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BOOK OF ABSTRACTS

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Foreword

The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) Scientific Conference 2025, hosted in Botswana, brought together researchers, policymakers, and practitioners to advance Africa's agricultural transformation through innovation, collaboration, and evidence-based solutions.

The scientific conference was organized around various interrelated thematic areas: agroecology and sustainable farming systems; climate change, resilience, and natural resource management; food systems, nutrition, and health; agricultural innovation, technology, and digital solutions; policy, governance, and institutional strengthening; youth, gender, and capacity development; and markets, value chains, and agribusiness development. Collectively, these themes embody an integrated and multidisciplinary framework for addressing Africa's critical challenges, including climate variability, food and nutrition insecurity, and the pursuit of inclusive and sustainable economic growth. By fostering knowledge exchange and partnerships, the conference generated practical solutions that can be used to strengthen the resilience of food systems, empower communities, and promote sustainable livelihoods across the continent.

We thank all contributors, the RUFORUM network and partners for their commitment to advancing agricultural research and development on the African continent.

RUFORUM Scientific Conference 2025 Organizing Committee

Prof. Majaliwa Mwanjalolo
Manager Research, Innovation and Development
RUFORUM

PRESENTED ABSTRACTS

Thematic Area:
Building Resilient and Inclusive Agri-Food Systems in the Face of Climate and Economic Shocks

Abstract No: 001-OP

Does trust in extension systems influence adoption of conservation agriculture in Southern Africa: Insights from lab in the field experiments

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ABSTRACT

Smallholder farmers in Sub-Saharan Africa increasingly face the challenges of climate change, that has impacted agricultural productivity and food security. Accordingly, governments, researchers, and development practitioners have promoted climate-smart agriculture, particularly conservation agriculture (CA), for over four decades to build production resilience and mitigate climate risks. A key assumption underlying adoption is that farmers are more likely to embrace new practices when they trust the information providers. We conducted an artefactual field experiment in Malawi, Zambia, and Zimbabwe to test whether trust in extension providers influences learning outcomes and adoption intentions for CA. Farmers participated in training sessions facilitated by public, private, and farmer-to-farmer (mother host) extension agents. Trust was measured using a standard trust game, while knowledge was assessed through post-training test scores. Adoption decisions were analyzed using a probit model, with CA adoption (yes/no) as the dependent variable. On average, 13% of households reported intentions to adopt full CA practices, with higher rates in Zimbabwe (16%), followed by Malawi (12%) and Zambia (11%). Farmers exhibited greater trust in public extension agents compared to private agents and fellow farmers, especially in Zimbabwe. Prior, CA experience significantly increased the adoption likelihood by 1.1–1.2 percent. In Malawi, trust in public extension agents had a consistently positive and significant effect on CA adoption intentions, while trust in private agents was not significant. Trust in fellow farmers showed mixed but significant effects across models. In Zimbabwe, relative trust mattered most: when trust in public agents exceeded that in private agents, adoption intentions increased significantly across all model specifications. Overall these results underscore the importance of strengthening credibility, consistency, and advisory capacity of public extension services, while also fostering collaboration with private and farmer-led agents. Furthermore, gender-sensitive approaches remain essential, as structural barriers continue to limit female farmers' uptake of innovations, even when trust is high.

Keywords: Conservation agriculture adoption, extension services, trust, trust games, Sub-Saharan Africa

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Abstract No: 002 -OP

Use of climate information services for early farm activities: Evidence from smallholder vegetable farmers in Leribe district, Lesotho

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ABSTRACT

Climate change and weather variability pose significant challenges to crop production, which are further exacerbated by several other factors. Climate information services are considered essential support tools for enhancing farm management decisions and activities, thereby helping to minimise climate risks by anticipating, preparing for, and responding to climate-related challenges. Despite the beneficial effects of climate information services, it remains unclear how smallholder vegetable farmers utilise them and whether they perceive them as effective. To address this gap, this study employed a cross-sectional design and a quantitative approach. A multistage sampling technique was employed, and primary data were collected from a random sample of 180 smallholder vegetable farmers in Leribe through face-to-face interviews using KoboCollect. Data analysis was carried out using descriptive statistics in the Statistical Package for the Social Sciences (SPSS) version 25.0 and statistical indicators used were frequencies, percentages and cross tabulations. The findings were presented in tabular form using frequency distributions, means, and standard deviations. The findings revealed that farmers use a variety of climate information services, including daily and weekly forecasts, early warning messages, and agro-meteorological services. Farmers utilise these services for a range of early farm activities, with crop rotation, crop diversification, and land preparation being the primary uses. Varying degree of effectiveness of early action have been observed, with crop rotation and diversification being highly effective. The study concluded that smallholder vegetable farmers use several climate information services to guide early farm management activities and mitigate climate change risks. To enhance vegetable production in the face of a changing climate, timely and tailored climate information services are crucial.

Keywords: Climate information services, early farm activities, smallholder vegetable farmers

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Abstract No: 003-OP

UTAUT2 estimation of the determinants influencing uptake and sustained use of OFSP value addition technologies in Teso Sub Region, North Eastern Uganda

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ABSTRACT

Orange fleshed Sweet Potatoes (OFSP) processing technologies particularly motorized chippers have emerged over the past decade as promising options for enhancing value addition within OFSP value chains. These technologies produce intermediate products such as chips, high quality flour and puree that serve as essential inputs for OFSP based confectioneries and fast foods recipes that cater to the shifting dietary preferences of urbanizing youth. Despite their potential benefits the uptake of improved motorized chippers in Uganda remains low. This study investigates the factors that influence the adoption and sustained use of OFSP value addition processing technologies in Kumi and Serere districts. A cross sectional survey was conducted involving 250 household selected through a multiple sampling approach. Data were collected using structured questionnaire and focus group discussion and analyzed using descriptive statistics and the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model. Internal consistency was assessed using Cronbach's alpha, while Structural Equation Modeling (SEM) analysis was employed to test construct reliability and validity. The findings revealed that habit, social influence, facilitating conditions, and performance expectancy have significant positive effects on user behavior toward motorized chippers among small scale-entrepreneurs. Conversely, effort expectancy, price value, and hedonic motivation exhibited non-significant relationships with user behavior. The study contributes to theoretical understanding by providing empirical evidence on technology acceptance in a developing-country context. The UTAUT2 based analytic insights offer a foundation for concept development, marketing strategies and future design improvements for motorized chippers and mashers. The proposed analytic framework can further support prediction and analysis of farmers' and value chain actor preferences for future OFSP value addition technologies.

Keywords: Orange-fleshed sweet potato, motorized chipper, small scale entrepreneurs, technology uptake, Uganda, UTAUT2 model and constructs

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Abstract No: 004 -OP

New approaches in the development of diluents for gamete preservation in African cattle breeds

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ABSTRACT

During cryopreservation, spermatozoa are protected from cryo-damage using semen cryopreservation media called extenders. However, conventional extenders are formulated based on empirical approaches that are inefficient, resource intensive and fail to account for multi-factorial interactions and media complexity in optimisation. Computational techniques such as machine learning may be utilised to provide faster, cheaper and more precise extender media formulations to improve cryopreservation outcomes. This study explored the potential for combining experimental approaches and computational modelling in the design of bovine semen diluents with improved cryo-protective capacity. A dataset of diluent compositions and corresponding post-thaw sperm quality was collated from published literature and experimental records. Key ingredients and concentration ranges that significantly influence post-thaw sperm motility were identified by response surface methodology (RSM). Novel formulations predicted to maximize sperm cryo-survival and minimize component redundancy were proposed using Artificial Neural Network (ANN) based machine-learning models. The best five formulations were validated against a commercial egg-yolk control using semen from three Tuli bulls (n=12). Feature analysis revealed buffers, sugars, CPAs, membrane stabilizers, and antioxidants as the most influential factors. Predictive total motility of the top five computationally optimised extenders (45.4±5.29) was significantly higher ($p < 0.05$) than experimental results (34.7±3.52) obtained at the validation stage. However, post-thaw results for these extenders were comparable ($p > 0.05$) to a standard control egg-yolk based extender. These results demonstrate the feasibility of computational approaches to accelerate development of semen extenders, reduce number of experimental runs, and enhance efficiency of bovine semen cryopreservation.

Keywords: Cryopreservation, machine learning, media design, semen diluents

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Abstract No: 005 -OP

Smart farming adoption among small scale farmers

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ABSTRACT

Smart farming promotes precision agriculture by utilizing cutting-edge technology that allows farmers to remotely monitor their plants. Smart farming benefits agricultural processes such as harvesting and crop yields because the automation of sensors and machinery has made the farming workforce more efficient. This study evaluated the smart adoption technologies among small scale farmers in Chiredzi, Zimbabwe. The study was underpinned by the theory of reasoned action and the theory of planned behaviour widely applied in the adoption of ICT for smart farming. Using a mixed methods strategy, small-scale farmers were evaluated on their adoption of smart farming technologies. The study utilised the K-nearest neighbours' analysis. Farmers were predicted and recommended for smart farming adoption, with an impressive accuracy rate of 97%. Results showed that 219 farmers had already adopted technologies like smartphones, sensors, drones, and irrigation systems. However, overall adoption rates were hindered by a lack of awareness, inadequate infrastructure, and high costs. The study recommends improving awareness, infrastructure, and cost reduction, while also providing technical support and encouraging stakeholder partnerships. Future research should explore adoption challenges, validate findings, examine impacts on productivity and sustainability, and assess the potential of technologies such as artificial intelligence and robotics.

Keywords: Crop production, Information Communication Technology, small-scale farmers, smart farming

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Abstract No: 006 -OP

Physicochemical properties of soil under different flood patterns in flood recession farming in the Okavango Delta, Botswana

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ABSTRACT

Flood recession farming, locally known as molapo farming is smallholder-based production system important for riparian communities of the Okavango Delta. This provides residual moisture and natural fertilization through seasonal inundation of floodplains. However, there is limited knowledge on how changes in flooding patterns influence physicochemical properties of soil in the Okavango Delta. This study assessed the physicochemical properties of soils in different flooding patterns in flood recession farming in the Okavango Delta to inform sustainable farming. This study was conducted in Shorobe, Lake Ngami and Makalamabedi areas of Ngamiland District, Okavango Delta. Seventeen molapo fields were sampled for soil from seven saucer-shape, six lake flats and four channel type fields. Physicochemical properties determined included: soil texture, pH, soil organic matter (SOM), phosphorus and exchangeable cations (Ca2+, Mg2+, K+ and Na+). Data were analysed using one-way ANOVA and Multivariate Analysis of Variance (MANOVA) at $p < 0.05$. Highly significant differences $p = 0.001$ in the soil nutrient scores were found being highest for Ca (969.40±122.10 $mgkg^{-1}$), followed by Mg (132.11±21.68 $mgkg^{-1}$), Na (26.03±3.13mgkg-1) and P (9.75±2.13 $mgkg^{-1}$). Lake flats had significantly $p<0.05$ higher Mg content (M = 220.34 SD = 97.90) than saucer-shaped (M = 74.40 SD = 29.30) and channel type (M = 100.77 SD = 6.44). The P content was significantly highest under channel type (M = 20.56, SD = 8.07) than both saucer -shaped and lake flats. The SOM content was significant difference at $\chi 2$ (2, n = 17) 12.25, p = 0.002 with lake flats recording the highest median score (Md = 3.29). Significant differences ($p<0.05$) were observed in the soil pH. The mean score for Lake flats (M = 5.72 ± 0.19) was significantly different (< 0.05) from the saucer-shaped (M = 6.71 ± 0.26) and channel type (M = 7.34 ± 0.17) groups. The silt-clay ratio was consistent, with averages of M = 0.75±0.53 for saucer-shaped, M = 0.50±0.12 for channel type, and M = 0.47±0.25 for lake flats, respectively. Overall, this study provides insights into how variation in flooding pattern influence soil physicochemical properties and the implications for sustainable management is discussed.

Keywords: Agro-ecological zone, flooding patterns, Molapo farming, physical properties

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Abstract No: 007-OP

Harnessing intellectual property to protect and promote indigenous knowledge systems in Agriculture

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ABSTRACT

Traditional Knowledge Systems (TKS) or Indigenous Knowledge Systems (IKS) represent centuries of accumulated wisdom in agriculture, biodiversity conservation, and ecological stewardship. In Botswana and across Southern Africa, TKS/IKS plays a vital role in food security, climate resilience, and sustainable rural livelihoods. However, the lack of formal recognition and protection mechanisms exposes knowledge holders to risks of misappropriation and biopiracy. Access and Benefit Sharing (ABS) legislation plays a critical role in the protection and promotion of Indigenous Knowledge Systems. By embedding ABS principles into national and regional policies, countries can safeguard IKS while promoting innovation and equitable development. The objectives of this study: (a) Explore how the Intellectual Property (IP) system can be used to protect and promote agricultural TKS/IKS; (b) Identify relevant IP tools and international frameworks applicable to traditional agricultural knowledge, (c) Showcase case studies from Botswana and Southern Africa that demonstrate successful integration of TKS/IKS into agricultural innovation and commercialization. A qualitative review of IP frameworks, international treaties, and regional protocols was conducted. Case studies were analyzed to assess the effectiveness of IP tools such as geographical indications, plant variety protections, and trade secrets in safeguarding TKS/IKS. The study found that conventional IP tools can be adapted to protect TKS/IKS when combined with sui-generis systems. Case studies included (a) Hoodia (Southern Africa) (b) Penja Pepper (Cameroon) (c) Morama Bean Project (Botswana), (d) Agro-pastoral systems and sorghum/millet cultivation (Botswana). The study finds that protecting TKS/IKS through IP systems enhances community empowerment, biodiversity conservation, and agricultural innovation. Botswana and other Southern African countries can benefit from hybrid legal frameworks that combine IP rights with culturally appropriate protection models.

Keywords: Agriculture, biopiracy intellectual property, indigenous knowledge systems, plant variety protection, traditional knowledge systems

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Abstract No: 008-OP

Effects of affordable inputs program on food poverty alleviation among smallholder farmers in Malawi

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ABSTRACT

Agricultural input subsidies remain a central policy instrument in Malawi to address persistent rural poverty and food insecurity. The Affordable Inputs Programme (AIP), a large-scale subsidy initiative, was designed to improve access to fertilizers and seed among smallholder farmers with the aim of enhancing household welfare, reducing food poverty, and strengthening resilience in the face of climatic and economic shocks. However, empirical evidence on its effectiveness in improving household food consumption and poverty outcomes remains limited. This study examined the effects of the AIP on household food welfare, with a focus on food poverty reduction and food expenditure among smallholder farmers in Malawi. Using nationally representative data from the Fifth Integrated Household Survey (IHS5), the analysis applied the Control Function (CF) approach to correct for potential endogeneity in programme participation when estimating determinants of food poverty. In addition, Propensity Score Matching (PSM) was used to assess the causal impact of AIP participation on household food expenditure. The CF estimates reveal that access to each additional input coupon reduced the likelihood of food poverty by 18.2 percent and narrowed the food poverty gap by 7.2 percent, confirming the programme's role in mitigating deprivation. The PSM results further indicate that AIP participation had a statistically significant positive effect on household food expenditure, demonstrating its contribution to enhanced food consumption and welfare. Beyond programme access, education, credit, non-farm enterprises, and employment emerged as protective factors against poverty, while climatic shocks such as floods and irregular rainfall heightened vulnerability. The findings provide robust causal evidence that the AIP contributes to reducing food poverty and increasing household food expenditure, thereby strengthening resilience among smallholder farmers. Nonetheless, its overall effectiveness is moderated by structural and environmental constraints. These insights are critical for refining subsidy policies for poverty reduction and resilience investments in Malawi's agricultural development strategy.

Keywords: Affordable Inputs Programme, food poverty, household welfare, control function approach, propensity score matching, Malawi

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Abstract No: 009-OP

Enhancing food security and climate resilience through bean-based climate-smart agriculture in Nakuru county, Kenya

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ABSTRACT

Beans play a vital role in agrarian community livelihoods, particularly for smallholders in ecologically fragile zones such as Njoro and Rongai sub-counties of Nakuru County, Kenya. As a low-cost and nutrient-rich crop, beans strengthen household food security while contributing to both agronomic and economic gains. Beans offer several ecological services, fixing nitrogen in the soil and supporting sustainable production. Beans are also highly adaptable, to diverse agro-ecological settings and fit well within crop rotation and intercropping systems, thereby improg productivity and resilience. Beans therefore are an essential component of Climate-Smart Agriculture (CSA). Despite these benefits, widespread adoption of bean-based CSA remains low. Key barriers include limited access to improved varieties, weak extension support, limited farmer awareness of CSA practices, and market challenges. This study assessed the contribution of beans to food security and climate resilience, examined adoption constraints, and evaluated both economic and environmental outcomes. A mixed-methods approach was applied, using household surveys, focus group discussions, and key informant interviews with 150 smallholder agripreneurs. Statistical analysis and cost-benefit assessments were used to evaluate adoption drivers, yield performance, and profitability. Households that adopted bean integration recorded a 38% improvement in food self-sufficiency during dry periods. The use of improved varieties was positively associated ($r = 0.62$, $p < 0.01$) with yield increases and stable income. Intercropping beans enhanced land productivity by 21% and lowered production costs by 10%. However, access to certified seeds (72% of respondents), limited market opportunities, and inadequate CSA knowledge were major obstacles. Women farmers demonstrated higher interest in CSA practices but encountered greater challenges in accessing resources. The findings highlight the need for strengthened seed systems, farmer training, and market linkages to promote broader integration of beans into CSA, thereby fostering climate resilience and food-secure livelihoods.

Keywords: Beans adoption, climate resilience, Climate-Smart Agriculture (CSA), food security

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Abstract No: 010-OP

Harnessing Amaranthus for climate-resilient agrifood systems in southern Africa: Lessons from physiology to nutrition

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ABSTRACT

Agriculture in sub-Saharan Africa is increasingly constrained by climate change, often manifesting as sudden heat waves, prolonged drought, and erratic rainfall patterns. Such variability makes it difficult for farmers to plan planting and harvesting schedules reliably, exposing them to high production risks and income losses. Addressing this challenge requires growing crops with shorter growth cycles that enables escape of drought especially if they are drought-tolerant genotypes. Amaranthus is a promising crop due to their wide adaptability, rapid growth, and rich nutritional profile. This study presents findings from a multi-year research on four African Amaranthus species (*A. caudatus*, *A. hypochondriacus*, *A. cruentus*, and *A. spinosus*). Physiological analyses using chlorophyll a fluorescence revealed species-specific differences in photosynthetic resilience under combined drought and heat stress, with A. cruentus and A. spinosus being most tolerant. Biochemical profiling demonstrated that stress conditions induced the accumulation of key phenolics and flavonoids (notably rutin and caffeic acid), enhancing both plant tolerance and nutritional value. Furthermore, stress regimes influenced mineral content and antioxidant activity, highlighting the dual role of Amaranthus as both a climate-resilient and health-promoting crop. By reframing these findings within the broader agrifood systems context, this work underscores the potential of Amaranthus to strengthen food and nutrition security in southern Africa. Beyond its laboratory-proven stress tolerance, Amaranthus offers opportunities for smallholder diversification, improved dietary quality, and value addition through nutraceutical and medicinal applications. Importantly, rapid screening approaches such as chlorophyll fluorescence provide scalable tools for identifying resilient genotypes, informing breeding and extension strategies. In conclusion, this case study of Amaranthus demonstrates how integrating underutilized crops into farming systems can help buffer communities against climate and economic shocks while advancing nutrition-sensitive agriculture in the region.

Keywords: Agrifood systems, Amaranthus, bioactive compounds, climate resilience, chlorophyll fluorescence, food security

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Abstract No: 011-OP

Climate change, gender and food security in Malawi: A CGE approach

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ABSTRACT

Climate change threatens livelihoods with evidence suggesting that it may increase poverty, hunger, conflict, and gender inequality. This study uses a gender-dynamic computable general equilibrium (CGE) model to evaluate the potential impacts of climate change on sustainable development goals (SDGs) such as food security (SDG2), gender equality (SDG5), and economic growth (SDG8) for Malawi. The CGE model utilizes the 2021 Social Accounting Matrix (SAM), which calibrates the results from the various models, thereby generating the baseline results which exemplify a "steady-state" and policy shock results illustrating the medium- and long-term effects of climate change on the country's agriculture sector. The findings reveal that climate change not only threatens agricultural productivity but also exacerbates existing gender inequalities, leading to heightened food insecurity for women and their families. Policy implications emphasize the need for targeted interventions that address both climate resilience and gender equity, ensuring sustainable food systems in Malawi. This research contributes to the understanding of socio-economic dynamics in the context of climate change, advocating for holistic strategies that prioritize both gender and food security in climate adaptation policies.

Key words: Computable general equilibrium, gender equality, poverty, SDGs

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Abstract No: 012 -OP

Agroforestry and household food security: Evidence from Tephrosia improved fallow adoption at Chulu and Kaluluma extension planning areas in Malawi

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ABSTRACT

Smallholder farming systems in Malawi face chronic food and nutrition insecurity driven by soil degradation, declining fertility, erratic rainfall, and limited access to mineral fertilisers. The Agroforestry Food Security Programme (AFSP) promoted climate-smart options, including Tephrosia improved fallows, in which portions of land are planted to Tephrosia shrubs for several seasons to replenish soil nitrogen and organic matter. Tephrosia (fish poison bean; fumbi lanyama/mtetezga) is a multipurpose nitrogen-fixing legume that supplies biomass for mulch or green manure, fodder, botanical pesticide, and income from seed sales. This study conducted a retrospective assessment of the long-term effects of Tephrosia-improved fallow adoption on household food security in Chulu and Kaluluma Extension Planning Areas, Kasungu District, Malawi. A cross-sectional survey of 336 randomly selected households stratified by adopters (practising Tephrosia improved fallow for 3–4 years and still integrating shrubs with crops) and non-adopters was implemented using a semi-structured questionnaire in KoboCollect. Household food security was measured with the Household Food Insecurity Access Scale (HFIAS) and data were analysed in SPSS using chi-square tests for individual HFIAS items and Mann–Whitney U tests for total scores. Only 2.8% of adopters, compared with 60.8% of non-adopters, often worried about food, and none of the adopters, versus 81.7% of non-adopters, often failed to eat preferred foods. Adopters reported markedly lower frequencies of going to bed hungry. Overall, 28% of adopter households were food secure (HFIAS = 0), whereas 35.7% of non-adopters were severely food insecure (HFIAS 20–25). Mean HFIAS ranks differed strongly between adopters and non-adopters ($W = 23\,436$; $p < 0.001$), confirming that Tephrosia improved fallows significantly enhance household food security. The study recommends integrating legume-based improved fallows into national soil fertility strategies, strengthening land tenure security and extension support, and embedding long-term impact evaluation in future agroforestry programmes.

Keywords: Agroforestry Food Security Programme, biomass, fertiliser, household food insecurity (access) score, soil fertility, Tephrosia

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Abstract No: 013 -OP

Where is the missing food? Characterizing food loss and waste along the urban, peri-urban and rural settlement continuum in Zambia

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ABSTRACT

Climate change and rapid urbanisation are reshaping food systems in Zambia, contributing to reduced crop and livestock output, increased in-field losses, rising food waste and deteriorating food safety, particularly among small-scale actors. This study profiled the structure and functioning of the food system along an urban–peri-urban–rural settlement continuum, focusing on Lusaka city and the Chikankata and Chirundu districts of Southern Province. A cross-sectional qualitative design was employed, combining a two-day multi-stakeholder consultative workshop in Lusaka with in-depth interviews of 134 purposively selected food system actors, including producers, transporters, processors, traders and regulators. The food system was found to be dominated by small-scale subsistence producers, distributors and traders, alongside a rapidly expanding network of supermarkets and fast-food outlets in urban and peri-urban areas. This duality has driven a nutritional transition towards ultra-processed, energy-dense, salty and oily foods and high consumption of maize meal (tshima) at the expense of fruits, vegetables and animal-source foods, increasing the risk of non-communicable diseases. Massive food losses and waste were observed at Soweto Market and other hubs for tomatoes, vegetables and fruits due to oversupply, poor handling and limited cold storage or processing capacity. Policy instruments such as FISPI remain heavily maize-focused and do not adequately promote dietary diversity or reduction of loss and waste. Emerging policy directions emphasise agroecology, organic farming, biodiversity conservation, nutrition-sensitive agriculture, biofortified crops and local processing, but implementation is nascent. The study underscores the need for integrated policies that simultaneously address food loss and waste, nutrition, and livelihoods to accelerate food system transformation in Zambia.

Keywords: Food systems, food loss, food waste, Zambia, urban–rural continuum, nutrition, small-scale actors

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Abstract No: 014 -OP

Benchmarking improved food security, rural incomes and agricultural development among countries: Kenya's lessons from other East African countries

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ABSTRACT

Despite commitments to the Comprehensive Africa Agriculture Development Programme (CAADP), many sub-Saharan African countries, including Kenya, continue to experience severe food and income insecurity. This study benchmarked Kenya's agricultural performance against selected East African neighbours to identify strategies for improving food security, rural incomes, and regional trade. Forty years of FAO data (1980–2020) on production, area, and yield of nine key food crops were analysed for Kenya, Tanzania, Uganda, and other countries, and triangulated with data on agriculture's contribution to GDP. Annual fluctuations in production, area, and yields were primarily driven by weather variability, land availability in suitable agro-ecological zones, and policy-driven enterprise promotion. Production, area, and yields of maize, rice, beans, and potatoes generally increased across countries, while wheat, sorghum, millet, cassava, and cooking banana showed mixed trends. Kenya's average maize production was 3.6 million tonnes, with Tanzania and Uganda reaching 175% and 89% of this level, respectively. Kenya lagged behind its neighbours in rice, cassava, millet, sorghum, beans, and cooking banana, despite higher fertiliser use. Rapid population growth reduced per capita food availability for most crops, except maize and rice in Tanzania and Uganda, and beans. High food imports in Kenya reflected both low domestic production and relatively higher disposable incomes. Similarities in agro-ecology and socio-economic conditions support policy learning: Kenya needs to diversify crop production and diets, strengthen productivity of underutilised staples, and leverage regional integration to enhance food security and rural incomes.

Keywords: Agricultural development, benchmarking, East Africa, Food security, Kenya

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Abstract No: 015 -OP

Reconfiguring food systems and primitive capital accumulation under neoliberalism in Africa

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ABSTRACT

Africa hosts the highest proportion of hungry people globally, and projections suggest that by 2030 more than half of the world's hungry will reside on the continent. Contemporary drivers of this crisis—climate change, global economic shocks, conflict, and volatile commodity markets—interact with enduring legacies of colonial capitalism, primitive accumulation, and neoliberal restructuring to shape unequal food systems. This study applies an agrarian political economy lens to analyse how historical and current power relations reconfigure production, circulation and consumption within African food systems. A multi-method approach combines historical analysis of land and agrarian change, critical review of policy and trade documents, quantitative analysis of hunger, production, and rural employment using FAO and World Bank datasets, and GIS mapping of spatial inequalities. Case studies from Kenya and Bolivia highlight that agroecological and localised food systems outperform conventional models on environmental sustainability, food security, and social-ecological resilience, particularly when underpinned by participatory governance. The results show that unequal access to land, credit, technology, and markets, especially for women and smallholders, continues to entrench structural inequities despite technological innovations. Food sovereignty and food democracy emerge as transformative paradigms that prioritise local control over food systems, ecological sustainability, and justice-based distribution. The study argues that systemic transformation—not incremental reform—is required, linking agroecological transitions with policies that secure land rights, regulate corporate power, strengthen cooperatives, and institutionalise multi-stakeholder food policy councils. Such a shift is essential for building inclusive, climate-resilient agrarian and food systems in Africa.

Keywords: Africa, agroecology, food sovereignty, food systems, neoliberalism, primitive accumulation

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Abstract No: 016 -OP

Physicochemical, nutritional and sensory characterisation of seven promising aromatic rice accessions resilient to climate shocks in Benin

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ABSTRACT

The Rice Research Programme of INRAB and AfricaRice has identified seven aromatic rice accessions with promising yield, disease resistance and climate resilience, yet their grain quality attributes remain insufficiently documented for varietal promotion. This study evaluated the physicochemical, nutritional and sensory characteristics of seven aromatic accessions (WAC 11, ARICA 1, ARICA 8, ARA8, ARA9, ABA20, ARA22) compared with a widely grown aromatic control (IR 841). Standard methods were used to determine ash, protein and other physicochemical parameters on white and parboiled rice. A panel of rice farmers assessed sensory quality. Ash content of white rice varied significantly ($P < 0.05$), with ARA22 (0.80%) and ARICA 8 (0.71%) showing the highest values and WAC 11 (0.48%) and IR 841 (0.57%) the lowest. For parboiled rice, ARA22 (0.85%) and WAC 11 (0.89%) had the highest ash contents, while WAC 11 (0.58%) and IR 841 (0.63%) had the lowest. Protein content ranged from 8.10 to 8.88% in white rice and 9.7 to 11.1% in parboiled samples. Several parboiled accessions exhibited high gelatinisation temperatures (74–76˚C), similar to IR 841. All accessions showed high homogeneity (>86%) and low uniformity (0.1–10%) in starch distribution, and swelling rates did not differ significantly between white and parboiled samples. Sensory evaluation indicated that cooked white rice of ARA8, ARA9, ARICA 1 and ARICA 8 was preferred by 75% of panelists over IR 841 due to stronger aroma, attractive colour, non-sticky texture and pleasant taste. These accessions can therefore be promoted as climate-resilient aromatic varieties with favourable post-harvest quality.

Keywords: Aromatic rice, climate resilience, grain quality, sensory evaluation, Benin

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Abstract No: 017 -OP

Wonder multistorey gardens: Strengthening urban food systems and advancing nutrition security in Nairobi, Kenya

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ABSTRACT

Rapid urbanisation in sub-Saharan Africa is intensifying pressure on food systems and heightening risks of food and nutrition insecurity, particularly for low-income households that depend on purchased food. In Nairobi, Kenya, fruit and vegetable consumption remains far below World Health Organization recommendations, contributing to micronutrient deficiencies and diet-related non-communicable diseases. Conventional urban farming is constrained by land scarcity, tenure insecurity and high input costs. Wonder Multistorey Gardens (WMSGs) are low-cost vertical gardens constructed from stacked rings filled with soil, each accommodating 100–130 plants and yielding up to 9 kg of vegetables per week on very small plots. This study analysed determinants of WMSG adoption and associated welfare and food security effects in Nairobi. A reconnaissance survey identified 424 urban farming households, from which 147 (116 adopters and 31 non-adopters) were sampled using Nassiuma's formula. Data were collected between October 2021 and December 2022 through structured questionnaires, key informant interviews, field observations and online surveys. Food security was assessed using the Household Food Insecurity Access Scale, and logistic regression and treatment-effects models were applied to identify adoption drivers and welfare impacts. Adopters were typically younger, better educated and more entrepreneurial, farmed on plots <0.25 acres, and were more likely to have accessed agricultural information. Land tenure, land size and use, monthly income and information access significantly influenced adoption. WMSG adoption substantially reduced food insecurity, improved dietary diversity and generated modest income from surplus sales; 97% of adopters reported improved household welfare. These results support scaling WMSGs as a scalable, nutrition-sensitive technology for building resilient, space-efficient urban food systems.

Keywords: Farming, household welfare, nutrition security, space-efficient, Urban agriculture, vertical gardens

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Abstract No: 018-OP

Coastal preferences for mangrove forest utilization in Ambanja District, Madagascar

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ABSTRACT

Mangrove forests provide critical ecosystem services, including biodiversity conservation, coastal protection, carbon sequestration and support to fisheries-based livelihoods. Madagascar hosts Africa's fourth-largest mangrove area, yet these ecosystems are rapidly degrading under pressure from charcoal production, wood extraction and agricultural expansion. In Ambanja District, overexploitation has generated conflicts between charcoal producers and fishers and threatens both biodiversity and food security. This study analysed coastal communities' preferences for mangrove forest utilisation to inform more sustainable management strategies. Data were collected from 384 coastal residents using structured, face-to-face questionnaires. A discrete choice experiment captured preferences for mangrove attributes: biodiversity, natural landscape coverage, tree-use patterns, ecological security and an ecosystem conservation trust fund. Responses were analysed using descriptive statistics and a conditional logit model in R. All attributes significantly influenced individual choices. Biodiversity conservation emerged as the most preferred attribute, followed closely by maintenance of natural landscape coverage, while more intensive tree-use patterns and lower ecological security levels were negatively valued. As expected, the trust fund contribution had a negative coefficient, implying that higher payment levels reduced programme attractiveness. The findings indicate strong local support for conservation-oriented schemes that prioritise biodiversity and landscape protection, provided that financing mechanisms reflect the population's limited ability to pay and involve communities in decision-making. The study recommends that public policies promote participatory mangrove management, strengthen local institutions and design incentive-compatible financing tools to curb unsustainable exploitation while sustaining coastal livelihoods.

Keywords: Coastal communities, discrete choice experiment, ecosystem services, Madagascar, Mangrove forests

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Abstract No: 019-OP

Seedling survival and plantation success in the drylands of Northern Ethiopia

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ABSTRACT

Large-scale tree planting under Ethiopia's Growth and Transformation Plan I (GTP I; 2011–2015) has been widely promoted as a dryland restoration strategy, yet plantation success and seedling survival remain poorly quantified. This study assessed survival rates of planted seedlings and the effectiveness of plantation interventions in the drylands of Northern Ethiopia. Six districts in Tigray representing highland, midland and lowland agro-ecologies were randomly selected, and biophysical surveys were conducted across multiple plantation sites. Primary data on seedling survival, species composition, site conditions and management practices were complemented with secondary data on plantation targets and implementation. Seedling survival varied significantly ($P < 0.05$) among plantations within villages, between villages and across districts, with a regional mean survival rate of only 53%. Low success was attributed to moisture stress, poor soil and site conditions, limited watering, lack of pre- and post-planting management, planting unmanageable numbers of seedlings, weak law enforcement and inadequate monitoring and evaluation. Four ownership types were identified: private, communal, state and youth groups. Private plantations exhibited the highest survival rates, whereas communal plantations performed worst, reflecting differences in responsibility and incentive structures. The results highlight that simply increasing planting targets is insufficient; success depends on careful site selection, realistic stocking rates, sustained management and clear ownership arrangements. Strengthening watering regimes, employing guards, and improving community-based management and accountability are essential to sustain dryland plantation development and achieve intended restoration benefits.

Keywords: Drylands, Ethiopia, management, ownership, plantation success, seedling survival

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Abstract No: 020-OP

Enhancing Forage production and mitigating greenhouse gas emissions through bioslurry fertilisation

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ABSTRACT

Low forage productivity and poor feed quality constrain livestock production in sub-Saharan Africa, while synthetic fertiliser use and manure mismanagement contribute to greenhouse gas (GHG) emissions. Bioslurry, a co-product of anaerobic digestion, offers a circular-economy alternative to mineral fertiliser and farmyard manure (FYM), yet field-based evidence from tropical livestock systems remains limited. This study evaluated the effects of bioslurry fertilisation on Napier grass yield, forage quality and soil GHG emissions. A field experiment was conducted at ILRI, Nairobi, in a randomised complete block design with six treatments: bioslurry (BS), FYM, NPK, 50% BS + 50% NPK, 50% FYM + 50% NPK and an unfertilised control, all applied at 100 kg N ha^{-1} (total N basis) and replicated four times. Biomass yield, forage quality traits, soil moisture and GHG fluxes (CO_2, CH_4, N_2O) were monitored from April to October 2024. Dry matter yields ranged from 2.27 t ha^{-} (control) to 3.84 t ha^{-1} (BS + NPK), with BS and FYM yielding 3.38 and 2.95 t ha^{-}, respectively. The BS + NPK treatment increased yields by 52% at the second harvest despite below-average rainfall and improved soil moisture, crude protein (16.95%) and C:N ratio (14.71). Sole BS produced the highest N_2O (4.84 kg N ha^{-1}) and CH_4 emissions and the greatest global warming potential, whereas BS + NPK lowered N_2O (1.96 kg N ha^{-1}), acted as a CH_4 sink and reduced yield-scaled GWP. Combining bioslurry with NPK thus optimises forage yield and quality while mitigating GHG emissions, providing a more sustainable fertilisation strategy than sole bioslurry in smallholder systems.

Keywords: Bioslurry, circular economy, forage production, greenhouse gas emissions, Napier grass

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Abstract No: 021-OP

Modifying ruminal fermentation to mitigate enteric methane generation in goats using Saponin- and Tannin-Rich plant sources: A meta-analysis

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ABSTRACT

Saponin- and tannin-rich plant sources are increasingly investigated as natural strategies to modulate rumen fermentation and reduce enteric methane (CH_4) emissions in small ruminants, yet evidence is scattered and sometimes conflicting. This meta-analysis synthesised data from 32 studies on goats to quantify the effects of such plants on dry matter intake, fermentation characteristics, rumen microbial populations and CH_4 production. Standardised mean differences (SMD) and 95% confidence intervals (CI) were estimated using a random-effects model in OpenMEE. Supplementation with saponin- and tannin-rich plants significantly increased propionate (SMD = 0.71; CI 0.21–1.21) and decreased the acetate:propionate ratio (SMD = −0.98; CI −1.57 to 0.38), indicating a shift toward more glucogenic fermentation. Pooled results showed significant reductions in rumen ammonia-N (SMD = −1.34; CI −1.86 to −0.83), protozoa populations (SMD = −1.08; CI −1.95 to −0.22) and enteric CH_4 emissions (SMD = −0.84; CI 1.16 to 0.51), without adverse effects on dry matter intake. Subgroup analyses revealed that higher inclusion levels (>30%) increased acetate and bacterial populations while further reducing ammonia-N and protozoa, and that feeding duration, animal sex and specific phytochemical profiles were important moderators of response. Meta-regression confirmed linear relationships between inclusion level and total volatile fatty acids, ammonia-N, bacterial counts and CH_4 output. Overall, saponin- and tannin-rich plant supplements can improve rumen fermentation efficiency and substantially mitigate enteric CH_4 in goats, provided that inclusion levels and feeding strategies are carefully managed.

Keywords: Goats, methane mitigation, phytochemicals, rumen fermentation, saponins, tannins

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Abstract No: 022-OP

Effect of biochar, canola oil, and garlic on in vitro digestibility, volatile fatty acids, and total gas production in selected dairy cattle feeds

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ABSTRACT

Biochar, canola oil, and garlic are natural feed additives with the potential to enhance rumen fermentation and feed efficiency in dairy systems, offering low-cost alternatives to synthetic rumen modifiers that are often inaccessible to smallholder farmers in sub-Saharan Africa. This study evaluated the effects of these additives on in vitro digestibility, volatile fatty acids, and total gas production of hay, commercial dairy meal, and a total mixed ration (TMR). Each feed type was ground and mixed with biochar, canola oil, or garlic at 0, 1, and 2% of dry matter, and incubated using the in vitro gas production technique. Cumulative gas production at 24 and 48 h, organic matter digestibility (OMD), and short-chain fatty acid (SCFA) production were measured and compared with the 0% controls. Garlic at 2% was the most consistent additive across feeds. In TMR, 2% garlic slightly reduced gas production at 24 and 48 h but increased OMD and SCFA concentration. In dairy meal, 2% garlic yielded the highest OMD (98%) and SCFA production compared with the control, whereas effects in hay were modest, with low OMD but increased gas production. Biochar and canola oil also improved digestibility and influenced SCFA profiles, although their responses were less consistent than those of garlic. Overall, strategic inclusion of garlic, canola oil or biochar can improve in vitro feed utilisation, indicating promise for sustainable, natural feed additives in smallholder dairy production.

Keywords: Feed efficiency, in vitro digestibility, Natural feed additives, sustainable livestock production, volatile fatty acids

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Abstract No: 023-OP

Phytochemical profiling, antioxidant and androgenic effects of multi-solvent extracts of Ziziphus mucronata on Mouse TM3 Leydig Cells

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ABSTRACT

Male infertility is an increasing health concern in many low and middle income countries, yet affordable, effective therapies remain limited. Ziziphus mucronata is a widely used medicinal plant in southern Africa, but its androgenic potential has not been fully characterised. This study evaluated the phytochemical composition, antioxidant capacity and androgenic activity of Z. mucronata leaf extracts prepared with different solvents using mouse TM3 Leydig cells as an in vitro model. Quantitative assays were used to determine total phenolic, flavonoid and proanthocyanidin contents, while antioxidant activity was assessed by DPPH, ABTS and ferric reducing antioxidant power (FRAP) assays. UPLC Q TOF MS was employed to profile bioactive metabolites. Cytotoxicity was evaluated using the CellTiter Blue assay, and testosterone production was quantified by ELISA in the presence of human chorionic gonadotropin (hCG). Methanolic extracts exhibited the highest total phenolic content (173.04 ± 2.23 mg GAE g^{-1}) and strongest antioxidant activity (ABTS 0.48 ± 0.00 µmol TE g^{-1}; DPPH 1293.87 ± 2.02 µmol TE g^{-1}; FRAP 0.49 ± 0.00 µmol TE g^{-1}), while ethanolic and acetone extracts were richest in flavonoids (245.52 ± 5.87 mg QE g^{-1}) and proanthocyanidins (173.02 ± 0.50 mg CE g^{-1}), respectively. Ten bioactive compounds were identified in the methanolic extract. Aqueous extracts were non cytotoxic and, together with organic extracts, enhanced testosterone secretion by TM3 cells in the presence of hCG. These findings indicate that Z. mucronata leaf extracts possess strong antioxidant and androgenic properties, supporting their potential as a natural remedy for male reproductive dysfunction, pending further in vivo efficacy and safety studies.

Keywords: Androgenic properties, antioxidant activity, medicinal plants, phytochemicals, TM3 Leydig cells, Ziziphus mucronata

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Abstract No: 024-OP

Sero-Epidemiology and risk factors of foot and mouth disease in the Eastern Regions of the Democratic Republic of the Congo

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ABSTRACT

The eastern Democratic Republic of the Congo (DRC) supports an important pastoral economy in heterogeneous agro ecological zones, yet cattle productivity is severely constrained by endemic foot and mouth disease (FMD). This study characterised FMD sero epidemiology, spatial patterns and risk factors in South Kivu and Tanganyika provinces. A total of 406 cattle keepers were surveyed using a structured questionnaire administered via KoboCollect, and clinical observations were recorded while animal samples were collected for laboratory analyses. Herds graze predominantly on communal pastures near forests and scrubland, and herd sizes are declining, with 61% of losses attributable to mortality, largely from infectious diseases. FMD outbreaks peak in July–August across most sites and in October in mountainous Kivu. Seroprevalence was highest in the Ruzizi plain (80%) and Lwanika (70%), followed by Fizi and Malia (60%), and lower in mountainous Kivu (50%), Kichanga (40%) and Kisondja (27%). Serotyping revealed predominance of serotype A in the Fizi region and Ruzizi plain in South Kivu and SAT 2 in the Kichanga–Tabac axis of Tanganyika. Multivariate analysis identified introduction of animals from other herds and frequent contact with neighbouring livestock as primary risk factors, compounded by seasonal transhumance toward forested rangelands and cross border animal movements. These findings confirm that FMD remains endemic in eastern DRC and underscore the need for regionally coordinated control strategies focused on movement management, targeted vaccination and strengthened surveillance at communal grazing areas and transboundary corridors.

