, particularly in rural and coastal areas. Nonetheless, the industry faces significant challenges, including inconsistent raw material supply, rising production costs, limited market access and strenuous working conditions. Despite these constraints, the Nipah industry holds considerable socio-economic potential. This study offers actionable insights and recommendations for CRAUN Research and other stakeholders to foster sustainable development, strengthen value chain efficiency and improve the livelihoods of Nipah-dependent communities.

Keywords: Nipah, sap, gula apong, entrepreneur, cottage industry, entrepreneurship, Sarawak

B2

[11]

**BARRIERS TO THE UTILISATION OF DIGITAL TECHNOLOGIES BY
SMALLHOLDER FARMERS IN THE EASTERN CAPE PROVINCE, SOUTH
AFRICA**

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Digital technologies have the potential to transform agriculture, particularly for smallholder farmers who represent a significant portion of the global agricultural producers. However, despite the potential benefits of digital technologies, the adoption by smallholder farmers remains limited. This can be attributed to several reasons. This study aimed to assess the challenges faced by smallholder farmers utilising digital technologies. Methods: A purposively selected sample of 250 smallholder farmers in Port St. Johns and Ingquza Hill Local Municipalities participated in the cross-sectional survey. The data was analysed using descriptive statistics. Research findings reveal that smallholder farmers encounter significant hurdles in using digital technologies, which fall into three main categories: end-user issues, service provider limitations, and digital technology characteristics. Notably, around 45% of farmers cited end-user constraints, including limited access to land, financial constraints, inadequate electricity supply, lack of awareness about digital technologies, lack of digital skills, and limited economies of scale in their agricultural activities. Service providers were also reported as a source of constraints, with 34% of respondents highlighting issues such as poor infrastructure and limited availability of spare parts, monopolistic practices, abstract value-added services, unreliable delivery times, inconsistent broadcasting schedules, and high mobile data costs. Additionally, 21% of respondents noted that digital technology features posed barriers to utilisation by smallholder farmers. These challenges include high costs, language barriers, a lack of integration with indigenous knowledge, inefficient delivery times, and information loss. Conclusions and Recommendations: The study concludes that even though there are various constraints on the utilisation of digital technologies among smallholder farmers, these constraints are not homogeneous across different farmers in the study area, requiring tailor-made and context-specific solutions.

Keywords: Constraints, digital technologies, Eastern Cape, smallholder farmers

B3

[12]

SOCIO-ECONOMIC FACTORS INFLUENCING THE ADOPTION OF TRACTOR-TRACTION BY SMALLHOLDER MAIZE FARMERS IN MBASHE LOCAL MUNICIPALITY, SOUTH AFRICA

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Traction in agriculture includes animal traction and tractor-traction that provides power and traction to mechanize agricultural tasks. Adoption of tractor-traction can improve smallholder maize farming efficiency, preserve soil health, enhance food security and thus, improve the livelihood of farmers; however, various socioeconomic factors can hinder or promote its uptake. This study examines socio-economic factors influencing the adoption of tractor-traction by smallholder maize farmers in Mbashe Local Municipality, South Africa. A cross-sectional research design was used to collect primary data from 138 smallholder maize farmers in Mbashe Local Municipality. Data were analyzed using binary logistic regression to analyse factors influencing the adoption of tractor traction. Age ($p < 0.1$), level of education ($p < 0.1$), years as a maize farmer ($p < 0.05$), and years using traction ($p < 0.05$) significantly influenced tractor-traction adoption. Age and prior traction use positively impacted adoption, while education level and years as a maize farmer negatively affected it. Tractor-traction adoption is linked to economic capacity and experience rather than external support or gender. Interventions should consider the negative impact of education and experience as a maize farmer on adoption.

Keywords: Tractor-traction, adoption, smallholder farmers, maize, socio-economic factors, South Africa

B4

[13]

IMPACT OF DROUGHT AND FLOODS DISASTERS ON COMMUNAL LIVESTOCK FARMERS AND THEIR ADAPTATIVE CAPACITY IN THE EASTERN CAPE PROVINCE SOUTH AFRICA

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The agricultural sector is highly vulnerable to climate change impacts, with communal livestock farmers (CLFs) in South Africa's Eastern Cape Province being particularly susceptible to droughts and floods that threaten their livelihoods. Despite documented struggles with climate change adaptation, these farmers continue to face challenges due to limited access to resources and support. This study investigates the impact of climate change disasters on CLFs, their adaptation strategies, and the challenges and factors hindering their ability to adapt to droughts and floods. The study used a snowball technique to select 175 communal livestock farmers who were interviewed using semi-structured questionnaires, with data analyzed through descriptive statistics in a cross-sectional research design and quantitative method. The 2021-2024 production period was marked by devastating floods and droughts, that had negative effects on agricultural production and infrastructure. The results of the study revealed that livestock diversification is a key coping strategy with cattle ranked as the most important and pigs the least, but climate-related disasters significantly impede livestock production. Farmers used rotational grazing, veld burning, and dipping to adapt to climate change-related disasters. The results highlight a positive relationship between livestock diversity and adaptation to climate change. However, CLFs face significant factors that affect their adaptive capacity, including limited access to credit, education, and training, and information gaps. There is a significant association ($p < 0.001$) between these factors. The study emphasizes the need for targeted support services to enhance CLFs' climate resilience and adaptive capacity, recommending improved access to climate-resilient management strategies and support services.

Keywords: Adaptation strategies, climate change disasters, livestock ownership and diversification

B5

[14]

UNDERSTANDING GENDER GAPS IN THE ADOPTION OF AGRICULTURE TECHNOLOGIES IN MALAWI: THE CASE OF VIBANGALALA EXTENSION PLANNING AREA (EPA) IN MZIMBA

