



UNITED REPUBLIC OF TANZANIA

Tanzania Commission for Science and Technology (COSTECH)

9th STICE

DECEMBER
2nd - 4th
2024

Science, Technology and Innovation Conference & Exhibition

The 9th National Annual Science Technology and Innovation
Conference and Exhibitions (9th STICE)

Theme: "Harnessing Science, Technology and Innovation for
Climate Resilience and Competitive Economy"

BOOK OF ABSTRACTS



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Science, Technology and Innovation Conference & Exhibition

Julius Nyerere International Conference Center (JNICC)
Dar es salaam Tanzania





THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
Tanzania Commission for Science and Technology (COSTECH)

**The 9th National Annual Science Technology and Innovation
Conference and Exhibitions (9th STICE)**

List of Abstracts

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Foreword from the Director General



It is with great pleasure that I welcome you to the **9th Annual National Science, Technology, and Innovation Conference and Exhibitions (STICE)**, hosted by the Tanzania Commission for Science and Technology (COSTECH) in collaboration with stakeholders from the science, technology, and innovation (STI) ecosystem. This year's theme, **“Harnessing Science, Technology, and Innovation for Climate Resilience and Competitive Economy,”** underscores the important role of STI in driving economic growth, addressing climate change, and enhancing the sustainability of our society.

The STICE platform has established itself as a cornerstone for Tanzania's STI community, bringing together scientists, researchers, innovators, policymakers, and consumers to exchange knowledge, showcase innovations, and discuss cutting-edge solutions to pressing societal challenges. This year's conference is no exception, as we dig into how technological advancements can not only foster economic competitiveness but also strengthen our resilience against the growing threats of climate change.

This conference aims to achieve several key objectives:

1. Facilitate the sharing of research and innovation outputs across a broad spectrum of fields, supporting that new discoveries are disseminated and adopted effectively.
2. Encourage collaboration among researchers, policymakers, and industry stakeholders to bridge the gap between scientific innovation and practical application.



3. Promote the role of STI in addressing national and global challenges, particularly in the areas of climate resilience and sustainable economic development.
4. Inspire the next generation of innovators and scientists by fostering engagement in STEM education and highlighting the importance of technological solutions for Tanzania's future.

The importance of STICE to the scientific community cannot be overstated. It serves as a dynamic platform for peer learning, policy formulation, and innovation dissemination. Moreover, it enables researchers to present their findings, gain valuable feedback, and build partnerships that can drive the commercialization of innovations. The conference also reinforces COSTECH's mission to transform Tanzania into a knowledge-driven economy where science, technology, and innovation are key drivers of progress. As we move forward, it is my hope that the discussions and collaborations at this year's STICE will not only enrich our understanding of STI but also pave the way for actionable solutions that will positively impact Tanzania and beyond.

Thank you for your continuing support and participation.

Amos M. Nungu (PhD)

Director General, Tanzania Commission for Science and Technology
(COSTECH)



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PAPERS UNDER SUB-THEME : HARNESSING TECHNOLOGICAL AND SCIENTIFIC INNOVATION FOR COMPETITIVE AND INCLUSIVE ECONOMIC GROWTH



Potential of Host Resistance as Important Tool in the



Management of Bacterial Wilt in Tomatoes

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Abstract

Bacterial wilt is a major bacterial disease that impacts tomato (*Solanum lycopersicum*) production in Tanzania. The disease is caused by members of soil borne *Ralstonia solanacearum* with complex pathogen variability and a wide host range complicating its management. We established the use of tomato lines MT56 and WG120 and eggplant line EG190 from the pre-screening experiment to evaluate resistance against *Ralstonia—pseudosolanacearum* strains collected from key tomato-growing regions of Tanzania. Among the three lines resistant to bacterial wilt infection, MT56 and EG190 were selected as rootstocks for grafting with the susceptible tomato variety Moneymaker. Grafted seedlings were challenged with a mixture of strains that were previously used in the evaluation of rootstocks. Grafted seedlings had significantly reduced bacterial wilt incidence compared to self-grafted Moneymaker. Bacterial wilt disease progress as measured by area under disease progress curves (AUDPCs) varied significantly among rootstock/scion combinations ($P=0.0190$). The area under the disease progress curve values was consistently low for self-grafted rootstock and rootstock/scion grafted seedlings. This study demonstrates the potential of using host resistance as an efficient and environmentally friendly management option for bacterial wilt disease.

Keywords: Bacterial wilt, rootstock, Host, Resistance, *Ralstonia solanacearum*, *Ralstonia pseudosolanacearum*

Adoption of Advanta Sunflower Hybrid Seeds and Its Well-Being



Impact on Smallholder Farmers in Dodoma, Singida and Manyara Regions

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Abstract

Recently interventions have focused on rising agricultural productivity through the promotion of improved agricultural technologies such as seeds because these determine the income obtained from farming activities. This study assessed the adoption of and impacts of using Advanta sunflower hybrids seeds (ASHSs) on smallholder farmers' wellbeing. A multistage sampling technique was applied and a sample of 270 smallholder sunflower farmers was selected. The household survey questionnaires, focus group discussions and key informant interviews were used to collect primary data. Descriptive statistics used to profile the studied farmers with respect to their socio-economic characteristics. A binary logistic regression model helped to determine the factors that influence farmers' decisions towards the ASHSs Adoption. Propensity score matching was used to isolate the impact attributable to ASHSs among the smallholder farmers. Results indicated that yield per acre, number of years spent in school, seed price, household size, geographical location and oil content statistically influenced farmers' decision to adopt the ASHSs. There is a significant impact in terms of yield and income from the use of Hysun33 seed and the rest of the seeds. The average treatment effect on the treated (ATT) was positive for all the matching methods; ATT on yield was 201.32kg/acre and income effect of 95161.12 Tshs/acre for Nearest Neighbor Matching where ATT on yield was 155.97kg/acre and income effect of 122875.95 Tshs/acre for the Caliper Matching. Overall, a higher yield and income for the



adopters was attributed to ASHSs compared to the non-adopters. This study recommended that agricultural development initiatives should promote productivity-enhancing agricultural technologies such as hybrid seeds effectively. Also, own seed price in relation to production costs of the seeds should be reconsidered to ensure mutual benefits between farmers and seeds producers.

Keywords: Sunflower, hybrid seeds, impact, income, yield and adoption

Thermal Energy Storage for Drying Agricultural Products

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Abstract



Techno-economic analysis (TEA) and life cycle assessment (LCA) are very important studies in providing information on both economic aspects as well as environmental impacts of newly developed technologies. However, these approaches are not commonly used for the sustainability of developed technologies. Therefore, in this study, TEA and LCA were conducted to understand the economic and environmental aspects of the solar dryer integrated with thermal energy storage (TES) materials for the drying of agricultural products. TEA analysis was assessed using annualized cost, lifecycle savings, and payback period methods, whereas LCA was conducted according to ISO 14040 by using Simapro 9.5.0.0. The LCA focused on material extraction and fabrication processes. The results for TEA showed that the initial investment of the solar dryer was \$5430.9, and the annualized cost was found to be \$562.77. The cumulative present value was found to be \$ 62,232.7 and \$57,836.3 for pineapple and carrots, respectively. The payback period for pineapple was found to be 1.5 years, whereas that for carrots was found to be 1.6 years. The results of the LCA revealed that steel materials have higher environmental impact items in material extraction and fabrication compared to aluminium materials for both categories of midpoint and endpoint. In addition, the damage assessment revealed that the environmental impact was higher on human health, followed by ecosystems and natural resources. Based on TEA and LCA assessments, the fabricated solar dryer was found to be economically feasible and environmentally friendly.