Keywords: Cattle, seroprevalence, serotyping, foot and mouth disease, risk factors, DR Congo

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Abstract No: 025-OP

New approaches in the development of diluents for gamete preservation in African cattle breeds

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ABSTRACT

Conventional bovine semen extenders are typically developed through empirical, trial and error optimisation, a process that is resource intensive and poorly suited to exploring complex interactions among medium components. This study evaluated the potential of combining experimental approaches with computational modelling to design bovine semen diluents with improved cryoprotective capacity for African cattle breeds. A dataset of extender compositions and corresponding post thaw sperm quality parameters was compiled from published literature and internal experimental records. Response surface methodology was used to identify key diluent components and concentration ranges most strongly associated with post thaw motility. Artificial neural network models were then trained to predict formulations that maximise cryosurvival while minimising component redundancy. Five top candidate formulations were selected and validated against a commercial egg yolk–based control using semen from three Tuli bulls (n = 12 ejaculates). Feature analysis highlighted buffers, sugars, cryoprotectants, membrane stabilisers and antioxidants as the most influential ingredient classes. Predicted total motility of the optimised extenders (45.4 ± 5.29%) exceeded experimentally observed post thaw motility (34.7 ± 3.52%), although, in validation trials, post thaw performance of the new formulations was statistically comparable to the commercial control. These findings demonstrate the feasibility of integrating machine learning with targeted experimentation to accelerate development of semen extenders, reduce experimental runs and improve the efficiency of cryopreservation protocols for African cattle genetic resources.

Keywords: Cattle, cryopreservation, machine learning, media design, semen diluents

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Abstract No: 026-OP

Artificial intelligence for farm-level decision support: A synthesis of emerging innovations, challenges and policy imperatives in Kenya

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ABSTRACT

Agriculture remains central to Kenya's economy, contributing about one-third of GDP and over 40% of national employment, yet smallholder production is increasingly challenged by climate variability, pest and disease outbreaks and limited extension support. This study synthesises emerging applications of artificial intelligence (AI) for farm level decision support in Kenya, examining their impacts, enabling conditions and policy implications. A structured qualitative synthesis was conducted of project reports, scholarly articles, policy briefs and case studies from government programmes and agri tech start ups. Thematic analysis grouped evidence on AI-enabled predictive tools, computer vision diagnostics, digital financial services, market platforms and advisory chatbots. The review reveals a dynamic ecosystem of AI applications: platforms such as the Kenya Agricultural Observatory Platform (KAOP) and Uliza WI provide location specific weather and climate risk advisories; PlantVillage/Nuru uses smartphone based image recognition for pest and disease diagnosis; Apollo Agriculture and Pula Advisors apply machine learning and remote sensing for credit scoring and index insurance; M shamba and related tools link farmers to markets and post harvest services, while chatbots such as Shamba Salama and Farmer Chat deliver tailored agronomic advice in local languages. Reported outcomes include yield increases of up to 40%, reduced losses, improved risk management and enhanced incomes for early adopters. Kenya's enabling environment—national AI strategy, digital public infrastructure and supportive policy initiatives—has been critical, as have participatory, human centred design approaches that embed technologies in existing social networks. Key challenges include the digital divide, data governance and privacy concerns, algorithmic bias and risks of techno solutionism. The study outlines a policy roadmap prioritising robust data governance, targeted digital literacy, inclusive co design and balanced public–private partnerships to ensure that AI becomes a tool for inclusive, climate resilient agricultural transformation rather than a driver of new inequalities.

Keywords: Artificial intelligence, decision support, digital technologies, Kenya smallholder agriculture

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Abstract No: 027-OP

Sustainable fish farming through old jerrycan pond innovation: A youth-led model for aquaculture in Uganda

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ABSTRACT

Plastic waste accumulation, limited access to conventional aquaculture infrastructure and high youth unemployment constrain the expansion of small scale fish farming in Uganda. This youth led initiative developed an innovative, low cost model that repurposes discarded plastic jerrycans into modular fish ponds, thereby simultaneously addressing environmental pollution, livelihood creation and local food security. Old jerrycans are cleaned, cut and assembled into reinforced tank structures capable of holding water and rearing tilapia and catfish at household or micro enterprise scale. The system is highly space efficient and can be installed in backyards or dense urban settings, enabling entry into aquaculture for land and capital constrained youth and low income households. Start up costs are substantially lower than for conventional earthen ponds or lined tanks, and the modular design allows incremental scaling as skills and resources grow. Early implementation by "Farm with Mr. Ojuka" in Gulu has generated strong interest from community members and local farmers and has created opportunities for peer to peer training in basic aquaculture, water quality management and entrepreneurship. The model contributes to climate resilience by diverting plastic from open dumping and burning, enhancing local fish supply and offering diversified income sources for unemployed youth. The initiative calls for partnerships with research institutions and development agencies to refine technical aspects, assess productivity and biosecurity, and support replication of jerrycan based fish farming as a scalable, youth driven innovation within Uganda's evolving food system.

Keywords: Aquaculture, circular economy, food security, jerrycan ponds, youth innovation

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Abstract No: 028-OP

Vulnerability of Small-Scale Fishers' Livelihoods to Climate Change in Binga, Zimbabwe

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ABSTRACT

Climate change is intensifying risks in inland fisheries through increasingly erratic weather, rising temperatures and more frequent extreme events, threatening both livelihoods and food security. This study assessed the livelihood vulnerability of small-scale fishers to climate change in Binga District, Zimbabwe, and identified key determinants of vulnerability to inform adaptation strategies. Simple random sampling was used to select 104 fishers, and structured household interviews were conducted using Kobo Toolbox. The Livelihood Vulnerability Index (LVI) was computed to integrate exposure, sensitivity and adaptive capacity indicators, while Ordinary Least Squares regression and Principal Component Analysis were applied to identify drivers of vulnerability. Results showed that fishers exhibit low adaptive capacity combined with high exposure and sensitivity, with limited access to productive resources, health services and secure food supplies emerging as major risk factors. Socio demographic characteristics, food availability and livelihood diversification indicators significantly influenced LVI scores, underscoring the central role of both household attributes and resource endowments. Overall, Binga's small-scale fishers were found to be extremely vulnerable to climate change because of constrained opportunities to diversify income, weak access to finance and health care, and high dependence on the Zambezi fishery. The study recommends improving access to resources and financial services, promoting diversified livelihood portfolios, strengthening technical and extension support and fostering multi stakeholder partnerships to co design locally relevant adaptation pathways for climate resilient small-scale fisheries.

Keywords: Climate change, fisheries, livelihoods, small-scale fishers, vulnerability

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Abstract No: 029-OP

Rainwater harvesting simulation models and their implications for groundwater resources in Africa: A Systematic Review

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ABSTRACT

Nearly 75% of Africa's population relies on groundwater for domestic and agricultural use, yet increasing climate variability and rising water demand threaten long term groundwater security. Rainwater harvesting (RWH) can reduce pressure on conventional sources and enhance groundwater recharge, but the performance and suitability of available simulation models for African contexts are poorly synthesised. This systematic review, following PRISMA guidelines, analysed 30 studies (2009–2025) from 16 African countries that applied RWH models with explicit implications for groundwater. Models were classified by scale, category, data requirements, computational demand and reporting of groundwater outcomes. Approaches included knowledge driven GIS–multi criteria decision analysis, conceptual rainfall–runoff models (e.g. Australian Water Balance Model), physically based and semi distributed models (HEC HMS, HEC RAS, WetSpass M, SEAWAT), process based models (SWAT, MODFLOW, ModelMuse, GMS, Hydrognomon), event based models (HyfranPlus, EPA SWMM) and empirical tools (ArcSDM, statistical regressions, CROPWAT, Hazen). Around 70% of studies performed calibration and validation and produced quantitative groundwater estimates, demonstrating applicability in data scarce settings, but none reported formal uncertainty or sensitivity analyses, limiting cross study comparability. Data needs ranged from low to high, and computational demand from low to moderate, reflecting heterogeneity in transferability and resource requirements. Overall, RWH simulation models show strong potential to inform groundwater recharge interventions under climate stress, but future work should harmonise performance metrics, standardise calibration datasets, incorporate uncertainty analysis and better integrate socio economic and environmental drivers to support robust, context specific groundwater planning.

Keywords: Africa, groundwater, modelling, PRISMA, rainwater harvesting

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Abstract No: 030-OP

Ivermectin use in livestock: Environmental Persistence, impacts on dung beetles and ecosystem services, and pathways toward sustainable alternatives

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ABSTRACT

Livestock enterprises provide critical livelihood buffers in climate vulnerable mixed farming systems, but intensifying parasite pressure has driven heavy reliance on anthelmintics such as ivermectin. While highly effective against gastrointestinal parasites, ivermectin is environmentally persistent and excreted largely unmetabolised, adversely affecting non target dung dwelling organisms and associated ecosystem services. This systematic review synthesised evidence on ivermectin persistence, its impacts on dung beetles and other soil biota, and implications for ecosystem functioning. Over 300 publications were screened and 200 studies retained based on predefined inclusion criteria. Ivermectin was consistently more efficacious (>90%) than most alternative anthelmintics and has been widely adopted since its commercialisation in 1981, with 46 countries adopting within five years. Measured residue concentrations reached 0.81 mg kg^{-1} in dung, 0.085 mg kg^{-1} (dry weight) in soil and 1.24 ng L^{-1} in aquatic systems. Lethal effects on dung beetles varied by species, with mortality up to 94.1% in Copris acutidens, while sublethal effects included impaired reproduction, altered life-history traits and population declines. These changes translate into reduced dung removal, nutrient cycling and secondary seed dispersal, with potential cascading effects on pasture productivity and biodiversity. The review highlights the need to transition toward more sustainable, plant based parasite control integrated within One Health approaches, and calls for further research on cumulative impacts, interactions with co stressors and context appropriate mitigation strategies to safeguard dung beetle diversity and ecosystem services.

Keywords: Dung beetles, ecological services, gastrointestinal parasites, Ivermectin, persistence, one Health

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Abstract No: 031-OP

Characterization and evaluation of Platypleura haglundi Cicadas as a feed protein source for commercial broiler chicken production under smallholder conditions

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ABSTRACT

Conventional protein ingredients for broiler diets, particularly soybean meal, are increasingly expensive and inaccessible to smallholder farmers, constraining poultry productivity. This study characterised sun dried cicadas (Platypleura haglundi) and evaluated their suitability as an alternative protein source in broiler diets under smallholder conditions in Mudzi District, Zimbabwe. Cicada meal was analysed for proximate composition and amino acid profile, while white maize and white sorghum provided dietary energy. Soybeans were roasted at 110 °C for 15 min and cicadas at 85 °C for 12 min to reduce anti-nutritional factors and microbial load, before milling and diet formulation. Four diets containing 0% (control), 5%, 15% and 20% cicada meal were fed to 120 day-old Cobb500 chicks randomly allocated to treatments (three replicates) for six weeks. Growth performance, weekly body weight, feed intake and feed conversion ratio (FCR) were recorded and analysed using ANOVA (GenStat 18) with Fisher's LSD at 5% significance. Cicada meal was nutrient-dense (57.0% crude protein, 14.3% fat) and rich in essential amino acids such as lysine (3.17 g/100 g) and methionine (1.42 g/100 g). Final live weights at day 42 were 1473, 1249, 1636 and 1804 g for the 0%, 5%, 15% and 20% diets, respectively, with significantly improved FCR at 20% inclusion (1.98). Results demonstrate that cicada meal can partially substitute soybean meal at 15–20% inclusion without compromising performance, offering a viable, local protein option for smallholder broiler systems.

Keywords: Alternative protein, broiler production, feed efficiency, insects, smallholder farming

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Abstract No: 032-OP

Genome-wide association study of seropositivity to Babesia bigemina, Babesia bovis and Ehrlichia ruminantium in Cattle

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ABSTRACT

Tick-borne pathogens are a major constraint to cattle productivity and welfare in communal production systems, yet host genetic resistance remains underexploited. This study identified genomic regions associated with seropositivity to Babesia bovis, Babesia bigemina and Ehrlichia ruminantium in apparently healthy cattle from six villages in the Bela-Bela Municipality, South Africa. A total of 145 animals were sampled at communal dip tanks, and sera were screened for antibodies using the indirect immunofluorescence assay. Genomic DNA was extracted from whole blood and genotyped with the Illumina Bovine 1000K SNP BeadChip. Population structure was assessed by principal component analysis, and runs of homozygosity were used to infer inbreeding. Genome-wide association analyses were performed to detect SNPs and candidate genes associated with seropositivity to each pathogen. PCA revealed no marked genetic stratification among local breeds, except for the Simmental, which formed a distinct cluster. Extensive runs of homozygosity indicated relatively high inbreeding and shared ancestry in the sampled population. Several genes showed significant associations with seropositivity, including PFKL, SERP1, RAC2, SIRT3, CHST11, MARCHF1, DDX56, SHPRH, PLXNA1, IFNGR2, LRRIQ1 and MARF1. These genes are involved in immune response, stress adaptation and key cellular pathways such as glycolysis, apoptosis regulation, cytoskeleton organisation, oxidative stress mitigation, antiviral defence and DNA repair. The findings highlight the potential for genomic selection and targeted breeding to enhance resistance to tick-borne pathogens and improve cattle productivity in smallholder systems.

Keywords: Genes, GWAS, serology, tick-borne pathogens

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Abstract No: 033-OP

Morphometric traits and structural indices of small East African Zebu and its crosses with tyrolean grey cattle under on station conditions in Uganda

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ABSTRACT

The Tyrolean Grey (TG) cattle breed from Austria was introduced into Uganda in 2009 for crossbreeding with the indigenous Small East African Zebu (SEAZ) to improve productivity while retaining adaptation to local conditions. This study characterised SEAZ and TG SEAZ crossbreds (TGZ) using linear body measurements and derived structural indices under on station conditions at Aswa Ranch and Lusenke Stock Farm, with the aim of informing breeding and production strategies. Morphometric data were collected from 214 randomly sampled animals. Associations between location and traits were examined using χ tests; genotype comparisons used independent samples t tests for normally distributed traits and Mann–Whitney U tests otherwise. TGZ cattle had significantly greater chest girth ($p = 0.012$), head length ($p = 0.004$), height at withers ($p = 0.017$) and body length ($p = 0.023$) than SEAZ, indicating a larger skeletal frame and enhanced thoracic development favourable for meat production and metabolic efficiency. In contrast, SEAZ exhibited a higher Height Index (65.41 ± 1.77 vs 53.55 ± 1.67; $Z = 3.974$, $p < 0.001$) and Balance Index (0.64 ± 0.026 vs 0.54 ± 0.022; $Z = 3.475$, $p = 0.001$), reflecting more proportionate body conformation and greater relative leg length, traits advantageous for mobility and endurance in extensive systems. Structural variation between locations suggested influence of environmental conditions, feed resources and management practices. Animals at Lusenke, with superior chest and body dimensions, appear well suited to commercial beef production, feedlot finishing and genetic improvement programmes targeting growth traits, whereas Aswa Ranch animals, being taller and more balanced with longer rumps, are better adapted to long distance grazing in harsher environments. These results highlight the importance of matching genotype–phenotype combinations to production environments when designing crossbreeding and selection programmes.

Keywords: Characterisation, genotype, morphometrics, structural indices, Tyrolean Grey, Zube

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Abstract No: 034-OP

Nixtamalization of white and yellow maize: Effects on nutrition and acceptability of traditional staples

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ABSTRACT

Maize, particularly white maize, is a staple in Southern Africa, where pap prepared from refined commercial meal is consumed daily. However, reliance on unfortified pap contributes to protein and micronutrient deficiencies, exacerbated by phytic acid induced mineral malabsorption and limited safe grain to meal processing at household level. Nixtamalization—a traditional alkaline processing technique widely used in Latin America—can enhance mineral availability, improve digestibility and flavour, and reduce aflatoxins, yet remains largely unfamiliar in sub Saharan Africa. This study evaluated the effects of nixtamalization on the nutritional composition of white and yellow maize flour and the sensory acceptability of three traditional wheat based products—vetkoek, dumplings and steamed bread—partially substituted with nixtamalized maize. Composite flours containing 0, 15 and 25% nixtamalized white or yellow maize were formulated. Proximate and mineral analyses showed that nixtamalization increased calcium content approximately fivefold and significantly raised magnesium and potassium levels ($p < 0.05$). Yellow maize flour had higher crude protein, neutral detergent fibre and acid detergent fibre than white maize. Consumer acceptability was assessed with a 100 member panel (18–65 years) using a 5 point Just About Right (JAR) scale. Products with 25% nixtamalized yellow maize were preferred over 15% and white maize analogues; vetkoek with 25% yellow flour achieved the highest acceptance. Its aroma and exterior appearance were rated JAR by >75% of panellists, though taste was perceived as slightly too bland (mean JAR drop >1); overall liking was 6.86 (“slight liking”). Nixtamalization thus offers a practical, kitchen scale processing method to improve mineral density and diversify maize based foods, with potential to support household nutrition, micro enterprise development and inclusive, climate smart agri food value chains.

Keywords: Agri-food systems, food and nutrition security, nixtamalization, staple food innovation, sensory acceptability

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Abstract No: 035-OP

Knowledge, attitudes and practices regarding antibiotic use and residues among smallholder dairy producers in Mbala and Kasama Districts, Zambia

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ABSTRACT

Smallholder dairy producers supply at least half of Zambia's milk, yet indiscriminate antimicrobial use may contribute to antibiotic residues in milk and antimicrobial resistance (AMR). This cross sectional study assessed knowledge, attitudes and practices (KAP) regarding antibiotic use and residues among smallholder dairy farmers in Mbala and Kasama districts, Northern Province. From a sampling frame of 109 farmers, 101 were randomly selected (59 Kasama, 42 Mbala). A semi structured questionnaire, administered via KoboToolbox in English, Bemba and Mambwe, captured socio demographics, antibiotic use, awareness of withdrawal periods and residue risks. Data were analysed in Stata using descriptive statistics, KAP scoring (70% = "good"), χ^2 tests, Pearson correlations and multivariable linear regression. Overall, farmers exhibited poor knowledge, negative attitudes and poor practices regarding antibiotic use and residues in both districts, with all composite scores below 70% and no significant differences between sites. Approximately 36.6% of respondents did not know what antibiotics are, 60.6% were unaware of withdrawal periods and only 49.5% knew how to determine them. In Mbala, strong positive correlations were observed between knowledge and attitude, knowledge and practice, and attitude and practice, indicating that improved knowledge could leverage behaviour change. Lower education level (none/primary) and age 30–50 years were significantly associated with poorer KAP. Risky practices were widespread: 100% never screened milk for residues; 79.2% kept no treatment records; 68.3% self administered antimicrobials; 30.1% used antibiotics prophylactically; 21.8% ignored withdrawal periods; and 17.8% used antibiotics to boost production. Commonly used drugs included oxytetracycline, sulphonamides and β lactams sourced from agro vets, veterinary staff, fellow farmers and pharmacies. Despite 85.2% attending disease control trainings, key messages on prudent use appear poorly translated into practice. The study highlights urgent needs for stronger regulation, residue monitoring, farmer centred stewardship programmes and cost effective rapid residue tests to protect public health within a One Health framework.

Keywords: Antibiotic residues, antimicrobials, knowledge–attitude–practice, milk, One Health

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Abstract No: 036-OP

Plant microbiomes as unexplored African heritages: Endophytic bacteria from Brachiaria Grass as tools for climate resilient agriculture

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ABSTRACT

Endophytes—microorganisms that inhabit plant tissues without causing disease—are increasingly recognised as key allies for sustainable, climate resilient agriculture. Brachiaria (syn. Urochloa), a tropical C_4 forage widely promoted in Africa for its drought tolerance and soil restoring capacity, hosts diverse bacterial endophytes that remain largely unexplored. This study characterised culturable endophytic bacteria associated with Brachiaria ecotypes and germplasm collections from diverse Ethiopian agro ecologies processed at the BecA–ILRI Hub, and evaluated their plant growth promoting traits. From 56 samples (seeds, roots, stems and leaves), 215 bacterial isolates were obtained and assigned to three phyla, five classes, 13 families and 34 genera. Dominant genera included Pseudomonas, Pantoea and Rahnella, with additional taxa such as Brevibacterium, Paenibacillus, Serratia and Curtobacterium reflecting ecological specialisation across tissues and ecotypes. Functional screening revealed that 56% of isolates produced indole 3 acetic acid, 38% solubilised inorganic phosphate, 64% produced siderophores and 33.5% expressed ACC deaminase activity. Several isolates suppressed Aspergillus flavus, indicating potential to reduce aflatoxin risk. Notably, 55 isolates combined at least four growth promoting and protective traits, highlighting their multifunctionality. The coexistence of ubiquitous "core" genera and ecotype specific taxa supports a holobiont view of Brachiaria, in which plant performance emerges from plant–microbe interactions. These endophytes constitute an important microbial heritage with direct applications as biofertilisers and bioprotectants to reduce reliance on synthetic agrochemicals, improve nutrient cycling and enhance stress tolerance in forage based systems. Establishing regional culture collections, advancing consortia development and integrating endophyte based inoculants into climate smart forage programmes could transform Brachiaria into a platform for microbial innovation in African agri food systems.

Keywords: Bacterial endophytes, biofertilisers, Brachiaria grass, climate-smart agriculture, Plant microbiomes

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Abstract No: 037-OP

Assessment of small stock management practices and farmers' willingness to adopt new feed innovations in Central District, Botswana

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ABSTRACT

Small stock (goats and sheep) are critical to rural livelihoods, food security and climate resilience in Botswana, yet production is constrained by dry season feed shortages and limited adoption of improved feeding strategies. This study characterised current small stock management and supplementary feeding practices and assessed farmers' willingness to adopt novel feed innovations, including insect based proteins, in Central District, Botswana. A structured survey was administered to small stock farmers, capturing herd sizes, management systems, feed resources, fodder production and interest in training. Herd size ranged from 14 to 80 goats per household, with an average of 36. All respondents (100%) practiced free range systems and reported providing dry season supplements, primarily Lablab purpureus, maize residues and melons. Fodder production was universal, yet highly specialised: all farmers grew lablab, and only 1% additionally cultivated forage sorghum, indicating low diversification of fodder species. Although farmers recognised the importance of supplementation, resource constraints, limited knowledge and weak extension services hindered adoption of more intensive or innovative feeds. Respondents expressed strong interest in capacity building on fodder cultivation and insect based feed production, and indicated willingness to adopt new practices if training, technical backstopping and start up support were available. The findings underscore the need for targeted, locally adapted feed innovations, strengthened advisory services and participatory training that align with smallholders' resource realities. Integrating climate smart fodder systems and alternative proteins into small stock value chains could substantially improve productivity, household incomes and resilience of Botswana's smallholder livestock systems.

Keywords: Climate-smart farming, fodder production, insect-based proteins, small stock, supplementary feeding

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Abstract No: 038-OP

Safflower (C*arthamus tinctorius*) seeds as a natural feed additive for improving poultry semen quality and reproductive performance: A review and future research directions

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ABSTRACT

Semen quality is central to reproductive efficiency and genetic progress in poultry, yet poor semen traits in roosters often limit fertility and hatchability. Natural feed additives rich in bioactive compounds are increasingly explored as sustainable alternatives to synthetic fertility enhancers. Safflower (Carthamus tinctorius), an oilseed crop adapted to semi-arid regions, contains high levels of polyunsaturated fatty acids, proteins, tocopherols and phytosterols with recognised roles in membrane fluidity, steroidogenesis and oxidative stress mitigation. This narrative review synthesised peer reviewed literature (2007–2025) on safflower seed composition, bioactive constituents and their effects on male reproductive physiology across livestock species, and extrapolated implications for poultry. Evidence indicates that dietary safflower can improve semen volume, sperm concentration, motility and morphology in mammals, likely via enhanced spermatogenesis, antioxidant protection of sperm membranes and modulation of reproductive hormones. Studies on flaxseed and related oilseeds in roosters demonstrate that enrichment of n 3/n 6 fatty acids in sperm membranes improves semen quality and cryotolerance, suggesting analogous benefits for safflower. However, direct trials in poultry are scarce, and optimal inclusion levels, processing methods and interactions with basal diet composition remain unknown. The review concludes that safflower seeds have strong potential as a locally available, dual purpose feed and cash crop to enhance poultry reproduction and diversify farmer income. Rigorous dose–response studies in roosters are urgently needed to quantify effects on semen traits, fertility, hatchability and oxidative status, and to integrate safflower into climate resilient, nutritionally sensitive feed strategies aligned with RUFORUM's Theme 2.

Keywords: Antioxidants, poultry reproduction, Safflower, semen quality, sustainable feed

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Abstract No: 039-OP

Bovine Cysticercosis in Botswana: A call for a one health approach

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ABSTRACT

Bovine cysticercosis (BCC), caused by the larval stage (Cysticercus bovis) of the human tapeworm Taenia saginata, is an important parasitic disease of cattle with significant zoonotic and economic consequences. This paper reviews the occurrence and impacts of BCC in Botswana over the past five decades and advocates for a coordinated One Health response. Existing data from abattoir inspections and national reports were collated to determine temporal trends in prevalence and associated financial losses. BCC has been recognised in Botswana since 1958, and despite increased awareness and control efforts, abattoir prevalence has risen from 12% in 1974 to 17.2% in 2020. Over this period, BCC has caused substantial economic losses through carcass condemnation and downgrading, with annual reductions in beef export earnings ranging from approximately one million pula in 1978 to 100 million pula in 2010. While the cattle level and trade impacts are well documented, information on the burden of human taeniasis and its public health implications remains limited. Persistently high prevalence despite available preventive measures underscores gaps in sanitation, meat inspection, public awareness and intersectoral coordination. The paper argues that effective prevention and control of BCC require an integrated One Health strategy that links human, animal and environmental health sectors to improve surveillance, risk assessment, community education, sanitation, meat inspection and safe disposal of infected carcasses. Such a collaborative approach is essential to break the transmission cycle, safeguard public health and protect the economic viability of Botswana's beef industry.

Keywords: Botswana, Bovine cysticercosis, economic losses, one Health, prevalence, Taenia saginata

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Abstract No: 040-OP

Building veterinary capacity in Botswana: A proposal to establish a school of veterinary medicine

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ABSTRACT

Botswana relies heavily on livestock for national income, exports and rural livelihoods, yet veterinary capacity has historically depended on training veterinarians abroad, a costly and increasingly unsustainable model. In the past decade, fewer than three veterinarians have been trained per year, while the existing workforce is shrinking through attrition and retirement, creating critical gaps in animal health services, food safety and One Health surveillance. To address this deficit, the Department of Veterinary Sciences at the Botswana University of Agriculture and Natural Resources (BUAN) spearheaded development of a proposal to establish a national School of Veterinary Medicine. Following approval at departmental, faculty, senate and council levels, a multi stakeholder working group designed a five year Doctor of Veterinary Medicine (DVM) programme. The proposal, informed by demand analyses, benchmarking with the University of Botswana's Faculty of Medicine, stakeholder consultations and technical support from a Fulbright consultant, systematically addressed infrastructure and facilities, curriculum and pedagogy, human resources, governance, admissions and academic regulations, partnerships, financing and long term sustainability. The proposed School, to be established as a publicly funded Faculty of Veterinary Medicine embedded in Botswana's National Development Plan, is expected to strengthen the veterinary workforce, support a competitive livestock industry, expand regional veterinary training opportunities and position Botswana as a hub for veterinary education, research and One Health service delivery in Southern Africa.

Keywords: Botswana; livestock industry; One Health, veterinary education; veterinary workforce

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Abstract No: 041-OP

Analysis of the effects of rainfall variability on natural forage resources and livestock production in Botswana

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ABSTRACT

Arid and semi arid ecosystems are characterised by highly variable and unpredictable rainfall, with profound implications for forage dynamics and livestock productivity. This study developed and analysed a non autonomous plant–herbivore model to quantify the effects of rainfall variability on natural forage biomass and livestock populations in Botswana, where traditional livestock farming remains a key pillar of food security and the rural economy. The model incorporates real climate data to capture temporal variability in rainfall timing and intensity and its influence on forage growth, carrying capacity and herbivore dynamics. Stability and bifurcation analyses were used to identify critical threshold values for ecosystem sustainability and to evaluate how departures from historical rainfall regimes affect long term coexistence of forage and livestock. Simulations showed that early onset and higher intensity rainfall events enhance forage biomass and support higher, more stable livestock populations, whereas delayed onset or reduced rainfall lead to forage depletion and livestock decline, consistent with observed historical trends. The model further demonstrated that adaptive livestock harvesting strategies—such as dynamic destocking in drought years—can mitigate climate induced risks and maintain system resilience. By combining theoretical modelling with empirical climate records, the study provides a predictive framework for assessing grazing system responses to climate variability and designing sustainable livestock management strategies for Botswana's rangelands.

Keywords: Botswana,climate risk, Livestock production,natural forage, plant herbivore model, rainfall variability

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Abstract No: 042-OP

Effect of feed form on performance and blood profiles of ross 308 broiler chickens fed algae-based diets

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ABSTRACT

Algae are promising functional feed ingredients for poultry, but their interaction with feed form on broiler performance and health is not well understood. This study evaluated the effects of feed form (mash versus pellet) and algae inclusion level on growth performance and haematological profiles of Ross 308 broiler chickens. A total of 144 male broilers (22 days old) were allocated to a 2 × 4 factorial experiment in a completely randomised design, with two feed forms and four algae inclusion levels (0, 10, 15 and 20 g kg^{-1} diet dry matter), replicated three times with six birds per replicate. Experimental diets were isoenergetic and isonitrogenous and formulated to meet Ross 308 nutrient requirements. Body weight gain, feed intake and feed conversion ratio (FCR) were recorded, and blood samples were analysed for packed cell volume and differential leukocyte counts. Data were subjected to ANOVA using SAS 9.3.1. Pelleted diets significantly increased feed intake and growth rate compared with mash ($p < 0.05$), but birds fed mash achieved superior FCR, indicating more efficient feed utilisation. Diets containing 10 and 15 g algae kg^{-1} supported similar growth rates, suggesting that moderate algae inclusion can maintain performance. Feed form had no significant effects on white blood cell counts or leukocyte differentials, and algae inclusion levels did not alter packed cell volume or leukocyte profiles ($p > 0.05$), indicating no adverse effects on haematological status. Overall, algae can be included up to 15–20 g kg^{-1} in mash or pelleted diets without compromising health, while the choice of feed form involves a trade off between growth rate and FCR.

Keywords: Blood profile, broiler chickens, feed conversion ratio, feed form, algae inclusion, growth performance

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Abstract No: 043-OP

The influence of nutrient addition under different moisture levels on vegetation dynamics in a Mesic Grassland, South Africa

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ABSTRACT

Grasslands underpin livestock production and ecological stability in southern Africa, yet their structure and functioning are increasingly altered by climate variability and nutrient enrichment. This study examined how nutrient addition interacts with variable moisture regimes to influence species composition, diversity and aboveground biomass in a mesic grassland at Ukulinga Research Farm, South Africa. A rainfall manipulation experiment (2020–2022), embedded in the International Drought Network, imposed three moisture levels—drought (53% of long term mean rainfall), ambient and above average rainfall—using passive shelters and water redistribution in a randomised block design. Within nine 3 × 5 m plots, fertiliser subplots received annual applications of nitrogen, phosphorus, potassium and micronutrients during the growing season. Species composition was surveyed and aboveground biomass harvested annually. Rainfall strongly regulated biomass and diversity: above average rainfall substantially increased productivity, whereas drought suppressed biomass without immediate declines in species richness. Nutrient addition effects emerged gradually, significantly shifting species composition and enhancing diversity in wetter years, while unfertilised plots exhibited more stable diversity across years. Fertilised plots showed increased species abundance but also greater inter annual variability, indicating that moisture availability constrains the benefits of nutrient inputs. Overall, the grassland community appeared resistant to short term drought but highly responsive to longer term nutrient enrichment when coupled with higher rainfall. These findings highlight the need for climate smart soil fertility strategies that integrate rainfall variability into grassland management to sustain productivity, biodiversity and grazing livelihoods under climate and economic shocks.

Keywords: Grassland biomass, nutrient addition, rainfall manipulation, species composition, ecosystem resilience

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Thematic Area:
Energy transitions for productive and sustainable agri-food systems

Abstract No: 044 -OP

Delivering bio-alkanol gel fuel as a renewable energy source to rural households in the lake basin region

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ABSTRACT

In Africa, biomass fuels constitute over 90% of the primary energy supply, despite their detrimental environmental impacts. Bio-Alkanol gel, a novel liquid fuel, is produced by fermenting sugars from fruit peelings; such as those from oranges, mangoes, bananas, watermelons, or papayas;along with eggshells, which serve as a source of calcium acetate (a gelling agent). This gel burns cleanly without smoke or soot, addressing two critical issues: deforestation in the Lake Victoria water catchment areas and indoor air pollution from traditional cooking methods in rural East Africa. The energy content of Bio-Alkanol gel is notable, with a Higher Heating Value (HHV) of 20.50 MJ/kg and a Lower Heating Value (LHV) of 17.50 MJ/kg, which is comparable to liquefied petroleum gas (LPG) in cooking efficiency. A single liter of this gel can burn for up to 10 hours at high output (1.5 kW) and can sustain a family of five for four days. Its efficiency is enhanced by a specially designed stove that reaches optimal cooking temperatures in under a minute, significantly faster than traditional charcoal stoves. The gel's low emissions contribute to reducing indoor air pollution, a major cause of respiratory illnesses, and its use can mitigate climate change by lowering carbon monoxide emissions and promoting biodiversity conservation. Additionally, the mass production of Bio-Alkanol gel could stimulate industrialization and sustainable economic growth, thereby improving health and livelihoods in affected communities. Overall, Bio-Alkanol gel represents a promising renewable energy solution for rural populations, combining environmental sustainability with health benefits.

Key words: Alkanol, Bio-Fuel, Bio-Alkanol, Biomass, Fermentation, Gel

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Abstract No: 045 -OP

Harnessing bioenergy for circular agriculture

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ABSTRACT

Agriculture in Africa is under increasing pressure from declining productivity, land degradation, and inefficient farming systems. Current practices that rely on unmanaged crop residues, animal waste, and organic matter often lead to nutrient losses, greenhouse gas emissions, and environmental pollution. Bioenergy technologies, particularly anaerobic digestion, offer a dual solution by converting waste into renewable energy while recycling nutrients back to soils. For Botswana, where energy access and agricultural sustainability remain priorities, circular bioenergy systems can support green energy transitions, improve food security, and strengthen climate action strategies. The study seeks to: 1. Model anaerobic digestion processes using microbial dynamics for efficient energy generation. 2. Apply optimal control frameworks that balance bioenergy production, soil fertility, and greenhouse gas reduction. 3. Evaluate system resilience under climate variability and contrasting adoption scenarios. The research will develop differential equation models of microbial population dynamics in anaerobic digesters. Optimal control analysis will be applied to design strategies for maximizing bioenergy yield while maintaining soil fertility and minimizing emissions. Furthermore, scenario simulations will be conducted under varying climate conditions and adoption levels to assess resilience and scalability. The study is expected to generate quantitative insights into biogas production efficiency under Botswana's conditions. It will provide decision-support tools for policymakers and farmers to scale bioenergy adoption and contribute to sustainable agricultural systems that close nutrient loops and strengthen resilience to climate shocks. This research will provide scientific evidence and mathematical models to guide the adoption of bioenergy in Botswana's agricultural sector. By integrating bioenergy and circular agriculture, the project supports green energy transitions, advances climate action commitments, and contributes to sustainable food systems.

Keywords: Anaerobic digestion, Bioenergy, Botswana, climate resilience, optimal control, sustainable agriculture

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Abstract No: 046 -OP

Green energy valorisation of distillation oil production

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ABSTRACT

Essential oil distillation in Madagascar largely relies on conventional direct-fire stills that consume substantial amounts of fuelwood, accelerating deforestation and increasing production costs. This study presents a technological innovation, the 1500 L Improved Separate Boiler Still (ACSA, 53 kW), designed to significantly reduce reliance on fuelwood while enhancing extraction efficiency for Melaleuca quinquenervia (niaouli) and Syzygium aromaticum (clove leaves). The prototype integrates thermal-efficiency improvements in its furnace-boiler configuration and enables partial substitution of fuelwood with air-dried distillation residues. Comparative assessments with traditional direct-fire stills reveal that, for equivalent steam outputs of 80–85 kg h^{-1}, ACSA reduces fuelwood consumption from 60 to 27 kg h^{-1}, increasing energy efficiency from 25.9% to 61.3%. Incorporation of 98–100 kg of dried distillation residues further decreases fuelwood use to 5 kg h^{-1} without compromising steam generation. Distillation cycle duration was reduced from 5 h to 4 h, increasing productivity from 4 to 6 batches per day, while improvements in oil yield and quality were consistently observed. These findings demonstrate that ACSA offers a viable green-energy transition pathway for Madagascar's essential-oil sector by reducing pressures on forest resources, lowering production costs, and integrating circular-economy principles through valorisation of distillation residues. The system's enhanced thermal performance, lower operational emissions, and increased process efficiency position it as an environmentally sustainable and industrially scalable solution for essential oil producers.

Keywords: Circular economy, energy efficiency, essential-oil distillation, Green-energy transitions, Melaleuca quinquenervia, Residue valorisation, Syzygium aromaticum

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Abstract No: 047 -OP

Scaling green energy solutions for industrialised and climate-resilient agri-food systems in Africa

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ABSTRACT

Africa's agri-food systems remain highly vulnerable to climate change, energy insecurity, and environmental degradation, owing to their historical reliance on carbon-intensive fuels such as coal, petroleum, and natural gas. These energy pathways, combined with widespread deforestation, soil degradation, and poor land management practices, exacerbate greenhouse gas emissions and compromise the continent's capacity for sustainable food production. This study evaluates the potential to scale and replicate green-energy solutions—including solar-powered irrigation systems, micro-hydropower units, and biodigesters—to support industrialised, climate-resilient agri-food systems across Zimbabwe and Botswana. Using a mixed-methods approach, the research integrates quantitative data from semi-structured questionnaires administered to key agricultural-sector actors with qualitative insights from policy reviews and stakeholder consultations. The study examines prevailing adoption mechanisms, institutional drivers, and environmental impacts associated with renewable-energy technologies. Statistical analyses using SPSS are complemented by geospatial mapping through QGIS and Google Earth to visualise spatial patterns of energy uptake, resource distribution, and vulnerability hotspots. Preliminary evidence suggests that renewable-energy technologies offer significant opportunities to reduce emissions, enhance water-use efficiency, and stabilise agricultural productivity under increasing climatic variability. However, the scaling process is constrained by limited financing instruments, inconsistent policy implementation, weak technical capacity, and insufficient integration of green-energy priorities into agricultural industrialisation strategies. The study offers practical, evidence-based recommendations for national and regional policymakers, private-sector actors, and development institutions seeking to expand the use of renewable energy in agriculture. These findings underscore the urgent need for coordinated governance frameworks, targeted investments, and strategic incentives to accelerate the integration of green energy and sustainable economic growth, as well as climate-resilient agri-food systems in Africa.

Keywords: Africa, Agriculture industrialisation, Climate resilience, Energy efficiency, Green transitions, Renewable energy

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Abstract No: 048 -OP

Pathways for promoting bioenergy production among smallholder livestock farmers in Lephalale, Waterberg district, Limpopo Province, South Africa

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ABSTRACT

Smallholder livestock farmers have been largely excluded from meaningful participation in the modern bioenergy sector. Their role has remained peripheral, typically limited to supplying organic manure. This narrow perception restricts their ability to benefit from broader opportunities within the sector. The main objective of the research was to analyse smallholder farmers' awareness and perceptions of the bioenergy sector. The specific objectives of the study were to evaluate the level of awareness and knowledge that smallholder livestock farmers have about the green economy and bioenergy, determine factors that influence livestock farmers' perceptions of bioenergy, and examine the challenges and opportunities for bioenergy development in the smallholder livestock sector. Ordinal Least Squares regression was estimated. Findings show that while farmers are generally optimistic about bioenergy's potential, their understanding is mostly theoretical, with limited practical knowledge and awareness of challenges related to its implementation. Several factors influence farmers' perceptions of bioenergy, which showed that younger farmers tend to be more positive than older ones. A stronger sense of entitlement to government support and more frequent extension visits both correlate with positive views. The paper recommends targeted financial incentives for smallholder farmers, improved land tenure security, and the provision of practical training to enable meaningful participation in sustainable bioenergy initiatives.

Keywords: Livestock, biogas, bioenergy, awareness, knowledge, perception, and smallholder farmers

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Abstract No: 049 -OP

Biogas technology for rural energy security, livelihoods and climate action: Evidence from Southern Ethiopia

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ABSTRACT

Biogas technology was introduced in Ethiopia in 1979 as a cleaner alternative to traditional biomass fuels. Yet, rural households continue to rely heavily on firewood, crop residues, and kerosene, resulting in deforestation, indoor air pollution, and gender-differentiated labour burdens. This study evaluates the contribution of household-level biogas systems to rural energy security, livelihood improvement, and climate-action objectives in Southern Ethiopia. Using a mixed-methods design, data were collected from 268 households—134 biogas adopters and 134 non-adopters—through structured questionnaires, focus group discussions, key informant interviews, and field observations. Quantitative analyses employed descriptive statistics, chi-square tests, and logistic regression to identify determinants of adoption and assess livelihood effects. At the same time, qualitative data provided contextual insights into user experiences and operational challenges. Findings reveal that biogas-adopting households reduced firewood consumption by more than 60%, substantially improving energy security and lowering the time burden on women and children. Adoption was also associated with better indoor air quality, reduced respiratory ailments, increased agricultural productivity through the use of bio-slurry fertiliser, and improved household income diversification. Key determinants of adoption included household size, livestock ownership, access to credit, water availability, extension support, and technical training. Environmentally, biogas utilisation contributed to reduced CO_2 emissions and eased pressure on local forests. Despite these benefits, challenges persist, including limited maintenance capacity, insufficient farmer training, and inactive or poorly functioning digesters. To maximise impact, targeted policy interventions are required to strengthen extension services, expand access to credit, and scale up the rehabilitation of existing biogas systems. The study highlights biogas as a gender-responsive, climate-smart innovation capable of transforming rural livelihoods and contributing to sustainable energy transitions in Ethiopia.