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Gender disparities in adopting Conservation Agriculture Technologies (CAT) remain a significant barrier to enhancing agricultural productivity and food security in rural Malawi. In Mzimba, a district heavily dependent on subsistence farming, women face more significant challenges than men in accessing resources such as land, credit, and extension services. These disparities, rooted in socio-economic and cultural factors, restrict women's ability to adopt and benefit from CAT, ultimately impacting the region's agricultural development. This study aims to analyze socio-demographic factors influencing CAT adoption among smallholder farmers in Mzimba, explicitly focusing on understanding how gender affects access to resources, decision making authority, and perceptions of technology. The goal is to identify barriers unique to female farmers and propose gender-sensitive policy recommendations to foster equitable technology adoption. Data was collected from 390 smallholder farmers in Mzimba through surveys. The data was entered in the SPSS version. Logistic regression analysis was employed to examine the relationships between socio demographic variables (age, education, farm size, etc.) and CAT adoption, with particular attention to gendered differences in access to resources and technology perceptions. The value of $p < 0.05$ was considered statistically significant. The results reveal stark gender disparities: 98.7% of male farmers manage their land, while only 1.5% of female farmers access rented land, underscoring women's limited land rights. Women were 1.419 times more likely to have knowledge of CAT than men ($p = 0.035$), yet resource constraints hindered their adoption. Gender differences in time perception were evident, as women were 2.166 times less likely to view CAT as time-consuming than men ($p = 0.039$). Although male farmers were 1.99 times more likely to adopt CAT than female farmers, this difference was not statistically significant ($p = 0.124$). The study highlights the need for gender-sensitive agricultural policies and targeted interventions in Mzimba to address female farmers' unique challenges. By improving women's access to resources, facilitating equitable decision-making, and providing tailored support, policymakers and development practitioners can promote gender-equitable CAT adoption, thus enhancing agricultural productivity and food security in rural Malawi.

Keywords: Gender Gaps, inequality in agriculture, food security, food insecurity, SSA

SUSTAINABILITY AND ENVIRONMENT

C1

[15]

THE PUMPKIN POTENTIAL: COMPREHENSIVE UTILIZATION OF PUMPKIN PLANT FOR SUSTAINABLE FOOD SYSTEMS

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Pumpkins are often discarded beyond pulp. Pumpkin peel, seeds, flowers and leaves are underutilized contributing to food waste. Novel approaches largely focused on cosmetic value from the plant, while creating a vacuum as a holistic plant resource. This review aims to address the gap, examining how the plant is conventionally and newly used globally. By adopting a comprehensive utilization, primary objectives are to unlock its full potential on finding food applications for economic gain. This could contribute to food waste reduction and ultimately could help in building resilient food systems. Since, pumpkin -the name is generic for various species in *Cucurbitaceae* family, this review considered three main species *C.Pepo*, *C.Maxima* and *C.Moshata*. Pumpkin seeds are consumed as roasted snacks by removing hull and maintaining less than six percentage of moisture for quality. Seed oil is obtained by roasting hull less seeds and pressing. It is valued as salad oil for its therapeutic compounds. Seed flour enhances conventional bakery products with studies recommending thirty percentage inclusion in cookies and less than thirty percentage in cakes. Hot air drying and microwave vacuum drying are employed for pumpkin pulp flours for jams, purees, soup mixes and ice cream mixes. Incorporating by product pumpkin peel powder adds nutritional value in wheat breads and extruded snacks. Furthermore, this adds value in livestock feed. Various cultures such as India and Africa use flowers and leaves in dried and fresh forms. Candied Sweets and Halwas are produced in small scale industries with vibrant yellow pumpkin pulp. This foundational assessment could contribute to strategic development by waste reduction and ultimately could help in building resilient food systems.

Keywords: Pumpkin flour, microwave vacuum drying, food systems, sustainability, therapeutic

C2

[23]

RHIZOSPHERE BIOENGINEERING: BIOCHAR-IMMOBILIZED *Bacillus Consortium* MODULATE *ELAEIS GUINEENSIS* – SOIL INTERACTIONS FOR AN IMPROVED SURVIVAL UNDER REDUCED CHEMICAL FERTILIZATION

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This study focused on evaluating the effectiveness of oil palm kernel shell biochar as a carrier for immobilized *Bacillus* consortium to improve the nutrient uptake and growth of oil palm seedlings. Immobilization processes like temperature, agitation speed, pH, and sago starch concentration were optimized using a central composite design. The results showed that the use of 30% optimized bio char with the *Bacillus* consortium enhanced seedling growth parameters such as height, girth diameter, and the chlorophyll index when compared to controls and conventional fertilizer treatments. Furthermore, the combination of bio char and *Bacillus* consortium maintained comparable seedling growth while decreasing the reliance on chemical fertilizers. Metabolomics analysis of seedlings showed that treatments enhanced plant resilience as some metabolites associated with stress mitigation were up regulated, suggesting increased resilience. The study results show that the application of palm kernel shell bio char with the *Bacillus* consortium affects plant-soil relationships positively, which leads to decreased chemical fertilizer use while increasing plant vitality and productivity, thereby promoting sustainable agriculture. The study proves the effectiveness of bioengineering strategies in improving *Rhizosphere* relationships for crop performance.

Keywords: Rhizosphere bioengineering, sustainable agriculture, plant growth promotion, plant-soil interaction, Omics

C3

[17]

EVALUATION OF INDIGENOUS MICROBIAL ISOLATES FOR GROWTH PROMOTION AND BIOCONTROL OF BACTERIAL PANICLE BLIGHT IN RICE

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Bacterial panicle blight, caused by *Burkholderia glumae*, significantly threatens rice production in tropical climates. This study explored the potential of indigenous microbial isolates as plant growth-promoting microorganisms and biocontrol agents against bacterial panicle blight. Fifteen composite soil samples were collected from Tanjung Karang, Sekinchan, and Sungai Besar in Selangor, Malaysia, and their physicochemical properties were analyzed. The variations in microbial diversity resulted in 31 isolates. Preliminary screening identified 12 isolates with beneficial traits, including phosphate solubilization, hydrogen cyanide production, urease activity, and nitrogen fixation. Molecular identification through 16S ribosomal RNA and internal transcribed spacer sequencing confirmed the presence of *Providencia vermicola*, *Trichoderma asperellum*, and *Trichoderma yunnanense*. In vitro antagonism assays using agar well diffusion revealed that *Providencia vermicola* SB8 (20.00 ± 0.05 mm) and *Trichoderma asperellum* (18.50 ± 0.04 mm) produced the largest inhibition zones at a concentration of 10⁷ colony-forming units per milliliter. These isolates were further evaluated in greenhouse bioassays with rice seedlings (variety MR297). After 28 days, *Trichoderma asperellum* significantly enhanced plant growth, achieving the highest plant height (51.2 cm), root length (12.3 cm compared to 8.9 cm in controls), and biomass (0.35 g dry weight, 1.46 g wet weight) at a concentration of 10⁸ CFU/ml. *Providencia vermicola* also promoted growth (51 cm plant height) and demonstrated strong and consistent biocontrol efficacy. Disease severity assessments indicated that *Trichoderma asperellum* reduced the disease severity index by 68% compared to untreated controls. The strong correlation between in vitro and in vivo results supports the potential of *Trichoderma asperellum* and *Providencia vermicola* as promising biocontrol and growth-promoting agents for integrated bacterial panicle blight management in rice, paving the way for their future deployment in field trials.