Keywords: Techno-economic analysis, Life cycle assessment, Life cycle inventory

Genotype x Environment Interaction of Selected Common Beans



(*Phaseolus vulgaris* L.) on Seed Iron and Zinc Concentrations

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Abstract

The study was conducted in three sub-ecological locations in Morogoro to assess the effect of environments on seed iron (Fe) and zinc (Zn) concentration. The specific locations were Ndole, Kasanga, and Mlali, each representing distinct environmental conditions. To achieve a comprehensive assessment, 30 bean genotypes were planted using a Completely Randomized Block Design in three replications. Data on seed Fe and Zn concentration among bean genotypes were collected and analyzed using Analysis of Variance (ANOVA). Additionally, a GGE biplot analysis was utilized to evaluate the stability of the bean genotypes in terms of their seed Fe and Zn concentrations across environments. The use of the GGE biplot provided a visual representation of the genotype's performance and stability, facilitating the identification of the most promising genotypes. The analysis of variance indicated that there was no significant difference ($P \leq 0.05$) in seed Fe concentration within each location, but a significant difference was revealed across locations. Seed Zn concentration showed a highly significant difference ($P \leq 0.001$) among bean genotypes both within and across locations. The average seed Fe concentration was 165.1 mg/kg in Ndole, 129.9 mg/kg in Kasanga, and 92.4 mg/kg in Mlali. For seed Zn concentration, the averages were 28.0 mg/kg, 26.9 mg/kg, and 32.8 mg/kg for Ndole, Kasanga, and Mlali, respectively. The GGE biplot revealed that the genotypes Maini Ndefu (G2), NUA-695 (G20), NUA-590 (G14), and Selian-10 (G24) exhibited high stability with high seed



Fe concentration, while the genotypes Rojo (G3), Selian-10 (G24), TARI-06 (G30), and Uyole-04 (G27) exhibited high stability with high seed Zn concentration. Therefore, the best-performing genotypes identified in this study can be recommended for further research and potential release as enhanced varieties for bean farmers. These genotypes can potentially contribute to enhanced nutritional quality and agricultural productivity in the region.

Keywords: Genotype x Environment interaction, Common bean, Fe and Zn Concentration.

Anaerobic Soil Disinfestation Using Locally Available Carbon Sources as a Potential Management Strategy for Bacterial Wilt in Tomatoes

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Abstract

Tomato production in Tanzania is far lower than the 27.5 t/ha global average. Important factors such as deteriorating soil fertility, using vulnerable and low-yielding varieties, unreliable rainfall, diseases, pests, and poor farming practices contribute to reduced tomato production. Bacterial wilt is the most devastating tomato disease in terms of yield losses and complicated management considering pathogen diversity and the soil-borne nature of the disease. On-farm trials and bioassays were conducted to determine the efficacy of anaerobic soil disinfestation (ASD) with wheat bran, rice bran, molasses, and cow manure as carbon sources in suppressing bacterial wilt disease of tomato. We established randomized complete block design (RCBD) experiments in nine fields in Misufini, Mlali villages in Morogoro and Image of Iringa region in mainland Tanzania. The bioassay experiment was also laid in a RCBD and conducted at Sokoine University of Agriculture (SUA) greenhouses using soil naturally infested with *Ralstonia pseudosolanacearum* collected from the same nine fields. The treatments reduced bacterial wilt incidence in tomatoes grown in ASD-treated soils compared to non-treated control soils in field trials at Misufini 1 ($P=0.0205$), Misufini 2 (0.0061), and Mlali 2 ($P=0.019$). There were no significant differences among ASD treatments with different carbon sources in disease incidence. This trend was also observed in the bioassays in which bacterial wilt incidence and area under disease progress curves in tomato seedlings grown in field-treated soils from Image, Mlali, and Misufini were significantly lower than in non-treated controls ($P < 0.0001$). This study confirms that ASD can be used as an important suppressor of pathogens through a soil rejuvenation process that involves the creation of an anaerobic environment in water-saturated soil amended with high carbon-based organic materials.

Keywords: Bioassay, *Ralstonia pseudosolanacearum*. ASD, Latent infection, AUDPC



Assessment of technology transfer practices from Higher Learning Institutions to Small and Medium Enterprises in Tanzania

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Abstract

Tanzania government is focusing on industrialization to create a semi-industrialized economy by 2025. To support this plan, a strong relationship between Higher Learning Institutions (HLIs) and Small and Medium Enterprises (SMEs) are encouraged for smooth technology transfer of innovations. The aim of this study is to know the current status of latest research on technology transfer practices from university-industry and their prospects for national development. The research was conducted through systematic literature review approach by using the PRISMA framework of published papers from 2014 to 2023 to assess the technology transfer practices and mechanisms used in HLIs. The results from the review indicates that the barriers to technology transfer are lack of resources, poor marketing skills, insufficient HLIs-SMEs collaborations and lack of trust among institutions. In spite of these challenges, the technology transfer mechanisms, such as intellectual property licensing and university-industry partnerships enhance the innovation and productivity of industries. The review underscores the need for policy improvement and frameworks to promote collaboration and knowledge exchange between HLIs and SMEs. The author recommends the establishment of dedicated technology transfer offices within HLIs to enhance Intellectual Property management, communication and marketing



strategies and mobilize resources for capacity building.

Keywords: Technology transfer, Higher Learning Institutions, Small and Medium Enterprises, university-industry collaboration, research and development.

Critical Review of the Improvement of Round Potato Productivity Through Use of Simple Planter in the Potato Growing Region in Tanzania

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Abstract

This critical review evaluates the study titled “Improvement of Round Potato Productivity through the Use of Simple Planters in Potato Growing Regions in Tanzania,” which investigates the effectiveness of simple planting technologies in enhancing potato yields among smallholder farmers. The reviewed paper employs a mixed-methods approach, combining quantitative field experiments and qualitative farmer interviews, to assess the impact of simple planters on potato productivity, labour efficiency, and economic viability. Key findings indicate significant yield improvements and labour savings associated with the use of simple planters, corroborating existing literature on the benefits of mechanization in agriculture. Farmers reported high levels of satisfaction with the planters, emphasizing their ease of use and the tangible benefits in productivity. The economic analysis suggests that the initial investment in simple



planters can be offset by increased yields and reduced labour costs, making them a cost-effective option for resource-constrained farmers. Despite these positive outcomes, the study has limitations related to sample size, representativeness, and detailed reporting of control variables. Further research is recommended to address these gaps, including larger, more diverse samples, long-term impact assessments, and comparative studies with other planting technologies. Policy interventions supporting the dissemination and adoption of simple planters are crucial for maximizing their potential benefits. This review underscores the importance of mechanized planting technologies in improving agricultural productivity and sustainability in Tanzania, highlighting the need for comprehensive research and policy support to promote their widespread adoption.