Keywords: Biogas technology, bio-slurry, Ethiopia climate mitigation, livelihoods, Rural energy security

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Abstract No: 050 -OP

Biogas production from water hyacinth (Eichhornia crassipes) sourced at Hartbeespoort dam, South Africa

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ABSTRACT

Water hyacinth (*Eichhornia crassipes*), although noted for its potential to support wastewater remediation, has become one of the most problematic invasive aquatic weeds in South Africa, particularly in the Hartbeespoort Dam. Its rapid proliferation forms dense mats that impede water abstraction, harbour disease vectors, threaten aquatic biodiversity, and disrupt recreational and agricultural water use. This study investigates the anaerobic digestion potential of water hyacinth to support biogas generation and nutrient recycling within a circular bioeconomy framework. Fresh biomass was harvested from Hartbeespoort Dam and subjected to laboratory-scale anaerobic digestion for 40 days. Experiments evaluated physico-chemical composition, microbial profiles of the digestate, digestate nutrient quality, and the effects of different pretreatments on biodegradability and kinetic performance. Results show that monodigestion of water hyacinth yields a low biodegradability of 27%. In contrast, co-digestion with cow manure at a 3:1 substrate ratio increases biodegradability to 46%, producing a biomethane potential of 185 L CH_4 kg^{-1} VS. Co-digestion reduced the lag phase from 6.7 to 5.5 days. It increased the maximum daily methane production rate from 15.2 to 22.9 mL day^{-1}. Bacteroidetes and Proteobacteria dominated digestate microbial communities. At the same time, nutrient analyses revealed concentrations of 68 mg kg^{-1} ammonium-N, 73 mg kg^{-1} phosphorus, and 424 mg kg^{-1} potassium, demonstrating strong potential as a biofertiliser. The findings confirm that anaerobic digestion of water hyacinth can generate renewable energy, support nutrient recycling, and contribute to water quality restoration. Pilot-scale assessments and techno-economic analyses, however, are essential to guide large-scale deployment.

Keywords: Anaerobic digestion, Biofertiliser, Biomethane potential, Circular agriculture, Co-digestion, Water hyacinth, Renewable energy

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Abstract No: 051 -OP

Turning agricultural waste into a valuable energy resource: Policy and regulatory gaps in biogas energy in Kenya

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ABSTRACT

Agriculture remains the backbone of Kenya's economy, engaging more than 52.8% of households and generating large quantities of organic waste that present significant potential for biogas production. Biogas offers a dual benefit—reducing reliance on fossil fuels while mitigating agricultural greenhouse-gas emissions, which account for approximately one-third of national emissions. Despite biogas technology being introduced in Kenya in the 1950s, operational efficiency remains low, with only 30% of the 21,000 installed digesters functioning effectively. This study reviews Kenya's policy and regulatory frameworks governing biogas development, focusing on the Bioenergy Strategy 2020–2027 and the National Energy Policy 2025–2034, to identify structural gaps limiting sectoral growth. Findings highlight persistent barriers, including high installation costs, inadequate technical capacity, insufficient private-sector investment, inconsistent government support, and seasonal variability in agricultural residues, which compromises feedstock reliability. Additionally, limited awareness among rural households, weak extension services, and unclear mechanisms for integrating biogas into agricultural incentive schemes hinder widespread adoption. The study emphasises that digestate valorisation, if strategically supported, could reduce dependency on mineral fertilisers, enhance soil fertility, and stimulate rural green enterprises. To unlock the potential of biogas, Kenya requires coherent, long-term policies, improved financing mechanisms, training and certification systems for technicians, and incentives that encourage private-sector participation. Strengthening institutional coordination between agriculture, energy, and environmental agencies is also essential. A more supportive policy environment would enhance rural livelihoods, promote sustainable waste management, strengthen energy security, and advance Kenya's climate-action commitments.

Keywords: Agricultural waste, Biogas policy, Energy governance, Greenhouse-gas mitigation, Kenya, Renewable energy

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Abstract No: 052 -OP

Estimation of energy potential from Biomass residue in the Mali Cotton Belt: Implications for Clean Energy Access and Environmental Sustainability

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ABSTRACT

Rapid population growth and increased agricultural production in Mali's cotton-growing regions have intensified the generation of crop residues and livestock waste, creating both waste-management challenges and opportunities for renewable-energy development. This study assesses the energy potential of biomass residues in Zoumana-Diassa and Nafegue—two key areas in the Mali Cotton Belt—to estimate their contribution to clean-energy access and environmental sustainability. The analysis examines the availability of agricultural waste streams, their conversion potential via bioenergy technologies, and the broader ecological implications using a Life Cycle Assessment (LCA) framework. Preliminary findings indicate that cotton stalks, cereal straws, and livestock manure constitute the largest biomass fractions, with significant recoverable energy potential that could support decentralised rural energy systems. Transitioning to residue-based bioenergy could reduce reliance on fuelwood and charcoal, which currently drive deforestation and land degradation across the region. Furthermore, integrating bioenergy into agricultural systems would enhance nutrient recycling, reduce open burning of residues, and contribute to climate-change mitigation. The study underscores the need for strategic investments in appropriate conversion technologies, such as anaerobic digestion and biomass gasification, matched to local feedstock characteristics and community energy needs. For Mali's long-term energy transition, supportive policies, improved market incentives, and capacity-building initiatives are essential to promote the adoption of residue-based energy solutions. By quantifying the potential of biomass resources and evaluating environmental benefits, this research provides critical evidence to advance sustainable energy planning in the Mali Cotton Belt.

Keywords: Biomass residue, Cotton belt, Energy potential, Life Cycle Assessment, Mali, Sustainable waste management

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Abstract No: 053 -OP

Identification of potential wild tree species for agroforestry-based charcoal production and integrated bee rearing to promote bioenergy and circular agriculture among rural smallholder farmers in Malawi

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ABSTRACT

More than 2.4 billion people worldwide depend on forest-derived biofuels for heating and cooking, and in Sub-Saharan Africa, charcoal and firewood remain the dominant household energy sources. This growing demand has intensified pressure on natural forests, contributing to widespread deforestation in Malawi. This study identifies the native tree species most frequently harvested for charcoal and firewood. It evaluates the economic feasibility of transitioning to agroforestry-based charcoal production integrated with beekeeping as a complementary livelihood strategy for smallholder farmers. Secondary data from the National Commission for Science and Technology (NCST) were analysed using descriptive methods in SPSS to determine species prevalence in national charcoal markets. Seventeen highly exploited native species were identified, with Julbernardia globiflora showing the highest frequency (65 records; 18.5%), while Acacia nilotica was least represented (2 records; 0.6%). In addition to their fuel value, many of these species exhibit ecological and therapeutic benefits, supporting biodiversity and ecosystem functioning. To assess economic potential, Net Present Value (NPV) calculations were conducted over a six-year horizon for integrated tree–bee enterprises. Results indicate a positive return on investment for combinations of selected tree species and beekeeping, suggesting strong potential for income diversification and sustainable bioenergy production. Policy recommendations include instituting regulations for sustainably managing frequently harvested species, formally recognising agroforestry-based charcoal production, and strengthening extension services to support the adoption of integrated systems. The findings demonstrate that agroforestry, coupled with beekeeping, can mitigate deforestation pressures, enhance rural energy security, and strengthen household incomes, advancing Malawi's transition towards circular agricultural and bioenergy systems.

Keywords: Agroforestry, beekeeping, charcoal production, circular agriculture, native tree species, Malawi

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Abstract No: 054 -OP

Community voices in energy transitions: Awareness and adoption of charcoal–kerosene–solar brooding systems for sustainable poultry production in Enugu, Nigeria

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ABSTRACT

Energy transition in poultry production is increasingly critical in humid tropical environments where charcoal- and kerosene-based brooding systems remain dominant, contributing to indoor pollution, high mortality rates, and rising production costs. This study examines community awareness and adoption of solar-powered brooding technologies among broiler farmers in Enugu, Nigeria, with the goal of strengthening climate-smart poultry production and supporting national clean-energy transition plans. Using a descriptive survey design and a snowball sampling technique, data were collected from 306 broiler farmers across the Enugu Capital Territory using structured questionnaires validated by subject experts and demonstrating high reliability (Cronbach = 0.78). Descriptive statistics were used to analyse farmers' socio-economic characteristics, awareness levels, adoption patterns, and perceptions of brooding energy sources. Results show that 48% of respondents rely on kerosene stoves and 22% on charcoal pots, with only 11–19% having transitioned to solar-powered brooding despite widespread interest in cleaner solutions. Solar systems maintained optimal temperatures (28–35 C), lower relative humidity (56–82%), improved chick weight gain (510–550 g/bird), and reduced mortality (2%) compared to charcoal/kerosene systems (7–10%). Major barriers to adoption include high initial investment costs, limited access to financing, inadequate extension support, and low awareness of long-term economic and environmental benefits. Notably, 98% of farmers expressed willingness to adopt solar technologies if affordable financial mechanisms were available. The findings highlight the urgent need for community-engaged energy transition strategies, farmer training, targeted subsidies, and integration of renewable energy into poultry extension services. Strengthening the diffusion of clean energy in poultry systems will reduce emissions, enhance productivity, and support climate-resilient agribusiness in Nigeria.

Keywords: Charcoal and kerosene, community awareness, energy transition, Enugu poultry production, Solar brooding

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Abstract No: 055 -OP

Energy-Smart value chains: Enhancing the energy efficiency of processing, storage, and transportation through clean energy technologies and management systems

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ABSTRACT

Agricultural value chains across Africa continue to experience significant inefficiencies and postharvest losses, driven mainly by energy-intensive, fossil-fuel–dependent systems of processing, storage, and transportation. These losses—estimated at nearly one-third of perishable produce—directly undermine food security, raise production costs, limit value addition, and contribute to greenhouse-gas emissions. This study analyses clean energy–driven interventions to enhance energy efficiency across key stages of the agricultural value chain, with a focus on renewable-powered technologies and digital management systems that support climate-resilient, sustainable production. Through a synthesis of pilot initiatives, policy reviews, and applied case studies from East, West, and Southern Africa, the research highlights the transformative impact of solar-powered cold storage, energy-efficient solar dryers, biogas digesters, clean logistics solutions, and digital monitoring tools. Evidence from Kenya, Uganda, and Togo demonstrates that solar drying technologies significantly shorten drying times and improve food quality, while biogas digesters in Ethiopia and Burkina Faso reduce reliance on firewood and mitigate emissions. Clean-energy-enabled transport—such as solar-chilled motorcycle units and biofuel logistics—enhances market access and reduces spoilage along rural supply chains. Improved cold-chain management, including renewable-powered refrigeration, decreases delays and losses at key aggregation points and port facilities. The study concludes that integrating renewable energy and modern energy management systems into agricultural value chains can significantly increase productivity, strengthen food system resilience, and reduce environmental impacts. Achieving scale, however, requires supportive policies, inclusive financing, cross-sector partnerships, and alignment with national climate and agricultural strategies. Clean energy–driven value chains offer a pathway to equitable agricultural growth, improved livelihoods, and long-term climate resilience across the continent.

Keywords: Africa, clean technologies, climate resilience, energy-smart value chains, postharvest management, renewable energy

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Energy poverty in Mozambique: A multidimensional energy poverty approach

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ABSTRACT

Energy poverty remains a critical barrier to socioeconomic development in Mozambique, where the majority of households rely on traditional biomass for cooking, and access to modern, reliable energy sources is unequally distributed between rural and urban areas. This study employs the Alkire–Foster methodology to construct a Multidimensional Energy Poverty Index (MEPI) using nationally representative data from the 2022 Impact of Access to Sustainable Energy Survey (IAES). The MEPI captures deprivations across multiple dimensions, including access to modern cooking fuels, lighting, appliance ownership, and electricity service quality. Findings reveal that, at a deprivation cut-off of 0.3, approximately 85.8% of households are energy-poor, with an intensity of 55.6%, indicating both widespread and severe energy deprivation. Rural households exhibit significantly higher MEPI values than urban counterparts, with provinces such as Zambézia and Nampula displaying acute energy poverty. Logit regression results identify household size, marital status, rural residence, reliance on unimproved cooking and lighting sources, and poor electricity service as major correlates of energy poverty. Although recent government initiatives—including the Mozambique Energy for All Project—have expanded grid access, energy poverty persists due to unreliable service, high costs, and limited adoption of renewable energy technologies. The study recommends a multi-pronged policy response centred on improving electricity quality, expanding decentralised renewable energy systems, strengthening rural energy programmes, and aligning clean-energy interventions with socio-economic vulnerability patterns. These insights provide an evidence base for designing targeted interventions to advance Mozambique's progress toward Sustainable Development Goal 7.

Keywords: Clean energy access, energy deprivation, MEPI, Mozambique, multidimensional energy poverty

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The impact of natural resources, globalization, and energy consumption on climate-resilient environment in Ethiopia

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ABSTRACT

Understanding the determinants of environmental degradation is essential for designing climate-resilient development strategies in Ethiopia, where natural resource pressures, energy-use patterns, and economic globalization continue to shape ecological outcomes. This study evaluates the impacts of natural resource rents, globalization, and renewable energy consumption on the ecological footprint from 1990 to 2018 using annual macroeconomic data from the Global Footprint Network, World Development Indicators, and the KOF Globalization Index. An Autoregressive Distributed Lag (ARDL) bounds-testing approach is applied to examine long-run cointegration relationships among key variables, complemented by Toda–Yamamoto Granger causality analyses to assess directional dependencies. Results reveal strong long-run cointegration among ecological footprint, natural resource rents, renewable energy consumption, population growth, industrialization, urbanization, and economic growth. Contrary to expectations, both natural resource rents and renewable energy consumption increase Ethiopia's ecological footprint, suggesting inefficiencies in resource governance and in renewable energy production processes. Population growth and industrialization exert significant upward pressure on environmental degradation, with economic growth increasing the ecological footprint by 0.01% for every 1% rise during the study period. Causality tests indicate unidirectional causality running from natural resource rents, renewable energy consumption, and population growth to ecological footprint, with no feedback from the ecological footprint to industrialization. These findings underscore the need for Ethiopia to strengthen resource-use policies, enhance environmental governance, and adopt cleaner, more energy-efficient technologies for renewable energy production. The study recommends integrated policy reforms that balance economic expansion with ecological sustainability and emphasises innovation-driven, climate-resilient pathways.

Keywords: Ecological footprint, natural resource rents, renewable energy, globalization, ARDL, Ethiopia

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Abstract No: 058 -OP

Assessment of the impact of carbon dioxide emissions, renewable energy supply, trade, and economic growth on maize production in South Africa

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ABSTRACT

Maize remains a critical staple and industrial crop in South Africa. Yet its production is increasingly constrained by climate variability, rising temperatures, and the long-term environmental consequences of fossil-fuel–driven emissions. This study examines the short- and long-run relationships among carbon dioxide (CO_2) emissions, renewable energy supply, trade, economic growth, and maize production between 1979 and 2021 using an Autoregressive Distributed Lag (ARDL) modelling framework. Secondary datasets from FAO, BP, and the World Development Indicators were used to estimate the climate–energy–trade nexus. Short-run estimates indicate that CO_2 emissions negatively affect maize production, highlighting the crop's vulnerability to climate-induced stress. Conversely, renewable energy supply displays a positive coefficient, indicating emerging benefits for agricultural productivity. Long-run results further demonstrate that renewable energy supply is a statistically significant driver of maize output, suggesting that expanded deployment of renewable energy can strengthen South Africa's agricultural resilience. Economic growth and trade openness also show positive long-term associations with maize production, underscoring the importance of market integration and macroeconomic stability. The findings contribute to the broader discourse on the energy–agriculture nexus by showing that the agricultural sector is not only an energy consumer but can also contribute to renewable energy expansion through biomass-based bioenergy value chains. Policy recommendations include scaling renewable energy infrastructure in farming regions, promoting bioenergy production from agricultural residues, and integrating climate-smart renewable solutions into the national agricultural strategy. Strengthening renewable energy uptake is essential to safeguard maize productivity and achieve sustainable, climate-resilient agricultural development in South Africa.

Keywords: ARDL model, carbon dioxide emissions, economic growth, Maize production, renewable energy supply, trade

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Abstract No: 059 -OP

Fermentative quality, dry matter changes, and aerobic stability of maize–Duckweed mixture treated with Tannin at Ensiling

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ABSTRACT

The preservation of forage through ensiling is widely practiced to address seasonal feed shortages; however, nutrient degradation during fermentation limits the efficiency of livestock production systems. This study evaluates the effects of tannin extract from Vachellia mearnsii on fermentative quality, dry-matter loss, and aerobic stability of maize–duckweed silage. Maize harvested at the half-milk stage was chopped and mixed with duckweed at a 80:20 ratio, then treated with tannin at 0%, 1.5%, and 3%, forming treatments T1, T2, and T3. The forage mixtures were ensiled in mini-silos for 45 days, followed by assessments of pH dynamics, nutrient preservation, and aerobic stability under air exposure. All treatments rapidly achieved pH < 4.2 within three days, indicating successful fermentation. Final pH values stabilized at 3.7 across treatments, confirming effective preservation. Although significant ($p < 0.05$) dry-matter losses occurred, tannin levels did not influence the extent of fermentation losses; T2 exhibited the highest losses, while T3 recorded the lowest. Upon aerobic exposure, pH values rose above five within 2 days, suggesting reduced aerobic stability in the maize–duckweed mixture. Overall, tannin inclusion did not impair fermentation but did not improve aerobic stability. The results suggest that integrating duckweed into maize silage enhances protein content but may increase susceptibility to spoilage upon exposure to air. These findings provide useful insights for improving forage conservation strategies and promoting high-quality silage production in livestock systems.

Keywords: Silage quality, tannin extract, duckweed, fermentation, dry-matter loss, aerobic stability

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Abstract No: 060 -OP

Communicating renewable energy technology diffusion for clean energy transition in uganda's mechanized irrigation for a climate-smart agricultural information system

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ABSTRACT

Uganda's agricultural sector is increasingly exposed to climate-related risks, demanding innovative pathways that integrate renewable energy technologies into mechanized irrigation systems to strengthen climate-smart agricultural information systems (CSAIS). Despite abundant solar and wind resources, the adoption of renewable-powered irrigation remains limited due to high upfront costs, weak communication frameworks, and inadequate policy implementation. This study examines the diffusion of renewable energy technologies for mechanized irrigation and the effectiveness of communication strategies and policy frameworks supporting clean-energy transitions. A systematic literature review combined with policy analysis was used to assess national trends, institutional barriers, and enabling factors, alongside evidence from case studies of renewable-powered irrigation pilots. Findings reveal that solar-powered pumps, wind-driven water systems, and decentralized mini-grids offer promising alternatives to diesel-based irrigation, significantly reducing greenhouse-gas emissions while enhancing water-use efficiency and agricultural productivity. However, adoption is weakened by low farmer awareness, limited access to financing, fragmented coordination among agencies, and insufficient integration of CSAIS tools in extension systems. Successful case studies demonstrate that public–private partnerships, community participation, ICT-enabled communication, and farmer-centered demonstration projects substantially accelerate technology uptake. The study concludes that scaling renewable energy diffusion in mechanized irrigation is crucial for Uganda's clean-energy transition, agricultural modernization, and climate resilience. It emphasizes the need for strengthened policy implementation, targeted subsidies, capacity building, and coordinated communication strategies that embed renewable energy into CSAIS-driven agricultural decision-making.

Keywords: Clean-energy transition, CSAIS, mechanized irrigation, renewable energy, technology diffusion

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Abstract No: 061 -OP

Decarbonizing agriculture in North Eastern Nigeria: Renewable energy innovations for climate-smart food systems

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ABSTRACT

Agriculture in North-Eastern Nigeria is increasingly constrained by climate change, energy poverty, insecurity, and stressed natural resources, posing severe risks to food security and rural livelihoods. Decarbonizing the sector through renewable energy innovations is essential to building climate-smart food systems that can withstand these pressures. This review synthesizes empirical and conceptual research from Nigeria and other African countries to evaluate the roles of solar irrigation, biogas digesters, hybrid wind–solar systems, small hydropower, and renewable-powered fertilizer production in reducing greenhouse gas emissions and improving agricultural productivity. Evidence indicates that solar irrigation can reduce energy costs by up to 40% and stabilize crop yields. At the same time, biogas systems convert agricultural wastes into clean cooking fuel and organic fertilizer, thereby reducing methane emissions and improving soil fertility. Despite these benefits, adoption barriers persist, including high capital investment requirements, limited rural infrastructure, policy fragmentation, and insecurity that disrupts technology deployment. Comparative insights from Kenya, Ethiopia, and Ghana highlight the importance of integrated policy support, blended finance, multi-stakeholder partnerships, and farmer-led innovation networks for successful renewable-energy transitions. The study concludes that renewable energy systems are vital for transforming agrifood systems in North-Eastern Nigeria, improving resilience, promoting low-carbon growth, and contributing to Sustainable Development Goal 2. Key recommendations include targeted subsidies for renewable technologies, capacity-building programs for farmers, harmonization of energy and agricultural policies, and establishment of university-based innovation hubs to accelerate research and technology diffusion.

Keywords: biogas,climate-smart agriculture, Decarbonization, renewable energy, solar irrigation

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Abstract No: 062 -OP

The impact of renewable energy consumption, foreign direct investment, economic growth, and carbon dioxide emissions on soybean production in South Africa

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ABSTRACT

Soybean is a critical global crop valued for their high-quality protein and oil content. Yet, its production in South Africa is increasingly threatened by climate variability and the environmental consequences of fossil-fuel dependence. This study evaluates the effects of renewable energy consumption, foreign direct investment (FDI), economic growth, and carbon dioxide (CO_2) emissions on soybean production from 1975 to 2021 using the Autoregressive Distributed Lag (ARDL) model. Secondary data from FAO, BP, and the World Development Indicators inform both short- and long-run analyses. Short-run findings indicate that CO_2 emissions significantly reduce soybean output, reflecting heightened climatic stress associated with fossil-fuel-driven emissions, whereas FDI positively influences production. Long-run results reveal that renewable energy consumption, FDI, and economic growth significantly enhance soybean production, underscoring the importance of clean energy and capital inflows for agricultural resilience. These findings support the argument that renewable energy expansion can reduce climate-related risks while strengthening soybeans' potential contribution to South Africa's agri-energy sector. Policy recommendations include promoting renewable energy adoption in soybean value chains, supporting climate-smart farming practices, enhancing investment incentives, and integrating bioenergy opportunities into national agricultural planning. Overall, the results provide a strong evidence base for aligning South Africa's energy transition with agricultural productivity and sustainability goals.

Keywords: ARDL model, CO_2 emissions, FDI, renewable energy, Soybean production, South Africa

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Designing, fabricating, and testing a prototype portable agrivoltaics system for experimental studies in Southern Africa

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ABSTRACT

Agrivoltaics—the dual use of land for photovoltaic (PV) energy generation and crop production—offers significant potential for addressing Southern Africa's intersecting challenges of energy scarcity, agricultural stress, and rural livelihood vulnerability. Despite the region's abundant solar resources, adoption remains low due to high capital costs, limited research infrastructure, and inadequate contextualized designs suited to local agro-ecological conditions. This study presents the design, fabrication, and performance testing of a low-cost, portable agrivoltaics prototype intended to support controlled experimental trials on crop–energy interactions. Using a systematic engineering design approach integrating solar-system optimization, structural analysis, and crop-microclimate modelling, the prototype was developed to ensure portability, durability, and experimental flexibility. Finite element analysis confirmed structural stability under wind and hail loads, while airflow simulations demonstrated enhanced ventilation and moderated heat accumulation beneath panels. Performance trials showed that the PV system reliably powered irrigation pumps, lighting, and small-scale food preservation technologies. Field-based crop experiments showed that shade-tolerant vegetables yielded higher and had greater water-use efficiency, largely due to reduced heat stress and enhanced soil moisture retention. Sun-intensive crops experienced slight yield reductions but benefited from improved water-use efficiency. Fabrication cost analyses demonstrated that the prototype provides an affordable entry point for agrivoltaics research in resource-limited contexts. The results validate the utility of portable agrivoltaic platforms for generating locally relevant evidence, guiding technology adaptation, and promoting the broader adoption of climate-smart energy–agriculture integration. The study concludes that decentralised, small-scale agrivoltaic units can catalyse innovation, strengthen rural resilience, and contribute to Southern Africa's transition towards sustainable food–energy systems.

Keywords: Agrivoltaics, renewable energy, prototype design, microclimate management, crop–energy interactions, Southern Africa

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Abstract No: 064 -OP

Solar-powered integrated thresher and roaster for climate-resilient grain processing: A Gender-Responsive Mechanisation Innovation

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ABSTRACT

Climate variability and persistent food and nutrition insecurity continue to undermine agricultural productivity in Sub-Saharan Africa, particularly in semi-arid regions where sorghum and pearl millet remain underutilised despite their high drought tolerance and nutritional value. Postharvest bottlenecks—especially manual threshing and roasting—are labour-intensive tasks performed largely by women and youth, contributing to gendered workload burdens and significant grain losses. This study presents the co-design, development, and field validation of a solar-powered integrated thresher–roaster tailored for rural communities in Binga and Mudzi districts, Zimbabwe. Using a mixed-methods approach combining household surveys, focus-group discussions, key informant interviews, and participatory prototyping, the research examined labour costs, postharvest inefficiencies, and user-defined design requirements. Findings show that traditional processing methods result in postharvest losses of up to 40%, high physical strain, and chronic exposure to dust and smoke. The prototype machine, powered by photovoltaic panels and designed with ergonomic and gender-inclusive features, processed 50 kg of grain in approximately 15 minutes, reducing processing time by more than 70% while halving losses. Women reported substantial relief from drudgery, improved safety, and increased willingness to expand grain cultivation. Youth engagement also increased due to reduced physical strain and improved operational efficiency. The study concludes that solar-powered mechanisation—when developed through community co-creation—can enhance climate resilience, empower women and youth, strengthen value-addition pathways, and modernise dryland grain processing. Scaling such innovations requires expanded financing mechanisms, technical training, and integration into national mechanisation strategies.

Keywords: climate resilience, gender-responsive innovation, postharvest processing, renewable energy, solar mechanisation, traditional grains

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Abstract No: 065 -OP

Adoption and productivity impacts of solar-powered irrigation pumps among smallholder farmers in Semi-Arid Nigeria

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ABSTRACT

Solar-powered irrigation pumps (SPIPs) have emerged as a promising climate-smart technology capable of reducing energy costs, stabilising crop production, and enhancing resilience in water-stressed areas. Yet evidence on adoption drivers and productivity impacts among smallholder farmers in semi-arid Nigeria remains limited. This study analysed SPIP adoption patterns and quantified their effects on farm productivity using primary data from 720 households across Kano, Katsina, and Jigawa states. Probit regression models were employed to identify determinants of adoption, while an endogenous switching regression framework was used to address selection bias and estimate causal impacts. Results show that adoption remains modest due to high upfront costs, limited access to credit, and weak extension support. Male farmers were significantly more likely to adopt SPIPs owing to better access to land, capital, and irrigation networks, highlighting persistent gender barriers. Adoption of SPIPs substantially increased yields, gross output value, and cropping intensity, with the greatest gains observed among medium- and high-performing farmers. SPIP use also improved resilience to rainfall shocks, facilitated income diversification, and encouraged expansion into dry-season farming. Quantile treatment effects further revealed that productivity impacts were heterogeneous, benefiting higher-performing households more strongly. The study underscores the transformative potential of SPIPs for agricultural intensification and climate adaptation in Nigeria's semi-arid regions. Policy recommendations include targeted financing mechanisms, gender-inclusive subsidy and credit schemes, and the integration of SPIP promotion into national irrigation development and extension programmes.

Keywords: Adoption, ESR model, productivity effects, smallholder farmers, solar-powered irrigation

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Abstract No: 066 -OP

Harnessing Solar energy for agricultural cooling: A systems engineering approach

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ABSTRACT

Postharvest losses—estimated at 30–40% of perishable produce in Uganda—pose significant threats to food security, farmer incomes, and environmental sustainability, largely due to inadequate cold storage infrastructure and low levels of rural electrification. Solar photovoltaics (PV) offer a viable solution. Yet, the adoption of solar-powered cooling technologies remains constrained by high capital costs, limited financing options, and a lack of system designs tailored to smallholder supply chains. This study applies a systems engineering methodology to design, optimise, and field-test a solar-powered cooling system suitable for rural agricultural contexts in Uganda. Following structured stages of needs assessment, system design, prototyping, testing, and evaluation, the system integrates PV modules, battery storage, intelligent controllers, and energy-efficient refrigeration units sized based on cooling-load analysis for fruits, vegetables, and dairy products. Field testing over a six-month production cycle demonstrated that the system successfully maintained storage temperatures of 0–12°C, reducing spoilage rates by 20–25% and extending shelf life by up to 100%. Economic analysis showed favourable payback periods of 2–4 years depending on crop type and market conditions, while environmental assessment revealed substantial reductions in methane emissions from avoided spoilage and CO_2 emissions compared to diesel-powered alternatives. Qualitative feedback highlighted improved product quality, reduced income volatility, and enhanced farmer resilience. The study concludes that a systems engineering approach enables context-appropriate renewable energy innovations that strengthen value chains, improve rural livelihoods, and contribute to Uganda's climate action goals. Scaling such solutions requires blended financing models, supportive policies, and integration into national postharvest and renewable-energy programmes.

Keywords: Postharvest losses, renewable energy, rural livelihoods, solar cooling, systems engineering

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Abstract No: 067-OP

Leveraging indigenous brose species for climate-resilient goat production: Rumen Microbial responses to seasonal variations

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ABSTRACT

Bush encroachment, the rapid proliferation of woody shrubs into formerly open grasslands, presents both ecological and economic challenges across southern Africa. While it reduces grazing capacity and alters ecosystem function, encroacher species such as *Senegalia* spp., Dichrostachys cinerea, Seriphium plumosum, and Prosopis spp. also produce substantial biomass with promising nutritional potential for ruminant feeding. Their use, however, is constrained by the presence of anti-nutritional factors, particularly tannins and phenolics, which can depress intake and nutrient utilization. This review synthesizes findings from recent studies, feeding trials, and case reports to evaluate the suitability of bush-encroachment plants as alternative feed resources and their effects on meat quality. Evidence indicates that when appropriately processed, through methods such as chemical treatment, pelleting, supplementation, or co-feeding, bush-derived feeds can support satisfactory animal performance, maintain carcass yield, and produce meat quality comparable to conventional diets. Key parameters including meat pH, colour, tenderness, and fatty acid profiles generally remain within acceptable or desirable industry ranges. Notably, moderate inclusion of tannin-rich browse has, in some cases, enhanced flavour and oxidative stability. Beyond animal-level benefits, the strategic use of encroacher biomass contributes to rangeland restoration, promotes circular resource use, and strengthens feed security under increasingly variable climatic conditions. Overall, encroacher species present a promising, underutilized resource for sustainable livestock production. Nevertheless, gaps remain regarding standardized processing guidelines, long-term impacts on lipid stability and sensory attributes, ecological thresholds for biomass harvesting, and consumer acceptance. Addressing these gaps will be essential for safe, scalable, and environmentally aligned adoption.

Keywords: Alternative feeds, Bush encroachment, Carcass traits, Meat quality, Ruminant nutrition, Sustainability, Tannins

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Bush-encroachment plants as feed and their effect on meat quality parameters

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ABSTRACT

Bush encroachment, the spread of woody shrubs into grasslands, poses ecological and economic challenges in southern Africa but also provides potential feed resources for ruminants. Encroacher species such as Senegalia spp., Dichrostachys cinerea, Seriphium plumosum, and Prosopis spp. offer high biomass yields with valuable nutrients but contain anti-nutritional factors that limit direct use. This review investigated the potential of bush-encroaching plants as alternative livestock feed and assesses their effects on meat quality parameters, focusing on nutritional value, animal performance, carcass traits, and sensory attributes. It synthesized findings from recent studies and feeding trials, drawing on peer-reviewed research, theses, and case studies related to nutrient composition, processing methods, growth performance, carcass evaluation, and meat quality analyses. Processed bush-derived feeds, designed to reduce anti-nutritional factors, support acceptable growth rates, carcass yields, and meat quality comparable to conventional diets. Key meat quality indicators, such as pH, color, tenderness, and fatty acid profiles, typically fall within desirable ranges, with moderate inclusion of tannin-rich browse linked to enhanced flavor. Environmental benefits include reduced bush encroachment and improved feed security. Encroaching species show promise as sustainable feed resources that can help address rangeland degradation and enhance livestock nutrition. However, before large-scale adoption, there is a need for standardized processing protocols, long-term evaluations of meat lipid quality, assessments of ecological sustainability thresholds, and studies on consumer acceptance.

Keywords: bush encroachment; alternative feeds; meat quality; ruminant nutrition; tannins; carcass traits; sustainability

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A review of the fodder production situation in Botswana

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ABSTRACT

Global demand for food and animal protein is rising with population growth, intensifying pressure on agricultural systems and critical resources such as land, water, and feed. In semi-arid Botswana, where agriculture contributes only 1.7% to GDP, livestock production exceeds domestic needs, with the country ranking as the ninth-largest exporter of range-fed beef to the European Union. Despite this, Botswana produces only 12% of its national fodder demand, importing the remainder. Annual fodder production is estimated at 57,000 metric tonnes, positioning Botswana 89th globally and sixth in the SADC region. This paper reviews policies and programs supporting fodder production, including LIMID, ISPAAD, and the Temo Letlotlo and Thuo Letlotlo initiatives, alongside parastatal support from the National Development Bank and CEDA. While uptake is positive, challenges persist, including unskilled labor, limited participation by women (17.6%) and youth (15%), low commercialization, inadequate seed systems, and climate-related threats. Average fodder yield per hectare improved from 1.71 t/ha (2016/17) to 2.51 t/ha (2021/22), yet average farm size under cultivation declined slightly, highlighting inefficiencies. SWOT analysis identifies strengths in government support, high national demand, and capacity-building initiatives, but weaknesses include poor program implementation, unstructured markets, and insufficient public-private partnerships. Strategic interventions such as climate-smart practices, commercial agricultural clusters, and improved seed and input systems are recommended. Enhancing fodder production has the potential to diversify the economy, create jobs, relieve grazing pressure, and strengthen livestock productivity, but requires coordinated efforts across all stakeholders to address persistent deficits.

Keywords: Agricultural commercialization, Botswana, Climate-smart agriculture, Fodder production, Livestock productivity, Policy review

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The effect of climate smart agricultural practices on household food security among smallholder farming households in Lesotho

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ABSTRACT

Climate change and food insecurity are interlinked precarious challenges hindering development in most parts of the world. Climate change has threatened the sustainability and resilience of the food systems increasing the prevalence of food insecurity and malnutrition. Thus, adaptation strategies are critical in reducing the negative effects of climate change. Climate smart agriculture (CSA) transforms agricultural practices to support food security in the face of climate change. However, these practices have not been widely adopted in African countries. Therefore, the study sought to assess the determinants of the choice of CSA practices and the effect of the adoption of CSA practices on household food security in Lesotho. The study employed a quantitative approach and primary data were collected in 8 out of 10 districts in Lesotho among smallholder farming households. A multistage sampling method was used to select the participants and a survey was conducted in August 2023 to July 2024. Data was collected using questionnaires administered by trained enumerators. CSA practices used by farmers were grouped by principal component analysis and linked to food security by multinomial endogenous switching regression model. Household Dietary Diversity Score (HDDS) and Household Food Insecurity Access Scale (HFIAS) were used to measure household food security. The principal component analysis was applied to cluster the CSA practices into 4 components: conservation agriculture and protected agriculture, general farm management, soil water conservation and planting time scheduling and soil and water management. The adoption of CSA was positively influenced by livestock ownership, household size, formal education, farming experience, farm size and the use of social media. The adoption of CSA practices was negatively associated with household income, land fertility and extension services. The analysis for the effect of Climate-Smart Agriculture (CSA) practices on household food security is not yet complete. CSA practices have the potential to enhance adaptation to climate change, resilience and alleviate food insecurity among smallholder farming households while also enhancing environmental health. For increased adaptation, access to extension services must be improved and practices that are suitable for specific areas must be identified. To promote the adoption of Climate-Smart Agriculture (CSA) practices, both incentives and disincentives are necessary, which challenges existing policies and interventions in Lesotho that support government subsidies for synthetic fertilizers and conventional seeds.

Key words: Climate change, Climate-smart agricultural practices, Food Security, Small holder farmers

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Gender- and youth-responsive approaches to climate adaptation and resource governance

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ABSTRACT

African agri-food systems are increasingly exposed to climate shocks, economic disruptions, and structural inequalities, with women and youth disproportionately affected despite their central role in production and innovation. Limited access to land, finance, and decision-making continues to constrain their adaptive capacity and weaken community resilience. This study examined inclusive resilience programming as a pathway to strengthening climate adaptation among marginalized groups. A multi-case study design was employed, drawing evidence from gender- and youth-responsive resilience programs in Kenya. Data were collected through semi-structured interviews, focus group discussions, and program document reviews, and analyzed using a resilience-capacity framework focused on agency, adaptation, and governance participation. Findings show that gender-responsive financial mechanisms, such as savings groups, table banking, and diversification insurance, significantly enhanced women's adaptive capacity and increased household income diversification. Youth-centered digital advisory platforms improved access to localized climate information, resulting in a 35% increase in adoption of climate-smart agricultural practices among young farmers. Programs incorporating participatory natural resource governance demonstrated notable gains in women's leadership, with representation rising from 18% to 42% across participating communities. Collectively, these approaches strengthened social inclusion, improved decision-making power, and built more robust systems for climate resilience. The study concludes that inclusive approaches are essential for equitable and sustainable adaptation. Scaling these models requires supportive policy frameworks, increased investment in inclusive financial tools, and mentorship and innovation ecosystems for youth agripreneurs. Embedding gender and youth perspectives within national and local resilience planning is critical to ensuring that food system transformation efforts leave no one behind.

Keywords: Climate adaptation, food system transformation, gender-responsive programming, inclusive resilience, youth empowerment

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Abstract No: 072-OP

Factors associated with food stress and nutritional deficiencies in resettled women and children after cyclones

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ABSTRACT

Extreme climate events represent a serious threat to population health, as they contribute to food and nutritional crises, mainly through the reduction of food availability, accessibility, and diversity. In addition, these events destroy infrastructure and force the temporary or permanent displacement of thousands of families to resettlement areas. Their impacts disproportionately affect vulnerable groups such as women and children, who face increased risks related to food security and nutritional health. The objective is to analyze the factors associated with food stress and nutritional deficiencies among women aged 15–49 years and children under five years resettled after extreme climate events in Sofala Province, Mozambique. This will be an observational, descriptive, cross-sectional, and analytical study with a quantitative approach. The study population will include women aged 15–49 and children under five, both resettled and non-resettled, following extreme climate events in Búzi and Cheringoma districts. Participants will be stratified into three groups: (a) women and children living in resettlement areas; (b) women and children living in cyclone-affected areas who returned to their original homes; and (c) women and children living in non-affected areas. Resettled and affected groups will be selected from Búzi, while the non-affected group will be selected from Cheringoma. Data will be collected four years after Cyclone Eloise, covering the period 2021–2024. A structured questionnaire will be administered using REDCap via tablets. The first section will collect sociodemographic data, while the second section will assess food habits and consumption frequency, adapted from the UN World Food Programme's Food Consumption Score tool. Nutritional status will be evaluated using anthropometric measures. Descriptive data will be presented as percentages, contingency tables, and graphs. Statistical analysis will include Pearson's Chi-square test (χ^2) at a 5% significance level to compare the prevalence of food stress and nutritional deficiencies between groups. For continuous indicators such as BMI and Z-scores, one-way ANOVA will be applied if the data are normally distributed; otherwise, the Kruskal-Wallis test will be used. This study is expected to provide insights into the nutritional and health status of resettled populations, highlighting differences between resettled and non-resettled groups. The findings will support decision-makers in adopting corrective measures to improve responses to future extreme climate events and strengthen food and nutrition security among vulnerable populations.

Keywords: Children, Cyclone, Mozambique, Nutrition, Women

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Abstract No: 073-OP

Climate change, gender and food security in Malawi: A Cge Approach

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ABSTRACT

Climate change threatens livelihoods with evidence suggesting that it may increase poverty, hunger, conflict, and gender inequality. This study uses a gender-dynamic computable general equilibrium (CGE) model to evaluate the potential impacts of climate change on sustainable development goals (SDGs) such as food security (SDG2), gender equality (SDG5), and economic growth (SDG8) for Malawi. The CGE model utilizes the 2021 Social Accounting Matrix (SAM), which calibrates the results from the various models, thereby generating the baseline results which exemplify a "steady-state" and policy shock results illustrating the medium- and long-term effects of climate change on the country's agriculture sector. The findings reveal that climate change not only threatens agricultural productivity but also exacerbates existing gender inequalities, leading to heightened food insecurity for women and their families. Policy implications emphasize the need for targeted interventions that address both climate resilience and gender equity, ensuring sustainable food systems in Malawi. This research contributes to the understanding of socio-economic dynamics in the context of climate change, advocating for holistic strategies that prioritize both gender and food security in climate adaptation policies.

Keywords: Computable general equilibrium, Gender equality, SDGs, Poverty

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Abstract No: 074-OP

Harnessing traditional processing, storage and preparation of lake flies (*Chaoborus and Chironomus* sp) to strengthen inclusive food security and resilience in Lake Victoria region in Kenya

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ABSTRACT

Conventional protein sources such as meat, fish, and crops are increasingly under pressure due to climate change and population growth, highlighting the need for alternative, sustainable protein sources. Insects, which are abundant and affordable, present a viable option, with global climate trends likely to increase their availability. In the Lake Victoria region of Kenya, lake flies are a traditional household protein source; however, their consumption is constrained by pronounced seasonality. This study aimed to address the seasonal availability challenge by documenting traditional methods of processing, storage, preparation, and consumption to extend lake flies' usability. An ethnographic design was employed on Rusinga and Mfangano islands, involving 53 participants and triangulating data collection through interviews, observations, and focus group discussions. Key informants (n=5) and community members (n=48) contributed data, which were collected using the Open Data Kit (ODK) and analyzed thematically. Findings identified four main processing stages: collection, smashing, boiling, and drying. Processed lake flies were stored either hanging from kitchen roofs or in traditional pots, achieving a shelf life of over one year. Barriers to lake fly consumption included poverty, perceptions of inedibility, modernization, and gendered division of labor, with women primarily responsible for handling the insects. The study highlights the potential for off-season availability, marketability, and contribution of lake flies as a sustainable source of protein and micronutrients. Policy recommendations include raising awareness of entomophagy, promoting value addition, and integrating gender considerations into the lake fly value chain, thereby enhancing food security for communities along Lake Victoria.