Keywords: Plant growth-promoting microorganisms, biocontrol agents, bacterial panicle blight, *Burkholderia glumae*, sustainable rice production

C4

[18]

BIOCHAR AS A GREEN SOLUTION FOR REMEDIATING CONTAMINATED SOIL*Abu-Sari, N.¹, Yong, S. K.², Abdullah, R.³*¹Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, Malaysia²Faculty of Applied Science, Universiti Teknologi MARA, Malaysia³Institute of Biological Science, Faculty of Science, Universiti Malaya, Kuala Lumpur, Malaysia

Biochar has emerged as a promising organic amendment for mitigating soil contamination due to its favorable physico-chemical properties and strong adsorption capacity. This study aims to evaluate the potential of biochar derived from agricultural residues in reducing the mobility of toxic trace elements in soil. Biochars produced from empty fruit bunch (EFB), rice husk (RH), and palm kernel shell (PKS) were characterized for their physical and chemical properties. Pyrolysis conditions, particularly temperature, were found to significantly influence bio char properties. Laboratory batch sorption experiments were conducted to assess the adsorption capacity for cadmium and arsenic. Results revealed that bio chars produced at higher temperatures exhibited increased pH, nutrient content, and surface area, which contributed to enhanced adsorption of Cd and As. Incubation studies further demonstrated that bio char amendments reduced soluble arsenic concentration in soil pore water by up to 82%, while also raising soil pH and lowering as bioavailability. These findings suggest that bio chars, especially those derived from oil palm residues, offer a sustainable solution for remediating contaminated soils. The application of bio char together with organic amendments showed the potential in reducing the heavy metals uptake by plant. The application of such amendments not only supports soil detoxification but also promotes carbon sequestration and waste valorization. Further field-scale trials are recommended to validate these outcomes across various soil types and contamination levels.

Keywords: Biochar, organic amendment, soil remediation, heavy metals, waste management

C5

[16]

**EVALUATION OF RICE FARMING SUSTAINABILITY IN PALI DISTRICT:
INCOME ANALYSIS AND FARMERS' PERCEPTIONS OF SOCIAL, ECONOMIC,
AND ENVIRONMENTAL ASPECTS**

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Rice farming has a strategic role in ensuring food security and supporting the community's economy, but faces various challenges related to its sustainability. This study aims to analyze the income and level of farmers' perceptions of the sustainability of rice farming in Pali District, South Sumatra. The study was conducted in Talang Ubi Utara and Benakat Minyak Village, using a purposive sampling method on 200 farmer respondents. Data collection was carried out through structured interviews, focus group discussions, and scale assessments to measure farmers' perceptions. Data analysis used two approaches: income analysis to calculate production costs and farming income, and the spider plot method to visualize and analyze farmers' perceptions of farming sustainability covering aspects of social networks, economic welfare, food security, and agricultural sustainability. The results showed that the income of rice farmers in Pali Regency reached IDR 7,178,396.99 per cultivated area per planting season, with a significant contribution of non-farm income. The spider plot analysis indicated that farmers' perceptions of the sustainability of rice farming were relatively high, especially in terms of supporting the economy. These findings provide important implications for the development of policies that support the strengthening of farmers' capacity in implementing environmentally friendly sustainable agricultural practices.

Keywords: Rice farming, sustainability, income analysis, spider plot, farmers' perception

C6

[20]

EFFECTS OF COMPOST AMENDMENTS ON SOIL STRUCTURAL STABILITY*Askri, A., Alkaabi, B., Alketbi, S., Alnaqbi, M., Aldhanhani, A., Ahmed, Z.F.*

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Soil degradation in arid regions poses a significant challenge to agricultural production, necessitating effective soil management strategies. This study investigates the effects of diverse compost amendments on soil structural stability in arid environments. Three amendments were evaluated: cow manure compost, chicken manure compost and a brown algae solution. The objective was to assess their impact on soil aggregate stability, organic matter decomposition, microbial biomass and polysaccharide formation. Soil samples were incubated with the amendments for 90 days, simulating approximately one year of field conditions. Organic matter decomposition, microbial and fungal biomass and soil aggregate stability were measured at regular intervals. Results showed that chicken manure compost had the highest organic matter decomposition rate (29.24%), followed by cow manure compost (23.05%), while the algae solution exhibited minimal mineralization (1.88%). Microbial biomass fluctuated, with cow and chicken manure composts showing the highest levels. Fungal biomass remained more stable, with cow compost supporting the highest fungal growth. Soil aggregate stability improved significantly with all amendments, with algae treatment reaching 2.94 mm by day 90 compared to 1.01 mm for chicken compost and 0.77 mm for cow compost. The study concludes that manure-based composts provide rapid soil fertility improvements, while algae-based amendments contribute to long-term soil stability and carbon sequestration. It is recommended that farmers in arid regions consider using a combination of these amendments for optimal soil health and sustainable agricultural practices.

Keywords: Structural stability, compost amendment, organic matter decomposition, microbial biomass

C7

[21]

DESIGN AND PERFORMANCE ASSESSMENT OF A HYBRID INDIRECT SOLAR DRYER WITH VARIOUS ABSORBER PLATE CONFIGURATIONS FOR DRYING RED ONION SLICES

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Indirect solar dryers are a sustainable solution for enhanced product preservation. They represent a clean and eco-friendly approach to reducing moisture content in various food and medicinal products. This innovative technology facilitates extended shelf life, enables compact storage solutions, and ensures product availability as needed. To maximize the utility of these systems, optimizing their efficiency becomes imperative. For this purpose, a hybrid indirect solar dryer was locally assembled and fabricated in Baghdad, Iraq. An experimental study on this solar dryer was conducted during April and May 2025. The primary aim of this study was to evaluate the drying process of onion slices within a hybrid indirect solar dryer. To achieve this, the investigation focused on three factors. The first factor was the shape of the absorber plates with three levels: a flat plate, a vertically corrugated plate, and a perforated, horizontally corrugated plate. The second factor was the type of plate coating. Two types of matte black paint were used: smooth and rough paint. The third factor was the airflow rate. Three levels of air circulation within the dryer were examined: natural convection, single fan, and three fans. The performance of the drying system was primarily evaluated based on the change in moisture content in onion slices. Accordingly, the interactions between these three factors were studied. Results indicated that the drying rate is affected by temperature and the amount of air entering the dryer. The highest drying rate was recorded when using three fans with a rough coating and a vertically stepped plate (F2P2S2), reaching 48.53 g/h. These parameters contributed to an increase in the air temperature entering the drying chamber. Furthermore, the highest efficiency (68.07%) was achieved with natural convection, a rough coating, and a vertically stepped plate (F0P2S2). These parameters increased the amount of air entering the dryer and contributed to a larger temperature differential, leading to an increase in extracted energy due to their direct proportionality. As extracted energy increases, so does efficiency. Additionally, temperature changes significantly influence pressure differential values. A greater temperature difference leads to higher pressure differential values, indicating a direct relationship between them. The highest-pressure differential was recorded with the interaction of natural convection, a rough coating, and a flat plate (F0P2S1), reaching (1.87 Pa), attributed to the increased temperature difference resulting from these parameters.