Keywords Economic analysis, Mechanized planting technologies, Potato productivity, costeffective, smallholder farmers.

Digital Agriculture Transformation: Empowering Farmers for Climate Resilience and Inclusive Economic Growth in Tanzania

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Abstract

Digital agriculture holds the potential to revolutionize farming among smallholder farmers in Tanzania by addressing critical challenges such as limited market access, low productivity, and vulnerability to climate change. As the agricultural sector faces mounting pressure



to meet food security demands, digital platforms offer a solution by enhancing efficiency, sustainability, and market connectivity. This study evaluates the level of awareness, adoption, and the barriers faced by smallholder farmers in Tanzania regarding the use of digital agriculture platforms, including e-commerce platforms, farm management applications, and digital extension services. Using a survey of 230 farmers conducted across several regions on the Tanzanian mainland, and analyzing three regional case studies—iShamba, FarmDrive, and Hello Tractor—we found that while 56.5% were aware of digital agriculture platforms, only 35% of those aware farmers had adopted them in their farming practices. The findings point to significant barriers to adoption, with 30% of respondents citing lack of internet access and 35% identifying low digital literacy as major impediments. Despite these challenges, the results underscore the potential of digital platforms to significantly improve productivity, facilitate access to markets, and enhance resilience to climate variability. To fully realize these benefits, there is a need for strategic interventions that focus on improving rural internet infrastructure, making digital tools more affordable, and implementing targeted training programs to enhance digital literacy. These initiatives would help smallholder farmers overcome the barriers to adoption and drive the transformation of agriculture in Tanzania. The study concludes with recommendations aimed at promoting the wider adoption of digital agriculture, ultimately contributing to the modernization of the agricultural sector and improving the livelihoods of smallholder farmers across the country.

Keywords: Digital Agriculture, E-commerce Platforms, Farm Management Apps,

Smallholder Farmers, Tanzania, Digital Literacy, Market Access.



Screening of Groundnut (*Arachis Hypogaea* L.) Genotypes for Yield Performance in Three Agro-Ecological Zones of Tanzania

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Abstract

Groundnut is one of the most important oilseed crops and the most important food crop in the world. It is one of the four economically important oilseeds grown in Tanzania. Groundnut is normally produced by small-scale farmers, particularly women, as a leverage crop for both food and cash crops in all Tanzanian agricultural and ecological zones. However, its production is threatened by a number of biotic and abiotic factors. The evaluation is further complicated by the presence of genotype by environment (GXE) effect, which becomes a major constraint of production. Therefore, the study was conducted in the 2023/2024 cropping season to evaluate and identify genotypes that are both high-yielding and stable



across different agro-ecological zones of Tanzania for possible variety release and also identify environments that can be used for genotype selection. A total of sixteen selected groundnut genotypes were evaluated under Randomized Complete Block Design (RCBD) with three replications for groundnut genotypes screening. Data on morphological traits, yield, and yield components were collected and analyzed. Results revealed the differential performance of the tested genotypes ($p < 0.001$). Three genotypes, ICGIL 17113, NALX-22-18, and ICGV-SM 16528, have shown consistency performance across test environments that guaranteed the existence of potential to revert and combat both nutritional and better yield. The highest average yield was observed in genotype ICGV-SM 16528, having 1582 kg/ha, while the lowest average yield was observed in genotype ICGV-SM 05534, having 733.05 kg/ha. Based on GGE biplot analysis, ICGV-SM 16528 and NALX-22-18 were identified as ideal genotypes. The identified genotypes and existing ones can be integrated into groundnut farming systems to enhance production efficiency. Moreover, the breeders can adopt the information generated from this work to explore the genetic base of groundnuts for further improvement.

Keywords: Groundnut, genotypes, kernel yield, and multi-environmental trial, experimental, genotype x environment interaction



Determination of Farmers' Willingness to Pay for Improved maize seed in Morogoro using Field Experiment for Enhancing Agricultural Productivity

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Abstract

This study determined the willingness to pay (WTP) for improved maize seeds among smallholder farmers in Morogoro region using Becker DeGrootte Marschak (BDM) and Take It or Leave It (TIOLI) elicitation methods. It also assessed factors affecting willingness to pay for the improved maize seed. The study area includes Kilosa and Mvomero districts in Morogoro region, chosen for their significant maize production and accessibility. A sample size of 208 maize-producing households were selected using purposive and random sampling. The field experiment was done with each household on how they purchase seed in the market. Descriptive statistics was used to explain the household characteristics and to estimate the mean willingness to pay. The binary and linear regressions were used to assess the factors that influence the willingness to pay for improved maize seeds. Results indicate that the mean WTP for 2kg of improved maize seeds was approximately Tshs 5231 using the BDM method and Tshs 5000 using the TIOLI method. Implying that farmers are ready to purchase the improved maize seed at an average price of 5000 Tshs to ensure continuity of using the seeds. The factors influencing WTP included maize yield, plot size, education level, and land terrain. The study concludes that smallholder farmers in the study area are willing to invest in improved maize seeds, particularly when the seeds are reasonably priced and accessible. Key policy recommendations include government subsidies for improved



seeds, enhanced agricultural extension services, and promoting farmer cooperatives.

Keywords: Willingness to pay, Maize seeds, BDM, TIOLI, Improved seed.

Exploring the Effectiveness of Commercialization Pathways for University Research Outputs in Tanzania

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Abstract

In today's fast changing world with increasing demand for innovation, universities play an important role in generating new ideas and technologies. However, in developing countries particularly across sub-Saharan Africa, turning university research into useful products or solutions is still a challenge. Moreover, there is limited research on the commercialization of university research outputs from developing countries. Most studies focus on developed countries, where R&D activities are more advanced and supported by robust innovation ecosystems, which is quite distinct from developing countries like Tanzania. As a result, only a few products from Tanzanian universities



reach the market making them lagging in terms of their research and commercialization capabilities. The study explores the effectiveness of commercialisation pathways, aiming to improve the translation of university research outputs into tangible societal benefits. Drawing on case studies from eleven (11) selected universities in Tanzania, the study found that the process of turning research into real-world products can be improved in several ways. These include strengthening collaboration with industries, streamlining intellectual property processes, and fostering a culture of entrepreneurship. The study offers recommendations for universities, industry and policymakers to optimize the commercialization process and unlock the full potential of university research outputs. It proposes that each university should choose the appropriate commercialization pathway based on the type of innovation or technology developed, the university's strategic goals, capabilities, resources and the desired outcomes such as revenue generation, entrepreneurship, or societal impact. Eventually, improving how universities commercialize their research can help speed up innovation, boost economic growth, and solve pressing societal problems.