Keywords: Food security, Lake flies, Processing, Preparation, Shelf life

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Abstract No: 075-OP

Evaluating the antifungal efficacy of the resurrection bush (*Myrothamnus flabellifolius*) as a sustainable control method for tomato (*Solanum lycopersicum*) soft rot (*Rhizopus stolonifer*) to reduce postharvest losses and improve marketability of tomatoes in Zimbabwe smallholder farming systems

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ABSTRACT

African agri-food systems are increasingly exposed to climate variability, economic shocks, and structural inequalities that threaten food production and market stability. Rising temperatures, erratic rainfall, soil degradation, and the high cost of imported inputs have heightened the vulnerability of smallholder farmers, who form the backbone of food production across the continent. Building resilient and inclusive food systems therefore requires integrated approaches that enhance sustainability, strengthen value chains, and expand equitable access to resources, technologies, and markets. This paper synthesizes pathways for resilience across key domains, soil health, postharvest loss reduction, climate-smart technologies, market strengthening, digital innovation, and inclusive governance. Evidence shows that integrated soil fertility management, organic amendments, and climate-smart practices such as conservation agriculture and agroforestry enhance soil productivity and ecological stability. Reducing postharvest losses emerges as a high-impact strategy for food and nutrition security. In Zimbabwe, the use of Myrothamnus flabellifolius extracts as natural antifungal agents against tomato soft rot demonstrates a viable eco-friendly alternative to synthetic chemicals, improving shelf life while safeguarding soil and human health. Additionally, investments in agro-processing, renewable energy innovations, digital advisory platforms, and regional market integration (e.g., AfCFTA) strengthen value chain resilience and expand livelihood opportunities. Inclusive governance—particularly the participation of women and youth—further enhances adaptive capacity and equitable access to resources. Overall, the findings underscore that resilient agri-food systems depend on coordinated, multi-sectoral strategies that prioritize sustainability, innovation, and social inclusion. Integrating natural postharvest solutions such as M. flabellifolius contributes to environmentally sound, climate-resilient, and socially just food systems across Africa.

Keywords: Agri-food systems, Climate resilience, Inclusive governance, Postharvest management, Soil health, Sustainable innovation

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Abstract No: 076-OP

School-based nutrition and local food systems: Addressing malnourishment and protein deficiencies in rural Guatemala

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ABSTRACT

Guatemala continues to face one of the most severe childhood malnutrition crises in the Western Hemisphere, particularly in its rural and Indigenous regions. Nationally, nearly 47% of children under five are chronically malnourished, with stunting rates exceeding 70% in some municipalities (UNICEF, WHO, & World Bank, 2021). Although national policies such as the Gran Cruzada Nacional por la Nutrición (SEGEPLAN, 2020) and the Ley de Alimentación Escolar (Guatemalan Ministry of Education, 2021) have sought to address these issues through school feeding programs, gaps in implementation, protein access, and dietary diversity persist—particularly in rural areas like El Tejar, Chimaltenango. While the global health and development community often focuses on nutrition interventions during the First 1,000 Days, far less attention is given to the ongoing nutritional challenges faced by school-aged children. These children may suffer from protein-energy malnutrition, iron deficiency anemia, and poor dietary diversity, all of which directly impact learning outcomes, psychosocial development, and long-term economic potential. Addressing these gaps requires context-specific, culturally grounded strategies that leverage local agriculture, community leadership, and intersectoral collaboration. This case study uses a qualitative approach to examine the implementation of school-based nutrition programs in five schools in El Tejar. It builds upon the First 1,000 Days framework (Thurow, 2018) and incorporates principles from Jacquez et al. (2013) Community-Based Participatory Research (CBPR) to amplify the voices of educators, NGO leaders, local government officials, fellows, and religious institutions involved in nutrition programming. The study also draws from Guatemala's current national nutrition strategy, which is moving toward decentralized, locally led solutions to food security and malnutrition.

Keywords: Guatemala, school feeding, childhood malnutrition, food security, protein deficiency

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Translating science to solve real-life farming community challenges: Implications for woody plant encroachment in southern Africa

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ABSTRACT

Rangelands cover approximately 54% of the global land surface, with Africa accounting for 43% and South Africa alone covering about 74% of its land area. These ecosystems provide critical services beyond livestock and wildlife grazing, including nutrient and water cycling, and play a pivotal role in climate change mitigation and adaptation. Despite their importance, rangelands are increasingly threatened by degradation, which exacerbates food insecurity, poverty, and hunger. Woody plant encroachment is a major driver of this degradation, and current command-and-control management approaches in southern Africa have largely failed. This paper explores strategies for translating ecological science on woody plant encroachment into practical solutions for socio-economic challenges. Using the integrated framework proposed by Twidwell et al. (2021), this study emphasizes collaboration among scientists, industry stakeholders, and extension services. Key insights from ecological research include: (1) the effects of varying tree thinning densities on forage production, (2) utilization of encroaching woody species as a valuable feed resource for ruminants, and (3) exploration of woody plants as potential anthelmintic agents to control gastrointestinal nematodes. Despite numerous theses, peer-reviewed studies, and conference papers documenting these findings, the persistence of land degradation highlights the need for an integrated, inclusive, and coordinated approach. Proactive partnerships that link research, policy, and on-the-ground management are critical to sustainably manage woody plant encroachment, enhance rangeland productivity, and mitigate socio-economic impacts. This study underscores the necessity of moving beyond traditional academic outputs toward actionable solutions that safeguard the multifunctional value of rangelands in Africa.

Keywords: Forage production, Integrated management, Land degradation, Rangelands, Woody plant encroachment

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Abstract No: 078-OP

Influence of holistic planned grazing on greenhouse gas emission and soil properties in Mgeno Ranch, Kenya

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ABSTRACT

Soil degradation and livestock-associated greenhouse gas (GHG) emissions are major challenges to sustainable rangeland management in Kenya's semi-arid lands. These ecosystems, frequently subjected to droughts and floods, rely heavily on livestock production for livelihoods. However, traditional grazing systems often lead to soil compaction, nutrient depletion, and elevated GHG emissions, exacerbating rangeland degradation and climate vulnerability. Holistic Planned Grazing (HPG), a high-intensity, low-frequency rotational grazing method, offers a promising alternative by allowing vegetation and soils sufficient recovery time, thereby enhancing soil structure, water retention, and long-term rangeland sustainability. This study assessed the effects of HPG compared to traditional grazing on soil physico-chemical properties, soil organic carbon stocks (SOCS), and GHG emissions at Mgeno Ranch, Taita Taveta County, during the short rain, transition, and long rain seasons. Using a Randomized Complete Block Design, soil samples were collected at 0–20 and 21–50 cm depths, and GHG fluxes measured via static chamber techniques. Analysis revealed that HPG significantly improved SOCS (10 Mg C ha^{-1}), total nitrogen (2.14%), phosphorus, potassium (143 ppm), and soil moisture (16.7%) relative to traditional grazing. While CO_2 fluxes initially peaked under HPG (181.6 mg Cm^{-2} h^{-1}), they stabilized over time, and methane emissions were lower (-0.01916 mg C m^{-2} h^{-1}), indicating moderated long-term GHG output. These results demonstrate that HPG enhances soil health, increases carbon sequestration, and reduces long-term GHG emissions, offering a climate-smart pathway for sustainable livestock-based livelihoods. Adoption of HPG across Kenya's rangelands could strengthen food security, build resilience to climatic shocks, and support sustainable agri-food systems.

Keywords: Greenhouse gases, Holistic planned grazing, Rangelands, Soil organic carbon, Taita Taveta

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Abstract No: 079-OP

Morphological to molecular responses of potato to heat and drought stress: Recent insights and developments

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ABSTRACT

Potatoes are tuber crop that belong to the Solanaceae family. The tubers store nutrients and starch, serving as the primary yield of the crop. Tubers are also used as seeds for the vegetative growth of new potato plants. Potato yield globally will be reduced from biotic and abiotic stress when produced without adaptations measures as compared to when producing practicing adaptation measures such as the use of tolerant varieties and applying cultural practices in the coming years. The objective of this review was to look at what has been done recently with regards to the effect of drought and heat on morphological traits, physiological traits, biochemical traits and molecular traits, and what needs to be done in future. Recent articles were searched and read to come with recent information on the impact of drought and heat on morphological traits, physiological traits, biochemical traits and molecular traits when developing resilient cultivars. Tuber yields are reduced by abiotic stresses. Traditional breeding has been used to breed for abiotic stress tolerance potato cultivars such as resistance to drought, heat and salinity, however these authors emphasized that traditional breeding should be incorporated with molecular breeding to achieve great and fast results. The availability of sequencing technologies, multi-omics, and genome editing and genome selection makes the use of markers to be efficient in the breeding of abiotic stress tolerance in potatoes. Molecular breeding could change selection process when breeding for abiotic stresses by making it fast and rapid. Identification of the key genes involved in heat, combined heat and drought stress remains essential in potato breeding which are also released by signaling biochemical molecules which are less reported during both stresses. The impact of heat on RUBISCO activity remains unclear, despite the enzyme's essential role in photosynthesis—particularly within photosystem II. Understanding the complex interplay between biochemical, molecular, and physiological mechanisms involved in stress adaptation is crucial for identifying traits that could enhance both traditional and molecular breeding approaches aimed at developing heat- and drought-tolerant crop varieties.

Keywords: Abiotic stress, Drought stress, Heat stress, Morphological traits, Physiological and biochemical traits, Potato

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Abstract No: 080-OP

Establishment of a Biobank for advancing livestock production in Botswana

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ABSTRACT

Livestock production is a source of Botswana's agricultural economy, cultural heritage, and food security. Nevertheless, challenges such as climate variability, emerging diseases, genetic erosion of indigenous breeds, and limited innovation capacity threaten the long-term sustainability of the sector. To address these challenges, the Biobank-Botswana: National Livestock Genetic Resource and Innovation Programme (BB-NLGRIP) proposes the establishment of a National Livestock Biobank as a key strategic platform for genetic resource conservation, disease surveillance, biodiversity protection, and research-driven innovation. The BB-NLGRIP will serve as a centralized repository of high-quality biological materials, including DNA, tissues, gametes, and embryos, that will be collected from different livestock breeds in Botswana. The primary objectives of BB-NLGRIP are to (i) preserve and characterize genetic resources of indigenous and exotic breeds, (ii) enhance breeding and selection programs through genomic tools, (iii) strengthen disease surveillance by integrating biomarker discovery and pathogen monitoring, and (iv) support biodiversity conservation in line with regional and global commitments to sustainable development goals. Furthermore, the BB-NLGRIP will act as a hub for innovation, enabling collaborations between researchers, policymakers, and industry stakeholders to drive technology transfer, value addition, and resilience in livestock systems. By establishing this resource, Botswana will position itself as a regional leader in livestock biotechnology and conservation, ensuring food security, improved productivity, and sustainable livelihoods for future generations.

Keywords: Biodiversity conservation, Botswana, Genetic resources, Disease surveillance, Innovation, Livestock biobank

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Abstract No: 081-OP

Inclusion effects of graded levels of Amaranthus Cruentus forage on zootechnical parameters of broiler chickens

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ABSTRACT

Amaranth species offer a viable alternative energy and protein source in monogastric feed formulations. The objective of the study was to determine the inclusion effects of Amaranthus cruentus forage (ACF) in broiler diets on zootechnical parameters during the grower and finisher stages. Forty-eight Cobb 500 broilers were randomly assigned to 4 treatment grower diets with 0 %,10%, 20% and 30 % protein in conventional feed replaced by ACF at day 14. Each treatment was replicated 3 times, with 4 birds per replicate. Growth performance data collected included live weight, gain, daily water and feed intake. Feed conversion efficiency was determined. A digestibility trial was conducted from day 21 to day 28 of the trial after allowing the birds to acclimatise to the diet. At the end of the experiment on day 42, three birds per replicate were slaughtered to determine intestine and caecum length, weights of the heart, liver, spleen, lung, and pancreas. An analysis of variance (ANOVA) for a complete randomised design was conducted using General Linear Models of SAS 9.4 and JAMOVI version 2.6.26 at a significance level of $P< 0.05$. Tukey's W test was used to perform post hoc comparisons for a significant ANOVA. ACF inclusion in the diet did not affect the daily feed, water intake, and the water-to-feed ratio ($P>0.05$) of the broilers during their growth. The addition of ACF significantly reduced the apparent digestibility of the feed, average daily weight gain, and feed conversion efficiency ($P<0.05$) of the broilers at 30 % ACF inclusion. Liver weight decreased with an increase in ACF content, and intestine length increased with an increase in ACF content ($P<0.05$), with no effect on all other organs ($P>0.05$). It was concluded that the inclusion of ACF in broiler grower diets at 10-20% does not significantly affect the zootechnical performance of broiler chickens.

Keywords: Amaranthus cruentus forage, Feed formulations, Monogastric

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Abstract No: 082-OP

Mycotoxins in swine feed and their implications for health and production systems in Southern Africa: A review

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ABSTRACT

Mycotoxins are toxic secondary metabolites produced by fungi, primarily Aspergillus, Fusarium, and Penicillium. The responsible condition to most of fungal growth on feeds was reported to be high moisture and warm temperatures of the stock. The exposure to mycotoxin contamination pose significant health problems to both humans and animals; leading to substantial economic losses. This review was intended to analyze mycotoxin contamination in staple feed crops, compound feeds, and animal-derived matrices with relevance to swine production in Southern Africa. A systematic literature search was conducted to compile data using scientific databases to provide relevant studies. Key terms included various staple crops, mycotoxins, swine, and Southern Africa. From 15 studies found, mycotoxin occurrence of aflatoxins, fumonisins, deoxynivalenol, zearalenone, and ochratoxin A were commonly detected in maize, sorghum, millet, cassava, and groundnuts, with contamination levels often exceeding regulatory limits. Maize based-feeds in intensive swine production showed high aflatoxin and fumonisin concentrations, while extensive systems relying on kitchen leftovers and brewing by-products exhibited variable contamination. Chronic exposure was linked to immunosuppression, hepatotoxicity, nephrotoxicity, and carcinogenicity in both animals and humans. Multi-mycotoxin detection using LC-MS/MS was proved most effective, highlighting the need for routine monitoring. Limited literature on mycotoxin contamination in swine production is an alarming gap. This review emphasizes that mitigation strategies must be tailored to production systems and regional environmental conditions to safeguard animal productivity and public health.

Keywords: Animal, Feed crops, Health impacts, Mycotoxin contamination, Southern Africa, Swine

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Abstract No: 083-OP

Azolla spp and Hermetia illucens meals as main protein sources for rabbit nutrition: Impact on feed quality, growth performance and meat quality

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ABSTRACT

Azolla and BSF larvae are two new, sustainable and environmentally friendly sources of protein that are promoted for use in animal feed. However, when introducing a new ingredient to a feed formula, the quality of the final product must be optimised. This study evaluated the impact of using Azolla and Black Soldier Fly (BSF) larvae meals as the main protein ingredients in formulated rabbit feed on the quality of the feed and the meat produced. Three isocaloric diets were formulated: Az_diet (Azolla meal as the main protein source), BSF_diet (BSF larvae meal as the main protein source), and SM_diet (soybean meal as the main protein source). The growth test was carried out on 36 weaned rabbits aged 5–6 weeks. The rabbits were divided into three treatment groups of 12 and fed one of the three diets (Az_diet, BSF_diet or SM_diet) ad libitum for 42 days. The measured parameters were growth parameters, apparent protein digestibility and the nutritional and health quality of rabbit meat. During the growth test, no mortality or significant differences in feed intake were recorded for the three treatments. The BSF diet treatment resulted in significantly higher weight gain (1012.5 ± 170.13 g). The Az_diet had the highest protein digestibility (80.39 ± 2.08%) and single carcass yield (53.93 ± 1.84%). The dry matter, protein and lipid contents of the hind leg meat of rabbits fed the Az_diet or BSF_diet were similar to those of the control (SM_diet). No Pb or Cd was detected in the hind leg meat of rabbits fed the three diets. In this study, using Azolla and BSF larvae meal as the main source of dietary protein did not negatively affect feed quality, rabbit growth, or rabbit meat quality.

Keywords: Azolla spp, Hermetia illucens, Protein digestibility, Rabbit meat quality

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Abstract No: 084-OP

Antibiotic residues in raw cow milk collected from smallholder dairy producers in Kasama and Mbala, Zambia

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ABSTRACT

Globally, milk production reached 965.7 million tons in 2023, with Africa contributing 53.8 million tons. In Zambia, smallholder dairy farmers supply approximately half of the country's milk, making dairy production a vital source of income, nutrition, and employment. However, widespread and often unregulated antibiotic use in livestock raises public health concerns due to antimicrobial residues in milk, which can contribute to antimicrobial resistance (AMR), allergic reactions, and other health risks. This study assessed antibiotic residues in milk from smallholder dairy farmers in Mbala and Kasama districts of Northern Zambia to evaluate food safety and compliance with established maximum residue limits (MRLs). A cross-sectional design was employed from May to June 2025, with 93 randomly selected lactating cattle. Milk samples were collected aseptically, stored under cold conditions, and analyzed at the Central Veterinary Research Institute using the Cham II competitive receptor assay for five antibiotic classes: Beta-lactams, Tetracyclines, Sulphonamides, Aminoglycosides, and Macrolides. Results revealed that 91.4% of milk samples contained residues above EU MRLs, with Mbala (98.1%) showing a higher prevalence than Kasama (82.1%) (p=0.006). Sulphonamides (68.8%) and Macrolides (58.1%) were the most prevalent, with Sulphonamides significantly differing between districts (p=0.000). These findings indicate frequent and indiscriminate antibiotic use, poor adherence to withdrawal periods, and inadequate regulatory oversight. The study underscores the urgent need for regulatory enforcement, routine surveillance of antimicrobial residues, and farmer education on antimicrobial stewardship to safeguard public health and mitigate AMR risks in Zambia.

Keywords: Antimicrobial residues, Cham II assay, dairy, food safety, maximum residue limits, one health

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Abstract No: 085-OP

Unmasking hidden threats in quinoa's resilience to ozone and drought stress

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ABSTRACT

In southern Africa, agricultural production is increasingly threatened by climate variability, recurrent droughts, and rising concentrations of tropospheric ozone (O3). While quinoa (Chenopodium quinoa Willd.) is promoted as a climate-resilient crop suitable for marginal environments, little is known about its performance under combined O3 and drought stress. Understanding these interactions is crucial for strengthening the resilience of the agri-food system and ensuring food security in regions experiencing both water scarcity and air pollution. This study investigated: (i) the impact of O3 fumigation on quinoa photosynthesis and growth, (ii) the interaction between O3 and drought stress, and (iii) the extent to which elevated CO_2 mitigates adverse effects. Quinoa plants were grown in open-top chambers and subjected to four treatments: ambient air, O3fumigation, drought stress, and combined O3 + drought, each under ambient and elevated CO_2 levels. Physiological responses were assessed using chlorophyll fluorescence (OJIP/JIP-test), gas exchange measurements, and biomass analysis to quantify stress impacts. O3 exposure significantly reduced photosynthetic efficiency (Po, PIABS) and biomass accumulation, with more substantial reductions when drought was imposed concurrently. Elevated CO_2 partially alleviated O3-induced damage by enhancing electron transport and water-use efficiency, though yield potential remained compromised under combined stress. While quinoa showed traits of stress tolerance, its resilience was limited in scenarios of simultaneous O3 pollution and drought. These findings reveal that O3 is an under-recognised constraint to crop resilience in southern Africa. The interactive effects of O3 and drought highlight the need to integrate air quality considerations into agricultural planning and policy. Strengthening monitoring systems, investing in stress physiology research, and promoting climate-smart practices are essential to safeguard food security and unlock the full potential of climate-resilient crops.

Keywords: Crop resilience, Drought stress, Elevated CO_2, Ozone pollution, Photosynthesis, Southern Africa, Quinoa

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Abstract No: 086-OP

Exploring the significance of camels in enhancing food security and adaptability in a changing climate: A review

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ABSTRACT

Camels contribute to resilient food systems by supplying nutrient-dense milk and meat, essential for protein intake in arid regions. There is an urgent need to integrate camels into innovative farming systems to enhance diversification and reduce reliance on climate-sensitive agricultural practices. This review aimed to assess the role of camels in strengthening drought resilience and enhancing food security, while facilitating climate change adaptation in arid environments. This review employed a variety of literature reviews, secondary sources, and personal observations to analyze the contributions of camels to food security and extreme weather adaptation, along with their socio-economic impacts. Results demonstrate that camels are integral to the livelihoods of numerous communities, offering vital resources such as milk, meat, income generation opportunities, and transportation. Camels' resilience and significance underscore their crucial roles in supporting rural communities and food systems in desert environments. Camels are instrumental farm animals in fostering resilient food systems and fulfilling the dietary requirements of inhabitants in arid environments by supplying nutrient-dense milk and meat, which are an essential source of protein. Camels play a significant role in the fight against poverty by creating opportunities for income generation and provision of nutritious food sources. In conclusion, the resilience of camels to withstand extreme weather events exemplifies the importance of climate-smart animal agriculture and sustainable farm animal management practices. The promotion of camel milk and meat should be encouraged as an alternative nutritional source that can strengthen drought and extreme weather adaptations, as well as food security in arid environments.

Keywords: Diversification, Drought resistance, Improved research, Nutritional adequacy, urgent actions

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Abstract No: 087-OP

Antibiotic residues in raw cow milk collected from smallholder dairy producers in Kasama and Mbala, Zambia

Zulu, G.E.[1,6]*, Hang'ombe, B.H.[2], Mainda, G.,[3] Kayesa, E.,[4] Makungu, C.,[3] Chipembo, A.C.,[1,6] Nchima, G.,[5] Pondja, A.,[1,6] Bila, N.M.[1,6] & Moiane, B.[1,6]

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ABSTRACT

The rising misuse of antibiotics in livestock production has intensified global concerns about antimicrobial resistance (AMR) and the presence of antibiotic residues in animal-source foods. In Zambia, where smallholder dairy farmers contribute substantially to national milk production, limited surveillance and weak regulatory systems heighten the risk of residues entering the food chain. This study assessed antibiotic residues in milk collected from smallholder dairy farms in Mbala and Kasama districts to evaluate food safety and compliance with established maximum residue limits (MRLs). A cross-sectional study was conducted from May to June 2025 involving 93 lactating cattle selected through simple random sampling. A total of 100 mL of raw milk was collected from each animal, properly stored, and analyzed at the Central Veterinary Research Institute using the Cham II competitive receptor assay to screen five antibiotic classes: beta-lactams, tetracyclines, sulphonamides, aminoglycosides, and macrolides. Results revealed that 91.4% of all samples contained residues above EU/MRL thresholds for at least one antibiotic class. Mbala recorded a significantly higher prevalence (98.1%) than Kasama (82.1%) (p=0.006). Sulphonamides (68.8%) and macrolides (58.1%) were the most prevalent classes, with sulphonamides showing a significant difference between districts (p=0.000). The high proportion of contaminated samples underscores widespread misuse of antibiotics, non-adherence to withdrawal periods, and weak enforcement of veterinary drug regulations. These findings indicate a serious public health risk and highlight the urgent need for strengthened antimicrobial stewardship, routine residue surveillance, farmer education, and improved regulatory oversight to safeguard food safety and support a One Health response to AMR.

Keywords: Antimicrobial residues, Dairy; Food safety, One Health, Permissible limits, Cham II assay

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Abstract No: 088-OP

Lessons from Guinea fowl farming and hidden antimicrobial risks in the era of climate change

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ABSTRACT

Climate variability threatens productivity in subsistence agri-food systems, disproportionately affecting vulnerable groups, particularly women and youth, who increasingly rely on resilient livestock such as guinea fowls for food security and income. This study assessed the socio-economic role of guinea fowl farming and associated public health risks in four districts of Midlands Province, Zimbabwe, using a mixed-methods approach combining surveys, focus group discussions, and microbiological sampling. Results indicated that 85% of women and 90% of youth actively manage guinea fowl production, with 80% relying on birds for household protein and supplemental income during breeding seasons. Microbiological analysis of E. coli isolates revealed alarming levels of antibiotic resistance, with 100% resistant to Ampicillin, 11.1% to Ciprofloxacin, and 10% showing intermediate resistance to Meropenem; one isolate was flagged as non-susceptible to carbapenems, highlighting a potential zoonotic risk. These findings underscore that while guinea fowl farming enhances climate resilience and livelihood security, it also exposes communities to multidrug-resistant pathogens. Integrating veterinary health services, antimicrobial stewardship, biosecurity education, and routine surveillance into climate adaptation and agricultural programs is essential to safeguard public health and ensure the long-term sustainability of inclusive, resilient agri-food systems.

Keywords: Agri-food systems, Antibiotic resistance, Carbapenems, Inclusive agriculture, Mapping

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Abstract No: 089-OP

Assessment of antimicrobial resistance of Escherichia Coli, Salmonella spp., and Enterobacter spp. from chicken meat in Mzimba for public food safety

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ABSTRACT

The global rise of antimicrobial resistance (AMR), largely driven by inappropriate antimicrobial use (AMU) in poultry production, presents a growing public health and food safety concern. In Malawi, where the poultry sector is rapidly expanding, limited evidence exists on AMU practices, farmer awareness, and resistance profiles in poultry products. This study assessed AMU patterns, knowledge, attitudes, and practices (KAP) related to AMR among poultry farmers, and characterized AMR profiles of Escherichia coli, Enterobacter spp., and Salmonella isolated from chicken meat in Mzimba District. A cross-sectional study conducted from February to May 2025 included structured interviews with 89 poultry farmers and veterinary drug vendors, alongside laboratory analysis of 100 meat samples. Results showed that 69% of samples contained E. coli, 12% Enterobacter, and 2% Salmonella, with 27% having multiple bacterial species. E. coli exhibited high resistance to ampicillin (91.3%), meropenem (82.6%), and tetracycline (71%), while Enterobacter spp. showed comparable resistance patterns, and multidrug resistance was widespread in both genera (75%). Antibiotic use was common among farmers (92%), primarily for treatment (97%), prevention (73%), and growth promotion (34.8%), yet only 46.1% demonstrated good AMR knowledge, and most relied on agro-dealers for drug advice. Weak regulatory oversight, informal supply chains, and poor storage practices further contributed to inappropriate antibiotic use. The high prevalence of multidrug-resistant bacteria in chicken meat underscores the urgent need for strengthened veterinary supervision, AMR stewardship training, improved regulatory enforcement, and promotion of responsible antibiotic use within Malawi's poultry sector.

Keywords: Antimicrobial resistance, Antimicrobial use, Bacterial isolates, Chicken meat, Escherichia coli, Mzimba

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Anthracnose resistance in farmer preferred common bean market classes in Uganda

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ABSTRACT

Common bean (*Phaseolus vulgaris* L.) is a globally important legume crop, valued for its nutritional benefits and contribution to sustainable agriculture, particularly in Sub-Saharan Africa. In Uganda, it is a major source of dietary protein, with more than 80% of farmers engaged in its cultivation. However, production is constrained by factors such as nutrient deficiencies, erratic rainfall, socio-economic limitations, pests, and diseases. Among the major diseases, anthracnose caused by Colletotrichum lindemuthianum is particularly destructive, with yield losses reaching up to 100% especially when susceptible varieties are grown. There are limited cultural management strategies available for the control of anthracnose in farmer-preferred market class genotypes, and the use of host resistance in these genotypes remains undocumented. This study aimed to identify resistant genotypes for major Ugandan bean market classes and determine the inheritance of resistance to C. Lindemuthianum. Eighty-eight genotypes, including differential cultivars, released varieties, and breeding lines, were screened under controlled conditions against three races (863, 3663, and 4041) of the pathogen using a split-plot design with four replications in the screen house at Kawanda. Disease severity scores were recorded, and resistance levels were determined. Differential cultivars such as KABOON (Co-12), MICHELITE (Co-11), TO (Co-5), and WIDUSA (Co-15, Co-33) showed strong resistance to all the tested races. Among the released varieties, NABE 9C and NAROBEAN 6 were consistently resistant. Additionally, several breeding lines, including ACC 31, KARP 63, G5686, OPRR 27, LINGOT BLANC, NOKIA, PAN 72, several NUV lines, and ARD00068CIC exhibited broad-spectrum resistance. To study inheritance, crosses involving KARP 84 and KARP 22 with Widusa, Kaboon, Montcalm, BAT 332, and ARD00068CIC were made using the North Carolina II design. Segregation in F2 populations evaluated against race 3663 revealed predominance of additive genetic effects over non-additive ones. Negative GCA effects in WIDUSA, KARP 84, and ARD00068CIC indicated their effectiveness as resistant parents. Promising crosses included KARP 84 x MONTCALM, KARP 22 x ARD00068CIC, KARP 22 x BAT 332, KARP 22 x KABOON, and WIDUSA x KARP 22. Chi-square tests suggested the involvement of three dominant genes, with broad and narrow-sense heritabilities of 0.53 and 0.39, and a Baker's ratio of 0.74. The study highlights host resistance as the most sustainable strategy for anthracnose control. Identified resistant genotypes and promising crosses should be integrated into breeding programs and evaluated under field conditions using molecular tools to enhance durable resistance in common beans. These findings provide valuable genetic resources for breeding programs aimed at developing anthracnose-resistant varieties, thus supporting sustainable bean production and improved food security in Uganda.

Keywords: Additive effects, Anthracnose, Breeding lines, Colletotrichum lindemuthianum, Common bean

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Abstract No: 091-OP

Impact of fermentation and extrusion on textural properties and water activity of pigeon pea (Cajanus cajan L.) Products

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ABSTRACT

Pigeon pea (Cajanus cajan L.) is a drought-tolerant legume with high nutritional value, rich in protein, vitamins, fiber, and minerals, yet it remains underutilized due to prolonged cooking times, anti-nutritional factors, and limited value-added processing. With growing demand for plant-based proteins, innovative processing methods such as fermentation and extrusion offer opportunities to enhance pigeon pea's functional properties. This study investigated the combined effects of fermentation and extrusion on the physicochemical and textural properties of pigeon pea chunks, incorporating button mushroom and cassava starch at varying ratios (90:7.5:2.5, 90:5:5, 90:2.5:7.5). Fermentation was conducted using wild lactic acid bacteria, while extrusion trials were performed using a single-screw extruder at moisture contents of 11%, 13%, and 15%, and barrel temperatures ranging from 100 C to 170 C. Results indicated that 13–15% moisture content and barrel temperatures of 100 C, 130 C, and 140 C in respective zones produced high-quality extrudates. Fermentation significantly increased hardness (up to 22,802 g) and crispness (up to 31,906 g/s) compared to unfermented samples, likely due to microbial production of exopolysaccharides and enzymatic modification of protein structures, enhancing matrix strength and texture uniformity. Water activity was also significantly reduced in certain fermented samples, contributing to improved microbial stability and extended shelf life. The study demonstrates that fermentation, particularly when integrated with extrusion, markedly improves pigeon pea's textural characteristics, water-binding properties, and consistency, highlighting its potential for development of shelf-stable, value-added legume products. Further research into microstructural changes, rheological properties, and microbial metabolic profiles is recommended to optimize processing protocols for enhanced functionality.

Keywords: Crispness, Extrusion, Fermentation, Hardness, Pigeon peas, Water activity

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Abstract No: 092-OP

Antibiotic residues in raw cow milk collected from smallholder dairy producers in Kasama and Mbala, Zambia

Zulu, G.E.[1,6]*, Hang'ombe, B.M.[2], Mainda, G.[3], Kayesa, E.[4], Makungu, C.[3], Chipembo, A.C.[1,6], Nchima, G.[5], Pondja, A.[1,6], Bila, N.M.[1,6] & Moiane, B.[1,6]

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ABSTRACT

In 2023, global milk production reached 965.7 million tons, with Africa contributing 53.8 million tons. In Zambia, smallholder farmers supply about half of the national milk output, underscoring the dairy sector's essential role in economic growth, food security, and nutrition. However, the increasing use of antibiotics in livestock — for growth promotion, disease prevention, and treatment — has led to growing concerns over antimicrobial resistance (AMR). Of the 12 million kilograms of antibiotics used globally each year, around 25% are used outside disease treatment, contributing to residues in animal products. Improper use of antibiotics in dairy production, especially failure to observe withdrawal periods, results in residues exceeding maximum limits. These residues pose significant health risks, including cancer, allergic reactions, and disruption of gut microbiota. AMR was responsible for an estimated 1.27 million deaths in 2019, with 4.95 million associated globally. In Zambia, AMR led to about 3,700 attributable and 15,600 associated deaths. Despite a 2017 "One Health" strategy informed by the World Health Organization's Global Action Plan (GAP), Zambia still faces regulatory, surveillance, and information gaps. This study uses the Cham II test to detect antibiotic residues in milk, offering crucial evidence for enhancing AMR response strategies, food safety, and policy development.

Key words: Food safety, Surveillance, Cham II test, Public health, Milk quality

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Industrial Hemp as Sustainable Crop and a Carbon Sequestrater in the Changing Climate: A Review

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ABSTRACT

Global warming is increasing and it's becoming a world concern. Policy makers are trying to find solutions and to put measures that can reduce the causes of global warming. Agricultural inputs are one of the causes of global warming. The growing of crops that require use of synthetic fertilizers and chemicals is contributing much to global warming. Nitrogen fertilizer has a notable impact on enhancing crop yields; however, it also influences the emission of greenhouse gases like CH4, CO2, and N2O. These three gases play a significant role in global warming and its effects on the climate. Fiber hemp is densely sown, and therefore it is generally regarded as a pesticide-free crop because it has the ability to successfully suppress weed growth. Moreover, its properties as a carbon sequestrator and soil improver make it suitable for sustainable agriculture and climate change mitigation strategies Also, due to its rapid growth and production; it is one of the most effective CO_2 biomass converters. Hemp has been proven to be an excellent carbon trap, absorbing more CO_2 per hectare than most agricultural commodity crops. Each hemp hectare has the capacity for absorption of up to 22 tons of CO_2 per hectare. Crops having a lot of biomass, such as hemp, can sequester more carbon through photosynthesis and then deposit this in the body and roots of the plant via bio-sequestration. In this study, we provide a discussion of the current state of knowledge regarding the production of industrial hemp without needing fertilizers and chemicals and its carbon sequestration properties so as to guide further researches. With relatively low fertilizer and chemical requirements compared to other crops, hemp shows great potential as a pesticide and fertilizer free crop, and a highly carbon sequestrator offering exciting possibilities to produce high yields in a changing climate.

Keywords: Carbon sequestration, Climate change, Fertilizer-free, Greenhouse gases, Hemp, Sustainable agriculture

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The carbon footprint of the tea agrifood system in the context of SDG 13 (Climate action)

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ABSTRACT

This study contributes to the growing interest and the need to enhance overtime transformational changes in the agrifood systems through understanding the environmental impacts of the tea agrifood system operations and identifying greenhouse gas emissions channels for improving and designing sustainable solutions to achieve SDG 13 (Climate action). It explores the main sources of greenhouse gas emissions (GHG) and methods used to measure carbon footprint and global warming potential. The study identifies different adaptation and mitigation strategies that reduce emissions from the tea agrifood system. Focusing on carbon footprint as the main factor in environmental sustainability and agrifood system resilience, 60 articles were systematically analyzed using MAXQDA software. The study found that the life cycle assessment of tea agrifood was highly conducted using SimaPro, openlca, and CCaLC2 frameworks under ISO14040:2006, ISO14044, and PAS 2050:2011 impacts evaluation standards. Moreover, electricity and energy were revealed as the leading sources of carbon emissions (CO_2), followed by the overuse of chemical fertilizers, which emit other greenhouse gases (CH_4 and N_2O) at the cultivation stage, and the use of coal and firewood in the processing and packaging stages. Likewise, the highest environmental footprint was due to consumption activities (47%), processing (27%), cultivation (17%), and packaging (9%). The study highlighted that various adaptation and mitigation strategies, including improving energy use efficiency, use of organic fertilizers, and waste composting from tea processing, can reduce carbon footprints, improve environmental sustainability, and enhance resilient, greener agrifood systems.

Keywords: Carbon footprints, Climate actions, Environmental sustainability, Life cycle assessment, Tea

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Variability of soil organic carbon stocks across land cover types in Ilakala village, Tanzania

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ABSTRACT

Soil Organic Carbon (SOC) stocks are a critical component of the global carbon cycle, influencing soil health and climate change mitigation. Understanding soil organic carbon stocks could be a pathway for improving management to increase yields in smallholder systems. The aim of this study was to assess the spatial variability of SOC stocks in various land cover types in Ilakala village. Soil physicochemical data (organic carbon, pH, sand, silt, clay) was collected from 100 sampling points at a depth of 0-30 cm following spatial stratified random sampling scheme. SOC stocks were estimated as a product of OC and bulk density measurements using a standard equation. Land cover types (LC) for the study area were established from a legacy FAO land cover map for Tanzania using the clipping geoprocessing function in QGIS software. Inverse distance weighting was also performed to develop SOC stocks maps with subsequent determination of SOC stocks zonal statistics for each LC in QGIS software. Four LCs were established with the largest areal coverage for Closed broadleaved decidous forest (71%), the least was Closed to open broadleaved evergreen or semidecidous forest (5%), while the Open needle leaved decidous or evergreen forest LC and Rainfed cropland LC had a similar areal coverage (12%). Estimated SOC stocks ranged from 103.2 Mg/ha to 1087.5 Mg/ha. Mean SOC stocks for LCs were of the order Open needle leaved decidous or evergreen forest > Closed to open broadleaved evergreen or semidecidous forest > Closed broadleaved decidous forest > Rainfed cropland, respectively, with values of 4056 Mg/Ha, 4006 Mg/Ha, 3166 Mg/Ha, and 2911 Mg/Ha. Levels of SOC stocks were generally in high range across all land cover types, however, sustainable agricultural practices will be essential to maintain productivity of Rainfed Croplands.

Keywords: SOC stocks, Spatial variability, Land Cover, Tanzania

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Genetic analysis of yield and yield traits in adapted finger millet germplasm

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ABSTRACT

Understanding the genetic architecture of finger millet is essential for developing high-yielding and resilient cultivars. This study aimed to: (i) assess the nature and magnitude of gene action governing yield and yield-related traits in adapted finger millet germplasm, (ii) estimate general combining ability (GCA) and specific combining ability (SCA) of lines, testers, and their interactions, and (iii) quantify heterosis in crosses of lines and testers. A Line Tester mating design was implemented in season one to generate F1 hybrids. In season two, the hybrids were evaluated in a Randomized Block Design for combining ability and heterosis. Analysis of the genetic architecture revealed that key yield traits, including finger length, grain yield per plant, and thousand-grain weight, were predominantly governed by additive gene action, as indicated by Baker's ratios close to unity (0.83, 0.84, and 0.67, respectively). Nonetheless, significant heterotic effects driven by overdominance were also observed, underscoring the role of non-additive gene action. Line 504 emerged as an outstanding general combiner, exhibiting highly significant GCA effects for productive tiller number, threshing percentage, and grain yield per plant, making it a prime candidate for pureline selection and population improvement. These findings highlight the dual importance of additive and non-additive gene effects in finger millet improvement and indicate substantial potential for initiating a hybrid breeding program. Leveraging the evaluated germplasm can facilitate higher genetic gains, improve crop productivity, and support sustainable finger millet cultivation.

Keywords: Combining ability, Finger millet, Gene action, Heterosis, Lines, testers

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Abstract No: 097-OP

Significance of pre-anthesis drought and heat stress on seed quality in diverse sorghum genotypes

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ABSTRACT

Seed quality is highly affected by heat stress and drought. Heat stress affects the reproductive stages (floret sterility and gametogenesis) more when compared to vegetative stages, as high temperature has got an effect on gametogenesis (microsporogenesis, megasporogenesis, pollen germination) and fertilization. This study was aimed to investigating seed physiological quality attributes of diverse sorghum genotypes. The study was carried out in two phases, with the first phase being planting of the 35 sorghum genotypes in pots at Lupane State University experimental plots under pre-flowering drought, heat stress and unstressed conditions, laid in a split plot following a Randomized Complete Block Design (RCBD) with three blocks. The second phase were the laboratory tests for seed viability and vigor of seeds grown under stressed and unstressed conditions using the Cold Test, Heat Shock Stress Test, Standard Germination Test, Seedling Vigor Test (coleoptile and radicle length), and Imbibition Capacity. A two-factorial laboratory experiment was laid in a completely randomized design (CRD) with three replicates. With the factors being seed of the 35 sorghum genotypes attained from crops grown under pre-flowering drought and heat stress and unstressed conditions. Significant differences were observed among genotypes for all seed quality parameters, indicating diverse physiological responses to stress. Genotypes IS 9405, IS 9548, IS 30047, IS 13813, IS 24272 and NPGRC 3127, had the best seed quality in terms of the seed quality tests done. The variation among genotypes underscores the influence of genetic background on maintaining seed quality and vigor under adverse environments. Genotypes with higher seed quality possess enhanced tolerance to stress-induced damage during reproductive development. Overall, the study demonstrates substantial genetic variability in sorghum seed quality under heat and drought stress, and the identified superior genotypes provide valuable genetic resources for breeding programs aimed at improving sorghum resilience and seed quality.

Keywords: Cold test, Heat shock stress test, Imbibition capacity and seedling vigour, Seed quality, Sorghum bicolour, Standard germination test

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AI-driven metabolomic profiling of cannabis beyond cannabinoids for predictive chemovar modelling and precision planting

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ABSTRACT

Artificial intelligence (AI) and digital technologies are revolutionizing agricultural practices by facilitating predictive modeling, precision planting, and resource optimization. This transformation is particularly impactful in Africa, where AI tools enhance crop monitoring, soil health assessments, and yield forecasting, supporting sustainable agriculture and food system resilience. This study assessed the integration of metabolomics and AI for predictive chemotyping and precision crop selection, using cannabis (Cannabis sativa L.) as a case study. Despite over 700 recognized cannabis varieties, chemical classification has primarily centered on cannabinoid content, neglecting a wide array of non-cannabinoid metabolites that may possess bioactivity. This oversight limits accurate chemovar classification and restricts precision planting strategies. Specifically the study aimed to (i) map the chemical space of cannabis cultivars, (ii) classify chemovars based on the chemical diversity of various plant tissues, and (iii) evaluate how these chemical profiles inform precision planting for targeted medicinal applications. Two cultivars, Amnesia Haze and Royal Dutch Cheese, were analyzed using high-resolution LC-MS/MS, generating spectral datasets processed through advanced metabolomics workflows. Results revealed a diverse metabolite profile, including flavonoids and phenylpropanoids, with distinct tissue-specific patterns that facilitated chemovar differentiation. AI models effectively classified cultivars based on metabolic fingerprints, highlighting significant anti-cancer potential linked to non-cannabinoid metabolites. This research illustrates how integrating digitalized LC-MS/MS data with AI and machine learning can enhance cultivar selection strategies, promoting precision planting aligned with desired bioactivities. The findings underscore the potential of omics sciences and AI in advancing sustainable agriculture, particularly in Africa, by fostering inclusive bioeconomies and supporting the UN Sustainable Development Goals (SDGs) related to health, innovation, and responsible production.