Keywords: Hybrid indirect solar dryer, absorber plate configuration, airflow rate, thermal efficiency

C8

[22]

EVALUATING ENVIRONMENTAL PERFORMANCE OF APPLE PRODUCTION SYSTEMS IN JAPAN: PATHWAYS TOWARD SUSTAINABLE AGRICULTURE

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This study assessed the environmental performance of apple production in Japan's Aomori and Iwate prefectures using Life Cycle Assessment to identify environmental hotspots and inform sustainable strategies. The study examined three orchard systems: traditional and tall-spindle in Aomori and open-center in Iwate, using a cradle-to-farm gate boundary with 1 kg of apples as functional units. Inventory data were gathered directly from Aomori and Iwate research institutes through field visits. Background data were sourced from Ecoinvent, and WFLCB. LCA, uncertainty and sensitivity analysis were performed using SimaPro 9.6.0, employing the ReCiPe 2016 Midpoint (H) methodology. The finding indicated that traditional system emits 0.230 kg CO₂ eq kg⁻¹, with fertilizers (53%) and pesticides (70%) as major contributors. The tall-spindle system shows lower global warming potential (0.189 kg CO₂ eq kg⁻¹) but higher machinery and gasoline use. The open-center system relies more on diesel (52%) and pesticides (77–82%), resulting in the highest impacts on terrestrial Eco toxicity and fossil resource scarcity. Across all systems, chemical fertilizers dominate global warming and terrestrial Eco toxicity in traditional and tall-spindle systems, while pesticides significantly affect freshwater Eco toxicity and human toxicity. The open-center system's impacts are driven by machinery and diesel use. Based on results, mitigation strategies should focus on precision agriculture to optimize chemical use, improve machinery efficiency, and adopt renewable energy. These findings show how regional farming practices influence environmental impacts and highlight the need for tailored mitigation strategies. Future research should adopt multicriteria LCA, integrating economic, land use (LANCA), and efficiency (DEA) metrics to assess apple production systems' sustainability.

Keywords: Life cycle assessment, apple production, Orchard training systems, environmental impact, sustainability agriculture

C9

[24]

CARBON BUDGET ANALYSIS OF FRESH FRUIT BUNCH AND OIL PALM SEED PRODUCTION USING LIFE CYCLE ASSESSMENT: A COMPARATIVE APPROACH FOR SUSTAINABLE PALM INDUSTRY PRACTICES

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Sustainability efforts within the oil palm industry have expanded to various operational sectors, including both the production of fresh fruit bunches (FFB) and ungerminated oil palm seeds. These activities contribute differently to greenhouse gas (GHG) emissions, making carbon accounting an essential tool in evaluating and guiding low-emission strategies. This study employs a comparative Life Cycle Assessment (LCA) approach to evaluate the carbon footprint and sequestration potential of oil palm FFB production and oil palm seed production, aiming to quantify net carbon balances as indicators of environmental sustainability. The assessment integrates OpenLCA 2.4.1 (2025) software with the Eco-invent 3.9.1 (2022) database and applies the IPCC 2021 impact methodology to calculate GWP100 values. Carbon sequestration estimates were derived from non-destructive field sampling and literature-based calculations focusing on aboveground biomass components. Results indicate that FFB production yields a higher GHG emission profile at 1.702 t CO₂-eq ha⁻¹ yr⁻¹ compared to 1.410 t CO₂-eq ha⁻¹ yr⁻¹ for seed production. However, the carbon uptake observed via trunk, frond, and fruit biomass reached 41.821 t CO₂-eq ha⁻¹ yr⁻¹ for FFB-producing plantations, and 38.157 t CO₂-eq ha⁻¹ yr⁻¹ for mother palm plantations. The net carbon balance calculations revealed that FFB production contributes a sequestration reserve of 35.388 t CO₂-eq ha⁻¹ yr⁻¹, while seed production results in a slightly lower reserve of 27.478 t CO₂-eq ha⁻¹ yr⁻¹. Despite these differences, both plantation objectives demonstrated positive carbon budgets, reaffirming the role of oil palm cultivation as a potential carbon sink and an integral component of climate change mitigation strategies in tropical agricultural systems. These findings underscore the importance of integrating LCA-based emission profiling with biological carbon accounting to advance sustainability in palm-based agribusiness.

Keywords: LCA; oil palm sustainability; GHG; carbon sequestration; carbon stock; carbon footprint

C10

[25]

EXPLORING GENDER DIFFERENCE IN ADOPTION OF SUSTAINABLE AGRICULTURAL PRACTICES IN SOUTHWESTERN ETHIOPIA

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The study aimed at analyzing gender difference in adoption of sustainable agricultural practice (SAPs) and source of gender difference. In this study, a total of 382 smallholder maize producers randomly selected from the Bunno Bedelle zone. Qualitative and quantitative data were collected from primary and secondary sources for this study. Both inferential statistics and econometric estimation were employed to analyze data. The findings of the study reveal a significant disparity in the adoption of sustainable agricultural practices between men-headed and women-headed households with a probability of success of 22.92% for men-headed households compared to women-headed households (7.47%). The greater likelihood of men-headed households to adopt a diverse range of sustainable agricultural practices can be attributed to their ownership of most productive resources. In contrast, women-headed households face challenges that limit their ability to adopt these practices, including restricted access to resources and support. By addressing the unique challenges faced by women and men in agriculture, stakeholders can foster a more inclusive environment that enhances productivity and contributes to environmental sustainability. By promoting equitable access to resources and support, as well as recognizing and valuing women's contributions, stakeholders can enhance the adoption of sustainable agricultural practices across both genders, leading to improved agricultural outcomes and environmental sustainability. The findings from this study can inform policymakers and agricultural practitioners about the need for gender-sensitive strategies that promote equitable access to resources, training, and support.