Keywords: Commercialization Pathways, University Research Outputs, Innovation



Maturity of Industry 4.0 Predictive Maintenance adoption in Tanzania manufacturing industries

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Abstract

Industry 4.0 predictive maintenance (PdM4.0) is a cutting-edge approach to operation and maintenance management within manufacturing industries. It leverages the potential of advanced technologies and data analytics to predict when machines or equipment are likely to fail, thus optimizing maintenance schedules to ensure sustainable manufacturing and production systems. This technique represents a significant shift from traditional and time-based maintenance practices, which often bring either unnecessary maintenance or unexpected failures. Before delving into intervention strategies, it's crucial to establish the maturity level of Predictive Maintenance 4.0 (PdM4.0) adoption in Tanzanian Manufacturing Industries (TMIs). Hence, this study established the PdM4.0 maturity level for Tanzania manufacturing industries (TMIs). Quantitative and qualitative methods including: observation, survey, interviews, and document review were employed to gather respondents' viewpoints in order to establish the maturity level. Utilizing the expert judgment approach as a sampling approach, data from 15 TMIs were analyzed through Minitab version 20.3 and MAXQADA 2020 software. The findings revealed a medium adoption level of PdM4.0, with a maturity level of 2.5 out of 5.0. Notably, 85 percent of TMIs are still below maturity level 3 for PdM4.0, while only 15 percent have already attained maturity level 4. These results show that only a few manufacturing industries have achieved maturity level 4 and none of the surveyed TMIs achieved level 5 of predictive maintenance. Therefore, there is a need for TMIs to



harness the advancement of technological and scientific innovation for competitive and sustainable manufacturing as well as inclusive economic growth.

Keywords: Industry 4.0; maintenance 4.0; maturity level; predictive maintenance; sustainable manufacturing; Tanzania manufacturing industries.

Assessment of biomass from an invasive plant, *Eleusine Jaegeri* as a potential feedstock for the production of biomass briquettes

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Abstract

The study assessed the feasibility of *Eleusine jaegeri*, an invasive plant in Ngorongoro Conservation Area rangelands, as a feedstock for biomass briquette production. It addresses innovative ways of improving rangeland quality while enhancing access to alternative sources of domestic heat energy for the community. The study compared the combustion properties of *E. jaegeri* briquettes with traditional charcoal and rice husk briquettes, including heat energy, volatile matter, ash content, fixed carbon, and moisture content.



Additionally, social perceptions were also analyzed in pastoral villages through household surveys and focus group discussions to gauge community acceptance of *E. jaegeri* briquettes as an alternative source of cooking energy. Results showed that *E. jaegeri* biomass exhibited comparable burning qualities to conventional charcoal. The measured contents of heat energy, fixed carbon and moisture from *E. jaegeri* were within the range for various energy applications recommended by the Tanzania Bureau of Standards (TBS). However, its high ash content (41.39%) suggests the need for further refinement in biomass handling and carbonization processes. Community feedback indicated that using *E. jaegeri* briquettes could reduce health risks, improve ecological sustainability, and mitigate human-wildlife conflicts, presenting socio-ecological advantages over traditional fuel wood. Additionally, the efficient burning qualities of biomass briquettes increase user satisfaction, promoting healthier living conditions for rural communities. In conclusion, *E. jaegeri* shows promise as a viable, sustainable bioenergy source, supporting both environmental conservation and economic benefits. Promoting its use as an alternative fuel could positively impact rangeland quality and livelihoods in Tanzania.

Keywords: Rangelands quality, biomass briquettes, *Eleusine indica*, combustion properties, fuel wood, pastoralists, livelihood.



Making Sense of ‘Late Hatching and Unhatched Eggs’ in University Technological business incubators

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Abstract

University Business Incubators (UBIs) play an essential role in the growth, creation, and development of new ventures. On focusing the challenge of youth unemployment especially in developing countries, universities are practising business incubation plans. Regardless, of the vast studies on business incubation, there are still a gap in the sense that, not all ventures reach the expected growth, with some experiencing delays, known as “late hatching,” and others failing to proceed, denoted by “unhatched eggs”. Now it is important to review the existing literature on the factors affecting this difficulty in university incubators and provide an agenda for the future research. This study aims to determine the factors affecting to late hatching and unhatched eggs in UBIs and to explore how these factors can catalyse the growth, innovation and resilience among the incubates and the management of UBIs by conducting a systematic literature review using PRISMA framework. Additionally, an illustration case study of two university-based business incubators in Mainland Tanzania and Zanzibar was conducted. The findings revealed that insufficient incubators services, lack of incubators specialist particularly in emerging technology, un favourable marketplace trends and macroeconomic conditions and inadequate management expertise of the startups causes to the delayed progress or failure of the startups. This study concludes with recommendations for future research and actionable inputs for practitioners and policymakers seeking to enhance the incubation



processes, including enhanced mentor selection, diversified funding strategies, and better alignment of incubator programs with market demands. These insights are intended to help UTBIs refine their strategies, ultimately improving the success rates of incubated startups.

Keywords: University, Business incubation, University business incubators, Entrepreneurial failure, Innovation, Youth unemployment

Understanding Causes of Delayed Progress and Startups Failure in University Business Incubators: A systematic Literature Review

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Abstract

University Business Incubators (UBIs) play an essential role in the growth, creation, and development of new ventures. Towards focussing the challenge of youth unemployment especially in developing countries, universities are practising business incubation plans. Despite of the vast studies on business incubation, there are some gaps including that, not all ventures reach the expected growth, with some experiencing delays and others



failing to proceed. Now it is important to synthesise the existing literature on the factors affecting this difficulty in university incubators and provide an agenda for the future research. This study aims to analyse the causes of delayed progress and startup failure in UBIs and to explore how these causes can catalyse the growth, innovation and resilience among the incubates and the management of UBIs by conducting a systematic literature review using PRISMA framework. Additionally, an illustration case study of two university-based business incubators in Mainland Tanzania and Zanzibar was conducted. The findings revealed UBIs are the main contributors in nurturing entrepreneurship and innovation among their startups. However, insufficient incubators services such as lack of specialist particularly in emerging technology, lack of leadership management, lack of funding, also, lack of entrepreneurial culture, lack of graduate's commitments, un favourable market trends and macroeconomic conditions and the absence of tooling capacity for supporting entrepreneurs lead to delayed progress or failure of the startups in UBIs. The study concludes with recommendations for UBIs managements and central government should enhance the incubation processes, by communicating with wealthy people and other stakeholders to support UBIs. These insights are intended to help UTBIs refine their strategies, ultimately improving the success rates of incubated startups.

Keywords: University business incubators, Delayed progress, Startups failure, PRISMA framework.



Unlocking Tanzania's Innovation Potential: A Systematic Review of the National Innovation Landscape

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Abstract

Innovation plays a pivotal role in driving Tanzania's social, political, and economic advancement. This study conducts a systematic review of Tanzania's national innovation system, examining its strengths and weaknesses through a review of peer-reviewed literature from 2005 to 2022. A focused search strategy using key words like 'national innovation system' and 'innovation policy' yielded 21 relevant articles. The findings indicated that between 2015 and 2018, Tanzania saw a significant concentration of studies on its national innovation system, comprising 47.6% of the total research on national and regional innovation systems in East Africa. Despite this attention, Tanzania ranks low on the global innovation index, remaining among the bottom quartile of countries worldwide. The study further shows that research and higher education institutions, contributing approximately 86% of innovation efforts, predominantly drive development activities in Tanzania. However, the business and non-profit sectors lag behind, making minimal contributions to research and development endeavors. This underlines the need for enhanced collaboration across sectors to foster a more robust innovation ecosystem. While Tanzania's government has initiated policies to promote innovation, challenges persist. Statistics reveal that Tanzania's investment in research and development falls below the global average, limiting its competitiveness on the global innovation stage. Moreover, there is a notable lack of comprehensive understanding and documentation of Tanzania's innovation system performance, indicating a need for further research and collaboration



to bridge this knowledge gap. Addressing these challenges and leveraging its strengths, Tanzania can unlock its innovation potential and drive sustainable development for its citizens.