Keywords: Cannabis, Chemovar classification, LC-MS/MS, machine learning, metabolomics, predictive modelling, precision planting, sustainable agriculture

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Abstract No: 099-OP

Gendered impacts of artificial intelligence–powered advisory services on farm productivity and household welfare in Nigeria

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ABSTRACT

Artificial intelligence (AI)–powered agricultural advisory systems are revolutionizing extension services by providing real-time, data-driven recommendations on crop management, input utilization, and market decisions. Nevertheless, gender disparities in digital access and technological adoption may influence the distribution of these benefits within farming households. This study evaluated gender-specific impacts of AI-enabled advisory platforms on agricultural productivity and household welfare in Southwest Nigeria, utilizing primary data from 588 farming households. Employing a quasi-experimental design that combines propensity score matching (PSM) with instrumental-variable regression, the research addressed biases associated with non-random participation. Productivity was quantified through yield and output value per hectare, while welfare was assessed via food security indicators, household expenditures, and asset accumulation. The findings indicate that AI advisory services substantially enhanced overall productivity and welfare; however, impacts differed by gender. Households headed by males reported higher yield gains attributable to superior access to mobile devices, credit facilities, and extension networks. Conversely, female-headed households experienced greater welfare improvements, including increased food security and more stable household expenditures. Constraints such as limited digital literacy, restricted access to technology, and unequal control over productive resources hinder women's full capacity to benefit from AI systems. Nonetheless, social networks partially mitigated these disparities by facilitating shared learning and information exchange. The study concludes that AI-enabled services have the potential to strengthen rural livelihoods but may also intensify digital inequalities in the absence of deliberate inclusion strategies. Policy initiatives should emphasize gender-responsive digital literacy programs, targeted subsidies, and equitable access to complementary inputs. Enhancing women's access to credit, land, and mobile technologies will be vital for realizing the full transformative potential of AI in agriculture.

Keywords: Artificial intelligence, Digital advisory platforms, Gender, Household welfare, Productivity

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AgriLens AI: A smartphone-based tool for real-time diagnosis and severity scoring of powdery mildew in cucurbits

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ABSTRACT

This study intended to i) create a comprehensive, annotated image dataset of healthy and powdery mildew-infected cucurbit leaves under Zimbabwean field conditions; ii) train and optimize a Convolutional Neural Network (CNN) for semantic segmentation to accurately identify and delineate disease lesions from leaf images; and iii) develop an algorithm to automatically calculate a disease severity score as a percentage of the affected leaf area. An extensive image dataset was collected from cucumber and squash fields in Zimbabwe using standard smartphones. The dataset includes over 1,500 high-resolution images capturing a full spectrum of conditions: healthy leaves, various stages of powdery mildew infection (incipient, moderate, severe), and common visual confounders such as nutrient deficiencies and pest damage. Each image containing disease symptoms was carefully annotated by creating pixel-level masks that precisely outlined the infected areas. A U-Net architecture, a type of CNN ideal for biomedical image segmentation, was trained on this dataset using the Google Colab platform. The model's performance was rigorously evaluated on a held-out test set using metrics such as the Dice Coefficient and Intersection over Union (IoU) to measure the accuracy of lesion segmentation. The disease severity score was then calculated from the model's output mask. The preliminary results are highly promising, demonstrating the viability of smartphone-based disease diagnosis. The trained U-Net model can accurately segment powdery mildew lesions from complex background images, achieving a Dice Coefficient of over 0.92, indicating a very high overlap between the AI's prediction and the ground-truth annotations. The system successfully distinguishes mildew symptoms from healthy leaf tissue and other forms of leaf damage. Crucially, the model's output is used to automatically generate a quantitative severity score (e.g., "17% leaf area infected"), transforming a subjective visual assessment into an objective, actionable data point. AgriLens AI demonstrates that advanced AI tools can be deployed on accessible hardware to create powerful decision support systems for small-holder farmers. By providing instant, in-field diagnosis and objective severity scoring, this tool empowers farmers to move from a reactive to a precise, data-driven disease management strategy.

Keywords: Artificial Intelligence (AI), Disease Severity, Image Segmentation, Powdery Mildew, Precision Agriculture, Smartphone Diagnostics

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AI solutions enhancing indigenous knowledge systems for weather forecasting and climate adaptation in Africa

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ABSTRACT

Indigenous Knowledge Systems (IKS) have historically supported climate forecasting, environmental stewardship, and agricultural decision-making among African communities. Traditional indicators—such as animal behavior, cloud formations, and plant phenology—have traditionally informed decisions regarding cropping schedules, water harvesting, and disaster preparedness. However, the oral transmission of IKS, in the absence of systematic documentation, jeopardizes its continuity, accuracy, and intergenerational transfer. This study identified an Artificial Intelligence (AI)-enabled approach to digitize, integrate, and operationalize IKS to enhance climate change mitigation and adaptation strategies. A comprehensive review of the existing literature was conducted to identify climate-related IKS indicators across various African nations and to evaluate their relevance in current climatic contexts. Building upon these insights, an AI architecture capable of processing images, videos, and textual data to recognize traditional indicators, interpret their significance, compare them with scientific forecasts, and disseminate localized advisories to farmers—including those with limited access to expert support is presented. Preliminary results suggest substantial untapped IKS resources that can be integrated into a dual-mode (online/offline) AI platform to support climate-informed decision-making. Such a system aims to bridge the gap between traditional ecological knowledge and modern climate science tools, thereby strengthening community resilience and facilitating local adaptation strategies. By institutionalizing IKS within AI-driven systems, this research contributes to culturally grounded, inclusive, and sustainable climate solutions for rural African populations.

Keywords: Adaptation, Artificial Intelligence, climate forecasting, Indigenous Knowledge Systems

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Abstract No: 102-OP

Blending traditional ecological knowledge with AI-driven data for context-specific agricultural insights

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ABSTRACT

Sustainable poultry production faces dual challenges of optimising feed-water utilisation and controlling gastrointestinal parasitism without overreliance on synthetic chemotherapeutics. Indigenous phytogenic resources, such as Neorautanenia brachypus, traditionally valued for medicinal properties, hold potential for integration into modern poultry systems. Coupling this ecological knowledge with AI-supported data analysis enables context specific insights into animal health and productivity, contributing to smart and resilient agriculture. A total of 400 Cobb 500 day-old broiler chicks were assigned to five dietary treatments under a Randomized Complete Block Design (RCBD): (E0) basal diet (control), (E1) basal diet + 2 g/kg N. brachypus powder in feed, (E2) basal diet + vitamin–mineral premix, (E3) basal diet + vitamin–mineral premix + 2 g/L N. brachypus in drinking water, and (E4) basal diet + vitamin–mineral premix + 2 g/kg N. brachypus in feed. Each treatment had four replicates (n = 20). Voluntary feed intake (VFI) and voluntary water intake (VWI) were measured daily, with weekly growth performance recorded. On Day 35, fecal samples (n = 12 per Treatment and n=3 per replicate) were pooled and analyzed using the modified McMaster technique to quantify Davainea proglottina eggs per gram (epg) and Eimeria maxima oocysts per gram (opg). Statistical analyses were performed in SAS 9.4 and supplemented with AI assisted pattern recognition to model interactions among intake, growth, and parasitic load. Significant treatment effects were observed ($p < 0.05$). VWI was highest in E3 (1791.66 ± 84.95 mL; $p < 0.0001$), while E2 recorded the lowest (1484.1 ± 84.94 mL). Feed intake peaked in E1 (945.1 ± 43.78 g; $p < 0.0001$) but was lowest in E3 (800.2 ± 43.78 g), indicating enhanced feed utilization efficiency. Growth performance followed the order E3 > E4 > E1 > E2 > E0, with E3 achieving the highest body weight (2589.0 ± 43.78 g at week 5; $p < 0.0001$). Parasitological assessment revealed significant reductions in D. proglottina and E. maxima burdens across all supplemented groups, with the strongest suppression in E1, E3, and E4 ($p < 0.0001$). Administration route did not alter antiparasitic efficacy. N. brachypus supplementation improved hydration, feed conversion, growth, and resistance to gastrointestinal parasites in broiler chickens. Supplementation through drinking water combined with vitamin–mineral premix (E3) was particularly effective. This study demonstrated how indigenous phytogenic knowledge, when integrated with rigorous experimentation and AI-driven analytics, can inform sustainable poultry production. The findings highlight N. brachypus as a functional phytogenic alternative to synthetic chemotherapeutics and indicated positive effects on the potential of blending traditional ecological knowledge with emerging technologies for smart and sustainable agriculture.

Keywords: AI-assisted agriculture, Broiler chickens, Chemotherapeutics, Gastrointestinal parasitism, Neorautanenia brachypus, Sustainable poultry production

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Abstract No: 103-OP

Using low-cost drone and artificial intelligence to assess forage biomass and quality in the Senegalese rangeland ecosystem

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ABSTRACT

Accurate assessment of forage biomass and nutritive value is essential for effective rangeland management in the Sahel region. However, traditional field-based sampling methods are labor-intensive, limited in spatial coverage, and financially costly. This research evaluated the potential of affordable drone imagery combined with artificial intelligence (AI) to estimate biomass and forage quality attributes across rangelands in Senegal. RGB imagery obtained from drones was processed to derive vegetation indices, which were then utilized as explanatory variables in Random Forest models calibrated against field-measured biomass and quality parameters. Validation results indicated strong predictive capability, with relative RMSEs of 31% for fresh mass and 37% for dry mass. Additionally, parameters such as crude protein, neutral detergent fiber, acid detergent fiber, and organic matter digestibility were predicted with RRMSE values of 32%, 9%, 8%, and 17%, respectively. Principal Component Analysis revealed that the first two components accounted for 53.3% of the total variance, demonstrating robust multivariate relationships between drone-derived vegetation indices and plant attributes. These findings suggest that low-cost drones, when integrated with machine-learning techniques, can produce reliable spatial estimates of forage biomass and quality, thereby offering a practical alternative to invasive sampling methods. This methodology presents significant advantages for pastoral resource monitoring, enabling rapid, scalable, and cost-effective assessments across heterogeneous landscapes. The integration of drone-AI systems into rangeland monitoring programs could significantly enhance decision-making related to grazing management, early warning systems, and climate-resilient pastoral practices in West Africa.

Keywords: Drone imagery, Forage quality, Machine learning, Photogrammetry, Rangeland monitoring

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Integrating indigenous knowledge with emerging technologies: AI-driven metabolomics of selected South African medicinal plants

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ABSTRACT

Medicinal plants serve as a vital intersection of biodiversity, Indigenous Knowledge Systems (IKS), and modern science, providing a rich source of natural products with significant therapeutic potential. In Africa, communities have utilized medicinal plants for centuries to treat various ailments, including malaria and cancer. In South Africa, Melianthus comosus and Hypoxis hemerocallidea are noted for their anti-venom, wound-healing, and anti-inflammatory properties. However, the phytochemical diversity and biochemical pathways of these plants remain poorly characterized, hindering systematic validation and integration into sustainable healthcare and agriculture. Recent advancements in Artificial Intelligence (AI) and computational metabolomics present opportunities to decode complex plant metabolomes. This study aimed to characterize the metabolomes of M. comosus and H. hemerocallidea using AI-enabled computational metabolomics with three objectives: (i) to generate comprehensive metabolomic profiles of leaves and roots, (ii) to integrate IKS with metabolomic evidence to elucidate plant uses in traditional medicine, and (iii) to explore sustainable cultivation and breeding strategies informed by this integration. Using methanol extracts analyzed via liquid chromatography-tandem mass spectrometry (LC-MS/MS), the study employed computational workflows for structural annotation and interspecies comparison. Results revealed a diverse chemical landscape, with M. comosus showing higher flavonoid abundance consistent with its anti-inflammatory applications, while H. hemerocallidea was rich in lipid-like compounds linked to wound healing. Integration with IKS validated traditional uses and identified bioactive compounds. This research demonstrates the transformative potential of combining AI-enabled metabolomics with IKS, highlighting its application in optimizing bioactive compound production, supporting predictive chemotyping, and promoting sustainable agricultural practices. By bridging traditional knowledge with modern science, this approach empowers local communities and fosters inclusive innovation in medicinal plant research and therapeutic development. It underscores the importance of integrating heritage knowledge with advanced technologies to drive sustainable and context-specific solutions in agriculture and healthcare.

Keywords: Artificial intelligence, Anti-venom, Anti-inflammatory, Computational metabolomics, Hypoxis hemerocallidea, Medicinal plants, Melianthus comosus, Natural products

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Thematic Area:
Application of Artificial Intelligence and Emerging Technologies for Smart and Sustainable Agriculture

Abstract No: 105-OP

Harnessing artificial Intelligence for Global Pest Surveillance: Applications, challenges and future directions

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ABSTRACT

Pest surveillance is a cornerstone of agricultural production, enabling farmers, researchers, and policymakers to detect, monitor, and manage pest populations before they reach economically damaging thresholds. Traditional surveillance approaches such as manual scouting, pheromone traps, and farmer reports have provided valuable information but are constrained by labor intensity, subjectivity, and delays in data processing. With the growing threat of invasive species, climate change-driven pest expansions, and rising pesticide resistance, there is an urgent need for scalable, accurate, and real-time surveillance systems. Artificial Intelligence (AI) has emerged as a transformative tool for revolutionizing pest surveillance, offering unprecedented opportunities for precision agriculture and integrated pest management (IPM). This paper reviews global advancements in AI-driven pest surveillance systems, highlighting the use of machine learning algorithms, computer vision, remote sensing, drones, and IoT-based smart traps. Applications in both developed and developing countries are discussed, alongside challenges such as data availability, model accuracy, and integration with existing pest management systems. How AI-based models improve early detection, enable predictive analytics, and support decision-making platforms for farmers. Case studies from Africa, Asia, Europe, and the Americas demonstrate AI's role in controlling pests such as fall armyworm (Spodoptera frugiperda), desert locusts (Schistocerca gregaria), rice plant hoppers, aphids, and fruit flies. Benefits include reduced pesticide misuse, enhanced food security, and improved farmer livelihoods. However, challenges remain in terms of data quality, infrastructure costs, algorithmic bias, farmer digital literacy, and ethical considerations related to data ownership. Future directions point toward combining AI with genomics, robotics, edge computing, and climate-smart agriculture for more resilient food systems. AI-powered pest surveillance is not a replacement for traditional methods but an enabler of smarter, faster, and more sustainable pest management strategies aligned with the Sustainable Development Goals (SDGs).

Keywords: Artificial Intelligence; Machine Learning; Internet of Things; Drones; Precision Agriculture; Integrated Pest Management; Climate-Smart Agriculture

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Abstract No: 106-OP

From oral traditions to algorithms: Translating indigenous climate knowledge into AI-enhanced agricultural decision support tools

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ABSTRACT

This research addresses the critical need to integrate Indigenous Knowledge (IK) into climate adaptation strategies for agriculture, which is often excluded from mainstream scientific models despite its deep temporal and place-based wisdom. The background recognises that Indigenous oral traditions hold invaluable insights into ecological patterns, seasonal cycles, and resilient practices that are increasingly relevant in the face of climate change. The primary objective was to develop a novel framework for ethically translating and codifying these oral knowledge systems into a format compatible with artificial intelligence (AI) and machine learning (ML) algorithms. The methodology employed a community-based participatory approach, working directly with local knowledge holders in Zimbabwe, Mozambique and South Africa to document, contextualise, and digitise qualitative narratives and observations on AI-IK hybrid system. This translated data can then be used to train and enhance an agricultural decision support tool (DST), where AI models integrating IK with quantitative meteorological and satellite data generate hyper-localised planting and harvesting recommendations. Key results indicate that the hybrid IK-AI model significantly improves the accuracy of seasonal forecasting and crop resilience advice compared to systems relying on scientific data alone. The study concludes that this synthesis creates more robust, culturally relevant, and equitable decision-support systems. The implications are profound, offering a pathway to bridge the gap between traditional and scientific knowledge, empower Indigenous communities, and foster climate-resilient agriculture through ethically aligned technology.

Keywords: Agricultural decision support, Artificial Intelligence, climate resilience, community-based participatory research, indigenous knowledge, knowledge translation

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Abstract No: 107-OP

Optimizing agricultural education outcomes through AI-driven innovative differentiated assessment frameworks: Exploring pedagogical inclusivity and learner diversity in rural African classrooms

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ABSTRACT

Rural African agricultural education systems will continue to face challenges related to learner diversity, resource limitations, and the need for innovative pedagogical approaches. Traditional uniform assessment methods are expected to inadequately address the varied learning needs of students, thereby limiting educational inclusivity and effectiveness. AI-driven differentiated assessment frameworks are anticipated to offer novel solutions by enabling personalized, adaptive learning experiences. This study will investigate how AI-driven innovative differentiated assessment frameworks can optimize agricultural education outcomes by promoting pedagogical inclusivity and addressing learner diversity in rural African classrooms. A mixed-methods research design will be employed, involving a purposive sample of approximately 250 students and 15 agricultural educators from rural schools across three districts in sub-Saharan Africa. AI-enabled assessment tools, including adaptive learning platforms and real-time analytics, will be implemented over 2 months period. Data will be collected through classroom observations, semi-structured interviews, and quantitative analysis of student performance metrics to evaluate the effectiveness and feasibility of these frameworks. It is anticipated that the AI-enhanced differentiated assessment frameworks will improve educators' capacity to identify individual learning needs and tailor instruction accordingly. Students are expected to demonstrate increased engagement, improved mastery of agricultural skills, and enhanced critical thinking. The study will also identify potential barriers such as digital literacy and infrastructure challenges, while proposing strategies to mitigate these issues. The integration of AI-driven differentiated assessment frameworks is expected to transform agricultural education in rural African settings by fostering inclusivity and innovation. Recommendations will be made for policy support, capacity building, and infrastructural investments necessary to scale these approaches, ultimately contributing to the development of a skilled and resilient agricultural workforce.

Keywords: Agricultural education, adaptive learning, Artificial Intelligence, differentiated assessment, learner diversity, pedagogical inclusivity

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Abstract No: 108-OP

Artificial Intelligence and Machine Learning in logistics and supply chain management in Africa: Opportunities, challenges, and future directions

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ABSTRACT

Artificial Intelligence (AI) and Machine Learning (ML) are increasingly transforming logistics and supply chain management (SCM) globally, yet their adoption and contextual performance in Africa remain underexplored. This study investigated the current state, opportunities, and challenges of integrating AI and ML into African logistics systems using a mixed-methods approach that combines qualitative insights from expert interviews, focus group discussions, and case studies with quantitative data from surveys across logistics firms in South Africa, Kenya, Nigeria, Egypt, and Ghana. Results show that approximately 60% of surveyed firms employ some form of AI or ML, with predictive analytics (45%), inventory forecasting (50%), and route optimization (35%) emerging as the most widely adopted applications. Firms perceive AI and ML as offering substantial benefits, including cost reduction (reported by 60% of respondents), improved operational efficiency (65%), strengthened demand forecasting (55%), and enhanced risk management (50%). Despite this promise, adoption remains uneven due to outdated infrastructure, limited access to quality data, insufficient digital skills, and high investment costs. Country-level disparities are pronounced: while 70% of South African firms report active AI/ML use, adoption levels are considerably lower in Nigeria (50%) and Ghana (45%). The study highlights the need for improved digital infrastructure, targeted capacity-building, regulatory frameworks that support data governance, and incentives for technological investment. AI and ML can substantially enhance African logistics performance and resilience if integrated into local contexts through participatory design, cross-sector collaboration, and sustained policy support.

Keywords: Artificial intelligence, Digital transformation, Logistics, Machine learning, Supply chain management

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Abstract No: 109-OP

Application of Geographic Information System (GIS) technology to monitor Peste des Petits Ruminants (PPR) Vaccine Coverage in Livestock in Garissa County, Kenya

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ABSTRACT

Peste des Petits Ruminants (PPR) remains a major constraint to small ruminant production in pastoral regions, yet vaccination coverage patterns and their spatial distribution are poorly documented. This study applied Geographic Information System (GIS) technology to assess PPR vaccination coverage in Garissa County, Kenya, over a five-year period (2018-2023) and to develop a real-time monitoring tool to support eradication efforts. Using retrospective vaccination records, livestock population data, and reported PPR incidences and mortalities, the study quantified the proportion of sheep and goats vaccinated and mapped the spatial distribution of vaccination activities across sub-counties, wards, and villages. Results show that only 1.76 million small ruminants representing 26.7% of the county's estimated 6.6 million sheep and goats were vaccinated, a level far below the recommended 70-80% threshold required to achieve herd immunity. Spatial analysis revealed significant geographic disparities, with minimal vaccination activity along the Kenya-Somalia border, an area characterized by insecurity and high livestock mobility. To enhance monitoring and decision-making, a PPR Vaccination Coverage Dashboard was developed using ArcGIS, integrating Survey123 for real-time field data collection and interactive mapping. The tool enables visualization of vaccination hotspots, gaps, and temporal trends, providing an evidence-based framework for targeted interventions. The findings underscore the need for increased vaccine supply, higher vaccination frequency, and prioritized coverage of high-risk, cross-border pastoral populations to advance PPR control and eradication in Garissa County.

Keywords: Peste des Petits Ruminants (PPR), GIS, vaccination coverage, small ruminants, Garissa County

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Leveraging machine learning and digital innovations for precision pest, disease, and soil health management in African agriculture

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ABSTRACT

Smallholder farmers in Africa face persistent challenges from pests, diseases, and declining soil fertility, which collectively reduce yields, threaten food security, and increase vulnerability to climate change. Conventional diagnostic methods are slow, costly, and often inaccessible in rural settings, resulting in delayed responses and substantial losses. Recent advancements in Artificial Intelligence (AI) and Machine Learning (ML) offer a transformative opportunity to deliver realtime, cost-effective, and scalable solutions for farm-level decision-making. This work explores the integration of AI-powered predictive models and digital platforms for early detection of pests and diseases, soil health diagnostics, and actionable decision support to enhance productivity and resilience in smallholder farming systems. We propose the deployment of ML algorithms such as Convolutional Neural Networks (CNNs) for image-based detection of pests and diseases and Random Forest models for yield risk forecasting, trained on multisource datasets including satellite imagery, soil test data, and farmer-reported observations. These models will be integrated into a mobile-enabled platform providing tailored recommendations on pest management, disease control, and nutrient application. Pilot implementation will focus on diverse agro-ecological zones to ensure model adaptability and local relevance. Previous studies demonstrate that CNN-based models can achieve over 90% accuracy in detecting crop diseases from field images, while integrated ML approaches improve precision in nutrient and pest management. Preliminary simulations indicate that combining AI-based diagnostics with real-time farmer feedback can reduce crop losses by up to 30% and optimize fertilizer use by 20%, leading to higher yields and reduced input costs. AIdriven solutions have the potential to close information gaps, reduce yield losses, and promote climate-smart agriculture across Africa. By coupling machine learning with locally relevant datasets and mobile technology, this approach can democratize access to precision agriculture tools, empower farmers, and accelerate the transition to sustainable agri-food systems.

Keywords: Artificial Intelligence, Detection, Machine Learning, Pest and Disease, Precision Agriculture

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Using chemometrics, machine learning and near-infrared spectroscopy for improved soil quality assessment

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ABSTRACT

Accurate and rapid soil quality assessment is essential for sustainable nutrient management and precision agriculture. Conventional wet-chemistry approaches, although reliable, are often labor-intensive, costly, and slow, limiting their suitability for real-time decision-making. This study integrates near-infrared (NIR) spectroscopy with chemometrics and machine learning to enhance the efficiency, accuracy, and environmental sustainability of soil analysis. A total of 120 soil samples (0–20 cm depth) were collected from pineapple fields in Ghana under different organic and inorganic amendment regimes. Samples were analyzed for key fertility indicators, including clay, organic matter, pH, CEC, and exchangeable nutrients, and scanned using a FieldSpec 4 spectrometer (900–2500 nm). Calibration and validation datasets were generated using the Kennard–Stone algorithm, while the Successive Projections Algorithm (SPA) was applied to optimize wavelength selection and reduce multicollinearity. Multiple machine learning models, PLSR, Random Forest, Artificial Neural Networks, Naïve Bayes, and Multiple Linear Regression, were trained to predict soil properties from spectral data. Random Forest consistently achieved the highest predictive accuracy, outperforming PLSR and ANN, particularly for clay content and exchangeable Ca, Mg, and K. MLR yielded strong predictions (R^2 = 0.90–0.93) for most attributes when stabilized using QR decomposition. However, all models showed reduced performance for pH and available phosphorus, indicating the need for further methodological refinement. Overall, the integration of NIR spectroscopy, chemometrics, and machine learning demonstrates significant potential for rapid, non-destructive, and scalable soil assessment. These approaches support more informed soil management decisions, enhance precision agriculture practices, and contribute to sustainable agricultural intensification across smallholder production systems.

Keywords: Chemometrics, machine learning, near-infrared spectroscopy, precision agriculture, soil quality, sustainability

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Abstract No: 112-OP

Adoption of digital climate-smart agriculture tools among smallholder farmers in central Uganda

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ABSTRACT

The Sub-Saharan African economy heavily relies on agriculture, a sector that's increasingly vulnerable to climate change, leading to acute food insecurity—a 159% increase since 2019. Paradoxically, the global agrifood system is also a major contributor to Greenhouse Gas (GHG) emissions. Smallholder farmers, dependent on rain-fed systems, face the highest risks. To address these interconnected challenges, the concept of Climate Smart Agriculture (CSA) emerged. CSA aims to simultaneously increase productivity, enhance resilience (adaptation), and reduce GHG emissions (mitigation) by employing context-specific technologies and practices. The potential of CSA is amplified by digital technologies (e.g., mobile apps, weather platforms) that provide timely information for better farm management and value chain connection. Despite the growing recognition of these digital CSA tools globally, their adoption status among smallholder farmers in Mukono and Kayunga districts, Uganda, remains undocumented. This study was therefore conducted to assess the extent of adoption of these tools, identify the socio-economic, institutional, and infrastructural factors influencing their use, and explore farmers' perceptions of their benefits and challenges. The findings will inform targeted interventions to build more resilient agricultural systems.

Key words: Agriculture, climate change, food insecurity, smallholder farmers, Sub-Saharan countries

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Abstract No: 113-OP

Plant health estimation using drone images

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ABSTRACT

Traditional plant health assessment methods in sub-Saharan agriculture, including manual scouting and periodic satellite imagery, are labor-intensive and often inadequate for timely stress detection. This study explored the use of unmanned aerial vehicles (UAVs) equipped with visible-spectrum cameras as a cost-effective alternative for rapid crop health estimation, validated against conventional laboratory nutrient tests. The objectives included acquiring high-overlap drone imagery over a 21-hectare commercial farm in Niger State, Nigeria, and establishing ground control points for accurate georeferencing. The UAV imagery was processed to create a geo-rectified orthomosaic and derive various vegetation index maps, including the Normalized Difference Vegetation Index (NDVI). The UAV data acquisition involved flying a multirotor drone in an 80% overlap grid, while Pix4DMapper software was used for image stitching and vegetation index computation. Crop nutrient health was estimated from UAV-derived indices and validated through laboratory analyses of nitrogen, phosphorus, and potassium (NPK) content in leaf samples from maize, soybean, cassava, groundnut, yam, and rice. Results demonstrated that the UAV-based NDVI effectively captured the range of vegetation health, correlating strongly with laboratory nutrient measurements, particularly in cassava ($r \approx 1.00$) and rice ($r \approx 0.85$). Alternative indices, such as the Normalized Excess Greenness (NExG), showed weaker correlations. This study concludes that UAV imaging combined with NDVI analysis offers a rapid and reliable precision agriculture tool, particularly valuable in resource-limited contexts. The approach enhances farm management through timely nutrient deficiency identification, supporting proactive agricultural practices and sustainable crop management in Nigeria and across Africa.

Keywords: NDVI, Precision agriculture, Remote sensing, UAV, Vegetation index

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Abstract No: 114-OP

Adoption of digital climate-smart agriculture tools among smallholder farmers in Central Uganda

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ABSTRACT

Agriculture remains central to national economies and food security across Sub-Saharan Africa, yet it is increasingly threatened by climate change, marked by erratic rainfall, droughts, flooding, and rising pest and disease pressures. With severe food insecurity affecting 58% of Africa's population, there is growing urgency to enhance agricultural productivity while strengthening resilience and reducing greenhouse gas emissions. Digital Climate-Smart Agriculture (CSA) technologies—such as mobile-based weather advisories, digital extension, and market information systems—offer promising pathways for improving smallholder adaptive capacity. However, evidence on their adoption and use in many rural contexts remains limited. This study assessed the extent, determinants, and perceived benefits of digital CSA tool adoption among 428 smallholder farmers in Mukono and Kayunga districts of central Uganda using a mixed-methods approach involving household surveys, focus group discussions, and key informant interviews. Results show high access to mobile phones (98%), with farmers adopting multiple CSA technologies including soil fertility management (69%), mobile weather advisories (64%), irrigation and water harvesting (58%), and digital extension services (57%). Adoption was higher in peri-urban Mukono than in Kayunga. Key determinants included education, digital literacy, smartphone ownership, participation in farmer groups, and access to extension services. Gender and income disparities significantly constrained uptake, particularly among women. Reported benefits included improved farm planning, reduced crop losses, better market access, increased incomes, and reduced dependence on traditional extension. Major barriers included high data costs, poor network coverage, low digital literacy, limited localized digital content, and unreliable power supply.
Strengthening digital literacy, expanding rural ICT infrastructure, promoting gender-sensitive interventions, and fostering public–private partnerships are essential for scaling digital CSA and supporting resilient, food-secure farming systems in Uganda.

Keywords: Adoption, Climate-Smart Agriculture, Digital Technologies, Smallholder Farmers, Uganda, Vulnerability

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Abstract No: 115-OP

Application of remote sensing and machine learning in soil salinity management in the Chokwé Irrigation Scheme

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ABSTRACT

Soil salinization poses a significant threat to global agriculture, impacting approximately 1 billion hectares (7% of the Earth's surface) across over 100 countries. In Mozambique's Chokwé Irrigation Scheme, around 30% of the irrigated area is affected, jeopardizing agricultural production and food security in the Southern Region. Urgent measures are needed to combat salinization. While conventional salinity measurement methods are accurate, they are time-consuming, expensive, and limited in coverage due to financial constraints. This study proposes the integrated use of remote sensing techniques and machine learning algorithms for the early detection of saline and potentially saline areas, focusing on the early delineation of priority zones for mitigation and recovery actions. The study will use imagery from Landsat 9 (30 m spatial resolution) and Sentinel-2 (10 m spatial resolution), processed on the Digital Earth Africa Sandbox platform, which provides an interactive and flexible work environment based on the Python programming language through Jupyter Lab. This approach will enable the generation of detailed soil salinity maps in the irrigation scheme, based on the calculation of vegetation and salinity spectral indices, which will serve as predictor variables for machine learning models. Four algorithms will be tested, namely: Random Forest (RF), Support Vector Machine (SVM), Artificial Neural Network (ANN), and k-nearest Neighbours (K-NN). The validation and calibration of the machine learning models will be based on soil sample collection using random sampling at a depth of 20 cm. Model validation will be conducted using variables such as Root Mean Square Error (RMSE), Coefficient of Determination (R), and others derived from the confusion matrix, including accuracy, precision, and F1-score. The expected results will contribute to the sustainable management of irrigated agriculture in the Chokwé Irrigation Scheme through: (i) identifying the most effective algorithm for salinity prediction, (ii) generating high spatial resolution soil salinity maps, (iii) identifying spatio-temporal patterns of salinization, and (iv) providing technical support for the implementation of sustainable management strategies and the recovery of degraded soils.

Keywords: Electrical conductivity, Irrigated soils, Machine learning, Spectral index

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Abstract No: 116-OP

Strain-specific fitness of Spodoptera frugiperda on pearl millet to support resistance screening

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ABSTRACT

The recent invasion and rapid spread of the Fall Armyworm in Africa has posed a significant threat to the production of several staple cereal crops, including pearl millet. The continuous and indiscriminate use of chemical insecticides to control FAW has raised serious concerns regarding their economic, environmental and human health impacts. Moreover, FAW populations have developed resistance to a range of commonly used insecticides, further complicating control efforts. Developing pearl millet genotypes with genetic resistance to FAW represents a sustainable and eco-friendly approach for managing this pest. However, there is limited information on the identification of FAW-resistant pearl millet genotypes and the genetic mechanisms conferring resistance. Additionally, the relative aggressiveness of the FAW C-strain versus the R-strain on pearl millet remains unclear. This study aimed to assess the feeding behavior of both FAW strains on pearl millet under laboratory conditions. The experiment consisted of two treatments (C-strain and R-strain), each with 50 replicates. Leaf portions of Pearl millet were cut into small pieces of 5 cm long and placed in 25 ml plastic vial. A single neonate of each strain was put in each vial. Leaves were changed every 2 to 3 days until pupation. Each pupa was kept in the 25 ml vial until the adult stages. The emerged adults were paired and fed with sucrose solution soaked in cotton wool for oviposition. The collected data was about the life table parameters of FAW strains including larval survival rate, pupal survival rate, adult emergence and sex ratio, numbers of eggs led. The C-strain demonstrated a higher larval survival rate, a shorter larval duration, higher adult emergence rates, a greater number of adults produced and a better-balanced sex ratio. In addition, fecundity assessments showed the Corn strain produced significantly more eggs. These findings highlight superior performance of C-strain across key developmental and reproductive parameters, suggesting this strain for use in artificial infestation experiments to screen pearl millet genotypes for resistance to Fall Armyworm.

Keywords: Artificial infestation, C-strain and R-strain, Feeding preference, Pearl millet resistance, Spodoptera frugiperda

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Abstract No: 117-OP

Knowledge, attitude and practices of maize farmers fall armyworm, spodoptera frugiperda, J. E. Smith management: Implication for extension practices in Botswana

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ABSTRACT

The study was carried out to analyze the maize farmers knowledge, attitude and practices (KAP) of fall armyworm management (FAW), Spodoptera frugiperda (J.E. Smith, Lepidoptera: Noctuidae) in Botswana. From each of the following six districts (Central, Kweneng, Kgatleng, Northeast, Southeast and Southern), 45 farmers were randomly selected making a total of 270 selected for the study. A set of validated pre-tested questionnaire were administered to solicit information from the respondents. Farmers' responses were classified into high, moderate, and low levels across the districts in respect of the KAP analysis. Mean plus or minus (±) Standard Deviation was used to categorize the KAP into levels. For knowledge, (≥ 38.29 = high, between 27.25 – 38.29 = moderate and ≤ 27.25 = low); attitude, (≥ 21.29 = high, between 16.13 - 21.29 = moderate and ≤ 16.13 = low); practices, (≥ 31.21 = high, between 25.74 - 31.21 = moderate and 25.74 = low). The results reveal a significant disconnect between farmers' knowledge of the pest and their actual management practices, with knowledge levels characterized as moderate to high in certain districts but practice levels uniformly low across all regions. Specifically, farmers in the Northeast and Southeast districts exhibited high knowledge levels (18.3% and 19.2%, respectively), yet their management practices remained insufficient (e.g., Northeast = 13.2%). In contrast, Central Kgatleng (26.3% each) and Southern (25%) displayed higher attitudes toward pest management but lacked the requisite knowledge to critically engage with effective pest management strategies. The study assessed the nature of existing information dissemination channels, revealing a reliance on traditional media (40 %) and personal observations (41 %) rather than structured extension services (17 %). The study concludes that insights gained from this study indicate that socio-economic constraints, including limited financial resources for pest control inputs, further exacerbate the gap between knowledge, attitude and practice. Though, knowledge of FAW is relatively widespread, especially in Northeast and Southeast, but did not translate into positive attitudes or sustainable practices. Central, Kgatleng, and Southern showed willingness yet require more knowledge and support. The findings emphasize the need for an elaborate approach to strong extension practices that enhances farmers' understanding of integrated pest management (IPM) strategies while addressing economic and behavioral challenges that impede effective pest management.

Keywords: Botswana, Spodoptera frugiperda, knowledge, attitude, practices, pest management, maize, farmers

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Credit constraint, unmet fertilizer needs and climate- and pest-related crop losses: evidence from three selected sub-Saharan African countries

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ABSTRACT

Climate and pest related crop losses pose a major challenge to agriculture in Sub-Saharan Africa (SSA), threatening food security and livelihoods. Credit constraints, defined as the inability of households to borrow against future income, can limit farmers' access to fertilizers, pest-control measures, and other inputs, exacerbating their vulnerability to climate- and pest-related shocks. This study investigates how credit constraints influence crop losses and the mediating role of unmet fertilizer needs, using nationally representative data from 7,526 farming households in Kenya, Nigeria, and Tanzania. Probit, IV-probit, and Two-Stage Residual Inclusion (2SRI) models were employed to correct for endogeneity between credit constraints and crop losses. Structural Equation Modelling (SEM) assessed the mediation effect of fertilizer access, while subgroup analyses explored heterogeneities by farm size, income level, and rural–urban residence. Results show that credit-constrained farmers are significantly more likely to experience crop losses, with the strongest effects observed among smallholders, poor households, and rural farmers. Credit constraints increase unmet fertilizer needs, which partially mediates the relationship with crop losses. Country-level effects were most pronounced in Tanzania. These findings highlight the critical role of financial inclusion in building climate-resilient agricultural systems. Policies that expand access to credit, coupled with support for fertilizers, improved seeds, irrigation, and extension services, are essential to reduce crop losses and enhance agricultural resilience. Targeted interventions for vulnerable groups can contribute to achieving Sustainable Development Goals 1 (No Poverty) and 2 (Zero Hunger).
Keywords: Agricultural resilience, Climate-related crop losses, Credit constraints, Fertilizer needs, Financial inclusion, Pest-related crop losses, Smallholder farmers, sub-Saharan Africa.

Keywords: Agricultural resilience, climate-related crop losses, credit constraints, fertilizer needs, pest-related crop losses, smallholder farmers

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Abstract No: 119-OP

Efficacy of bitter leaf powder (Vernonia amygdalina) against root knot nematodes on tomato in Borno State, Northern Nigeria

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ABSTRACT

Field trials were carried out to assess efficacy of bitter leaf (Vernonia amygdalina) powder against root knot nematodes (Meloidogyne spp) on tomato (Solanum lycopersicum L.). The objectives of the study were to evaluate the efficacy of bitter leaf (V. amygdalina) powder in reducing plant parasitic nematode population in tomato; and to assess the effect of the amendment on growth and yield of tomato. The experiment was laid out in a randomized complete block design (RCBD) with four (4) treatments and three replications. The treatment used are: 4g, 8g, 12g/ plant stand of bitter leaf and control. The parameters observed were: initial nematode population (Pi), final nematode population (Pf), reproduction factor (Rf), change in nematode population, galling index, fresh shoot height (cm), fruit weight (kg/ha), root length (cm), and dry shoot and root weight (g). The results obtained revealed that significant difference (P 0.05) were observed in nematode population, shoot weight, root length, root gall index, dry shoot and root weight. Significant difference (P 0.05) were observed on shoot height and root weight. The result shows that least (9.3) nematode population was recorded in 12g/plant stand of bitter leaf, followed by plot treated with 8g/ plant stand , then 4g/ plant stand with 21 and 31 respectively. Furthermore, highest (-90.7) percentage change in population was recorded in 12g/ plant stand and the lowest (62) was observed under control. The result further shows that at the highest dose rate of 12/ plant stand, tomato fruit weight of 269.33g while at the least dose rate of 4g/ plant stand, 165g fruit weight was recorded, when compared with the control which recorded least fruit weight of 119.67g. The study concluded that improved results were observed in all treated plants, were bitter leaf powder reduced the adverse effect of nematodes as result of reduced population due to toxicity of V. amygdalina on root knot nematode can be suggested for tomato farmers for use as it proved to be effective in the management of nematodes.

Keywords: Botanicals, Meloidogyne spp., Nematodes, Tomato, Vernonia amygdalina

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Abstract No: 120-OP

Efficacy of bitter leaf powder (*Vernonia amygdalina*) against root knot nematodes on tomato in Borno State, Northern Nigeria

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ABSTRACT

Traditional fermented beverages are important sources of Lactic Acid Bacteria (LAB) with recognized probiotic potential. However, LAB may carry antibiotic resistance genes, posing public health risks. This study investigated the phenotypic antibiotic resistance profiles of LAB isolates from Kwete, a maize-based fermented beverage consumed in Northern Uganda. LAB isolates were obtained from two ethnic sub-regions (Acholi and Lango) and included Lacticaseibacillus rhamnosus ATCC 7469 as a reference strain. Antibiotic susceptibility testing was performed using the disc diffusion method against twelve commonly used antibiotics, and results were analyzed with ANOVA and heat maps to compare resistance patterns. Findings revealed marked heterogeneity in antibiotic susceptibility across isolates. All LAB from Acholi and L. rhamnosus ATCC 7469 were resistant to colistin, gentamicin, ciprofloxacin, and metronidazole, but susceptible to amoxillin. In contrast, Lango isolates displayed broader resistance, with isolate 111 showing resistance to the highest number of antibiotics. Multiple antibiotic resistance was observed in all isolates, with resistance patterns varying by sub-region. Sulphamethoxazole, tetracycline, and erythromycin resistance were more prevalent in Lango isolates. The results indicate that regional variations in microbial ecology, production practices, and local ingredients influence antibiotic resistance profiles of LAB in fermented beverages. This study highlights the need for safety evaluation of LAB from traditional fermented foods before their use as probiotics. Monitoring antibiotic resistance in LAB can inform selection of safe strains for functional food development, guide public health campaigns, and ensure the promotion of safe, culturally relevant probiotic beverages.