Keywords: Gender Gap, sustainable agricultural practices, Southwestern Ethiopia

C11

[26]

AI-DRIVEN INNOVATIONS IN FARMING: A SYSTEMATIC LITERATURE REVIEW ON ADVANCING SUSTAINABLE AGRICULTURE*Kollipara, Y.V.P.*, El-Gayar, O.

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The rapid adoption of artificial intelligence (AI) is transforming modern farming practices, offering new pathways to achieve sustainable agriculture and long-term food security. This study presents a systematic literature review that examines the application of AI-driven innovations in farming, focusing on enhancing efficiency, environmental sustainability, and resource optimisation. Following PRISMA guidelines, academic and industry sources from major scientific databases were analysed to identify trends in precision agriculture, smart irrigation, crop health monitoring, and predictive analytics for yield forecasting. The review highlights how machine learning, computer vision, and decision support algorithms are increasingly utilised to monitor soil health, detect crop diseases, optimise input usage, and reduce environmental impact. Additionally, the study synthesises emerging evidence on AI enabled integration with Internet of Things (IoT) devices, drones, and satellite systems for real time data collection and actionable insights. The findings emphasise the potential of AI to support climate-resilient farming practices, minimise resource wastage, and improve decision making in sustainable food production systems. By consolidating current research and identifying knowledge gaps, this review provides a comprehensive foundation for future studies and guides policymakers, agronomists, and technology developers in leveraging AI for sustainable agriculture.

Keywords: Artificial intelligence, precision agriculture, sustainable farming, machine learning, smart agriculture

C12

[19]

FARMERS' PERCEPTIONS OF CONSERVATION AGRICULTURE BENEFITS AND ADOPTION IN MOPANI DISTRICT, SOUTH AFRICA

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The Mopani District faces challenges from climate variability, including floods and droughts, which threaten food security amid high unemployment rates. Climate change worsens resource degradation, particularly affecting emerging farmers. In response, the Department of Agriculture promotes conservation agriculture (CA), but adoption rates vary based on individual experiences and socioeconomic conditions. This study aimed to identify the key factors affecting the adoption of CA by Mopani emerging farmers. Quantitative cross-sectional design and stratified random sampling for 52 farmers employed. Data collected using structured questionnaires, analysed with descriptive and inferential statistics, particularly logistic regression. A higher percentage of female farmers (56.3%) adopted CA compared to male farmers (43.8%), and both groups showed low levels of educational attainment. CA adopters had an average education level of 3.5, while non-adopters averaged 2.4; adopters tended to be slightly older, with an average age of 58 years, compared to 56 years for non-adopters. Positive perceptions of CA were associated with increased crop yields, whereas negative views were linked to concerns about yield. Key socioeconomic factors, including age, education, land size, and gender, significantly influence decisions on CA adoption. Access to financial resources and credit is essential for investing in CA technologies, and the availability of quality extension services. While CA offers benefits for both farmers and the environment, successful implementation relies on addressing farmers' perceptions, providing adequate support, and tailoring initiatives effectively. Understanding the factors that influence farmers' choices is crucial for promoting sustainable practices and ensuring food security.

Keywords: Conservation agriculture, emerging farmers, perceptions, adoption

FOOD SAFETY AND FOOD WASTE

D1

[27]

FOOD STANDARDISATION AND AUTHENTICATION; A LEGAL STUDY WITH SPECIAL REFERENCE TO THE GI AGRICULTURE GOODS IN INDIA

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Food standardization and authentication refer to practices adapted for ensuring that food is free from adulteration and fraud. The standards and authentication of agricultural goods are necessary for improving the market conditions of agricultural GIs and their consumption. Standardization and authentication are needed to protect consumers from food fraud. The FAO and WHO joint efforts created CODEX ALIMENTARIUS, which advocates for a code book of international food standards and guidelines for trade and food safety. Being a member of CODEX India enacted the FSSAI Act of 2006 for food safety and standardization. In the Indian context, the Food Standardization legal framework is applicable through regulations of the Food Safety and Standard Authority of India, and the authentication mechanism is assured through lab tests. Despite these steps, it is not assured that the quality of agricultural goods is the same as it is intended to be. The instances of the mixing and supply of unauthentic GI agriculture goods are common with similar GI agriculture goods of neighboring states. The standardization must meet the global benchmarks with assurance of authentic Food. This paper is addressing the legal issue and challenges in current legal framework for food standardization and authentication with special reference to GI Agriculture Goods in India. The doctrinal methodology is adopted for analyses of the effectiveness of the current legal framework in the Food Standardization and Authentication of Agriculture GI Goods in India.

Keywords: Food standardization, food authentication, food fraud, GI agriculture goods.

D2

[28]

CONTROL AND PARETO CHART TO PROLONG SHELF LIFE OF FRUITS AND VEGETABLES

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This study focuses on reducing weight loss and extending the shelf-life of green bell peppers using an evaporative cooling system combined with bio plastic packaging. Key factors influencing quality were identified using Pareto chart, while MR charts enable real-time adjustment to cooling intensity based on sensor feedback. The researcher evaluates a wooden storage box with three layers, designed to prolong shelf life and reduce weight loss of perishable fruits and vegetables. The case study was green bell pepper with and without packaging, The optimal conditions achieved an average shelf life of 24 days using combination of cooling, packaging, and lower air speed (CGPS1). The study monitored relative humidity and temperature, assessing quality using a Hedonic scale. Findings indicate that lower air speeds better preserve quality. The MR charts analysis provides insights into storage stability and data variability. Additionally, the research explores the use of stored peppers in bio plastic packaging, prototypes, creating a closed-loop system. This approach not only extends shelf life but also promotes sustainable food practices by reducing post-harvest losses. The integration of evaporative cooling with control and Pareto charts offers a comprehensive strategy for enhancing the shelf life of fruits and vegetables, contributing to food security and waste reduction efforts.