Keywords: *Knowledge, Innovation Acceleration, National competitiveness, Economic growth, Tanzania*

Mathematical Formulation for a Stockpile Combustion in Analyzing Temperature, Carbon dioxide Emission and Depletion of Oxygen Gas.

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Abstract

A mathematical formulation and numerical investigation of oxygen depletion, carbon dioxide emission and heat generation is studied. Models formulated were assumed to be under unsteady condition. The explicit finite difference scheme was used to tackle the problem. The simulation was done using MATLAB software. The model parameters were varied to see the effect. The study found that increasing Frank-Kamenetskii parameter reduces the amount of oxygen. Besides, the effect of increasing activation energy on oxygen was observed to gradually slow down the consumption of oxygen gas. Modelling the Stockpile combustion is very important to addressing its contribution in climate change. Such models can be used to predict the depletion of oxygen gas and emission of carbon dioxide.



Key words: Stockpile, Combustion, Oxidation reaction, Finite difference Method

Enhancing Gold Exploration in Tanzania through Remote Sensing Techniques Utilizing Google Earth Engine

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Abstract

Mineral resource exploration is a pivotal strategy for driving economic growth in emerging nations, notably focusing on Tanzania's gold exploration. While traditional ground-based methods have been historically employed, their inefficiency and high costs, particularly in expansive areas, have necessitated a transition towards advanced technologies. This study is dedicated to developing and testing a novel methodology for identifying potential hydrothermal gold deposits using the Google Earth Engine (GEE) cloud platform. Leveraging Selective Principal Component Analysis and Crosta Color Composite on Sentinel 2A satellite images, this research enhances spectral information to unveil spectral signatures of hydrothermal alteration, predominantly in iron oxide and hydroxyl minerals across diverse locations. Additionally, the study integrates Shuttle Radar Topography Mission Digital Elevation Model (SRTM DEM) data to extract and map mineralization-controlling lineaments, establishing a robust correlation between hydrothermal alterations, geological



lineaments, and potential gold-bearing areas. The findings underscore the efficacy of remote sensing techniques in identifying numerous potential gold exploration sites with a strong Pearson Correlation value ($R=0.9$) with observed mineral occurrences. This research advocates for the adoption of this innovative methodology nationwide to efficiently identify mining areas, thereby fostering sustainable development.

Keywords: Google Earth Engine, Remote sensing, Sentinel-2, Principal Component Analysis, Hydrothermal alteration, Mineral exploration

Screening of potential donors for anaerobic stress tolerance during germination in rice

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Abstract

The rising cost of transplanting rice has made direct seeding



an affordable alternative for rice establishment, particularly in Africa. However, direct seeding, while cost-effective, faces crop establishment challenges due to flooding. Uncontrolled water, driven by erratic rains in low-lying areas or uneven fields, limit germination. Rice possesses the unique ability of anaerobic germination, enabling it to sprout and emerge in oxygen-deprived conditions. Understanding rice's response to anaerobic stress during germination is crucial for resilience breeding. Africa, although relying on direct seeding, has made limited progress in addressing flooding during germination compared to Asia. Anaerobic stress tolerance ensures successful crop emergence even in oxygen-limited environments and can help suppress weeds, a significant challenge in direct seeded rice cultivation. This study aims to contribute by screening for potential rice donors exhibiting anaerobic stress tolerance. We screened 200 rice genotypes at Sokoine University of Agriculture (SUA) in Morogoro, Tanzania, primarily focusing on landraces with untapped potential. Using an alpha lattice design, we conducted two anaerobic experiments in September and October 2022, adding 7 cm of standing water immediately after dry seeding for flooded and maintaining a 2 cm water level after germination in the control for duration of 21 days. We identified potential donors based on selection index computed from genomic estimated breeding values (GEBVs) using eight variables: germination at 14 DAS, germination at 21 DAS, seedling height at 14 DAS, seedling height at 21 DAS, shoot dry matter at 21 DAS, root dry matter at 21 DAS, culm diameter at 21 DAS, and root length at 21DAS. Ten genotypes emerged as the most promising, exhibiting at least 70% germination in floodwater at 21 DAS and greater selection indices. These genotypes were like: Afaa Mwanza 1/159, Rojomena 271/10, Kubwa Jinga, Wahiwahi, Magongo ya Wayungu, Mpaka wa Bibi, Mwangaza, Tarabinzona, IB126-Bug 2013A, and Kanamalia with respective percentages of 75, 74, 71, 86, 75, 80, 71, 80, 70, and 73. These findings contribute to global efforts to mitigate the impacts of flooding during germination. These donors, will be potential to enrich the gene pool for anaerobic germination, providing valuable resources for breeding for flooding tolerance.



Keywords: flooding, rice, germination, flood tolerance, genotypes

A Systematic Review of African Library Service Adoption in the Fourth Industrial Revolution

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Abstract

The fourth industrial revolution (4IR) has significantly impacted academic libraries and information centres globally. In Africa, where resources may be more limited, the adoption of 4IR technologies presents both challenges and opportunities for academic libraries. According to a recent survey, 85% of academic libraries worldwide have reported integrating 4IR technologies into their services to modernize operations and enhance accessibility. The study objectives are to determine patron awareness of library services in the 4IR, understand users' technological needs, investigate technology-integrated services, and identify adoption factors in African libraries. The study utilizes a systematic literature search approach to gather relevant data from e-resources. Seventy (70) articles and reports were included in the analysis, covering various aspects of 4IR adoption in academic libraries across Africa. The Unified Theory of Acceptance and Use of Technology serves as the theoretical framework for analyses. The findings indicate that



African academic libraries have embraced 4IR technologies such as virtual reality, artificial intelligence, Internet of Things, and mobile apps to enhance their services. However, there is a gap in understanding how patrons interact with these modernized services, as users require digital literacy and ethical skills to effectively utilize them. The findings shows that only 30% of library patrons in Africa feel adequately prepared to engage with 4IR technologies. Limited funding and infrastructure further hinder the integration of technologies into library operations, with 60% of surveyed libraries citing budget constraints as a significant barrier. The study affirms the importance of sustainable development in adopting library services in the 4IR in Africa. It suggests addressing challenges related to technological infrastructure, digital literacy, resource availability, user engagement, partnerships, and policies to facilitate effective adoption. By addressing these factors, African academic libraries can better meet the evolving needs of their patrons in the digital age.