Keywords: Acholi, Antibiotic resistance, Kwete, Lactic acid bacteria, Lango, Northern Uganda

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Abstract No: 121-OP

Bio-efficacy of phytopesticidal extracts of Tagetes minuta L. and Melia azedarach L. as protectant of Maize (Zea mays) against fall armyworm (Spodoptera frugiperda)

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ABSTRACT

Fall armyworm (FAW) is a nocturnal, voracious, and polyphagous pest native to tropical regions of the Americas, feeding on more than 80 plant species, preferably cereals, including maize. Firstly, reported earlier in 2016 in Africa, its severe damage to maize is responsible for losses estimated to be approximately a billion per year in over 45 countries in sub-Saharan Africa, with direct impact on food insecurity and poverty exacerbation. The study aimed to determine the efficacy of biopesticidal extract of T. minuta and M. azedarach on the population of S. frugiperda as a sustainable and effective low-cost means of its biocontrol. Carried out at the Sebele valley (24 33'S, 25 54'E, 994 m above sea level), the experiment consisted of a Factorial Block laid in a randomized complete block design (RCBD). Extracts of Melia (M) and T. minuta (T) and in 1:1 ratio, the combination of both Melia and Tagetes (TM), were studied as the treatments with three doses (100g, 500g and 1000g/5L of water) replicated three times each, with two controls (Negative, with no application) and Positive (Cypermethrin, a commonly used insecticide at 20mL/20L of water). The plant extracts were isolated and characterized using Sukhdev's protocol for qualitative and quantitative analysis of phytochemical profile. Bioassay on larvae population was carried out in controlled conditions using IRAC method adapted to FAW. The phytochemical analysis results showed different concentrations of total flavonoid content on M. azaderach (87.7 and 87.2 mg QE/mL) and total phenolic content and on T. minuta (46.7 and 47.63 mg QE/mL) as active compounds responsible for both repellence and lethality, while qualitative analysis showed considerable concentrations of flavonoids, tannins, saponins, and terpenoids. The results on incidence and severity indicated that the negative control exposed maize to FAW attack with a prevalence of 94% and severity of (3.56±1.25a). Comparatively, Melia treatments were effective in FAW control with a cumulated average of 14.8% of FAW occurrence and a severity score of 0.36±0.91 (null to light attack), while Tagetes treatment were less effective, as plots treated respectively T1, T2 and T3 (66.7; 63.9; and 50%) were by far, the most suitable feeds of FAW inflicting light to moderate attacks, with a cumulated severity score of 2.93±2.03 (moderate to intense attack). The combined doses have shown promising tolerance to the presence of FAW, with mostly absence to light attacks (quasi absence of damages on upper parts, leaves and stems) though they highly hosted FAW population (TM1 (44.4%) being most hospitable, followed by TM2 (33.3%) and TM3 (25%). Standard control seemed to be a better means of control since it led to lower occurrence (19.4%) and almost null severity (0.53±1.13). The plant extracts exhibited positive effects

on yield components as the combination doses led to the highest yield per plot (11.6±1.28), followed by Melia (5.84±0.53), Tagetes (3.58±0.52) and negative control (2.72±0.74). The highest mortality of larvae under bioassay was obtained from SC and M3 (100% after 24 hours of larvae exposure to plant extracts, while the worst result was obtained from T1 (25% after 48 hours), and TM2 has shown intermediary results as it led to a mortality ranging from 50 to 70% after 48 hrs of exposure. The study highlighted the importance of nature-based solutions for FAW control. Moderate doses of M. azedarach combined with T. minuta are recommendable for effective and low-cost, affordable and eco-friendly FAW control and sustainable agriculture. Providing affordable solutions to control one of the most pressing pest in framework of sub-Saharan agriculture where millions of farmers live under the poverty threshold would improve productivity, food security, and alleviate poverty.

Keywords: Bio-efficacy, Melia azedarach, Phytopesticidal extracts, Spodoptera frugiperda, Tagetes minuta, Zea mays

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Abstract No: 122-OP

Assessment of infestation, damage levels and eggs parasitism of fall armyworm (Spodoptera frugiperda) in maize Moamba (Sabie)

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ABSTRACT

Maize (Zea mays L.) is a staple crop in Africa, providing essential calories and carbohydrates. However, its production and the livelihoods of smallholder farmers are increasingly threatened by the fall armyworm (FAW), Spodoptera frugiperda. This study assessed FAW infestation levels and the contribution of egg parasitoids as natural biocontrol agents in maize fields of Moamba District, Mozambique. A survey was conducted from 17th to 21st March 2025 across 19 small-scale maize fields at the vegetative stage (V5–V12) with no prior insecticide application. In each field, 50 plants were randomly selected using a "W" sampling pattern. FAW presence, leaf damage (1–9 scale), egg mass abundance, and parasitism rates were recorded. Results showed the highest FAW infestation in Diamane (91.6 ± 5.15%), followed by Gavaza (85.0 ± 3.0%) and Godjua (79.0 ± 6.19%), with the lowest in Ligongole (60.0 ± 6.0%), indicating significant spatial variation (P = 0.049). Although the mean number of egg masses and egg mass infestation rates did not differ significantly among sites, Diamane recorded the highest egg mass count (3.4 ± 1.75), and Sabie Sede had the highest egg mass infestation (8.0%). Significant parasitism by native parasitoids, especially Trichogramma spp., was observed, suggesting potential overlap in biological control with other stemborer pests. These findings emphasize the importance of integrating biological control into FAW management strategies. Conservation approaches, including intercropping, reduced pesticide use, and habitat enhancement to support natural enemies such as Trichogramma and Telenomus spp., are recommended to strengthen sustainable pest management and improve maize productivity in Mozambique.

Keywords: Egg, Integrated pest management, Maize, Parasitoids, Spodoptera frugiperda, Food security

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Abstract No: 123-OP

Identifying optimal lines for enhanced symbiotic performance in a mini-core collection of cowpea [Vigna unguiculata (L.) Walp]

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ABSTRACT

Cowpea (*Vigna unguiculata* L. Walp), is an important food security and climate-resilient legume grain crop grown in the semi-arid regions of sub-Saharan Africa (SSA). It can symbiotically fix atmospheric nitrogen and improve soil fertility, which should be harnessed to increase its yield in the region. This study assessed the mini-core cowpea collection genotypes for effective and efficient nodulation, aiming to select the superior genotypes for further field evaluation in Ugandan agro-ecologies. A total of 252 cowpea genotypes were planted in pots in a screen house at Makerere University Agricultural Research Institute, Kabanyolo, (MUARIK), in a randomized complete block design (RCBD) with two replications. Seeds were inoculated with Bradyrhizobium spp, (Strain ICB756). At early pod formation stage, data were collected on plant vigor (based on plant height, leave greenness and biomass) and nodulation-related traits including number of nodules per plant (NN), proportion of active nodules (AN) and nodule dry weight per plant (NDW). Results showed that NN and AN ranged from 0 to about 89 and 0 to 100%, averaging 25 and 44.6%, respectively. NDW ranged from 0 to 128.9 mg/plant, averaging 31.7 mg/plant. Analysis of variance showed significant differences ($p<0.05$) among genotypes for AN, and NDW, indicating a genetic diversity between the genotypes which were grouped in 4 clusters. There was a positive correlation between symbiotic traits and plant vigor, implying a combined possible improvement of these traits. Genotypes such as TVu-14971, TVu-1477, and TVu-14691 were identified as best performers for both nodulation traits and plant vigor, while TVu-9259, TVu-14621 and TVu-7719 exhibited poor nodulation. After confirmation under standardized screening conditions, the present findings could contribute to cowpea breeding programs aiming at developing new cultivars, contributing to agricultural sustainability and food security while maintaining a healthy environment.

Keywords: Biological nitrogen fixation, Bradyrhizobium spp, Mini core genotypes, Nodulation, screening

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Abstract No: 124-OP

Effectiveness of raw Diatomaceous earth alone or/in combination with permethrin dust against Rhyzopertha dominica (Coleoptera: Bostrychidae) on stored wheat (Triticum spp)

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ABSTRACT

Laboratory experiments was carried out to evaluate the efficacy of raw DE alone or/in combination with permethrin dust against R. dominica on wheat, to assess insect mortality caused by exposure to raw DE and/ or permethrin, effects on progeny production of exposed beetles and prevention of grain damage by the test insect. R. dominica was obtained from laboratory cultures which has been maintained in the laboratory for over year, where F1 progeny was used for the experiment. The raw DE was tested at application rates of 0 (untreated control) 500, 750, 1000, 1500 mg raw DE/kg alone and with 2 and 5 mg active ingredient permethrin to each DE dose making a total of 12 treatment combinations. Each treatment combination and control, 50 g grain samples in three replicates were place in 250 ml capacity bottles, and thirty adults insects were placed into each replicate. Adult mortality, progeny production and percentage damage kernel by R. dominica were assessed. The result reveals that at higher dose rate of 1500 mg/kg of raw DE and with combination of permethrin gave appreciable adult mortality after 7 days of exposure interval, after continuous exposure to 14 days, complete 100% adult mortality was noticed at 1500 mg/kg dose rate. Progeny production was suppressed after 40 and 80 storage period. Greater than 88% progeny suppression where recorded at the lowest dose rate of 500 mg/kg on raw DE and enhanced DE as the dose rate increases, complete progeny inhibition were noticed at the highest dose rate of 1500 mg/kg or 500 mg + 2 or 5 mg permethrin when compared with untreated controls. The percentage damage kernel decreases at the dose rate of 1500 mg/kg with raw DE combined with 2 and 5 mg/kg were 1.3±1.0 and 0.0±0.0, respectively.

Keywords: Diatomaceous earth, Mortality, Progeny Rhyzopertha dominica, Wheat

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Abstract No: 125-OP

Water stress effect on chlorophyll content at different rice (Oryza sativa L.) Plant growth stages

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ABSTRACT

Rice (Oryza sativa L.) is a major staple food crop, and its demand is increasing in Uganda. Drought is a major yield-reducing factor by affecting various physiological and biochemical processes. Rice is known to be very sensitive to drought during the vegetative and reproductive stages. Plant responses to drought are complex and involve many physiological changes, including a reduction in chlorophyll content. This study aims to examine the effect of drought on rice chlorophyll content during the vegetative and reproductive stages. Sixty-one rice genotypes with varying degrees of drought tolerance were grown under controlled conditions in two separate sets of experiments. In the first experiment, the plants were stressed during the vegetative stage and reproductive stage in the second experiment, by withholding watering for 14 days and re-watering. As a response to dehydration conditions, the study showed that genotypes, when stressed during the vegetative stage, recorded less chlorophyll dehydration grand mean (28.14) and median (31.25) compared to when stressed during the reproductive stage (Mean=36.44, Median=45.5). However, the slightly higher recovery grand mean was observed during the vegetative stress (46.82) than during the reproductive stress (46.55). The highest value was recorded in NM-17-72-6 (49.65), while the lowest value was recorded in NM-17-72-33 (20.85). After re-watering the plants for seven days to assess the recovery, the readings ranged from 52.8 to 33.54. The highest value was recorded in NM-17-72-22 (52.8), while the lowest value was recorded in Basmati 307 (33.54). Highly significant differences were observed among genotypes and genotypes by irrigation methods interaction for chlorophyll dehydration and recovery. In the two experiments, the findings showed a remarkable variation in chlorophyll dehydration (reduction) among the studied genotypes at the end of the water stress episodes; however, the dehydration effect observed on the plants was more severe during the vegetative stage. After re-watering, the plants stressed during the vegetative stage also showed a higher recovery rate compared to when stressed during the reproductive stage. Overall, the best and highest chlorophyll recovery from dehydration in the two experiments was recorded in NM-17-72-22, NM-17-72-30, NM-17-72-23, NM-17-72-37, 42 (56), NM-17-72-40, NM-17-72-17, and NM-17-72-48. In cereals, higher total chlorophyll content under stress conditions has been reported as an indicator of drought tolerance. Therefore, these genotypes hold high drought tolerance potential and can be used in the subsequent breeding stages for drought.

Keywords: Chlorophyll Dehydration, Chlorophyll Recovery, drought, reproductive stress, vegetative stress

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Abstract No: 126-OP

Effect of risk management on the performance of rice production supply chain in Kebbi State, Nigeria

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ABSTRACT

This study examines the impact of risk management on the performance of the rice production supply chain in Kebbi State, Nigeria. Risks include weather, biological, environmental, market, logistics, financial, and operational risks. The research uses Contingency Theory and an exploratory mixed-methods research approach, involving interviews and questionnaires. The results show that risks from weather, biology, market, finance, logistics, and operations affect the efficiency of the supply network. The study found a connection between the variables and a statistically significant risk effect, while risk mitigation had a statistically significant effect. The study highlights the importance of risk management in the success of the rice production supply chain, enabling stakeholders to make informed decisions and invest in risk mitigation strategies. The study provides new empirical data on risk management's impact on rice production supply chain performance, enabling policymakers and stakeholders to make informed decisions and invest in risk mitigation strategies.

Keywords: Management, performance production, rice, risk, supply chain

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Distributional impact of agricultural land tenure and contract systems on climate-smart agriculture intensification in Ghana

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ABSTRACT

The adoption of climate-smart agriculture (CSA) practices is crucial for enhancing agricultural productivity, mitigating carbon emissions, and building resilience among smallholder farmers in Sub-Saharan Africa (SSA). Despite the proven benefits, adoption rates in SSA remain low due to both supply- and demand-side constraints, including input availability, credit access, labor shortages, land tenure insecurity, and farmer behavioral biases. This study examines the influence of land tenure systems and agricultural contracts on CSA adoption among rural farmers in Ghana. Employing a quasi-experimental design with multistage sampling, four districts across Northern and Southern Ghana were selected. Data were collected from treated and control groups and analyzed using Poisson regression models. The results reveal that insecure land tenure, such as short-term rentals or sharecropping arrangements, significantly reduces farmers' incentives to adopt CSA practices. Conversely, farmers engaged in pre-planting and buyer contracts demonstrated higher adoption intensities, reflecting the importance of formalized agreements in facilitating access to inputs and markets. These findings underscore the role of institutional and contractual arrangements in shaping adoption behavior. Policy implications include the formalization of land tenure through titles or legally recognized customary systems, capacity-building for contract negotiation, and the establishment of deferred input credit schemes. Additionally, fostering collaboration between farmers, input suppliers, and financial institutions can enhance access to CSA technologies. Overall, understanding the interplay of land tenure, contractual arrangements, and behavioral factors is critical for designing effective interventions that promote sustainable agricultural intensification and food security in Ghana.

Keywords: Agricultural contracts, agricultural land tenure system, climate change, climate-smart agriculture, food security, smallholder farmers

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Abstract No: 128-OP

Assessing biomass accumulation of three cassava varieties under different cutting lengths and growth media

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ABSTRACT

This study was conducted to assess biomass accumulation patterns of three cassava varieties Cape Vars bankye, Taah bankye, and Adom bankye, under different stem cutting lengths and growth media. It intended to identify cost-effective propagation strategies that enhance early growth and improve cassava productivity. A factorial experiment arranged in a Completely Randomized Design CRD was carried out at the University of Cape Coast with three cutting lengths of one-node, 15 cm, and 30 cm, two growth media of soil and sawdust, and three cassava varieties, giving 18 treatment combinations with five replications. Data collected included root fresh weight, root length, shoot fresh weight, and total biomass, and were analyzed using ANOVA with Tukey's HSD for mean separation. The results showed that cutting length and variety significantly influenced all measured traits, whereas growth medium alone had no significant effect. Longer cuttings of 15 cm and 30 cm consistently outperformed one-node cuttings in root and shoot development, with 15 cm cuttings proving more resource efficient than 30 cm cuttings. Among the varieties, Taah bankye accumulated the highest biomass, followed by Cape Vars bankye, while Adom bankye performed poorly across all parameters. Interactions revealed that Cape Vars bankye performed best in sawdust, whereas Taah bankye accumulated more biomass in soil. It is concluded that 15 cm cuttings represent the optimal balance between planting material use and growth performance. Farmers are recommended to adopt 15 cm cuttings for efficient cassava propagation, while variety-specific responses to growth media should be considered in nursery and field management strategies.

Keywords: Biomass, cassava, cuttings, growth, media, productivity

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Abstract No: 129-OP

Conservation agriculture practices for resilient maize production under soil fertility constraints in Kavango East, Namibia

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ABSTRACT

Soil fertility declines and increasing climate variability pose major threats to maize production in Sub-Saharan Africa. In Namibia's Kavango East region, smallholder farmers are particularly affected, experiencing reduced yields due to nutrient-depleted soils and erratic rainfall patterns. These challenges undermine food security, household incomes, and the overall resilience of rural farming systems. Conservation agriculture (CA) has gained prominence as a sustainable approach for restoring soil health and enhancing adaptive capacity in resource-constrained environments. This study assessed the effects of key conservation agriculture practices, minimum tillage, crop rotation, residue retention, and agroforestry integration, on soil fertility and maize productivity. Field observations from the Musese Green Scheme were combined with secondary data from research reports and farmer interviews to compare outcomes between conventional tillage and CA-based systems. Preliminary results show that CA significantly improves soil organic matter, enhances moisture retention, and increases water infiltration, resulting in more stable maize yields under variable rainfall. Farmers practicing CA also reported reduced production costs and lower dependence on external inputs, indicating improved economic resilience. These combined ecological and financial benefits suggest that CA can strengthen farmers' capacity to withstand climate and market shocks. Overall, conservation agriculture presents a promising pathway for sustainable maize production and resilience-building in Namibia. Scaling up adoption will require targeted extension support, farmer-led knowledge exchange, and enabling policy frameworks that incentivize sustainable land management. Strengthening CA uptake can contribute meaningfully to food security, climate adaptation, and the development of inclusive, shock-resilient agri-food systems in the region.

Keywords: Climate change, Conservation agriculture, Maize production, Namibia, Resilience, Soil fertility

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Green extraction of starch from pseudo cereals (quinoa and amaranth): A review

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ABSTRACT

Pseudo cereals such as quinoa and amaranth are increasingly recognized for their nutritional value and adaptability to marginal environments. Their starch content presents significant potential for food and industrial applications. However, conventional extraction methods, such as mechanical, chemical, and enzymatic, often rely on chemical reagents that pose environmental and health concerns, particularly in food-grade contexts. However, water-based extraction has emerged as a green alternative, aligning with sustainability goals and minimizing carbon footprints. This review critically examined starch extraction methods applied to pseudo cereals, with a focus on water-based techniques. It highlights the environmental and functional properties of aqueous extraction, especially in reducing chemical usage and supporting clean-label starch extraction. A systematic literature review was conducted using peer-reviewed articles, book chapters, and technical reports published between 2010 and 2025. Extraction methods were categorized into mechanical, chemical, enzymatic, and aqueous approaches. Comparative analysis was performed on starch yield, purity, physicochemical analysis, environmental impact, and suitability for food-grade applications. Emphasis was placed on studies involving amaranth and quinoa. The review found that water-based methods yielded starch with minimal damage, with a lower yield and purity in comparison to other methods. Compared to alkaline and solvent-based techniques, aqueous methods reduce chemical usage by over 90% and decrease wastewater toxicity. Functional properties such as gelatinization temperature, swelling power, and paste clarity were preserved and enhanced. Additionally, water-extracted starch demonstrated compatibility with biodegradable packaging and clean label formulations. Water-based starch extraction from pseudo cereals offers a viable and sustainable alternative to conventional methods, particularly for food-grade applications. Its low environmental impact, cost-effectiveness, and preservation of functional integrity make it suitable for a climate-resilient agri-food system. The adoption of aqueous extraction supports global efforts to reduce carbon footprints and transition towards eco-friendly processing technologies. Future research should focus on optimizing process parameters, scaling up water extraction, and integrating renewable energy sources to further enhance sustainability.

Keywords: Aqueous extraction, clean label processing, pseudo cereal starch, starch extraction sustainability

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Integrative effect of triple superphosphate, urea, and chicken manure on cabbage productivity in North-Central Namibia

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ABSTRACT

Smallholder cabbage (Brassica oleracea var. Capitata L.) producers in North-Central Namibia often experience low yields due to infertile soils with low nitrogen and phosphorus contents. While chemical fertilizers can supply nutrients quickly, their high costs limit farmers' adoption; conversely, ecologically friendly, locally available organic amendments release nutrients more slowly. Integrated nutrient management (INM) that combines chemical and organic fertilizers may offer both agronomic and economic benefits. A two-season field trial was conducted at the University of Namibia-Ogongo Campus during the 2023 and 2024 winter seasons to evaluate the effects of different fertilizers on cabbage performance. A factorial arrangement of three triple superphosphate rates (0, 45, and 90 kg P ha–), three urea rates (0, 60, and 120 kg N ha–) and three chicken manure (M) rates (0, 20, and 40 t ha–) was laid out in a randomized complete block design with three replications. The combined application of 90 kg P ha– , 120 kg N ha– , and 40 t M ha– consistently produced the highest cabbage yields, before trimming (119.0–127.6 kg ha–) and after trimming (90.7–95.0 kg ha–), demonstrating the synergistic effect of the INM approach. As a way of reducing fertilizer costs, we recommend that farmers use the band-placement application method, which could save up to 60% of the fertilizer requirement. Moreover, future studies should strive to identify the economically optimal combination of chemical and organic fertilizers for smallholder cabbage producers and conduct cost-benefit analyses to guide INM recommendations.

Keywords: Cabbage yield, integrated nutrient management, smallholder farmers, sub-Saharan Africa, Sustainable agriculture

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Abstract No: 132-OP

Investigating gender differences in sorghum variety selection and agricultural practices under climate change conditions in Masvingo District, Zimbabwe

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ABSTRACT

The study had the objectives to investigate gender differences in sorghum variety selection and agricultural practices in Masvingo District, Zimbabwe, as coping mechanisms against drought and water stress related to climate change. We examined how men and women farmers differ in their choice of sorghum varieties, agronomic practices, and decision-making processes, considering economic gains and climate resilience. Our findings revealed a significant gender difference in decision-making and agricultural practices, with men prioritizing economic gains and women focusing on crop yield. Men predominantly made decisions on planting dates, methods of planting, and when to harvest, while women managed weeding, pest and disease scouting, and marketing of produce. However, men ultimately controlled financial decisions, determining how income from sorghum sales was utilized. The study highlights the need to integrate gender perspectives into climate-resilient agricultural practices, ensuring that both men and women's needs and priorities are considered. The findings have implications for policy and practice, emphasizing the importance of gender-sensitive agricultural extension services, inclusive decision-making processes, and climate-resilient sorghum varieties that meet both men's and women's needs.

Keywords: Agricultural practices, climate resilience, gender differences, sorghum varieties, decision-making, Zimbabwe

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Evaluation of soil water dynamics using selected irrigation water management tools under two irrigation systems

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ABSTRACT

Botswana is a semi-arid country and therefore, water-conserving irrigation methods and tools are essential. Self-regulating Low Energy, Clay-based Irrigation (SLECI) is an innovative system that uses the suction force of soil to regulate water release within the system and is ideal for dryland agriculture. The objectives of this study were to: Investigate the performance of irrigation water management tools under drip and SLECI irrigation systems and; to determine the quantity of water used by under the two irrigation systems to grow maize (hybrid SC 419). In the first objective, the performance of the irrigation water management tools: Tensiometers; Time Domain Reflectometry TDR); Wetting Front Detectors (WFDs); and Chameleon soil water sensors were evaluated. In the second objective, the quantity of water used was digitally measured. The studies were conducted at BUAN's, Notwane farm in Gaborone. Experiments were laid out following a split-plot design, with the two irrigation systems as the main plot and depth below the soil surface as the sub-plot. Secondary-treated wastewater was used. Tensiometers readings were higher under SLECI (6.5 kPa), compared to drip-irrigated plots (10.9 kPa). Similarly, TDR measurements indicated higher volumetric moisture content in the SLECI plot (15%), compared to drip-irrigated plot (12%). Chameleon soil water sensors recorded continuous wet and moist conditions in the SLECI plots, compared to the variable readings under drip irrigation. WFDs underestimated soil moisture status in the SLECI plot compared to the conventional drip-irrigated plot. Out of 160 observations of the WFDs under SLECI irrigation, only 3 observations were active (up / yes response) due to a rainfall event. Whereas under drip irrigation, WFDs worked well because a wetting front infiltrated the base of the WFDs funnel to activate the float. Maize irrigated with the SLECI system received significantly less water than the conventional drip system to achieve similar or even higher crop yields. The cumulative volume of irrigation water for SLECI and drip irrigation systems was 4.731 and 6.601 m3, respectively. Water productivity of the SLECI irrigation system was 1 kg/m3 compared to 0.5 kg/m3 of drip irrigation system. The implications of these findings are discussed.

Keywords: Chameleon soil sensors, conventional drip irrigation, Irrigation water management tools, Tensiometer, Waterfront detector, Time domain reflectometry, SLECI

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A study on the effects of botanical rooting stimulants on the vegetative propagation of dragon fruit (Hylocereus undatus)

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ABSTRACT

Dragon fruit (Hylocereus undatus) is an emerging high-value crop with strong potential for commercial production in Zimbabwe due to its nutritional benefits, medicinal properties, and suitability for climate-resilient farming systems. However, widespread adoption remains limited by the low availability of vegetative planting material and low rooting success of stem cuttings. This study investigated the use of botanical rooting stimulants, Aloe barbadensis and Cinnamomum verum, as sustainable, climate-smart alternatives to commercial rooting hormones for enhancing the rooting performance of H. undatus stem cuttings. A 2 × 4 factorial experiment was conducted using full and half stem-cuttings treated with A. barbadensis gel, C. verum, commercial rooting hormone, and water (control). Treatments were arranged in a randomized complete block design under shade-house conditions, with irrigation applied every five days. Data on aerial roots, underground roots, and incidence of rot were collected 40 days after planting. Results showed that full-length stem cuttings produced significantly ($p<0.05$) higher numbers of both aerial and underground roots compared to halved cuttings. Full stem-cuttings treated with A. barbadensis gel exhibited the highest ($p<0.05$) underground root development, outperforming *C. verum* and the control. Rot incidence differed significantly ($p<0.05$) across treatments and was most prevalent in halved cuttings. These findings demonstrate that botanical stimulants, particularly A. barbadensis, enhance rooting success and reduce propagation constraints for H. undatus. Overall, the study provides important insights for improving the climate-smart and sustainable production of dragon fruit in Zimbabwe, supporting its wider adoption among growers.

Keywords: Botanicals, Hylocereus undatus, Phytochemicals, Rooting stimulants, Stem-cuttings

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Abstract No: 135-OP

Growth Performance and Haematology of Oreochromis Niloticus (Linnaeus, 1758) Fed Phosphorus-Supplemented Feeds and Physiological Response of Lactuca Sativa (Linnaeus, 1753) in Aquaponic System

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ABSTRACT

Aquaponics is a bio-integrated system that links recirculating aquaculture with hydroponic production. Bio-integration is beneficial for resource efficiency, climate resilience, increased product diversity and profit. Though Oreochromis niloticus and Lactuca sativa are common in aquaponic production, nutrient balance particularly phosphorus, a vital macronutrient for both species reportedly varies across growth phases. This study investigated the effects of phosphorus supplemented feed on the growth performance, nutritional content and hematological response of *O. niloticus* and *L. sativa* in aquaponics. Three iso-experimental diets were differentiated by graded phosphorus levels: commercial feed (control, 1.1g/kg, T0), (6.1g/kg, T1) and (8.6g/kg, T2). The experiment was conducted in triplicate using O. niloticus fingerlings (9.3±0.10g) and two weeks old L. sativa seedlings stocked at 7.5kgm^{-3} and 15seedlings m^{-2} respectively. Weekly, O. niloticus growth (length, weight) and survival and *L. sativa* response (growth, total chlorophyll) were determined for 10 weeks. Then, the proximate and mineral content and haematology of O. niloticus and L. sativa were evaluated. The specific growth rate was significantly higher T2 (2.55±0.27%) compared to T1 (2.40±0.18%) and T0 (1.99±0.16%). The haemoglobin concentration was significantly higher at T2 (10.13±0.03g/dL) than T1 (9.37±0.03g/dL) and T0 (7.849±0.04 g/dL). Crude protein of L. sativa was significantly higher at T2 (1.81±0.01%), than T1 (1.71±0.10%) and T0 (1.60±0.13%). Total chlorophyll content was significantly higher at T2 (19.46±2.85) compared to T1 (15.92±1.88) and T0 (15.42±2.48). Phosphorus (8.6g/kg) enhanced metabolic activities including nucleic acid synthesis, erythropoiesis, chlorophyll biosynthesis enhancing cell physiology. Strategies to improve phosphorus availability in aquaponics are crucial to optimize the potential and sustainability of aquaponics. This study mainly contributes to Sustainable Development Goals 2; 12; 13 of zero hunger, responsible consumption and production and climate action respectively.

Keywords: Aquaponics, Botswana, Oreochromis niloticus, Lactuca sativa, Phosphorus-supplement

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Spatial variation of climate change-induced heat stress risk for dairy cows in Botswana

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ABSTRACT

Rising temperatures and frequent heat waves associated with climate change pose a significant challenge to dairy production, particularly in arid and semi-arid regions such as Botswana. Heat stress in dairy cattle results from elevated metabolic heat loads, reducing productivity, reproduction, health, and welfare, and causing economic losses for smallholder farmers. This study assessed the spatial and temporal distribution of heat stress for dairy cows in Botswana under current (2020) and projected future conditions (2030, 2050, 2070) using the Temperature Humidity Index (THI) under the high-emission scenario SSP5-8.5. Data from 24 synoptic weather stations across nine administrative districts were analyzed, and spatial mapping was performed using ordinary kriging in ArcGIS Pro. Results indicate a warming trend across Botswana, with annual mean maximum temperatures increasing from 27.97–31.77 C in 2020 to 31.93–35.82 C in 2070. Correspondingly, THI values and the number of heat stress days are projected to increase, particularly in northern districts, where moderate to severe heat stress will dominate. By 2070, the entire country is projected to experience over 320 days of heat stress per year, with severe heat stress increasing in frequency and intensity in the north. The findings highlight the urgent need for cost-effective heat abatement strategies and climate adaptation measures to support sustainable dairy production in Botswana. Without interventions, large areas of the country may become unsuitable for dairy farming due to escalating heat stress, underscoring the importance of integrating climate projections into policy and development programs for the sector.

Keywords: Botswana, Climate Change, Climate Projections, Dairy Cows, SSP5-8.5, Temperature Humidity Index

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Assessment of physicochemical properties of soil under different flood patterns in flood recession farming in the Okavango Delta, Botswana

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ABSTRACT

Flood recession farming, locally known as molapo farming, is a critical livelihood for riparian communities in the Okavango Delta. This study assessed the influence of different flooding patterns on soil physicochemical properties across three floodplain types: saucer-shaped (Shorobe), lake flats (Lake Ngami), and channel type (Makalamabedi). Seventeen molapo fields were sampled, and soil samples were collected at 30 cm depth along systematic transects to create composite samples per field. Soil analyses included texture, pH, organic matter (SOM), available phosphorus, and exchangeable cations (Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}). Statistical analyses included one-way ANOVA, MANOVA, and Kruskal-Wallis tests with Bonferroni-adjusted alpha for multiple comparisons. Results indicated that flooding patterns significantly influenced soil nutrients, SOM, and pH. Calcium was the dominant nutrient (969.40 ± 122.10 mg/kg), while lake flats exhibited the highest magnesium (M = 220.34 ± 97.90) and channel type the highest phosphorus (M = 20.56 ± 8.07). SOM was highest in lake flats (Md = 3.29), reflecting greater organic matter accumulation and potential fertility. Soil pH varied, with lake flats showing acidic conditions (M = 5.72 ± 0.19), whereas saucer-shaped and channel type soils were near-neutral. Soil texture, classified as sandy loam, and silt-clay ratios were consistent across all flood types, indicating physical properties were largely unaffected by flood pattern. These findings highlight that flooding dynamics shape nutrient availability, SOM, and pH, with implications for crop suitability and sustainable management in flood recession farming. Understanding these patterns can guide targeted interventions to optimize productivity in wetland agricultural systems.

Keywords: Flooding patterns, Molapo farming, Okavango Delta, Organic matter, Soil nutrients, Soil pH

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Abstract No: 138-OP

Early warning systems and risk reduction strategies

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ABSTRACT

The increasing threat of climate-related disasters highlights a critical gap in traditional post-event disaster response. A paradigm shift toward proactive risk reduction is essential for building long-term resilience, yet a significant research gap exists in understanding how community-based early warning systems (EWS), anticipatory action plans, and financial tools are effectively integrated to protect livelihoods. The purpose of this systematic literature review was to investigate the efficacy and key factors influencing the successful implementation of integrated risk reduction strategies. The study aimed to provide a unified framework that guides policymakers, practitioners, and communities in developing more robust and effective disaster preparedness programs. A rigorous systematic literature review was conducted, synthesizing academic and grey literature from 2000 to the present. Searches were performed across five major databases (Scopus, Web of Science, PubMed, JSTOR, and Google Scholar) using a combination of keywords related to EWS, anticipatory action, and financial risk tools. A qualitative thematic synthesis approach was used to analyze extracted data and identify recurring themes related to implementation challenges and success factors. The study findings are consistent with the "diffusion of innovations theory," which postulate that successful implementation requires co-creation. Robust community engagement, accessible and timely information channels, and strong cross-sectorial partnerships were foundational for program success. The most compelling result was that financial tools, such as weather-index insurance, provided the crucial catalyst that turned a passive warning into an active, livelihood-protecting decision. This research contributes a comprehensive, integrated framework to the field of disaster risk reduction. It underscores that the true power of these strategies is realized through their strategic fusion, which closes the "last-mile" gap between warning and action. The findings provide a clear directive for future practice: prioritize community-centric co-creation models, invest in multi-channel communication, and foster strong public-private partnerships to build sustainable, disaster-resilient communities.

Keywords: Anticipatory action, climate resilience, disaster risk reduction, early warning systems, financial risk tools

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Empowering smallholder farmers: unveiling the key drivers of climate smart agriculture adoption across Africa: a systematic review

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ABSTRACT

Climate change presents a serious threat to African agriculture, resulting in food shortages; thus, the adoption of climate-smart agricultural (CSA) practices is crucial for ensuring food security and sustainability. However, smallholder farmers, particularly in Africa, have low adoption rates despite the potential benefits, such as higher yields, increased resilience and reduced input costs. This review aims to synthesize existing literature to identify key factors influencing CSA adoption among smallholder farmers, with an emphasis on gender disparities. This study conducted a systematic literature review following PRISMA guidelines, focusing only on peer-reviewed articles in English and using keywords related to "climate-smart agriculture" (with/without hyphen) or "CSA" AND "smallholder farming/ agriculture" OR "small-scale farmers," in titles, keywords, and abstracts. After screening and selection, 39 relevant studies published between 2013-2024 were included in the analysis. The review identified over 30 CSA practices, grouped into soil-based (e.g. zero/minimum tillage), crop-based (e.g., crop rotation), and water-based (e.g. irrigation), alongside adoption factors categorized as socio-demographic, institutional, and resource endowment. The findings indicate that factors such as age, gender, education, household size, farm size, income, access to credit, and livestock ownership have mixed effects on CSA adoption, reflecting geographic, practice-specific and cultural variations. In contrast, access to extension services, media exposure, market access, and farmer group membership consistently enhance adoption. Notably, many studies report lower adoption rates among female farmers, often linked to structural barriers such as limited land rights and access to inputs. These insights highlight key patterns in CSA adoption and provide a basis for gender-sensitive policy approaches. By providing evidence-based insights, this review can inform targeted extension programs, enabling interventions to promote CSA adoption and address gender disparities among African smallholder farmers.

Keywords: Adoption, Agricultural policies, Climate Change, Empowering farmers, Extension services, Gender-sensitive approachess

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BUAN staffs' perception of challenges constraining delivery of applied research in Agriculture and Natural Resources

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ABSTRACT

Applied research is central to the mandate of Higher Education Institutions (HEIs), yet many institutions worldwide continue to struggle to produce research that meaningfully influences practice. Although common barriers—such as limited resources, heavy teaching loads, weak research cultures, inadequate funding, and insufficient institutional support—are well documented, their severity and manifestation differ across contexts. This study investigates the extent to which these factors constrain the Botswana University of Agriculture and Natural Resources (BUAN) in delivering impactful applied research within the agriculture and natural resources sectors. Guided by a positivist paradigm, the study adopts a descriptive survey design and utilizes a structured, valid, and reliable questionnaire targeting all 230 academic staff members at BUAN. The objectives are to: (i) determine the level at which identified barriers hinder applied research, (ii) examine correlations between staff perceptions and selected demographic characteristics, and (iii) test for significant differences across demographic groups. Ethical standards—including informed consent, confidentiality, and voluntary participation—are strictly observed. Data will be analyzed using SPSS, applying appropriate parametric or non-parametric procedures depending on data distribution. The results, presented through tables and graphical summaries, will inform key conclusions and practical recommendations aimed at strengthening BUAN's institutional capacity for impactful applied research. The findings are expected to guide evidence-based interventions to enhance research productivity, relevance, and contribution to national development in agriculture and natural resources.

Keywords: Agriculture and Natural Resources, Botswana, BUAN, Higher Education Institution, Applied Research

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Abstract No: 141-OP

Unearthing the roots of weak university-industry linkages: the UPLIFT Agriculture project findings in Kenya, Rwanda, Burundi and Zimbabwe

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ABSTRACT

Agriculture remains a critical sector in Africa, yet the quality and relevance of agricultural higher education is constrained by persistent weaknesses in university–industry linkages. As part of the EU-funded UPLIFT Agriculture project involving nine universities across Kenya, Rwanda, Burundi and Zimbabwe, a baseline survey was conducted in 2024 to identify the factors underlying weak collaboration and to inform strategies for strengthening partnerships. Using the Graz Model for institutional transformation and established frameworks on university–industry collaboration and barriers, three questionnaires were administered to 63 university decision makers, 232 agriculture lecturers, and 142 industry representatives. Results show that existing linkages are dominated by informal interactions, primarily through conferences, while deeper forms of collaboration, such as consulting, joint supervision, staff exchanges, and shared facilities—are either rare or ineffective. Student internships remain the strongest connection point, yet opportunities for co-supervision and industry-funded research are underutilized. Liaison and technology transfer offices are widely perceived as ineffective, especially by academic staff. Key barriers include misalignment of priorities, insufficient incentives, lack of funding, bureaucratic hurdles, limited awareness in industry of collaboration benefits, and aging university infrastructure. Industry partners highlight the need for more targeted research, training programmes, and coordinated engagement mechanisms. Decision makers acknowledge the potential of innovation centres but note their limited use. The study concludes that strengthening linkages requires a multipronged approach: clearer policies, improved institutional mechanisms, incentives for faculty engagement, greater industry involvement in teaching and research, enhanced capacity for innovation and IP management, and a cultural shift toward entrepreneurial, problem-solving research aligned with industry needs.

Keywords: Agriculture, Barriers, Industry, Linkages, Technology transfer, Training, University

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Harnessing University Innovation Hubs for Agri-Food Transformation: The Tugizimana Lab Model at the University of Johannesburg

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ABSTRACT

Transforming Africa's agro-food systems necessitates ongoing investment in universities as catalysts for innovation, human capital development, and technological dissemination. University innovation centers and research parks are vital for generating context-specific knowledge and translating it into scalable agricultural solutions. This paper introduces the Tugizimana Lab (TTL)—a flagship innovation hub within the University of Johannesburg's Research Centre for Plant Metabolomics—as an exemplary model for advancing science, innovation, and entrepreneurship across Africa. TTL combines high-throughput metabolomics, artificial intelligence (AI), and bioinformatics to promote progress in crop resilience, biostimulant development, precision agriculture, and natural product discovery. With over 25 researchers and postgraduate trainees, TTL employs interdisciplinary, industry-aligned, and problem-oriented methodologies. Its primary techniques include LC-MS–based untargeted and targeted metabolomics, molecular networking, computational modeling, and AI-driven data integration. Research conducted by TTL has generated valuable insights into biochemical pathways responsible for stress tolerance, enhanced nutrient-use efficiency, and the identification of bioactive compounds in medicinal plants. These findings support sustainable farming practices and the development of innovative agricultural biotechnological products. Furthermore, the hub integrates innovation into its educational programs through postgraduate training in analytical chemistry, computational biology, data science, and translational research. Through collaborations with agritech enterprises, farmers, African universities, and international research organizations, TTL translates laboratory discoveries into practical agricultural applications, including biostimulant formulations, climate-smart production systems, and value-added natural products. The study concludes that high-caliber university innovation hubs such as TTL provide a scalable model for bolstering Africa's research capacity, agricultural innovation, and entrepreneurial ecosystems. Strategic investments in such hubs possess the potential to drive widespread transformation across the continent by fostering talent, encouraging evidence-based decision-making, and generating sustainable agri-food innovations.

Keywords: Agricultural research, Agri-food transformation, AI-driven analytics, Biostimulants, metabolomics, University innovation hubs

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Exposition on a three- pillar university extension strategic framework: preliminary experiences from the Botswana university of agriculture and natural resources

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ABSTRACT

Higher Education Institutions (HEIs) play a pivotal role in driving sustainable socio-economic development, particularly through strengthening linkages with surrounding communities. For a specialised agricultural university such as the Botswana University of Agriculture and Natural Resources (BUAN), extension serves as a critical mandate alongside teaching and research, enabling the translation of innovations into practice. This paper presents BUAN's preliminary experience in modelling a three-pillar University Extension Strategic Framework aimed at enhancing Research–Extension–Farm Communities and Enterprise Linkages (REFELs) in Botswana. The framework comprises three integrated pillars: the Agricultural Media Resources and Extension Laboratory (AMREL) as a communication and media hub; the On-Station Demonstration Site (OSDS) as a field laboratory for validating and showcasing innovations; and the Adopted Village Extension System (AVES) as a community laboratory for participatory extension, outreach, and rural transformation. An experiential methodology was employed, focusing on BUAN's implementation of AMREL and OSDS, while Oliphant Drifts village was adopted as the pilot community for AVES. Farmers in the village were mobilized into commodity-based cooperative groups, and an on-farm demonstration site (OFDS) was established to strengthen university–community engagement. The paper highlights each pillar's core purpose, operational functions, crosscutting strategic objectives, and expected outcomes, and presents a graphical model of the BUAN Adopted Village Extension (BAVE) strategic framework. Additionally, the paper outlines proposed academic programmes, including degrees in Agricultural Extension and Communication Technology, Agricultural Journalism, and Rural Development Studies, designed to reinforce REFELs. Collectively, the three pillars are envisioned to position BUAN as a national leader in innovation dissemination, rural empowerment, and sustainable agricultural development. The paper concludes by recommending the formulation of a University Extension Policy to fully institutionalize and drive the framework.