Keywords: Evaporative cooling, weight loss, shelf life, sustainable practices, postharvest management

D3

[29]

**ERRORS ASSOCIATED WITH MYCOTOXIN ANALYSIS DUE TO
HETEROGENEITY OF MYCOTOXIN ACCUMULATION AND RELATED
SAMPLING PROBLEMS**

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Mycotoxin contamination in foods stored under uncontrolled humidity is a major food safety problem, especially in the tropical countries. Mycotoxin accumulation in crops is a continuous time related process with linear, curvilinear, or bimodal accumulation patterns associated with different mycotoxigenic fungi. Mycotoxin analysis is the only mechanism available to ensure food safety of market products. Preparing samples from lots for mycotoxin analysis consists of three steps – Sampling, Sample Preparation and testing. The heterogenous nature of mycotoxin accumulation in foods makes reliable assessment of mycotoxin concentrations challenging. The errors that could occur in the three steps of analysis is reported to vary from 77 - 99%, 0.4 – 20% and 0.1 - 0.2 % at sampling, sample preparation, and testing respectively for corn, hazelnuts and other commodities. Mycotoxin accumulation varies among individual grains or nuts making truly representative sampling of foods challenging. This has led to recommending homogenization of 20 kg samples from lots under examination to ensure reliable test results, which is not always possible. Of the various crops susceptible to mycotoxin contamination copra (smoke dried coconut kernels) stands high as the oil serves as an important nutrient for growth of toxigenic *Aspergilli*. With 100-fold high kernel size of copra compared to peanuts, the heterogeneity of aflatoxins in a lot tends to be extremely high. A study was conducted to examine changes in heterogeneity of aflatoxin in copra, steamed copra pieces of 2-5 mm particle size, oil expelled from copra pieces and resulting copra cake at commercial level from 45 oil expelling mills, testing 414 samples. The coefficient of variation of aflatoxins were 2.7, 1.4, 1.0 and 1.1 respectively for selected contaminated kernels, copra pieces, coconut oil and copra cake respectively. Sample reduction or examination of oils from oilseed crops are recommended in estimation of aflatoxins at commercial operations to take food safety decisions.

Keywords: Food safety, Mycotoxins, sampling, heterogeneity

D4

[30]

EVALUATION OF AGRONOMIC TRAITS, YIELD, AND NUTRITIONAL QUALITY OF SEVEN QUINOA VARIETIES UNDER ARID ENVIRONMENTAL CONDITIONS IN SAUDI ARABIA

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Quinoa (*Chenopodium Quinoa* Willd.) has gained global recognition as a resilient, nutrient-rich crop with the potential to enhance food security, especially in arid and semi-arid regions. This study evaluated the agronomic and nutritional performance of seven quinoa varieties under arid conditions at the Al Kharj Agricultural Experimental Station in Riyadh, Saudi Arabia. Key parameters included plant height, stem diameter, biomass, and number of branches per plant; yield components such as panicle length, number of panicles per plant, and grain yield; as well as biochemical and nutritional traits including chlorophyll, carotenoids, saponin, grain protein, starch, minerals, phenols, and flavonoids. The results revealed significant variation among the varieties. Golden Afternoon and Mint Vanilla excelled in vegetative growth and yield performance, producing 4.3 and 4.0 t ha⁻¹ respectively, demonstrating high adaptability to arid conditions. In contrast, Oro de Valle underperformed across most parameters, yielding only 1.5 t ha⁻¹, indicating limited suitability for such environments. Peppermint stood out for its high grain protein content (16.2%), highlighting its value for nutritional enhancement, while Red Head, despite its robust morphology and moderate yield, recorded the lowest protein content (11%), but exhibited the highest saponin content. Overall, Golden Afternoon emerged as the most promising variety for sustainable quinoa cultivation in arid regions, while Peppermint offers significant potential for improving nutritional quality in marginal agro-ecosystems. These findings underscore quinoa's ecological adaptability and nutritional diversity, supporting its role in sustainable agriculture and food security in resource-limited, climate-stressed regions.

Keywords: Quinoa, Food security, Saudi Arabia, Arid regions, nutritional quality, sustainable agriculture

POSTER PRESENTATION ABSTRACTS

P1

[31]

PLANT GROWTH-PROMOTING EFFECTS OF *Phialocephala Fortinii**Udaakhbayar, J.*¹, Takeshi, T.²¹The United Graduate School of Agricultural Sciences (UGSAS), Tottori University, Japan²International Platform for Dryland Research and Education (IPDRE), Tottori University Technology, Japan

Endophytic fungi inhabit a wide range of plant tissues and organs without causing visible disease symptoms. Increasing evidence suggests that these microorganisms can promote plant growth, enhance tolerance to abiotic and biotic stresses, and stimulate the production of secondary metabolites. Due to these multifunctional benefits, endophytic fungi are considered valuable microbial resources with significant potential for application in agriculture and environmental sustainability. This study aimed to isolate and identify fungal endophytes from *Larix sp.*, and to evaluate their plant growth-promoting (PGP) characteristics through laboratory and plant-based experiments. Endophytic fungi were isolated from Larix trees collected during both winter and summer seasons using a common isolation method. The isolates were screened for plant growth-promoting traits via in vitro assays. Selected active strains were subsequently inoculated into *Lactuca Sativa* (lettuce) under controlled conditions, and plant growth responses were monitored over a 21-day period. A total of 103 fungal endophytes were isolated from *Larix sp.*, and 90 were identified through DNA sequence analysis. The dominant species were *Phialocephala Fortinii* and *Pezicula Ericae*. To evaluate their plant growth-promoting (PGP) potential, 29 isolates were selected based on key traits such as indole-3-acetic acid (IAA) production, phosphate solubilization, and siderophore activity. IAA production ranged from 16.8 ± 0.07 to 58.2 ± 0.004 $\mu\text{g/mL}$, while phosphate solubilization index (PSI) values ranged between 2.2 and 4.2 mm. Over 30% of the isolates showed positive siderophore activity. Notably, *Phialocephala Fortinii* significantly promoted lettuce growth in bioassay experiments. These findings indicate that the endophytic fungus *Phialocephala Fortinii* may have potential as a bio inoculant for promoting plant growth. Further studies are needed to evaluate its effectiveness on tree species and other cultivated plants under various conditions.