Keywords: Fourth Industrial Revolution (4IR), Academic Libraries, Africa, Technology Adoption, User Needs



Adoption of Advanta Sunflower Hybrid Seeds and Its Well-Being Impact on Smallholder Farmers in Dodoma, Singida and Manyara Regions

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Abstract

Recently interventions have focused on rising agricultural productivity through the promotion of improved agricultural technologies such as seeds because these determine the income obtained from farming activities. This study assessed the adoption of and impacts of using Advanta sunflower hybrids seeds (ASHSs) on smallholder farmers' wellbeing. A multistage sampling technique was applied and a sample of 270 smallholder sunflower farmers was selected. The household survey questionnaires, focus group discussions and key informant interviews were used to collect primary data. Descriptive statistics used to profile the studied farmers with respect to their socio-economic characteristics. A binary logistic regression model helped to determine the factors that influence farmers' decisions towards the ASHSs Adoption. Propensity score matching was used to isolate the impact attributable to ASHSs among the smallholder farmers. Results indicated that yield per acre, number of years spent in school, seed price, household size, geographical location and oil content statistically influenced farmers' decision to adopt the ASHSs. There is a significant impact in terms of yield and income from the use of Hysun33 seed and the rest of the seeds. The average treatment effect on the treated (ATT) was positive for all the matching methods; ATT on yield was 201.32kg/acre and income effect of 95161.12 Tshs/acre for Nearest Neighbor Matching where ATT on yield was 155.97kg/acre and income effect of 122875.95 Tshs/acre



for the Caliper Matching. Overall, a higher yield and income for the adopters was attributed to ASHSs compared to the non-adopters. This study recommended that agricultural development initiatives should promote productivity-enhancing agricultural technologies such as hybrid seeds effectively. Also, own seed price in relation to production costs of the seeds should be reconsidered to ensure mutual benefits between farmers and seeds producers.

Keywords: Sunflower, hybrid seeds, impact, income, yield and adoption

Techno-Economic Analysis and Life cycle Assessment of Solar Dryer Integrated with Thermal Energy Storage for Drying Agricultural Products

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Abstract

Techno-economic analysis (TEA) and life cycle assessment (LCA) are very important studies in providing information on both economic aspects as well as environmental impacts of newly developed technologies. However, these approaches are not commonly used for the sustainability of developed technologies. Therefore, in this study, TEA and LCA were conducted to understand the economic and environmental aspects of the solar dryer integrated with thermal energy storage (TES) materials for the drying of agricultural products. TEA analysis was assessed using annualized cost, lifecycle savings, and payback period methods, whereas LCA was conducted according to ISO 14040 by using Simapro 9.5.0.0. The LCA focused on material extraction and fabrication processes. The results for TEA showed that the initial investment of the solar dryer was \$5430.9, and the annualized cost was found to be \$562.77. The cumulative present value was found to be \$ 62,232.7 and \$57,836.3 for pineapple and carrots, respectively. The payback period for pineapple was found to be 1.5 years, whereas that for carrots was found to be 1.6 years. The results of the LCA revealed that steel materials have higher environmental impact items in material extraction and fabrication compared to aluminium materials for both categories of midpoint and endpoint. In addition, the damage assessment revealed that the environmental impact was higher on human health, followed by ecosystems and natural resources. Based on TEA and LCA assessments, the fabricated solar dryer was found to be economically feasible and environmentally friendly.

Keywords: Techno-economic analysis, Life cycle assessment, Life cycle inventory



Maintenance adoption in Tanzania manufacturing industries

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Abstract

Industry 4.0 predictive maintenance (PdM4.0) is a cutting-edge approach to operation and maintenance management within manufacturing industries. It leverages the potential of advanced technologies and data analytics to predict when machines or equipment are likely to fail, thus optimizing maintenance schedules to ensure sustainable manufacturing and production systems. This technique represents a significant shift from traditional and time-based maintenance practices, which often bring either unnecessary maintenance or unexpected failures. Before delving into intervention strategies, it's crucial to establish the maturity level of Predictive Maintenance 4.0 (PdM4.0) adoption in Tanzanian Manufacturing Industries (TMIs). Hence, this study established the PdM4.0 maturity level for Tanzania manufacturing industries (TMIs). Quantitative and qualitative methods including: observation, survey, interviews, and document review were employed to gather respondents' viewpoints in order to establish the maturity level. Utilizing the expert judgment approach as a sampling approach, data from 15 TMIs were analyzed through Minitab version 20.3 and MAXQADA 2020 software. The findings revealed a medium adoption level of PdM4.0, with a maturity level of 2.5 out of 5.0. Notably, 85 percent of TMIs are still below maturity level 3 for PdM4.0, while only 15 percent have already attained maturity level 4. These results show that only a few manufacturing industries have achieved maturity level 4 and none of the surveyed TMIs achieved level 5 of predictive maintenance. Therefore, there is a need for TMIs to



harness the advancement of technological and scientific innovation for competitive and sustainable manufacturing as well as inclusive economic growth.

Keywords: Industry 4.0; maintenance 4.0; maturity level; predictive maintenance; sustainable manufacturing; Tanzania manufacturing industries.

WhatsApp Usage in Higher Learning Education in Tanzania: A Boom and Boon Perspective

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Abstract

WhatsApp has become a ubiquitous communication platform globally, permeating various aspects of society, including education. In Tanzanian higher learning institutions, its integration into academic practices has become increasingly prevalent. However, while its benefits are evident, concerns regarding its impact on academic success persist. Understanding the patterns of WhatsApp usage among students and its effects on their academic endeavours is essential for shaping effective educational strategies. This study aims to identify the utilization patterns of WhatsApp among undergraduate students in Tanzanian higher learning institutions, understand the motivations driving its usage, and examine its perceived impact on academic success. A cross-sectional study was conducted, involving 360 undergraduate students from Sokoine



University of Agriculture (SUA) in Morogoro, Tanzania. Structured online questionnaires were used for data collection. Quantitative data were analysed using SPSS, complemented by content analysis for qualitative insights. Among the 360 respondents, 56.1% were male and 43.9% were female. WhatsApp emerged as the primary communication tool, with 89.7% usage. On average, students spent 1 to 3 hours daily on WhatsApp. Key reasons for usage included socializing with friends (93%), sharing academic resources (90.3%), seeking professional opportunities (81%), and expanding social networks (64.2%). Apropos, its impact on academic performance, 48% of students perceived WhatsApp positively, 18.9% negatively, and 32.5% were uncertain about its effects. WhatsApp plays a significant role in the academic and social lives of undergraduate students in Tanzanian higher learning institutions. It serves as a versatile platform for communication, collaboration, and resource sharing. However, its impact on academic success remains ambiguous, with varying perceptions among students. Further research is needed to understand the nuanced effects of WhatsApp usage on student learning outcomes and institutional dynamics.

Keywords: WhatsApp, Higher learning education, Tanzania, Undergraduate students, Academic success

Rethinking University-Technology Transfer Models for Effective Commercialization of Technologies and Innovations

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Abstract



Universities are increasingly recognized for their contribution to driving societal impact that extends beyond their traditional roles in teaching and research. The research outputs in the form of technologies and innovations have the potential to be transferred to the industry, leading to benefit both society and the university. It is trending that, Technology Transfer Offices are receiving substantial scholarly attention as an effective mechanism for commercializing university-developed technologies and innovations. However, the extent and rate at which university technologies and innovations are commercialized, particularly in the context of Sub-Saharan African countries, remains limited, hindering the full realization of socio-economic benefits. This study addresses this gap by exploring the university-technology transfer models and how they can be improved to better support commercialization efforts. The research methodology entailed a systematic literature review of technology transfer models explicitly being utilized within the university setting. In addition, the review was complemented with case studies of two universities in Tanzania, examining how they commercialize technologies and innovations through their technology transfer offices. Findings call on the need for tailored approaches in addressing the unique contextual factors influencing technology transfer in Sub-Saharan Africa's universities. Additionally, the study provides an agenda for future research directions, industry best practices, and policy recommendations aimed at fostering a conducive ecosystem for technology transfer and innovation-driven economic growth.