Key words: Extension, Adopted Villages, HEI, Technology transfer, metabolomics, University innovation hubs

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Incorporating education for sustainability in agricultural higher education in Mozambique

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ABSTRACT

Climate change and the pursuit of sustainability pose major challenges for global socio-economic development, particularly in developing countries such as those in sub-Saharan Africa, where environmental degradation is accelerating. Addressing these challenges requires multisectoral and interdisciplinary efforts, aligned with the 17 Sustainable Development Goals proposed by UNESCO. In the field of education, the curricular approach to sustainability has been largely limited to Environmental Education (EE), focusing on the human-nature relationship. However, the contemporary approach points to Education for Sustainability (EpS), a broader concept that, in addition to the environmental dimension, embraces the complexity of current socio-environmental challenges, involving values and attitudes, citizenship and social transformation oriented towards a sustainable future. Bringing this framework to higher education, particularly in agricultural sciences, is an effort to encompass other sustainable development goals through education, with a view to short- and long-term social transformation. The agricultural sector itself is a key contributor to environmental degradation, through practices such as deforestation for farmland expansion, excessive use of synthetic fertilizers, uncontrolled burning, charcoal production, and unsustainable farming methods. In this context, this study stems from the need to transition from the traditional framework of EA to an EpS approach in higher education curricula in Mozambique. Hence, the objective of the study is to incorporate EpS content into the higher education agricultural curriculum in Mozambique, with an emphasis on an experimental study at the Faculty of Agricultural Sciences of Licungo University. The qualitative research consisted of incorporating EpS content into the 'Cross-Curricular Themes' component of the curricula, recognised as areas of knowledge that cut across different subjects and courses, promoting the comprehensive training of critical citizens in ethical, cultural, social and environmental dimensions. The methodology adopted was Design-Based Research (DBR), involving students and teachers from the Faculty of Agricultural Sciences at Licungo University in two cycles of interaction (2022 and 2023). DBR, as a systematic and flexible approach, not only identifies educational problems but also refines solutions and implementation strategies iteratively, aiming to introduce innovative pedagogical practices that improve the teaching and learning process. The findings demonstrated that it is feasible to integrate sustainability into curricula through cross-curricular themes, covering economic, social and environmental dimensions, although methodological refinements remain necessary. The results culminated in the development of a prototype curriculum of cross-cutting themes integrated with sustainability for agricultural higher education in the area under study, based on a humanistic, holistic and ecological approach. This prototype, which can be applied in other areas of the country, values the acquisition of knowledge, the development of cognitive, social, emotional and behavioral skills, as well as communication skills, linking agricultural learning with the economic, environmental and sociocultural dimensions of sustainability.

Keywords: Agricultural higher education, Cross-cutting themes, Design-Based Research, education for sustainability

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Competence-based education in Africa's higher education institutions: Rationale, Constraints, and strategic interventions

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ABSTRACT

Competence-Based Education (CBE) has gained prominence as African higher education institutions grapple with graduate unemployment, skills mismatch, and curricula that inadequately reflect the continent's development priorities. Despite rising expectations for universities to produce work-ready and entrepreneurial graduates, many institutions continue to operate with Eurocentric, theory-heavy programmes that underprepare students for Africa's socio-economic realities. This paper synthesizes initiatives undertaken by Ugandan and Kenyan universities under the "AgrCBE" project to strengthen the adoption of competence-based agricultural curricula. Using document reviews and project evidence, the study highlights capacity-building interventions for teaching staff, development of a generic competency framework, and creation of minimum benchmark standards to align learning outcomes, pedagogy, and assessment with labour market needs. Early results reveal improved lecturer readiness for CBE delivery, increased integration of practical components, and enhanced alignment of agricultural programmes with experiential learning and industry partnerships. However, systemic constraints—including fragmented reforms, limited funding, insufficient lecturer capacity, political interference, and inadequate stakeholder coordination—continue to undermine meaningful curriculum transformation. The study underscores the need for holistic, context-responsive reforms that empower educators, strengthen governance structures, and integrate industry and community partnerships. It recommends regional harmonisation of CBE frameworks, sustained professional development, inclusive co-design involving women and youth, and the establishment of innovation hubs and field-based learning platforms. Ultimately, embedding competence-based education in Africa's higher education landscape requires long-term political will, strategic investment, and collaborative action to ensure graduates possess the practical, entrepreneurial, and soft skills needed for Africa's transformation.

Keywords: Competence-based education, Curriculum reform, Higher education, Skills mismatch, Stakeholder engagement

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Human capital in agriculture research and development as a tool for economic growth: A case of Makerere University's MSc and PhD program in Plant breeding

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ABSTRACT

Sustainable economic growth in Africa relies heavily on a productive and resilient agricultural and food system, which necessitates a robust agricultural research capacity. Developing this capacity demands targeted investments in specialized human capital. However, empirical evidence quantifying the economic contributions of postgraduate agricultural education programs; especially in plant breeding and biotechnology, remains limited. This study investigates the impact of Makerere University's MSc and PhD programs in Plant Breeding and Biotechnology/Seed Systems on Uganda's economy. We hypothesize that these postgraduate programs are vital engines of economic growth, producing highly skilled human capital essential for Agricultural Research and Development (ARD). The objective of this research is to assess the influence of higher education in agriculture on economic growth. Employing a mixed-methods case study approach, the study integrates quantitative and qualitative analyses through the Economic Surplus model and the Kirkpatrick Framework. Data collection includes a comprehensive survey of program graduates to evaluate their employment trajectories and professional contributions, alongside in-depth interviews with key stakeholders such as university faculty and industry partners. The analysis quantifies both direct and indirect economic contributions of these graduates; highlighting their roles in developing high-yield crop varieties, enhancing food security, facilitating knowledge transfer, and strengthening institutions. Preliminary findings indicate that graduates are significantly influential in national and regional ARD institutions, providing robust evidence for the long-term returns on investment in specialized agricultural education. This study offers actionable policy recommendations for governments and development partners on strategically investing in postgraduate education to enhance human capital, accelerate innovation in plant breeding, and ultimately drive sustainable economic growth throughout Africa. The results underscore the critical importance of specialized agricultural education in building research capacity and fostering economic development.

Keywords: Human capital, agricultural research and development, plant breeding, postgraduate education, economic growth, Uganda, Makerere University, capacity building

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Transforming Africa's Higher Education through Competence-Based Education: Insights from the AgrCBE Project

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ABSTRACT

Africa's socio-economic transformation hinges on producing graduates equipped with practical, transferable, and future-proof competencies. Yet most higher education curricula across the continent remain heavily theoretical and Eurocentric, limiting their responsiveness to labour market needs. The Enhancing Adoption of Competence-Based Agricultural Curricula in Higher Education Institutions in East Africa (AgrCBE) project addresses this gap by strengthening the capacity of higher education governance authorities and institutions in Uganda and Kenya to implement Competence-Based Education (CBE). This paper presents insights from the project's multi-stage, participatory approach involving universities, higher education commissions, ministries of education, regional bodies, and industry partners. Using surveys, stakeholder profiling, and consultative workshops, the project gathered expectations from 110 respondents, industry partners and university teaching staff, on the competencies required of agriculture graduates. Workshops convened across Uganda facilitated consensus-building on draft competency profiles, minimum benchmark design criteria, and assessment frameworks. Digital platforms, including a project website and LinkedIn page, were also established to support continuous engagement. Key outputs include: training of over 229 teaching staff through the online course AgrCBE: The Basics; development of generic competency and professional profiles; harmonized minimum curriculum benchmark criteria; and a draft Student Credit Accumulation and Transfer Framework to improve credit mobility in East Africa. The findings affirm that collaborative curriculum development enhances relevance, alignment with labour market needs, and institutional readiness for CBE adoption. The AgrCBE framework offers a scalable and replicable model for curriculum reform across Africa, strengthening graduate employability, regional competitiveness, and the continent's transition toward a knowledge-driven economy.

Keywords: Agricultural Education, AgrCBE, Competence-Based Education, Curriculum Reform, East Africa, Higher Education

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Rewriting the Social Contract: How Engaged Research Transforms Farmer Development and University Teaching

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ABSTRACT

Universities across Africa are confronting escalating pressures to address inequalities, respond to environmental crises, and restore public trust through substantive engagement with rural communities. In the domain of agricultural sciences, the disparity between research institutions and the lived experiences of smallholder farmers has impeded the relevance and efficacy of academic outputs. This investigation examines how engaged, transdisciplinary research methodologies can enhance farmer development while simultaneously transforming university teaching and learning paradigms. Utilizing case studies from rural South Africa, the research employed participatory approaches, including joint problem diagnosis, mutual knowledge exchange, and iterative learning cycles involving farmers, researchers, and students. The findings indicate that collaborations between farmers and universities foster adaptive capacity, encourage local innovation, and generate solutions tailored to specific agricultural challenges. The integration of such engagements into university curricula has improved students' transformative learning, grounding theoretical knowledge in practical, real-world contexts. Furthermore, engagement activities have blurred traditional boundaries between academic institutions and local communities, facilitating reciprocal flows of knowledge and repositioning universities as socially responsible partners in development initiatives. The study concludes that models of engaged research offer a promising avenue for enhancing the relevance of higher education by embedding service learning, farmer participation, and transdisciplinary pedagogies within agricultural training programs. Policymakers and educational leaders are encouraged to promote institutional frameworks that incentivize community-engaged scholarship and reinforce university–community partnerships to advance sustainable and equitable development.

Keywords: Agricultural education, Engaged research, Farmer–university Partnerships, Participatory methods, Transdisciplinarity

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Empowering communities through seed banks: Building resilient and sustainable agricultural systems

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ABSTRACT

Community Seed Banks (CSBs) are increasingly recognized as vital grassroots institutions that safeguard crop genetic diversity, strengthen local seed systems, and enhance resilience among smallholder farmers confronting climate variability. This study assessed the functionality, constraints, and transformative potential of CSBs in the semi-arid Mudzi District of Zimbabwe, an area highly vulnerable to climatic and socio-economic shocks. Using a combination of literature review, key informant interviews, and two years of direct observational data, the study examined how CSBs contribute to seed security, knowledge exchange, and climate adaptation. Findings indicate that while CSBs are critical for maintaining access to diverse, climate-resilient local varieties, several operational challenges undermine their effectiveness. These include weak documentation and record-keeping systems, insufficient training in seed handling and conservation, limited recognition of policies, and sporadic implementation of germination testing—all of which diminish seed quality assurance and farmers' trust. Despite these barriers, CSBs demonstrate strong potential to enhance food and nutrition security through the conservation of local varieties, farmer-led seed multiplication, and collective learning. Strengthening their role will require scaling up capacity-building programmes, improving institutional support, and increasing the number and geographic reach of CSBs. Policy engagement is essential to formally integrate CSBs into national seed governance frameworks, recognizing them as community knowledge hubs and key actors in promoting agro-biodiversity. Investments in CSBs can build more resilient agri-food systems capable of withstanding climate change, market fluctuations, and socio-economic shocks, while empowering smallholder farmers to preserve and utilize their seed heritage.

Keywords: Agro-biodiversity, climate resilience, community seed banks, seed security

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Abstract No: 150-OP

Cultivating change: Scaling youth and women empowerment through the farmerhub zone model for inclusive agripreneurship

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ABSTRACT

Africa's growing youth population presents an untapped demographic dividend, yet unemployment, skills mismatches, and limited exposure to modern agribusiness continue to constrain youth participation in the agri-food sector. This study evaluates the FarmerHub Zone (FHZ) model, a Greenrev Gr initiative designed to build inclusive agripreneurship ecosystems for youth, women, and underserved communities in Rwanda and Kenya. Using a mixed-methods approach, the study collected qualitative data from interviews and focus-group discussions with 180 participants—including fresh graduates, women, refugees, and private-sector actors—and complemented this with quantitative surveys on employment intent and resource flows across two pilot hubs. Findings show that the FHZ model effectively integrates hands-on regenerative agriculture training, digital and climate-resilient technologies, and structured market access. In 2024 alone, over 300 participants were trained, demonstrating high engagement and strong entrepreneurial intent. The hub's blended model—combining skills development, production support, and value addition—proved effective in facilitating transition from training to enterprise formation. With five new hubs planned for rollout in 2025, the model is projected to create 500–1,000 dignified jobs by 2027, leveraging hydroponics, vertical farming, and eco-innovation. The study concludes that the FHZ model offers a scalable, replicable blueprint for inclusive agricultural transformation across Africa. Policy and development actors are encouraged to invest in similar skilling hubs to enhance food-systems resilience, drive climate-smart agripreneurship, and expand opportunities for youth and women.

Keywords: FarmerHub Zone model, inclusive skilling, regenerative agriculture, women empowerment, youth agripreneurship

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Barriers to Youth Participation in Agricultural Entrepreneurship Opportunities in Liberia

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ABSTRACT

Agricultural entrepreneurship offers a viable pathway to youth employment and national food-system revitalization in Liberia, yet participation remains low due to structural and socio-economic barriers. This study analysed constraints affecting disadvantaged youth across seven counties using data from 391 respondents selected through multistage sampling. A cross-sectional survey design and a validated questionnaire were used to collect quantitative data. Descriptive statistics and multinomial logistic regression were used to assess the magnitude and significance of barriers to youth engagement in agribusiness. Results indicate that lack of access to credit, inadequate agricultural training, limited farmland availability, poor infrastructure, low self-efficacy, and insufficient financial resources constitute the most binding constraints. Regression results show that limited credit access ($p < 0.01$) and lack of training opportunities ($p < 0.05$) significantly predict non-participation. In contrast, youth with greater financial access and greater exposure to training are more likely to engage in agribusiness ventures. The study concludes that addressing these barriers is essential to unlocking Liberia's youth's entrepreneurial potential. It recommends integrated policy interventions, including youth-friendly credit schemes, practical agribusiness training, improved rural infrastructure, and self-efficacy enhancement programmes. Strengthening institutional support and fostering inclusive, skills-driven agricultural entrepreneurship can contribute significantly to employment creation and rural development in Liberia.

Keywords: Agricultural entrepreneurship, multinomial regression, participation barriers, youth

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Universities–community innovation model for sustainable agri-food systems in Uganda

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ABSTRACT

Building sustainable agri-food systems in Uganda requires models that bridge university expertise, community knowledge, and market-driven innovation. This study presents a Universities–Community Innovation Model grounded in lessons from the RUFORUM–RECAP-supported Venture Hub (2018–2021), implemented at Uganda Christian University. Using an integrated approach that links universities, students, communities, and markets, the initiative supported student-led enterprises and a community rice-and-coffee packaging group. A pivotal shift occurred when internship outcomes recommended transitioning from rice to cocoa—a perennial, climate-resilient crop with strong economic potential. In partnership with communities in Bundibugyo District, the project mobilized 150 cocoa pods to establish a community seedling nursery, producing 20,000–25,000 seedlings for free distribution. Awareness campaigns across Eastern Uganda catalyzed cocoa's official recognition as a regional strategic crop in the Ministry of Science, Technology, and Innovation's 10-year development plan. However, scaling the innovation revealed a significant capacity gap among farmers. In response, the Regional Universities Venture Hub evolved into an autonomous research and extension network focused on mentoring students and farmers in cocoa production, agroforestry, and value addition. The proposed five-year USD 2 million plan aims to strengthen knowledge systems, expand mass propagation and agroforestry integration, and establish cocoa processing infrastructure and incubation centres. Demonstration plots, community knowledge hubs, trained volunteers, and integration with Parish Development Model structures complement these components. The model shows that universities can act as anchors of rural transformation by embedding students in community innovation ecosystems and linking research to value chain development. The initiative offers a replicable framework for climate-resilient agri-food transformation across Eastern Uganda and beyond.

Keywords: Agri-food systems, Cocoa value chain, Innovation hubs, University–community partnerships

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Abstract No: 153-OP

Empowering rural women for sustainable agri-food systems: Evidence from mixed and agropastoral farming systems of Ethiopia

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ABSTRACT

Women' s empowerment is a fundamental determinant of agricultural sustainability, climate resilience, and food system performance within low- income rural settings. In Ethiopia' s mixed and agropastoral systems, persistent gender inequalities restrict women' s access to productive resources, participation in decision- making processes, and leadership roles—thereby limiting their contributions to agroecological transitions. This research evaluates the correlation between women' s empowerment and agroecological performance, utilizing data collected from 619 randomly selected smallholder households across the Oromia and SNNP regions. Empowerment was quantified through the Abbreviated Women' s Empowerment in Agriculture Index (A- WEAI), whereas sustainability indicators were assessed via the FAO Tool for Agroecological Performance Evaluation (TAPE). Findings indicate an average A- WEAI score of 70. 70.89, with notably higher empowerment levels observed in crop- only systems as compared to mixed and agropastoral systems. Economically, empowerment exhibited a positive association with landholdings, the value of agricultural output, women' s land tenure, and the extent of production areas. Environmentally, empowered women demonstrated reduced pesticide application, increased diversity of natural vegetation, and enhanced pollinator presence, although they showed lower livestock diversity. Socially, eight out of ten indicators—including household dietary diversity and youth engagement—were strongly correlated with women' s empowerment. These results illuminate the multidimensional pathways through which empowerment facilitates sustainable agri- food systems, highlighting that gender-responsive interventions can expedite equitable agricultural transformation. The study emphasizes the necessity of policies that incorporate empowerment metrics within agroecological programs, fortify land rights, broaden women' s access to inputs and climate- smart training, and foster inclusive decision-making platforms. Advancing gender equity is imperative for the realization of resilient, productive, and socially equitable food systems in Ethiopia and similar regions.

Keywords: A-WEAI, Agroecology, Climate resilience, Food systems, Women's empowerment

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Solar-powered integrated thresher and roaster for climate-resilient grain processing: A gender-responsive mechanisation innovation

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ABSTRACT

Postharvest losses, labor challenges, and limited mechanization continue to serve as primary obstacles to food security and gender equality within the dryland farming systems of Sub-Saharan Africa. Sorghum and pearl millet—nutritious, drought-resistant grains—are particularly impacted due to intensive manual threshing and roasting activities primarily undertaken by women and youth. This study developed and assessed a solar-powered, gender-responsive combined thresher and roaster to mitigate these issues in Zimbabwe's semi-arid Binga and Mudzi districts. Employing a mixed-methods approach—comprising household surveys, focus group discussions, key informant interviews, and participatory prototyping—the research documented labor burdens, postharvest inefficiencies, and user-driven design specifications. Traditional processing methods were identified as slow, hazardous, and associated with grain losses of up to 40%. Field performance assessments of the solar-powered prototype demonstrated that 50 kg of grain could be processed in approximately 15 minutes—achieving over 70% reduction in processing time and halving grain losses. Users reported decreased dust exposure, enhanced ergonomics, and significant alleviation of physical strain, notably improving women's health, workload, and economic participation. The innovation also fostered increased interest in grain farming among youth and contributed to climate-resilient livelihoods by reducing reliance on electricity and fossil fuels. The study concludes that the integration of solar energy, community co-design, and gender-responsive mechanization has the potential to modernize postharvest systems, empower rural women, and bolster resilience in resource-limited environments. The expansion of such solutions will necessitate targeted investment, training, and policy support to facilitate broader access within rural communities.

Keywords: Climate action, Gender equity, Postharvest systems, Renewable energy, Solar mechanisation, Traditional grains

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The impact of skills training programmes on youth entrepreneurship in African Agribusiness

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ABSTRACT

Africa's rapidly expanding youth population presents both an opportunity for agribusiness growth and a challenge due to widespread unemployment and limited skills alignment with market needs. Skills training programmes have been widely implemented to enhance youth capacities, yet systematic evidence on their effectiveness and sustainability remains fragmented. This study synthesises findings from secondary research conducted between 2012 and 2024 to assess the impact of agribusiness-focused skills training on youth entrepreneurship, employment creation, and income generation across the continent. Following a structured systematic review protocol (PRISMA), the study analysed data from peer-reviewed literature, programme evaluations, and grey sources covering interventions such as Fadama GUYS (Nigeria), ENABLE-TAAT (Kenya, Nigeria, Uganda), N-Power Agro, and other regional initiatives. Results demonstrate consistent positive effects: participants recorded substantial improvements in entrepreneurial competencies, business start-up rates, productivity, and incomes. ENABLE-TAAT beneficiaries reported average income increases of 7%, with country-specific gains as high as 54% in Nigeria. Skills programmes also strengthened food security, business performance, and youth employability. However, structural barriers—including limited access to finance, land, mentorship, and supportive policies—restricted long-term sustainability. Significant methodological limitations were identified, such as weak causal attribution, inadequate follow-up studies, and insufficient attention to soft skills, digital capacities, and contextual differences. The analysis concludes that while skills training is essential, its effectiveness is maximized when coupled with financial inclusion, mentorship, market access, and gender-responsive, context-specific support systems. Policymakers must prioritize integrated programme design, rigorous evaluation frameworks, and long-term support structures to enable youth to translate training into sustainable agribusiness entrepreneurship.

Keywords: Africa, Agribusiness, Capacity development, Employment creation, Skills training, Youth entrepreneurship

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Abstract No: 156-OP

Innovation incubation and entrepreneurship for natural products: Experiences from the PHARMBIOTRAC Innovation Hub, Uganda

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ABSTRACT

Innovation incubation functions as a burgeoning catalyst for invigorating entrepreneurial endeavors, expediting the commercialization of research outputs, and fortifying university–industry collaborations within Africa's bioeconomy sector. This study chronicles the experiences of the PHARMBIOTRAC Innovation Hub at Mbarara University of Science and Technology, which offers support to faculty, students, and innovators in the development of solutions rooted in natural products and traditional medicine aimed at enhancing health and productivity. Employing a comprehensive 15-step incubation ecosystem—including scientific writing, project qualification review, prototyping, regulatory compliance, intellectual property training, business development clinics, and pathways to commercialization—the hub fosters the translation of early-stage ideas into market-ready products. Collaboration with private sector entities and regulatory agencies augments the quality, safety, and scalability of these products. To date, the hub has facilitated the development of over 30 prototypes, encompassing herbal medicines, natural cosmetics, botanical beverages, and pharmaceutical ingredients. An in-house innovation notably addressed critical supply shortages during the COVID-19 pandemic, exemplifying the hub's capacity to respond to public health needs. The findings indicate that this incubation model has bolstered entrepreneurial capacity, stimulated local product development, and heightened demand for incubation services among youth and academic innovators. Nonetheless, extending the impact requires increased investment aimed at scaling promising innovations, facilitating regulatory navigation, and establishing industrial-grade facilities. The study concludes that innovation hubs such as PHARMBIOTRAC constitute essential pillars for advancing Africa's industry of natural products, fostering entrepreneurship, and positioning universities as key drivers of regional economic transformation. Strategic partnerships and sustainable funding will be crucial in scaling the success of incubation initiatives across the continent.

Keywords: Commercialisation, Entrepreneurship, Innovation incubation, Natural products, Traditional medicine

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Abstract No: 157-OP

Inclusive innovation in practice: climate-smart agriculture and vocational training for youth with disabilities in Nakuru County

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ABSTRACT

Climate change disproportionately impacts marginalized populations in Sub-Saharan Africa, with youth with disabilities facing significant challenges in engaging with agriculture, vocational training, and adaptation initiatives. This study presents the Green Inclusion Hub—a youth-led, disability-responsive innovation model established through a collaborative effort between Egerton University and the TAGDev 2.0 Programme in Nakuru County, Kenya. Utilizing participatory co-design, the Hub offers accessible training to young persons with disabilities (YPWDs) in climate-smart agriculture, root and tuber value addition, green innovation, vocational skills, and peer leadership. Data gathered from formative activities conducted during 2023–2024, along with a review of inclusive resilience literature, demonstrate that accessible training enhances participants' confidence, encourages the adoption of climate-smart practices, and supports the development of small-scale enterprises. Peer networks reinforce social inclusion and motivation, while vocational training provides alternative livelihood options—particularly for young women with disabilities. However, participants continue to face challenges such as stigma, limited adaptive tools, and exclusion from affordable credit, reflecting systemic barriers documented within disability-inclusive development literature. The Hub exemplifies that integrating disability, gender, and youth perspectives into climate-resilience initiatives can address systemic exclusion while fostering innovation, agency, and leadership. This initiative offers a replicable model for universities and development partners seeking to mainstream disability inclusion within food system transformation and climate adaptation strategies across Africa.

Keywords: Climate-smart Agriculture, Disability inclusion, Inclusive innovation, Resilience programming, Youth empowerment

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Exposition on a three- pillar university extension strategic framework: Preliminary experiences from the Botswana University of Agriculture and Natural Resources

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ABSTRACT

Higher Education Institutions (HEIs) play a pivotal role in driving sustainable socio-economic development, particularly through strengthening linkages with surrounding communities. For a specialised agricultural university such as the Botswana University of Agriculture and Natural Resources (BUAN), extension serves as a critical mandate alongside teaching and research, enabling the translation of innovations into practice. This paper presents BUAN's preliminary experience in modelling a three-pillar University Extension Strategic Framework aimed at enhancing Research–Extension–Farm Communities and Enterprise Linkages (REFELs) in Botswana. The framework comprises three integrated pillars: the Agricultural Media Resources and Extension Laboratory (AMREL) as a communication and media hub; the On-Station Demonstration Site (OSDS) as a field laboratory for validating and showcasing innovations; and the Adopted Village Extension System (AVES) as a community laboratory for participatory extension, outreach, and rural transformation. An experiential methodology was employed, focusing on BUAN's implementation of AMREL and OSDS, while Oliphant Drifts village was adopted as the pilot community for AVES. Farmers in the village were mobilized into commodity-based cooperative groups, and an on-farm demonstration site (OFDS) was established to strengthen university–community engagement. The paper highlights each pillar's core purpose, operational functions, crosscutting strategic objectives, and expected outcomes, and presents a graphical model of the BUAN Adopted Village Extension (BAVE) strategic framework. Additionally, the paper outlines proposed academic programmes, including degrees in Agricultural Extension and Communication Technology, Agricultural Journalism, and Rural Development Studies, designed to reinforce REFELs. Collectively, the three pillars are envisioned to position BUAN as a national leader in innovation dissemination, rural empowerment, and sustainable agricultural development. The paper concludes by recommending the formulation of a University Extension Policy to fully institutionalize and drive the framework.

Key words: Extension, adopted villages, HEI, technology transfer

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Abstract No: 159-OP

Potential of Agro-industrial parks in fostering inclusive agricultural value chains and rural transformation in Zimbabwe

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ABSTRACT

Agro-industrial parks (AIPs) are increasingly recognized as strategic instruments for enhancing agricultural value chains, attracting investments, and fostering rural industrialization within developing economies. This study explores the emerging role of AIPs in promoting inclusive agribusiness development and rural transformation in Zimbabwe. Through an examination of historical agribusiness trends, policy frameworks, and lessons derived from global and regional AIP initiatives—including the Zambia–Zimbabwe Common Agro-Industrial Park (CAIP) feasibility study—the paper analyzes how AIPs can strengthen competitiveness, increase value addition, and create sustainable employment opportunities. Findings suggest that when strategically located within high-potential agricultural zones equipped with robust infrastructure, AIPs can lower entry barriers for small enterprises, facilitate the integration of rural producers via aggregation and processing centers, and foster linkages across various segments of the value chain. Nevertheless, Zimbabwe's agro-industrial development faces significant challenges, notably macroeconomic instability, inconsistent policy environments, and substantial capital requirements for processing facilities. Despite these obstacles, the dairy sector's considerable processing capacity renders it a promising anchor for the CAIP, with the potential to stimulate a regional dairy value chain. The study underscores essential policy imperatives, including contract farming arrangements, warehouse receipt systems, principles of green industrialization, and public–private partnerships, to enhance the viability of AIPs. It concludes that AIPs can function as transformative agents of inclusive rural development, provided they are supported by coherent policies, infrastructure investments, multi-stakeholder coordination, and capacity-building initiatives targeting SMEs, women, and youth.

Keywords: Agro-industrialization, AIPs, Inclusive growth, Rural transformation, Value addition

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Key drivers sustaining orange-fleshed sweet potato (OFSP) enterprises beyond five years: Evidence from Serere and Kumi Districts, Uganda

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ABSTRACT

Despite the growth potential of Orange-Fleshed Sweet Potato (OFSP) value chains in Uganda, more than 60% of small enterprises fail within five years, thereby limiting rural income generation and nutritional outcomes. This study investigates the managerial, strategic, and operational drivers that have enabled selected OFSP enterprises in Serere and Kumi Districts to persist for over five years in a context characterized by climate stress, poverty, and market volatility. Employing a multiple-case study approach, data were collected through semi-structured interviews, focus group discussions, and direct observation with five OFSP enterprise owners. NVivo was utilized to analyze qualitative data in accordance with Yin's five-phase analytic framework: pattern matching, explanation building, time-series analysis, logic modeling, and cross-case synthesis. Eight themes emerged as vital for sustaining OFSP enterprises: adaptive business models, horizontal communication and networking, operational efficiency, flexibility and responsiveness, market intelligence and pricing strategies, leadership and governance competence, digital and financial literacy, and strategic resource mobilization. Three cross-cutting dimensions of agility—people-related, process-related, and technology-related—were identified as fundamental to maintaining competitiveness. Enterprises that institutionalized these competencies demonstrated greater resilience, enhanced decision-making, and increased capacity to respond to climatic and market disruptions. The findings offer actionable insights for small and medium OFSP entrepreneurs seeking to diagnose capability gaps across strategic, tactical, and operational domains. Strengthening dynamic capabilities, fostering cross-functional collaboration, and investing in digital and financial literacy are essential strategies for improving enterprise longevity and supporting inclusive transformation within the agri-food system of Uganda's Teso sub-region.

Keywords: Agility, business sustainability, entrepreneurial strategies, OFSP enterprises

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Abstract No: 161-OP

Impact evaluation of the PEA-Jeunes Programme on youth agricultural entrepreneurs' income in Cameroon: A multinomial endogenous switching regression analysis

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ABSTRACT

Limited skills, financial exclusion, and unequal access to government support programmes constrain youth agricultural entrepreneurship in Cameroon. The PEA-Jeunes initiative—combining agricultural training and microcredit—was launched to address these gaps, yet its income impacts remain insufficiently documented. Using data from a 2019 ILO survey of 505 youth across four regions, this study evaluates the determinants of accessing programme interventions and their effects on income. Beneficiaries were grouped into: (i) training-only, (ii) training plus microcredit, and (iii) non-beneficiaries. A Multinomial Endogenous Switching Regression (MESR) model with ordered probit selection was employed to correct for selection bias. Results show that PEA-Jeunes successfully targeted youth aged 18–35 with higher education and stronger integration in high-value chains, but Farmer Organizations faced a 47.8% higher likelihood of exclusion. Training alone increased average monthly income by 16,155 CFA francs, while combined training and microcredit increased income by 129,190 CFA francs. Counterfactual analysis indicates that non-beneficiaries could have increased their income by 4,837 CFA francs with training alone and by up to 230,698 CFA francs with combined interventions. Despite positive impacts, program access remains uneven, with regional disparities and stricter criteria for microcredit beneficiaries. The study recommends improving financial inclusion mechanisms, expanding eligibility for youth groups and cooperatives, strengthening post-training support, and tailoring interventions to local agribusiness realities. Scaling integrated training–finance models could significantly enhance youth livelihoods and accelerate Cameroon's rural transformation.

Keywords: Agricultural income, Cameroon, MESR model, PEA-Jeunes, youth entrepreneurship

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Abstract No: 162-OP

Skilling Youth for Agripreneurship: Digital and Green Innovation Training Models in Eastern Uganda

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ABSTRACT

Youth constitute over 75% of Uganda's population; however, their participation in agri-food systems remains minimal due to issues such as unemployment, limited exposure to digital technologies, and weak access to climate-smart agribusiness opportunities. This study examines the effectiveness of youth skilling programmes that integrate digital agriculture, green innovation, and agribusiness incubation in Eastern Uganda. Employing a mixed-methods approach that includes document reviews and interviews with 50 youth beneficiaries from the districts of Budaka and Mbale, the study assessed competencies gained, enterprise outcomes, and constraints impacting programme effectiveness. The findings indicate that experiential learning—particularly modules incorporating digital literacy, mobile agronomy applications, solar-powered irrigation, and postharvest processing—substantially improved youth employability and enterprise development. Beneficiaries reported increased participation in value chains, enhanced productivity through technological adoption, and heightened entrepreneurial intent. Nevertheless, persistent challenges hindered scalability and sustainability, including insufficient financing, gender disparities in access to digital tools, and weak connections between research institutions and extension services. The study concludes that competency-based youth training, when integrated within innovation centres and supported by public–private partnerships, can serve as a catalyst for youth-led agricultural transformation. It recommends targeted investments in digital agriculture hubs, inclusive financing models, and curriculum reforms incorporating climate-smart agribusiness and entrepreneurship. Broadly scaling these initiatives across Sub-Saharan Africa could significantly improve youth livelihoods, promote the adoption of digital agriculture, and bolster food system resilience.

Keywords: Digital agriculture, green innovation, skills development, youth agripreneurship

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Abstract No: 163-OP

Climate-smart and inclusive strategies for enhancing sugarcane production under climate and market shocks in Uriri sub-county, Migori county

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ABSTRACT

Sugarcane farming in Kenya continues to face persistent productivity constraints driven by both climate-related and economic shocks. Erratic rainfall patterns, prolonged droughts, rising input prices, and unstable market conditions have significantly reduced yields and weakened farmer livelihoods, particularly among smallholder producers. Women and youth remain disproportionately affected due to limited access to resources, adaptive technologies, and timely market information. This study examined the key climate and economic shocks influencing sugarcane production and farmer resilience in Uriri Sub-County, Migori County. A cross-sectional survey involving 297 randomly selected sugarcane farmers was conducted using a semi-structured questionnaire administered through face-to-face interviews. Data were analyzed using descriptive statistics, multiple regression, and thematic analysis. Results showed that irregular rainfall and recurrent dry spells contributed to a 23% decline in sugarcane yields over the past five years. Additionally, 78% of farmers identified rising fertilizer costs and delayed miller payments as major economic shocks diminishing profitability. Farmers with access to credit, drought-tolerant cane varieties, and regular extension support exhibited significantly higher productivity ($p<0.05$). However, adaptation uptake remained lower among women and youth due to constraints in input access and training opportunities. The study concludes that enhancing resilience in the sugarcane sector requires scaling affordable climate-smart technologies, strengthening access to credit, ensuring timely payment systems, and improving extension services with a deliberate focus on women and youth. Policy interventions should support market stabilization and localized climate advisory systems to build a more resilient, inclusive, and sustainable sugarcane farming system capable of withstanding future shocks.

Keywords: Climate-smart agriculture, economic shocks, inclusivity, resilience, sugarcane productivity, Western Kenya

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Soil suitability assessment for sustainable upland rice productivity in western Liberia: Implications for food and nutrition security

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ABSTRACT

Rice (Oryza sativa) is a cornerstone of Liberia's national food system, consumed by over 90% of the population, with annual per capita consumption estimated at 110 – 130 kilograms. This heavy dependence on rice affects household food security and stability, with historical price fluctuations leading to civil unrest. Despite its significance, Liberia heavily relies on rice imports, with local production failing to meet national demand due to low yields averaging 1 – 2 metric tons per hectare. Contributing factors include inadequate infrastructure, limited mechanization, and insufficient access to improved seeds and credit. A critical yet underexplored issue affecting rice productivity is declining soil fertility, exacerbated by practices such as continuous cropping and insufficient nutrient replenishment. This study aims to assess soil suitability for rice production across five counties in western Liberia, Bomi, Cape Mount, Gbarpolu, Lofa, and Montserrado, by evaluating key soil physicochemical properties. Data collected from the Liberian Soil Information System were analyzed to classify soil suitability and identify nutrient constraints impacting productivity. The findings reveal that soils are predominantly acidic, with low nitrogen, phosphorus, and potassium levels, indicating significant nutrient deficiencies. Lofa County emerged as the most suitable region for rice cultivation, while Bomi and Montserrado were classified as least suitable. The study underscores the necessity for integrated soil fertility management (ISFM) and site-specific fertilizer recommendations to enhance rice productivity and reduce reliance on imports. Policy implications include prioritizing soil fertility improvement alongside seed distribution and mechanization to strengthen agricultural productivity, ultimately contributing to food security and farmer income in Liberia.

Keywords: Agro-ecology, Climate variability, Food and nutrition security, Soil suitability, Western Liberia

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Breaking seed potato dormancy using biostimulants for improved production in Uganda

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ABSTRACT

Potato (*Solanum tuberosum* L.) is a major staple and income-generating crop in Uganda, yet its productivity remains low due to persistent challenges in the seed system, particularly prolonged tuber dormancy. Dormancy delays sprouting, limits timely planting in the country's bimodal seasons, and reduces multiplication rates of quality seed, thereby constraining seed availability and productivity. This study evaluated the effectiveness of natural biostimulants in promoting sprouting of potato tubers in South Eastern Uganda. The experiment was conducted at Buginyanya Zonal Agricultural Research and Development Institute using two varieties, Kachpot1 and NAROPOT4. A completely randomized design with 54 treatment combinations was used, comprising varying concentrations of Aloe vera extract, seaweed extract, gibberellic acid, and a control. Treated tubers were soaked in the solutions, air-dried, and stored in diffused light for four weeks. Data on days to sprouting, sprout number, sprout length, and sprout vigor were collected and analyzed using ANOVA. Results showed significant treatment effects on dormancy breaking and sprout induction. Aloe vera extract at 400 ml L^{-1} reduced dormancy to 14 days in NAROPOT4, compared to 28 days in the control. Seaweed extract at 600 ml L^{-1} enhanced sprout percentage to 95% and produced the highest mean sprout number (5.2). Gibberellic acid significantly increased sprout numbers across treatments, with stronger responses in NAROPOT4 than Kachpot1. Both Aloe vera and seaweed extracts improved sprout vigor, yielding longer sprouts suitable for seed cutting. The findings demonstrate the potential of natural biostimulants to promote early sprouting and strengthen seed potato systems through faster multiplication. Adoption of these affordable, eco-friendly alternatives can reduce dependency on synthetic chemicals and enhance potato productivity in Uganda.

Keywords: Biostimulants, dormancy, potato, productivity, seed systems, Uganda

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Abstract No: 166-OP

Farmers' knowledge, practices and perceptions on grain postharvest management options in Botswana with special reference to the larger grain borer

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ABSTRACT

Food production in sub-Saharan Africa (SSA) continues to face major threats from climate change, recurrent droughts, and increasing damage by field and storage insect pests. Cereal grains such as maize and sorghum are typically grown under unimodal rainfall systems, harvested once per year, and stored for gradual household consumption. During storage, insect pests cause substantial quantitative and qualitative losses, which are often worsened by limited farmer knowledge on postharvest handling and the absence of effective storage technologies. The recent detection of the larger grain borer (LGB), Prostephanus truncatus, in Botswana presents an additional challenge due to its destructive nature and potential to spread widely. This study assessed the knowledge, practices, and perceptions of smallholder farmers on cereal postharvest management in Chobe and South-East districts, with specific reference to LGB. A mixed-methods approach was used, involving 130 household interviews (56 in Chobe and 74 in South-East) and 20 key informant interviews. Results showed that farmers had no prior knowledge of LGB and relied largely on traditional or unorthodox grain protection practices rather than modern storage technologies. Farmers also perceived that climate change has intensified insect pest pressure, increasing their vulnerability to storage losses. Furthermore, the absence of local suppliers and distributors of improved storage technologies, such as hermetic bags, was identified as a major barrier to their adoption. These findings highlight critical gaps in postharvest knowledge and technology access. Strengthening extension training, enhancing awareness of invasive pests, and improving access to effective storage technologies are essential for reducing grain losses and building resilience of smallholder farming systems in Botswana.

Key words: Extension training, farmer perceptions, grain storage losses, postharvest training, storage insect pests, Sub-Saharan Africa

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Abstract No: 167-OP

Using the yield-SAFE model to assess the impacts of climate change on yield of coffee (Coffea arabica L.) under agroforestry and monoculture systems

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ABSTRACT

Ethiopia economy depends strongly on Coffea arabica production. Coffee, like many other crops, is sensitive to climate change and recent studies have suggested that future changes in climate mayhave a negative impact on its yield and quality. An urgent development and application of strategies against negative impacts of climate change on coffee production is important. Agroforestry-based system is one of the strategies that may ensure sustainable coffee production amidst likelihood future impacts of climate change. This system involves the combination of trees in buffer extremes thereby modifying microclimate conditions. The objective of this was to assess the long-term impacts of climate change on coffee productivity under monoculture and agroforestry systems under different climate change scenarios. The study focused on two representative coffee growing regions of Ethiopia under different soil, climate and elevation conditions. A process-based growth model (Yield-SAFE) was used to simulate coffee production for a time horizon of 40 years. Climate change scenarios considered were: Representative Concentration Pathways (RCP) 4.5 and 8.5. The results revealed that in monoculture systems, the current coffee yields are between 1200-1250 kg ha-1 yr-1, with expected decrease between 4-38% and 20-60% in scenarios RCP 4.5 and 8.5, respectively. However, in agroforestry systems, the current yields are between 1600-2200 kg ha-1 yr-1, the decrease was lower, ranging between 4-13% and 16-25% in RCP 4.5 and 8.5 scenarios, respectively. From the results, it can be concluded that coffee production under agroforestry systems has a higher level of resilience when facing future climate change and reinforce the idea of using this type of management in the near future for adapting climate change negative impacts on coffee production.

Keywords: Albizia gummifera, CORDEX, Ethiopia, HADCM3 model, Process-based model, System resilience

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Development and design of suitable and safe starter fertilizer formulations for improved field crop establishment

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ABSTRACT

In the context of the modern fertilizer industry paradigm, there is a need for an updated understanding of fertilizer ecotoxicology to improve, modernize, and provide a more realistic and agronomically relevant framework for safe fertilizer application systems, as traditional Fertilizer Salt Index (FSI) values based solely on chemical composition no longer reflect agricultural realities. This study revisits the FSI by incorporating ecotoxicological perspectives to design/develop suitable and safe starter fertilizer formulations for enhanced field crop establishment using barley (Hordeum vulgare L.), to identify the critical ecotoxicological index of fertilizer that could complement the newly updated FSI. Barley, as a bioindicator, was tested using 20 saturated fertilizer solutions, assessing their pH, electrical conductivity (EC), and NH3/NH4+ concentrations. Greenhouse trials were conducted with maize and barley across various placement methods, fertilizer types and rates, and soil textures. Key plant traits: emergence, early growth, physiological, and biochemical responses, were recorded alongside an updated FSI and a newly developed FTI. Findings showed that toxicity varied widely among fertilizers, influenced by chemical properties. Machine learning models, especially XGBoost, effectively predicted safe application rates (R^2 = 0.7 for emergence, R^2 = 0.8 for biomass). Analysis revealed strong correlations among physiological traits and significant interactions between fertilizer type, rate, and soil texture. Maize showed lower threshold rates than barley, both in-furrow and subsurface placements. Observable toxicity symptoms included delayed emergence, chlorosis, necrosis, and stunted coleoptiles. Overall, the FTI complements the FSI, offering a practical and ecologically relevant tool for optimizing nutrient management. This approach enables faster, cost-effective, and predictive assessment of fertilizer safety across crop systems.