Keywords: Agriculture, endophytic fungi, plant growth-promoting

P2

[32]

CORRELATIONS BETWEEN MICROBIAL COMMUNITY AND VOLATILE COMPOUNDS IN BERBASSA, A UNIQUE SUDANESE FERMENTED MILK STARTER*Eltayeb, M.M.*^{1,2}, Eltigani, S.A.^{1,3}, Taniguchi, T.¹, Ishihara, A.¹, Arima, J.¹, Elgasim, E.E.²¹Tottori University, Japan²University of Khartoum, Sudan³Ahfad University for Women, Japan

In northern Sudan, a traditional fermented milk starter known as Berbassa is used to produce Gergoush, a dry snack known for its pungent aroma and cultural value. However, little is known about the microbial processes involved in developing its characteristic flavors. This study aimed to investigate the bacterial and fungal communities and their metabolites in Berbassa milk starters prepared with addition of chickpea and cumin. The starter culture was prepared using traditional techniques. Bacterial and fungal communities were analyzed using next-generation sequencing, while volatile metabolites were identified using gas chromatography-mass spectrometry. Pearson correlation analysis was used to examine associations between microbial community and volatile compounds. Firmicutes was identified as the dominant bacterial phylum, while *Ascomycota* and *Basidiomycota* were the primary fungal phyla. *Bacillus* and *Clostridium sensu stricto* 1 were the most abundant bacterial genera. Although many fungal genera remained unidentified, *Nothophoma*, *Alternaria*, *Trichosporon*, *Aspergillus*, and *Mortierella* were the dominant identified genera. Several types of volatile compounds, including aldehydes, ketones, esters, and organic acids, were detected. Significant associations were observed between several microbial genera and aroma related compounds, suggesting their involvement in flavor development of Berbassa. This research provides insight into the association between microbial and metabolic profiles in Berbassa, laying a foundation for future applications such as developing pure strain starters to verify their roles in aroma formation.

Keywords: Microbial community, Volatiles compounds, Berbassa, Gergoush

P3

[33]

VARIATION IN ROOT TRAITS AND ROOT-ENDOPHYTE INTERACTIONS IN PRIMARY SYNTHETIC WHEAT DERIVED FROM *Aegilops Tauschii* COLLECTED FROM DIVERSE SOIL TYPES

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Modern wheat breeding has largely emphasized aboveground traits, often at the expense of belowground characteristics such as root biomass, architecture, and beneficial microbial associations. This has narrowed genetic diversity, impacting traits essential for stress resilience and efficient nutrient and water acquisition—factors expected to become increasingly critical under climate change. In this study, we evaluated 36 primaries synthetic (PS) hexaploid wheat lines developed by crossing *Aegilops tauschii* with the durum wheat cultivar Langdon (LNG) and compared them with LNG and the hexaploid variety Norin 61 (N61). We observed significant variation in root length, biomass, and associations with fungal endophytes, including beneficial *Arbuscular Mycorrhizal Fungi* (AMF) and *Serendipita indica*, and pathogenic *Alternaria sp.* Clustering analysis based on these traits identified three distinct PS groups: (1) lines with greater root length and biomass, high AMF and *S. indica* colonization, and low *Alternaria* infection; (2) lines with intermediate traits; and (3) lines with reduced root traits and high *Alternaria* susceptibility. Notably, these phenotypic patterns corresponded closely with the soil classification of the *Ae. tauschii* progenitors' origin, such as Cambisols (supportive of root growth), and *Gleysols* and *Calcisols* (restrictive of root growth). This highlights the soil microenvironment as a key determinant of belowground trait expression. By comparing PS lines with domesticated tetraploid and hexaploid wheat, we identified and selected PS lines derived from diverse *Ae. tauschii* with enhanced root traits. Our study emphasizes the potential of wild D-genome diversity to restore critical root traits for breeding resilient wheat.

Keywords: Genetic diversity, root length, root biomass, *Arbuscular Mycorrhizal* fungi, *Serendipita Indica*, *Alternaria*, soil classification

P4

[34]

TECHNICAL EVALUATION AND CALIBRATION OF DRONE SPRAYERS FOR PEST AND DISEASE CONTROL IN OIL PALM PLANTATIONS

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Oil palm is one of the world's most important sources of edible oil, producing up to 10 times more oil per hectare than other major oilseed crops such as soybean and sunflower. This makes it the most efficient oil-producing crop globally. Its high productivity requires relatively less land, positioning it as a critical contributor to global food security. However, pest and disease (P&D) outbreaks remain a significant threat to yield and sustainability in oil palm plantations. With the rapid advancement of agricultural technology, drone-based solutions are emerging as valuable tools in plantation operations. This study presents a technical assessment of a drone sprayer for P&D management in oil palm plantations, focusing on key performance parameters such as droplet coverage, uniformity, droplet size, and operational efficiency. Using Water Sensitive Paper to evaluate spraying precision, we examined the effects of flight altitude, spray width, flight interval, and application volume on spray effectiveness. Additionally, productivity, mission planning, and logistical considerations were assessed to optimise drone performance in large-scale operations. After the trial parameters were standardised and concluded, the study was applied to a real-case plot within an outbreak area, where a pre- and post-treatment census was conducted to monitor pest and disease control effectiveness. The findings underscore the viability of drone sprayers as an efficient tool for P&D management in oil palm plantations, offering advantages in both operational precision and environmental sustainability. Calibration of the parameters was essential, as different drone models may exhibit varying capabilities and specifications, which can influence the effectiveness of the spraying method. Further optimisation of these parameters, alongside careful selection and calibration of drone models, is suggested to enhance scalability for commercial industry adoption.

Keywords: Drone spraying, technical assessment, calibration, pest and disease management, oil palm plantation

P5

[35]

BIOCHEMICAL ANALYSIS OF MATURE DATE PALM FRUIT ASTRINGENCY: TOWARD FRUIT QUALITY IMPROVEMENT

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High-quality date palm cultivars grown in UAE are usually harvested at three maturation stages: Bistr, Rutab and Tamer for the local and international markets. Understanding fruit ripening process of date will assist the right time to harvest fresh fruit (Bistr, Rutab) for the market, storage and reduce postharvest loss. There is relatively limited information on the mechanism of date palm fruit destringency. This study will highlight the correlation between the removal of fruit tannins using ethylene treatment, biosynthetic pathways of astringent substances, and regulatory mechanisms of various UAE date palm cultivars. The activities of ethylene biosynthesis enzymes such as ACS and ACO and fruit quality attributes such as tannin contents, color, firmness, taste, and decay (senescence) were assessed. The physiological process, tannin content, destringency-related enzyme activity were measured. The ethylene production had an effect on the level of soluble tannins in date palm fruits of different cultivars and reduced fruit astringency at Bistr stage of high tannin cultivar “Khesab”.
Conclusions and Recommendations: This ethylene hormone treatment anticipated to activate enzymes associated with astringency removal, though the efficacy may vary by cultivar

Keywords: Date, destringency, ethylene, tannins, antioxidant enzymes

P6

[36]

EVALUATION OF ALTERNATIVES TO SULFUR DIOXIDE FOR MICROBIOLOGICAL CONTROL IN WINEMAKING

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The objective of this study was to evaluate the effectiveness of various substances as alternatives to sulfur dioxide in controlling specific microorganisms that negatively affect wine quality. The research focused on two problematic organisms: lactic acid bacteria from the genus *Pediococcus*, which can alter aroma and flavor through metabolite production, and certain spoilage yeasts capable of surviving in adverse conditions and generating undesirable odors. An *in vitro* experiment was conducted to compare the inhibitory effects of potassium metabisulphite, plasma-activated water, a mixture of sorbate and fumaric acid, dimethyl dicarbonate, and chitosan on these microorganisms. The analysis measured the viability of the target organisms after 3 and 24 hours of treatment under controlled conditions. The results demonstrated that, while sulfur dioxide remains a reliable preservative, other substances, particularly dimethyl dicarbonate, plasma-activated water, chitosan, and the sorbate-fumaric acid combination, also exhibited promising antimicrobial activity. These findings highlight potential alternatives that align with the growing consumer demand for products with fewer chemical additives and suggest a viable path for the wine industry toward more natural preservation methods.