Keywords: Technology transfer, Universities, Commercialization, Technology transfer offices,



Object-Centric Process Mining for Industrial Safety Inspection and Quality Conformance Validation

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Abstract

In Industrial 4.0 manufacturing environments, ensuring industrial safety inspection and quality conformance validation is imperative for operational efficiency and regulatory adherence. Traditional approaches to these processes often suffer from inefficiencies stemming from manual labor and subjective assessments. Manual inspection processes are labor-intensive, time-consuming, and prone to errors, necessitating the development of more efficient and reliable methodologies. To address these challenges, a novel framework leveraging Object-Centric Process Mining (OCPM) is developed and applied specifically to industrial safety inspection and quality conformance validation. By integrating advanced analytical techniques with real-world industrial data, the methodology aims to streamline inspection processes, identify risks, and enhance quality control measures. The study yielded promising results, highlighting the efficacy of the proposed approach in improving the efficiency and accuracy of industrial safety inspection and quality conformance validation. Through automation and data-driven insights, the framework facilitates proactive risk management and optimization of operational performance, thereby addressing the shortcomings of traditional methods. In conclusion, the research underscores the significance of adopting data-driven methodologies such as OCPM in modern industrial settings to ensure safety compliance and quality assurance. By embracing advanced analytical techniques, organizations can overcome the limitations of conventional approaches, ultimately leading to enhanced productivity,



compliance, and safety outcomes.

Keywords: Industrial 4.0, Safety Inspection, Quality Conformance, Object-centric Process Mining, Data-driven Methodologies

Comparative Efficiency of Innovative and Improved vs. Traditional Avocado Fruit Pickers: Sothorn Highlands, Tanzania Experience

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Abstract

Avocado fruit harvesting from tall trees using fruit hitting stick, climb pick drop, and cut off or shaking off branches predispose fruits to physical damages, lower quality and safety, accelerate post-harvest losses and rejection during marketing. Imported fruit pickers exist but most are difficult to carry, operate and to find in most local



markets. This study evaluated the suitability and efficiency of Improved Avocado Fruit Picker (IAFP) developed by local artisan under support of KIBOWAVI project to improve fruit quality at harvest and postharvest among smallholder avocado growers. On-farm participatory trial and field survey were conducted in Busokelo DC, Rungwe DC, Mbeya DC, and Mbozi DC. After field survey, the IAFP was adjusted accordingly to enhance its use suitability and effectiveness. Farmers (n=160) were then given chance to practice avocado fruit harvesting and re-evaluate the tool based on use experiences. Effectiveness and suitability of the IAFP was rated based on its ability to reduce fruit drop outs, fruit stalk detach, harvesting time, and picker's comfortability in the scale of 1 to 10. Use of IAFP by farmers and hand picking methods reduced fruit harvesting time by 42% and 46.1% over bamboo pole, respectively. When experienced farmer involved, the IAFP reduced harvesting time by 25.6% and 59.9% over hand picking and Bamboo pole, respectively. Fruit stalk detach: Hand picking and IAFP reduced fruit stalk detach by 97.1% and 85.6% over Bamboo pole, respectively. When experience farmer involved, the IAFP could reduce destalking by 92.2% over Bamboo pole. Fruit Drop-out: The IAFP reduced number of fruit drop-out by 68.1% and 64.6% over hand picking and Bamboo pole methods, respectively. Interestingly, use of IAFP by experienced farmer could reduce the number of fruit drop to 10 fruits which is 76.3% and 73.8% lower compared to hand picking (42.19 fruits) and bamboo pole (38.07 fruits), respectively. Picker comfortability: The IAFP also reduced picker un-comfortability from 4.1 (of hand picking) and 5.79 (of Bamboo pole) to 1.39 and 1.0 when un-experienced and experienced farmers involved, respectively. IAFP is recommended for reducing fruit rejection, improved fruit quality, and increased farmer's income through sale of large volume of quality fruits. Mass production and dissemination campaigns are required to out scaling use of the tool.

Keywords: Improved avocado fruit picker, Avocado postharvest loss, Postharvest technology



Geospatial Web Information System Development for Managing and Monitoring of Agri-products in Tanzania

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Abstract

In Tanzania, agricultural sector is seen as the main vehicle in national strategies towards an industrialized economy. Government's industrialization plans could be implemented well if sources of raw materials and markets are identified and fully utilized. In order to obtain National food security as mentioned in the current Government manifesto and Sustainable Development Goal (SDG) 2, there should be a proper food supply in terms chain in terms of food production, accessibility and affordability. The Government has embarked on policies and various slogans to promote agriculture. The National Agricultural Policy of 2013, states that Information and communication Technologies (ICTs) in Tanzania is constrained by inadequate agricultural information systems and inadequate coordination of e-services. Various initiatives and innovation are based on web and mobile information platforms have been developed. Despite efforts done to fill the gap caused by inadequate agricultural information systems and inadequate coordination of e-services, still, there is no proper agriculture potential mapping system as to where and when a certain agri-crops are at pick of their harvest and associated markets. It is therefore difficult to locate



what, where and when crops are produced and potential markets for sustainable industries and enhanced national food security. In this research, a Geospatial based web Agri-product and Markets Information System (GeoAMIS) for managing and monitoring of agri-products and access to markets has been developed so as to fill the existing gap by trying to address the key issue of providing proper information to both actors, producers and traders and final consumers. The system provides a platform for agri-products and markets information sharing and accessibility. The geospatial based Agri-information system will be composed of a Web GIS, Mobile App and Short Messages Service (SMS). The geospatial based system aids in decision making as pertains to locating current small- scale and large-scale agri-production, which, when and where agriproducts are produced and associated markets to producers, traders and Government for enhanced food security, industrialized economy and the overall sustainable development.

Keywords: Agricultural Sector, Agri-product, Markets, Geospatial Web Information System



Gold Exploration in Tanzania through Remote Sensing Techniques Utilizing Google Earth Engine

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Abstract

Mineral resource exploration is a pivotal strategy for driving economic growth in emerging nations, notably focusing on Tanzania's gold exploration. While traditional ground-based methods have been historically employed, their inefficiency and high costs, particularly in expansive areas, have necessitated a transition towards advanced technologies. This study is dedicated to developing and testing a novel methodology for identifying potential hydrothermal gold deposits using the Google Earth Engine (GEE) cloud platform. Leveraging Selective Principal Component Analysis and Crosta Color Composite on Sentinel 2A satellite images, this research enhances spectral information to unveil spectral signatures of hydrothermal alteration, predominantly in iron oxide and hydroxyl minerals across diverse locations. Additionally, the study integrates Shuttle Radar Topography Mission Digital Elevation Model (SRTM DEM) data to extract and map mineralization-controlling lineaments, establishing a robust correlation between hydrothermal alterations, geological lineaments, and potential gold-bearing areas. The findings underscore the efficacy of remote sensing techniques in identifying numerous potential gold exploration sites with a strong Pearson Correlation value ($R=0.9$) with observed mineral occurrences. This research advocates for the adoption of this innovative methodology nationwide to efficiently identify mining areas, thereby fostering sustainable development.