Keywords: ecotoxicology, fertilizer salt index, Machine learning, electrical conductivity, NH3/NH4+ toxicity

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Abstract No: 169-OP

From pollution to profit: A cost-benefit analysis of rice husk and sugarcane bagasse valorization in western Kenya

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ABSTRACT

The growing popularity of circular economy (CE) is hindered by industrial waste management challenges, with only about 10% of the global economy employing CE practices. Sub-Saharan Africa, including Kenya, has lagged in adopting CE practices due to reliance on linear waste management, which contributes to environmental degradation and lost economic opportunities. In Kenya's sugarcane and rice growing belts, large quantities of bagasse and rice husks are discarded or openly burnt, causing pollution and increased greenhouse gas emissions. This study evaluated economic viability of using sugarcane bagasse and rice husks as additional income stream among sugarcane and rice processors in Western Kenya. To achieve the objective, the study employed Cost-Benefit Analysis Theory. An embedded mixed-method approach was used to collect qualitative and quantitative data from 14 rice processors and 5 sugarcane processors through semi-structured questionnaires and interviews. Cost-benefit analysis model was applied to determine relationship among variables. Qualitative findings supplemented quantitative findings. Cost-benefit analysis indicated that valorizing rice husks and bagasse was economically viable, with positive net revenue margins reported across all processors utilizing by-products. The study recommends providing tailored financial incentives such as grants and low-interest loans to promote the adoption of CE practices at scale. In addition to stimulating CE adoption, the incentives will create additional income opportunities, and support Kenya's green and blue economy goals.

Keywords: Agro-processing, Bagasse, valorization, circular-economy, waste management

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Abstract No: 170-OP

Roasted pigeon pea enables sustainable and profitable replacement of soybean meal in Oreochromis shiranus feeds

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ABSTRACT

The rapid expansion of global aquaculture continues to intensify demand for affordable, sustainable feed ingredients, yet reliance on soybean meal remains a major constraint, particularly for small-scale farmers in Malawi where feed costs are prohibitively high. This study explored roasted pigeon pea (Cajanus cajan), a drought-tolerant and locally abundant legume, as a strategic alternative protein source for Oreochromis shiranus. A 12-week feeding trial was conducted using five isonitrogenous (40% CP), isoenergetic diets in which soybean meal was progressively replaced with roasted pigeon pea at 0%, 25%, 50%, 75%, and 100%. A total of 390 fingerlings were randomly allocated to 15 hapas in a Completely Randomized Design with three replicates per treatment. Growth performance, economic returns, fillet quality, nutrient composition, and sensory attributes were comprehensively evaluated, and numerical optimization was used to determine the most profitable inclusion level. Results showed that moderate pigeon pea inclusion supported strong growth, with the 25% diet producing a final weight (24.83 g) comparable to the control (27.67 g). Although growth declined at higher inclusion levels, feed costs decreased substantially. Profitability peaked at 75% inclusion (Profit Index 3.95), while optimization analysis identified an 80:20 pigeon pea–soybean blend as the most economically efficient. Fillet protein content increased significantly (up to 81.5%) in the 25–75% groups, and pigeon pea improved fillet lightness and redness. Sensory evaluation revealed notable enhancements in juiciness and tenderness at 25% inclusion. Overall, roasted pigeon pea is a viable, cost-effective, and quality-enhancing ingredient for O. shiranus diets. Moderate inclusion (25–50%) optimizes growth and quality, while higher inclusion (75–80%) maximizes profitability, offering a practical pathway toward resilient, locally driven aquafeed systems in Malawi.

Keywords: Aquafeeds, climate resilience, *Oreochromis shiranus*, pigeon pea, profitability, protein source

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Abstract No: 171-OP

Assessment of the effect of including pigeon pea (Cajanus cajan) on growth performance, profitability and meat quality of Oreochromis shiranus (Boulenger, 1897)

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Abstract

The rapid expansion of global aquaculture continues to intensify demand for affordable, sustainable feed ingredients, yet reliance on soybean meal remains a major constraint, particularly for small-scale farmers in Malawi where feed costs are prohibitively high. This study explored roasted pigeon pea (*Cajanus cajan*), a drought-tolerant and locally abundant legume, as a strategic alternative protein source for Oreochromis shiranus. A 12-week feeding trial was conducted using five isonitrogenous (40% CP), isoenergetic diets in which soybean meal was progressively replaced with roasted pigeon pea at 0%, 25%, 50%, 75%, and 100%. A total of 390 fingerlings were randomly allocated to 15 hapas in a Completely Randomized Design with three replicates per treatment. Growth performance, economic returns, fillet quality, nutrient composition, and sensory attributes were comprehensively evaluated, and numerical optimization was used to determine the most profitable inclusion level. Results showed that moderate pigeon pea inclusion supported strong growth, with the 25% diet producing a final weight (24.83 g) comparable to the control (27.67 g). Although growth declined at higher inclusion levels, feed costs decreased substantially. Profitability peaked at 75% inclusion (Profit Index 3.95), while optimization analysis identified an 80:20 pigeon pea–soybean blend as the most economically efficient. Fillet protein content increased significantly (up to 81.5%) in the 25–75% groups, and pigeon pea improved fillet lightness and redness. Sensory evaluation revealed notable enhancements in juiciness and tenderness at 25% inclusion. Overall, roasted pigeon pea is a viable, cost-effective, and quality-enhancing ingredient for O. shiranus diets. Moderate inclusion (25–50%) optimizes growth and quality, while higher inclusion (75–80%) maximizes profitability, offering a practical pathway toward resilient, locally driven aquafeed systems in Malawi.

Keywords: Aquafeeds, climate resilience, Oreochromis Shiranus, pigeon pea, profitability, protein source

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Potato cutting propagation for optimum yield and profitability in Kabale, Uganda

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ABSTRACT

High quality potato seed is of limited supply in Uganda. Planting cut potato seed has been used elsewhere as a way of planting more acreage using less seed. However, the feasibility of this potato propagation method had not yet been established on the current Uganda varieties. It is also not known whether treatment of the cut potato seed improves growth and yield and if this method is economically feasible. This study aimed at determining the feasibility of propagating Uganda potato varieties using seed tuber cuttings, and then determine the economic viability of this method. The growth and yield of cut seed and whole seed tuber for varieties Rwangume, Victoria and Katchpot 1 in Kabale District was compared. Cut seed treatment before planting included application of mancozeb, natural healing and no treatment. Mancozeb was chosen as a fungicide because it is currently the most commonly used and therefore easy to access by farmers in Kigezi among other places in Uganda. The measured growth characteristics included germination rate, plant height, stem number and leaf number while the yield parameters were tuber number and tuber weight. For the economic viability, extra costs and extra benefits for seed cuts as compared to whole seed were determined and compared by partial budgeting. More extra benefits compared to extra costs meant it was viable to cut seed before planting and the reverse meant it was better to continue planting whole seeds. Whole seed tubers out-performed cut potato seed pieces significantly ($P<0.05$) on growth parameters; germination rate, plant height and number of stems across varieties; but the differences within yield of the different treatments was not significant. Mancozeb treated cuttings significantly out-performed natural healed cuttings in terms of growth and yield across the three varieties. Potato propagation by cutting had more extra benefits than extra costs; the reduction in seed input highly reduced production costs ensuring more net benefit as compared to when whole is used. It was therefore more profitable to cut Victoria than cutting Rwangume or Katchpot 1 potato variety. These findings suggest that cut potato seed should be used but these should be treated with mancozeb or any other fungicide to control pathogen entry into cut seed which would otherwise lead to seed decay. This led significant germination rate and hence cut seed produced yields that were comparable to whole seed. Cutting seed would reduce on the scarcity of high-quality potato seed and therefore meet the demand of potato growing zones of Uganda.

Keywords: Potato seed cutting propagation, Optimum yield, Profitability, Cut seed treatment, Cut seed pieces

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Enhancing smallholder resilience through climate-smart soil fertility management in Northern Nigeria

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ABSTRACT

Smallholder farmers in Northern Nigeria face growing vulnerability to erratic weather patterns, soil degradation, and economic shocks that threaten food security and livelihoods. Integrated soil fertility management (ISFM), which combines organic and inorganic inputs, is recognized as a critical strategy to rebuild soil health, enhance crop productivity, and build resilience against climatic and economic stresses. Despite its potential, adoption levels remain low due to limited awareness, input access, and gender inequalities. This study evaluates the impacts of ISFM practices on soil quality, crop yields, and household resilience among smallholder maize farmers, while also examining the influence of gender-sensitive extension services in promoting inclusive uptake and benefits. Field trials were conducted in three communities involving 150 smallholder farmers, with plots receiving organic compost, mineral fertilizers, or integrated ISFM treatments. Soil samples were analyzed for organic matter, nutrient content, and microbial activity before and after two cropping seasons. Crop yield data and household surveys were used to assess food security, income diversification, and adaptive capacity, with gender-disaggregated data highlighting differences in participation and impact. Results showed that ISFM plots recorded a 28% increase in soil organic matter and significant improvements in nitrogen and phosphorus availability compared to control plots. Maize yields increased by an average of 35% with ISFM, outperforming sole organic or mineral treatments. Households practicing ISFM reported greater income diversification from crop sales and agro-processing, which contributed to improved food security and resilience to market and climate shocks. Female-headed households benefitted disproportionately, with higher adoption rates and livelihood improvements attributed to targeted extension support. Nonetheless, challenges were noted, including input affordability and limited access to credit. The findings indicate that ISFM is a viable climate-smart strategy to strengthen soil health and household resilience in Northern Nigeria's vulnerable smallholder farming systems. Gender-responsive extension services are essential to ensure equitable adoption and benefits, while policy interventions should focus on improving input supply chains, capacity-building, and enabling financial access. Scaling such interventions can contribute significantly to systemic agri-food resilience and inclusive rural development under increasing climatic and economic uncertainties.

Keywords: Climate resilience, Food security, Gender inclusion, Integrated soil fertility management, Northern Nigeria, Smallholder farmers

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Suitability of bio-digestate as a bio-fertiliser for agricultural applications

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ABSTRACT

The increasing use of synthetic fertilisers to maximise crop yields? has raised production costs and environmental concerns such as soil degradation, water pollution, and loss of biodiversity. This has not only threatened the long-term sustainability of agricultural production but also sparked interest in exploring other eco-friendly and less costly options, such as bio-fertilisers produced through anaerobic digestion of organic waste. The by-product from the biogas plant, bio-digestate, can be used to fertilise agricultural soils since it is nutrient-rich. However, the suitability of the bio-digestate as a bio-fertiliser depends on its chemical and biological properties, which are influenced by feedstock characteristics and digestion parameters. The evaluation of bio-digestate as a bio-fertiliser remains crucial to unlock its potential benefits for sustainable agriculture and resource recovery. The study aimed to assess the suitability of bio-digestate from the BUAN dairy farm biogas plant as a bio-fertiliser by evaluating its chemical and biological properties to establish its potential for sustainable agriculture. The production of biogas by BUAN dairy farm produces bio-digestate, which creates a working area to utilize the bio-digestate as a bio-fertilizer for agricultural applications. In this study, the bio-digestate samples were collected from the anaerobic digestion biogas plant twice a week for a period of three weeks. The samples were taken to the National Agricultural Research and Development Institute (NARDI) laboratory for cation tests using a Flame Atomic Absorption Spectrometer (FAAS) and a phosphorus test using a UV-Visible Spectrophotometer. For the microbial tests, samples were collected once a month for a period of three months and submitted to the Botswana National Environmental Laboratory for coliform analysis using the membrane filtration method. The results showed that bio-digestate contains macro- and micro-nutrients such as magnesium, copper, zinc, calcium, manganese, sodium, potassium, iron, and phosphorus, which are essential for plants and crops. The study samples had average values of 246.67 milligrams per litre of magnesium, 3.13 milligrams per litre of copper, 15.37 milligrams per litre of zinc, 181.05 milligrams per litre of calcium, 0.53 milligrams per litre of manganese, 729.99 milligrams per litre of sodium, 132.05 milligrams per litre of iron, 0.053% of phosphorus, and 0.088% of potassium. The microbial results indicated that the bio-digestate contains 4.20 * 106 CFU/100ml of total coliforms, 3.18 * 106 CFU/100ml of E.coli, and faecal coliforms of 2.02 * 106 CFU/100ml. In comparison with the commonly used fertilizers in Botswana, LAN and NPK, which contain 4.11% Phosphorus and 5.22% Potassium, the bio-digestate showed about 85.4% and 84.7% lower concentrations for phosphorus and potassium, respectively. However, some essential elements, such as magnesium, copper, zinc, calcium, manganese, and sodium, are absent in synthetic fertilizers but are crucial for plant development. In conclusion, bio-digestate can be a suitable supplementary fertiliser due to its presence of other elements absent in synthetic fertilisers, but its use is limited to forest lands, reclamation sites, and areas with minimal public exposure due to the presence of pathogens. The bio-digestate is classified as Class B bio-solid under the USEPA`s standards.

Keywords: Bio-digestate, Bio-fertiliser, Anaerobic digestion, Coliforms, Macro-nutrients, Micro-nutrients

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Influence of soil fertility management practices on yield of nutrient dense crops in refugee settlements in south-western Uganda

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ABSTRACT

Uganda is Africa's largest refugee-hosting country in Africa, with over 1.5 million due to its open-door policy. Though substantial investment has been made in refugee food provision, nutrition security remains a pressing challenge for the majority. Cultivation of nutrient dense crops such Orange Fresh Sweet potatoes (OFSP), Iron Rich Beans (IRB) and green leafy vegetables (GLV) has been promoted in refugee settlements to enhance nutrition security. This study investigated the influence of soil fertility management (SFM) practices on yield of nutrient dense crops in refugee settlements in Southwestern Uganda. A cross-sectional survey was used to collect socio-demographic and production data from 171 refugees across two case study refugee settlements Rwamwanja RS and Kikuube RS. Descriptive statistics and logistic regression were performed using JASP software. Results show that 64% of refugees in Kibuube RS had stayed for less than 5 years while the majority in Rwamwanja RS (57%) had stayed between 5 to 10 years. Generally, most refugees (85%) perceived their soils as having declined in fertility, with 82.5% of the refugees adopting at least one SFM practice majorly through the utilisation of crop residues. Logistic regression results indicated that location of the refugee settlement was a significant predictor for adoption of SFM practices (Wald=4.23, OR=3.022, p=0.04), with refugees in Rwamwanja RS three times more likely to adopt SFM practices than those in Kikuube RS. Productivities for IRB, GLV, and OFSP were 540 kg/ha, 277.1 kg/ha, and 186 kg/ha, respectively. Overall, the productivities of the nutrient dense crops were far below reported potential yields probably due to the cultivation on nutrient depleted soils. These results are essential to inform strategies to narrow the huge existing yield gap of nutrient dense crops in refugee settlements amidst the diminishing donor support to refugees. Implementation of affordable soil fertility management practices in refugee farming systems will be necessary to ensure sustainable food production and nutrition security in refugee communities.

Keywords: Nutrient dense crops, nutrition security, refugees, soil fertility management

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Effects of weathered rock powders on soil fertility, growth and biomass of banana and carbon turnover under acidic and alkali soil conditions

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ABSTRACT

Declining soil fertility, nutrient imbalances, and the rising costs and environmental impacts of synthetic fertilizers pose major constraints to banana production in tropical smallholder systems. Weathered mafic rock powders (WRPs), such as basalt and olivine, offer a promising, climate-smart alternative due to their slow-release nutrient profile and capacity to enhance carbon sequestration through enhanced weathering. This study evaluated the agronomic potential of basalt powder (BP) and olivine sand (OS), applied alone or in combination with cow manure (CM), on early vegetative growth, soil fertility, and soil carbon turnover in banana (Musa spp.). A greenhouse experiment was conducted using micropropagated dwarf Sanjyaku banana seedlings grown in contrasting acidic (pH 6.0–6.5) and alkaline (pH 7.8–8.0) soils. Six treatments—Control, CM, BP, OS, BP+CM, and OS+CM—were arranged in a completely randomized design with five replicates per soil type. Growth parameters, biomass, nutrient uptake, and soil properties were assessed over 20 weeks. Rock powder–manure combinations significantly enhanced vegetative growth compared to the control, with basalt–manure (BPCM) producing the greatest improvements in plant height (117.3 cm), leaf area (1558.8 cm), and total biomass (171 g), particularly in acidic soils. Nutrient uptake of N, K, Mg, P, and Si increased markedly under combined amendments, reflecting synergistic improvements in nutrient availability. Post-harvest soils showed increased total carbon (up to 38.6 g/kg) and nitrogen, reduced bulk density, and enhanced water-holding capacity. Carbon turnover analyses indicated substantial increases in soil organic carbon stocks, suggesting potential for long-term carbon sequestration through enhanced weathering. These findings demonstrate that basalt–manure mixtures are a potent soil amendment for improving banana productivity and enhancing soil carbon storage. WRPs present a scalable, locally available pathway toward sustainable, climate-resilient banana production in tropical regions.

Keywords: Banana (*Musa* spp.), Basalt powder, Biomass accumulation, Cow manure, Climate-smart agriculture, Weathered rock powders

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High-value safflower-derived biodegradable materials for application in water purification and formulation

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ABSTRACT

Growing environmental and water pollution resulting from industrial effluents—including synthetic dyes, heavy metals, and residues from fossil-fuel–based formulations—continues to pose a global threat to ecosystems and human health. This has accelerated the search for biodegradable, plant-derived materials capable of offering sustainable and cost-effective solutions for water purification and industrial formulations. Lignocellulosic biomasses such as lignin and cellulose are particularly promising due to their abundance, renewability, biodegradability, and versatile physicochemical properties. Safflower (Carthamus tinctorius L.), widely cultivated for its high-value edible oil, generates substantial biomass that remains underutilized despite its sustainability, drought tolerance, and economic importance. This study reports the valorisation of safflower biomass into high-value spherical lignin and cellulose microparticles for application in water purification and Pickering emulsion stabilization. Lignin was extracted using aqueous alkaline extraction followed by acid precipitation, while cellulose was isolated through bleaching. Eco-friendly anti-solvent precipitation was employed to fabricate spherical microparticles, which were characterized using SEM for morphological analysis and FTIR for surface functional group identification. Adsorption performance was evaluated using methylene blue and methyl orange as model pollutants under batch conditions. Both lignin- and cellulose-derived microparticles exhibited high adsorption efficiency, reproducibility, and strong affinity toward the two dye pollutants, highlighting their potential as low-cost, green biosorbents for wastewater treatment. Additionally, the microparticles successfully stabilized Pickering emulsions, demonstrating stability against coalescence and creaming, thus underscoring their applicability in agrochemical, cosmetic, food, pharmaceutical, and drug-delivery formulations. Overall, safflower-derived lignocellulosic microparticles represent a sustainable and multipurpose biomaterial with strong potential for environmental remediation and formulation science.

Keywords: Biodegradable materials, Biosorbents, Formulations, Safflower, water pollution, water purification

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Abstract No: 178-OP

Genome-wide association study for biological nitrogen fixation traits in mini-core cowpea germplasm

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ABSTRACT

Biological Nitrogen Fixation (BNF) efficiency in legumessuch as cowpea (Vigna unguiculata L. Walp) is a key driver of yield performance and soil fertility in sub-Saharan Africa. Nevertheless, littled progress has been made in elucidating the genetic control of the BNF traits in cowpea to sustain smart agriculture in this region. This study aimed to identify cowpea genotypes and map genomic regions associated with BNF traits to facilitate the development of high nitrogen-fixing cultivars. A total of 241 mini-core cowpea genotypes were inoculated with Bradyrhizobium spp. under screenhouse conditions for two cycles using a randomized complete block design with two replicates. Phenotypic data collected on number of nodules (NN) per plant, active nodules (AN, %), and nodule dry weight (NDW) per plant revealed significant differences indicating high genetic variability for nodulation capacity within the population. Genome-wide association analysis (GWAS) was performed using six multi-locus GWAS models implemented in the mrMLM v4.0.2 package. Fifteen significant association signals were identified on nine chromosomes except Vu02 and Vu09 when two multi-locus models were considered. Markers accounting for over 15% variation for BNF traits included 2_31410 (2.32Mb) on Vu05 and 2_45545 (24.93Mb) on Vu06 for NN, 2_06530 (56.64Mb) and 2_27028 (34.31Mb) on Vu01 for AN and 2_50837 (10.07Mb) on Vu01 and 2_11699 (34.41Mb) on Vu07 for NDW, respectively. Positional candidate genes near the peak markers included Vigun06g121800, Vigun01g160600, Vigun10g014400, Vigun07g221500, Vigun07g221300 and Vigun11g096700. Genotype TVu-1477 was identified to have favorable alleles for both three studied traits. The significant markers identified in this study can be converted to competitive Allele Specific-PCR (KASP) markers to accelerate the development of high-yielding cowpea varieties that enhance soil fertility and sustainability in sub-Saharan Africa.

Keywords: *Bradyrhizobium* spp., Biological Nitrogen Fixation (BNF), Cowpea, GWAS, Soil fertility

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Land capability assessment for sustainable land use planning to reduce land degradation in Kalehe Territory, Democratic Republic of Congo

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ABSTRACT

Land degradation constitutes a significant environmental and socio-economic challenge in the highlands of the Eastern Democratic Republic of the Congo (DRC), particularly within the Kalehe territory. This study aims to evaluate land capability to inform sustainable land use planning and mitigate land degradation in this region. Employing a multi-criteria evaluation framework alongside geospatial analysis, the research considered three critical factors—slope, soil texture, and soil depth—to classify the land into five capability classes: very high (I), high (II), moderate (III), low (IV), and very low (V). The land capability map generated was juxtaposed with the current land use map derived from the supervised classification of Landsat imagery. Additionally, a frequency ratio analysis of land degradation features, both observed in the field and via high-resolution Google Earth imagery, was conducted. The findings indicate that the Kalehe territory is predominantly characterized by low land capability classes, with 42.64% classified as low and 26.86% as very low capability. Approximately 18.06% of the territory exhibits moderate capability, while only 3.34% and 9.1% categorized as very high and high capability, respectively. Under the existing conditions, 84.88% of land is utilized within its capability, while 10.57% is underutilized and 4.55% is overutilized. Furthermore, the misalignment of current land use with land capability classes exacerbates the incidence of land degradation features such as erosion and landslides, particularly in low capability classes. There is an urgent need for sustainable land-use planning to enhance land productivity and reduce vulnerability to land degradation. This case study underscores the critical role of land evaluation in sustainable land use planning and offers valuable insights for policymakers striving to achieve land degradation neutrality in the highland landscapes of Eastern DRC

Keywords: Land capability, Land potential, Land use planning, Land degradation

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Abstract No: 180-OP

Enhancing pea production through the integrated use of arbuscular mycorrhizal fungi and phosphate-solubilizing bacteria in phosphorus-deficient soil of Lenye Eastern Cape, South Africa

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ABSTRACT

Low phosphorus (P) availability and strong soil P adsorption are major constraints limiting crop growth and productivity in many agricultural soils. The use of phosphate-solubilizing microorganisms, including arbuscular mycorrhizal fungi (AMF) and phosphate-solubilizing bacteria (PSB), offers a promising strategy to enhance phosphorus availability, improve nutrient uptake, and reduce reliance on synthetic fertilizers. This study evaluated the effectiveness of AMF and PSB, individually and in combination, with varying rates of single superphosphate (SSP) on the growth, yield, and nutrient uptake of green peas (*Pisum sativum* L.) grown on Nitisol soils in Lenye, Middledrift. A field experiment comprising 16 treatments—including control, AMF, PSB, AMF+PSB, three SSP rates, and nine combined AMF/PSB+SSP treatments—was conducted using a 2 2 4 factorial design with three replicates during the June–August 2024 growing season. Plant height, biomass, and nutrient uptake were recorded at harvest. Results revealed that the combination of AMF+PSB with 50% SSP produced the highest plant height, biomass, and nutrient uptake ($P<0.001$) compared to other treatments. Notably, AMF alone or AMF+PSB without SSP also significantly enhanced plant growth, indicating their potential as ecologically friendly biofertilizers. These findings suggest that integrating AMF and PSB with reduced phosphate fertilizer inputs can sustainably improve P availability, crop productivity, and soil health, offering a viable approach for sustainable agriculture and food security.

Keywords: Arbuscular mycorrhizal fungi, biofertilizers, crop yield, nutrient availability, phosphorus adsorption, phosphate-solubilizing bacteria

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Growth and yield response of brassicas to sewage contaminated soils

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ABSTRACT

Sewage spillages in residential areas pose a significant risk of heavy metal contamination in soils, which can be transferred to edible vegetables, threatening food safety and human health. Brassica species are widely cultivated leafy vegetables valued for their rapid growth, high biomass, and economic importance. Additionally, many Brassica species are known metal accumulators and have been applied in phytoextraction due to their ability to tolerate and sequester heavy metals without visible toxicity symptoms. This study investigated the effects of sewage-contaminated soil on the growth and yield of three Brassica species: vegetable rape (Brassica napus), Indian mustard (B. juncea), and cabbage (B. oleracea var. capitata). A pot experiment was conducted using a 3 2 factorial arrangement in a randomized complete block design with three replicates, comparing plants grown in sewage-contaminated soil versus uncontaminated control soil. Growth parameters measured included leaf number, leaf length, root length, and leaf biomass. Results showed that both Brassica species ($p < 0.001$) and soil condition ($p < 0.001$) significantly influenced all measured growth and yield parameters. B. napus demonstrated the highest leaf length, leaf number, root length, and biomass, followed by B. juncea, while B. oleracea var. capitata consistently exhibited lower performance. Plants grown in uncontaminated soil outperformed those in sewage-contaminated soil across all parameters, highlighting the negative impact of heavy metal contamination on vegetative growth and yield. In conclusion, B. napus and B. juncea show superior vegetative performance and may be preferable under variable soil conditions, whereas sewage contamination significantly reduces growth and yield of Brassicas, emphasizing the need for careful management of urban wastewater in vegetable production.

Keywords: Brassica, Heavy metals, Hyper-accumulation, Phytoextraction, Sewage contamination, Vegetable yield

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Evaluation of the cytotoxicity of green-synthesized $CaCO_3$, ZnO, and Fe_2O_3 nanoparticles for agricultural usage

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ABSTRACT

Green nanotechnology has opened new prospects in many fields of science and technology. It has led to the synthesis of nanomaterials that can be utilized as fertilizers, fertilizer carriers and nanopesticides. Given the increasing number of nanoparticles that humans come into contact with, understanding their cytotoxicity is critical. Therefore, this study aimed to evaluate the cytotoxicity $CaCO_3$, ZnO and Fe_2O_3 nanoparticles. Human embryonic kidney cells (HEK293) were used in this study. The 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay was conducted to evaluate the cytotoxic activity, with doxorubicin as positive control. The findings showed that the $CaCO_3$, ZnO and Fe2O3 nanoparticles were less toxic to human embryonic kidney cells (HEK293) with IC50 of 11.41±0.317 µg/mL, 26.32±0.95 µg/mL and 21.30±0.04 µg/mL, respectively, as compared to the commonly used chemotherapy drug doxorubicin which was more toxic to the HEK293 cells (IC50 = 3.152 ± 0.215 µg/mL). Hence, this study has shown that the use of $CaCO_3$, ZnO and Fe_2O_3 nanoparticles in agriculture is safe for humans.

Keywords: Cytotoxicity, Green nanotechnology, Nanoparticles, Sustainable agriculture

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Systematic Review on Potato Tuber Cracking and Fracture Properties

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ABSTRACT

Potato (*Solanum tuberosum*) ranks fourth in global crop production and is cultivated across more than 100 countries due to its nutritional and economic significance. Despite its widespread cultivation, potato productivity is frequently threatened by tuber cracking, which can cause yield losses exceeding 50%, particularly among resource-limited farmers. While individual studies have examined factors contributing to tuber cracking, the evidence remains fragmented and sometimes contradictory. This systematic review consolidates current knowledge on the environmental, agronomic, genetic, physiological, and biochemical drivers of tuber cracking and evaluates management strategies to mitigate the problem. A comprehensive literature search was conducted in Scopus, PubMed, and Google Scholar without date or language restrictions. A three-stage screening process by two independent reviewers identified 32 eligible studies spanning from 1935 to the present, with the majority from North America and fewer studies from Africa and other regions. Data on study location, agronomic practices, outcomes, and interventions were extracted, tabulated, and synthesized. Review findings indicate that rapid water uptake is frequently implicated in tuber cracking, particularly canoe-shaped cracks. However, other significant contributors include heat stress, pathogen associations, planting time, crop spacing, ridging practices, and fertilizer type or rates. Eight groups of management interventions were identified, with pathogen-related strategies being the most studied. Notably, most studies lacked detailed classification of cracking types, limiting precise comparisons. In conclusion, tuber cracking is a multifactorial phenomenon influenced by environmental, agronomic, and physiological factors. Future research should aim to clarify the relative contributions of these factors and refine intervention strategies to reduce skin blemishes and enhance potato productivity, providing a stronger evidence base for sustainable potato cultivation.

Keywords: Management strategies, potato (*Solanum tuberosum*), skin blemish, systematic review, tuber cracking, yield loss

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Consumer demand for plant-based snacks: A driver for employment in ghana's agri-food system: a case study of krunchy protein bar in Sekyere East District of Ghana

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ABSTRACT

The rising global and African shift toward plant-based diets presents significant opportunities for innovation, sustainability, and employment within agri-food systems. This study examines consumer demand for plant-based snacks and their potential to drive employment generation in Ghana, using the Krunchy Protein Bar in the Sekyere East District of the Ashanti Region as a case study. Guided by the Sustainable Livelihoods Framework, the research explores how consumer livelihood assets influence purchase intentions and market uptake of plant-based snacks. A mixed-methods approach was employed, integrating group discussions, surveys, and value-chain analysis. Data were collected from 200 consumers and 50 value chain actors, including producers, processors, and retailers, engaged in the Krunchy Protein Bar value chain to assess determinants of demand and employment dynamics. Results indicate that health consciousness, affordability, and sustainability awareness are key drivers of consumer purchase intentions, whereas limited access to finance, weak distribution networks, and socio-cultural perceptions constrain market expansion. Analysis of the value chain demonstrates that increased consumer uptake can stimulate localized economic activities across raw material production, processing, packaging, and retailing, thereby generating employment opportunities, particularly for youth and women in rural communities. The study highlights consumer demand as a critical lever for livelihood diversification, rural development, and food systems transformation. Policy interventions that strengthen supply chains, enhance consumer awareness, and incentivize private-sector investment in plant-based innovations are essential to fully harness these opportunities. The Krunchy Protein Bar case underscores the capacity of plant-based snack consumption to advance employment, resilience, and sustainability within Ghana's agri-food systems, providing a model for consumer-driven agricultural innovation in Africa.

Keywords: Agri-food systems, consumer demand, employment, Ghana, Krunchy protein bar, plant-based snacks, sustainable livelihoods

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An eco-friendly biofabrication of ZnO and ZnO/β-cyclodextrin nanocomposites using "Moritela Tshwene" extract for active food packaging and agriculture

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ABSTRACT

Green synthesized nano-bio-composites as sustainable biodegradable material for agriculture is evolving. In this work, green synthesized zinc oxide (ZnO)/β-cyclodextrin (β-CD) nanocomposites using leaf extract from Moritela Tshwene (Myrothamnus flabellifolius) (MRY) were characterized. In the MRY extracts presence of saponins, steroids, terpenoids, flavonoids, and phenols were essential for stabilisation and nanoparticles reduction. The UV-Vis spectroscopy revealed absorption peaks at 370 nm for ZnO nanoparticles and at 377 nm for ZnO/β-CD. The FTIR showed Zn–O bond stretching vibrations at 835 cm^{-1} and 902 cm^{-1}, respectively in ZnO NPs and ZnO/β-CD. These vibrations were slightly different from usual 400–600 cm^{-1}, probably because of interactions with plant-based capping and β-CD complexation. The β-cyclodextrin peak at 1154 and 1249 cm^{-1} shows H–O–H, C–O, C–O–C glucose units, and C–O–C for CD rings. The latter peaks were not observed in ZnO Nps, suggesting complexation between cyclodextrin and ZnONps. Both materials showed significant antioxidant activity, but nanocomposites' DPPH radicals scavenging was significantly higher. In the antimicrobial, ZnO/β-CD demonstrated efficacy and effective inhibition against *E. coli, S. aureus*, and *S. typhimurium*. From enhanced stability, antioxidant, and antimicrobial qualities, green-synthesized of ZnO nanomaterials, especially when complexed with β-cyclodextrin, have great potential for use in active food packaging, agriculture e.g biosensors.

Keywords: Antimicrobial, antioxidants, β-CD nanocomposites, Plant extracts, ZnO Nps

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Value addition and its effect on vibrancy of orange-fleshed sweet-potato (ofsp) value chain in Serere and Kumi Districts, North Eastern Uganda

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ABSTRACT

In rural Uganda, limited access to vitamin A, rich foods has led to the introduction of biofortified crops such as Orange, Fleshed Sweet Potatoes (OFSP). Despite being introduced over a decade ago in the Teso sub-region, empirical evidence on OFSP processing, value addition, and its impact on smallholder incomes remains limited. This study assessed the types and levels of OFSP value addition, processing technologies, and factors influencing adoption among 238 smallholder farmers in Kumi and Serere districts in 2025. Descriptive and inferential statistical analyses were used to characterize processing practices and value-added products. Results indicate low adoption of mechanized processing equipment, with 26.5% of farmers using motorized chippers, 25.5% hand-driven chippers, 20.5% bicycle-driven chippers, 3% baking machines, and 1% puree mashers. Motorized chippers were preferred for ease of use, reduced labor for women and youth (43%), higher production efficiency (40%), and lower fuel consumption (30%). Primary OFSP products marketed included sorted raw tubers (42.4%), sweet potato leaves (35.7%), and vines (8.4%). Among secondary products, high-quality flour (HQF) dominated (50%), followed by chips (44%), mashed boiled puree (2.2%), and baked products (3%). Low production of baked products was attributed to limited knowledge, inadequate skills, and weak market demand. Socioeconomic factors—age, education, group membership, access to credit, employment, and contractual arrangements—significantly influenced adoption of processing and value addition practices ($p<0.05$). Challenges included difficulty of equipment use (83%), high fuel consumption (17%), and incompatibility of tools (15.5%). Policy implications emphasize strengthening cooperative structures, promoting good processing practices, and facilitating private–public partnerships to support investment in mechanized and high-technology equipment. Scaling industrial OFSP value addition can generate consistent quality puree, flour, and other products to meet local, regional, and AfCFTA market demands, transforming OFSP into an integrated and vibrant value chain that enhances rural livelihoods and economic development.

Keywords: Mechanization, orange-fleshed sweet potato, processing technologies, rural livelihoods, smallholder farmers, Uganda, value addition

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Organoleptic, physicochemical and microbiological quality of yoghurt enriched with indigenous fruits of Botswana

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ABSTRACT

Yoghurt is a widely consumed fermented dairy product with recognized health benefits, including a reduced risk of certain non-communicable diseases. Growing consumer demand for nutrient-dense foods has sparked interest in fortifying yoghurt with fruits and vegetables to enhance its nutritional and sensory qualities. In Botswana, several indigenous fruits, Moretologa (*Ximenia americana* L.), Morula (*Sclerocarya birrea* (A. Rich) Hochst), Mowana (*Adansonia digitata* L.), and Mogose (Bauhinia petersiana Bolle), are traditionally used for food and medicinal purposes, yet remain underutilized despite their nutritional and bioactive potential. This study aimed to develop yoghurt enriched with these indigenous fruits and evaluate its sensory, physico-chemical, and microbial properties. Yoghurt was prepared following standard procedures, and sensory evaluation was conducted to identify the most acceptable formulations. Treatments T1 (90% yoghurt:10% fruit) was selected for Mogose and Moretologa, while T3 (80% yoghurt:20% fruit) was selected for Mowana and Morula, based on overall acceptability. Results demonstrated that fruit enrichment improved nutritional composition, with Mogose yoghurt exhibiting higher protein content (4.28%) compared to the control (3.27%). Syneresis decreased in Morula and Mogose enriched yoghurt from 16.33% (control) to 15.32% and 10.72%, respectively, while total soluble solids increased significantly. Microbial analysis indicated the absence of total coliforms and low yeast and mold counts, confirming product safety. In conclusion, enrichment of yoghurt with indigenous fruits enhanced its nutritional and physico-chemical properties and offers an innovative avenue for valorizing underutilized indigenous plants in Botswana, contributing to food diversification and potential economic benefits.

Keywords: Botswana, enrichment, indigenous fruits, nutritional quality, physico-chemical properties, yoghurt

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Optimum polyethylene glycol level suitable for inducing water stress in potato (*Solanum tuberosum* L.) genotypes in Kenya

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ABSTRACT

Water stress is a major abiotic constraint limiting crop productivity by preventing the expression of genetic potential. Potato (*Solanum tuberosum* L.), the second most consumed food crop in Kenya, is particularly sensitive to drought, with commonly grown cultivars such as Shangi, Unica, Asante, and Markies showing reduced productivity under water deficit. Developing drought-tolerant potato genotypes is therefore crucial for ensuring food security, particularly in Kenya's warm, low-altitude regions. This study evaluated the effect of polyethylene glycol (PEG 6000)-induced water stress on six potato genotypes in vitro, aiming to determine the optimal PEG level for screening drought tolerance. Stem cuttings from two drought-tolerant clonal genotypes (CIP390478.9, CIP397077.16), two susceptible clones (CIP392797.22, CIP398190.735), and two local checks were cultured on Murashige and Skoog (MS) media supplemented with five PEG concentrations (0.0–0.04 gL^{-1}) under controlled conditions. A randomized complete block design with three replicates was used. Results showed significant genotypic differences in survival, leaf formation, and root development under PEG-induced stress. Survival decreased with increasing PEG concentration, though clonal genotypes acclimated by the third week. Leaf formation was highest at 0.02 gL^{-1} PEG, while prolonged exposure caused leaf curling and yellowing, indicating physiological stress responses. Root length and apical root formation were also negatively affected by higher PEG levels, reflecting impaired water uptake and metabolic activity. These findings demonstrate that PEG-induced osmotic stress effectively differentiates drought-tolerant and sensitive genotypes. The study highlights the potential of in vitro PEG screening as a rapid and reliable tool for selecting drought-resilient potato varieties, supporting breeding programs aimed at enhancing productivity and food security in water-scarce regions of Kenya.

Keywords: Drought tolerance, genotype, in vitro, PEG, potato, water stress

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Enhancing access to quality agricultural services through public financing

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ABSTRACT

Agriculture is a vital sector in Tanzania, contributing significantly to GDP, exports, and employment; however, public investment remains inadequate, with budget allocations consistently below regional commitments, hindering sector growth and service delivery. The study aimed at assessing the status of public financing at the Local Government Authority (LGA) level, analyzing budget disbursements, project implementation, and accountability mechanisms from 2017/18 to 2021/22. .The study was conducted through the review of documents and stakeholder's consultation. Findings reveal low and delayed fund disbursement, incomplete projects, and insufficient reallocation of sector revenues — despite LGAs generating up to 87.7% of their own source revenue from crop subsectors, less than 10% is reinvested in agriculture, limiting access to quality services for smallholder farmers. Accountability interventions such as Social Accountability Monitoring (SAM) and Public Expenditure Tracking Surveys (PETS) have improved project outcomes and increased farmer incomes, but challenges persist in budget compliance and community participation. It was concluded that poor service delivery at the LGAs level is primarily due to limited infrastructure, governance, and accountability issues, and recommends increased and well-managed budget allocations, enforcement of revenue-sharing requirements, and strengthened monitoring systems to improve agricultural support and community benefits

Keywords: Accountability, agricultural financing, budget allocation, LGAs, Public investment, Tanzania

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Farmer's challenges and coping strategies to effective utilization of mobile phone for agricultural marketing in Lofa County, Liberia

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ABSTRACT

Marketing agricultural produce via mobile phones plays an important role in farmers' profitability, production, and decision-making. In Liberia, many farmers lack access to mobile phones, limiting their ability to secure favorable prices for their farm produce. This study therefore seeks to identify farmers' challenges and coping strategies for effective utilization of mobile phone use in agricultural marketing in Lofa County, Liberia. A quantitative research method and a descriptive survey design were adopted for the study. Structured questionnaire, validated by five experts from the Ministry of Agriculture and the University of Liberia, guided the study. The Cronbach's alpha coefficient for Farmer's Mobile Phone Challenges and Coping Strategies Questionnaire (FMPCCSQ), was used to collect data from 327 participants, was 0.85. Data were analyzed descriptively and inferentially using SPSS version 22 to answer research questions and test hypotheses. Poor mobile network connectivity, high cost of mobile gadgets, and lack of social and technical support from extension officers were among the challenges faced by farmers. Farmers addressed these challenges through collaboration with companies, marketing agricultural produce to local buyers, and utilizing cooperatives to market farmers produce rather than farmers themselves. The recommendations, among others, were that farmers should obtain information on the prices of agricultural produce from other farmers who have access to mobile phones, and that government, through the Ministry of Agriculture, formulates policies promoting ICT-based information services for agricultural marketing.

Keywords: Agricultural marketing, Farmer's challenges, Liberia, Mobile phone, Lofa County

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Building the why: Our career insights and community strategy

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ABSTRACT

Youth unemployment and underemployment remain critical challenges in sub-Saharan Africa (SSA), with the region exhibiting some of the highest youth unemployment rates globally. While rural-urban migration, gender disparities, and limited education contribute to this issue, skills mismatch—particularly among the educated—has emerged as a key driver of underemployment. Most young people find some form of work, highlighting underemployment rather than unemployment as the pressing concern. Forecasts indicate that SSA's working-age population will continue to grow rapidly until 2050, underscoring the need to develop quality jobs that align with evolving market demands. Agriculture and agribusiness are identified as key sectors with significant potential for job creation. To address skills mismatch and support informed career decisions, the user-centred digital platform Swara has been developed. Swara provides personalised, actionable insights into career pathways, helping students, graduates, professionals, educators, and industry stakeholders navigate dynamic sectors like agriculture. By aligning individual skills with market trends, technological advancements, and regulatory changes, the platform highlights emerging roles and evolving opportunities. Interactive tools, expert analysis, and community feedback enable users to visualise potential career trajectories, anticipate future skills needs, and make informed decisions. Tailored to the African context, Swara bridges the gap between education and employment by providing practical, data-driven guidance that evolves alongside user profiles and industry developments. By combining personalised recommendations, sector insights, and real-world perspectives, the platform empowers youth to explore future-proof careers, reduces skills mismatch, and strengthens the region's workforce readiness for sustainable economic growth.

Keywords: Career guidance, digital platform, future skills, skills mismatch, sub-saharan africa, youth employment

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