Keywords: Wine preservation, microbial control, lactic acid bacteria, Sulfur Dioxide alternatives, spoilage yeasts.

P7

[37]

MULTI-PURPOSE FORAGES POTENTIAL TO ENHANCING MIXED SMALLHOLDER FARMING PRODUCTIVITY AND FOOD SECURITY IN MALAWI

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The livestock sector is integral to Malawi's mixed farming systems, contributing 22–30% of GDP and employing over 80% of the labor force. However, a lack of scientific information on integrating mixed farming systems, coupled with inadequate stakeholder coordination, has hindered its potential to enhance farm productivity. This challenge is exacerbated by population growth, which has led to land fragmentation among smallholder farmers. Farmers and extension workers often fear that cultivating forages will reduce land available for food crops, prioritizing crop production at the expense of livestock feed. Consequently, smallholder farmers face low livestock productivity due to insufficient quality feed, while continuous plowing has resulted in soil erosion, fertility loss, and declining crop yields—ultimately reducing overall farm productivity and perpetuating household food insecurity. To address these challenges, a reconnaissance survey was conducted in December 2024 to identify opportunities for integrating multipurpose forages into Malawi's mixed farming systems. The study team assessed predominant farming systems, identified challenges, and gathered stakeholder perspectives on cultivated and native forages. Field observations and discussions with farmers, researchers, government officials, development agencies, and private sectors across Malawi's northern, central, and southern regions revealed opportunities for forage integration. Forage production strategies such as backyard planting, intercropping, alley cropping, crop rotation, agroforestry, and Push-Pull systems are recommended as entry points for improving livestock feed availability while simultaneously enhancing soil fertility, reducing erosion, and controlling pests. Prioritizing the development of improved forage varieties and robust seed supply systems are also recommended to support these strategies. The findings provide valuable insights for policymakers, researchers, farmers, private sector actors, and international donors, offering actionable pathways to unlock the potential of mixed farming systems in Malawi.

Keywords: Malawi mixed agriculture, multipurpose forages, farm integration; food security

P8

[38]

SOCIOECONOMIC FACTORS AFFECTING SMALLHOLDER FARMERS' ACCESS TO FORMAL FINANCIAL CREDIT IN SELECTED RURAL AREAS OF ALICE TOWN, SOUTH AFRICA

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One major challenge facing smallholder farmers in developing countries like South Africa is their limited access to financial capital and credit, particularly from formal lending institutions. Objective: The study analysed the socio-economic factors affecting smallholder farmers' access to formal financial credit in Alice Town under the Raymond Mhlaba Municipality, focusing specifically on the Msobomvu and kwaGaga villages. Methods: Primary data using a cross-sectional research design was collected from 50 smallholders from the two villages. The data was collected using a structured questionnaire using face-to-face interviews. Descriptive statistics and binary logistic regression techniques were used to analyze the data. Results: The findings revealed a positive influence between access to formal financial credit and farmers' awareness of available government support programs, significant at the 5% level. A negative influence was found between access to credit and farm size, also significant at the 5% level. At the same time, off-farm income showed a positive relationship with access to credit, significant at the 10% level. Conclusions and Recommendations: The study highlights several socio-economic factors that significantly affect access to formal financial credit while noting that gender does not seem to play a relevant role. There should be more government support programs to boost credit access and provide finance opportunities to farmers, regardless of land size.

Keywords: Smallholder farmers, formal financial credit, socioeconomic factors, agricultural finance, credit access, financial inclusion

P9

[40]

WILLINGNESS TO PAY FOR FODDER SEED TECHNOLOGY: PRICE SENSITIVITY AND ADOPTION BARRIERS AMONG SMALL-SCALE LIVESTOCK FARMERS IN OR TAMBO DISTRICT MUNICIPALITY, SOUTH AFRICA

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This study examines small-scale livestock farmers' willingness to pay (WTP) for fodder seed technology within the OR Tambo District Municipality of the Eastern Cape Province, South Africa. The scope of willingness to pay for the study considered farmers' sensitivity to the price of fodder seed technology and adoption barriers to various types of fodder seed technology. A cross-sectional research design was employed and 151 small-scale farmers selected from three local municipalities of the OR Tambo District. King Sabata Dalindyebo, Port St Johns, and Ingquza Hill were local municipalities. Data was collected through face-to-face interviews using semi-structured questionnaires. The continuous valuation method (CVM) was used to determine the WTP for five fodder seeds varieties: Agriboost, Enhancer, Sukari, Endurance, and LS 35. Farmers were given two bid levels for each variety to assess price sensitivity. Thereafter, descriptive statistics were used to analyse the two bid levels and the reasons for farmers' WTP. Binary logistic regression was used specifically to assess significant determinants of WTP. The results revealed that approximately 95.36% of the farmers expressed a positive WTP for Sukari, suggesting a high level of perceived need and potential adoption. WTP varied significantly between varieties, with LS 35 demonstrating the lowest WTP. Furthermore, the WTP decreased for all varieties as the bid level increased, highlighting the importance of price. The binary logistic regression analysis identified specific socioeconomic factors such as income and education level and farm-related characteristics such as farm size, livestock holdings and access to extension services to significantly influence WTP. The study suggests that interventions aimed at promoting the adoption of forage seeds should consider the specific characteristics of the fodder seed variety and the socio-economic context of farmers. This study contributes to the understanding of technology adoption in communal rangeland settings and offers practical recommendations to improve livestock productivity and livelihoods in similar regions.

Keywords: Contingent valuation method, forage seeds, feed scarcity, livestock productivity, Eastern Cape