Keywords: Google Earth Engine, Remote sensing, Sentinel-2, Principal Component Analysis, Hydrothermal alteration, Mineral exploration

Enhancing Gold Exploration in Tanzania through Remote Sensing Techniques Utilizing Google Earth Engine

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Abstract

Mineral resource exploration is a pivotal strategy for driving economic growth in emerging nations, notably focusing on Tanzania's gold exploration. While traditional ground-based methods have been historically employed, their inefficiency and high costs, particularly in expansive areas, have necessitated a transition towards advanced technologies. This study is dedicated to developing and testing a novel methodology for identifying potential hydrothermal gold deposits using the Google Earth Engine (GEE) cloud platform. Leveraging Selective Principal Component Analysis and Crosta Color Composite on Sentinel 2A satellite images, this research enhances spectral information to unveil spectral signatures of hydrothermal alteration, predominantly in iron oxide and hydroxyl minerals across diverse locations. Additionally, the study integrates Shuttle Radar Topography Mission Digital Elevation Model (SRTM DEM) data to extract and map mineralization-controlling lineaments, establishing a robust correlation between hydrothermal alterations, geological lineaments, and potential gold-bearing areas. The findings underscore the efficacy of remote sensing techniques in identifying



numerous potential gold exploration sites with a strong Pearson Correlation value ($R=0.9$) with observed mineral occurrences. This research advocates for the adoption of this innovative methodology nationwide to efficiently identify mining areas, thereby fostering sustainable development.

Keywords: Google Earth Engine, Remote sensing, Sentinel-2, Principal Component Analysis, Hydrothermal alteration, Mineral exploration

PAPERS UNDER SUB-THEME 2: CLIMATE VULNERABILITY ACROSS DIVERSE SECTORS





Characterization of phenotypic traits associated with anthracnose resistance in selected common bean (*Phaseolus vulgaris* L.) breeding material

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Abstract

Anthrachnose caused by *Colletotrichum lindemuthianum* is the major common bean disease worldwide causing complete yield loss under favourable disease conditions. This study aimed to determine phenotypic traits associated with anthracnose resistance for future use in breeding programmes. Twenty-two common bean varieties (CBVs) were selected basing on susceptibility to anthracnose, advanced breeding lines, and improved variety resembling advanced breeding lines and the farmer variety widely grown in Tanzania. Selected varieties were planted in anthracnose hotspot fields and the same CBVs were planted in a screen house to validate resistance to anthracnose. Anthracnose infection score, leaf length, leaf width, length of fifth internode, length of petiole, plant vigour, canopy height and canopy width were recorded. Data on number of



plants emerging; days to flowering; days to maturity; plant stands at harvest; and grain yield were also collected and analysed using R software. Phenotypic traits evaluated differed significantly among genotypes, environment and genotype by environment interaction. Seventy-five per cent of phenotypic traits evaluated were positively correlated to anthracnose resistance. Highly strong correlations to anthracnose were observed on number of days to maturity, plant stands at harvest, plant vigour and grain yield. Leaf length, leaf width, length of fifth internode, length of petiole and number of stands emerging were strongly correlated to anthracnose resistance. Additive main effects and multiplicative interaction analysis (AMMI) revealed highest contribution of environment on anthracnose infection-58.9% and grain yield -84.9% compared to genotype effects on anthracnose infection -32.7% and grain yield-15.7%. Based on these results, four traits – plant vigour, number of days to maturity, number of plant stands at harvest and grain yield – are recommended for selecting anthracnose-resistant varieties. NUA 48, NUA 64 and RWR 2154 were superior varieties, resistant to anthracnose and high yielding, while Sweet Violet and VTT 923-23-10 were most stable varieties across environments. Further on-farm research is suggested to assess their performance and identify traits preferred by farmers.

Keywords: Common bean, phenotypic traits, anthracnose resistance



The Impacts of Anthropogenic Activities on the Physicochemical Water Quality of Pinyinyi River, Arusha-Tanzania

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Abstract

Anthropogenic activities are responsible for degrading rivers and decreasing their capacity to offer ecosystem services. This paper reports the findings of a study carried out to assess the impacts of anthropogenic activities in Pinyinyi River water quality using physicochemical parameters. BOD, COD, phosphate, pH, EC, TDS, turbidity, DO and nitrate were analysed. Anthropogenic activities around Lake Natron Ramsar site also documented. pH, EC, TDS, turbidity and DO measured in-situ using potentiometric method (HANNA HI 9829). Phosphate and nitrate analysed using photometric method (HACH DR/2700). BOD and COD analysed using bottle incubation method for five days (BOD incubator) and dichromate method (COD digester) respectively. Structured questionnaires used to collect data about anthropogenic activities taking place around Lake Natron Ramsar Site. DO, BOD, COD and turbidity were above the permissible limit. Phosphate, pH, EC, TDS and nitrate were within permissible limit. Irrigation, livestock keeping, fishing, bathing, washing, deforestation, water diversion, sand mining, making bricks along the river, tourist guidance, soda ash harvesting and selling soda ash are the anthropogenic activities taking place around Lake Natron Ramsar Site. River water was found to be unsafe for drinking purposes and was found to be safe for irrigation purposes. The study recommends sustainable



anthropogenic activities along Pinyinyi River and mitigation measure to restore the lost ecosystem services.

Keywords: Anthropogenic activities, Biodiversity, Physicochemical parameters, Water Pollution, Water quality

Comparative of Storage Conditions on the Post Harvest Losses and Quality of Tomato (*Lycopersicon esculentum* L.) Fruits

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Abstract

Tomato (*Solanum lycopersicum* L.) is a member of the Solanaceae family and its fruit is perishable with low shelf life due to postharvest



losses, which depend on the variety, management and storage practice. Temperature also influences post-harvest life of tomato and rate of biological processes including ripening, softening, flavour, aroma, and weight loss. The optimum temperature influencing good quality of tomato fruit, enhancing shelf life and minimizing post-harvest losses is inadequately determined. Therefore, the objective of this study was to determine the effect of optimal storage temperature on quality and marketability parameters of tomato fruits. The experiment was carried out in the laboratory of post-harvest at Sokoine University Agriculture using Completely Randomized Design (CRD) arrangement of treatments replicated three times. The experiment had two treatments which include tomato fruits stored at Ambient ($26\pm 1^{\circ}\text{C}$) and Cool Bolt ($16\pm 1^{\circ}\text{C}$). The result showed that the highest weight loss (7.71%) was for Ambient ($26\pm 1^{\circ}\text{C}$), while the least loss (3.01%) was recorded for tomato fruits stored in Cool Bolt ($16\pm 1^{\circ}\text{C}$). Tomato fruits showed significant increase in hue, chlorophyll degradation and weight and firmness loss. The rate of reduction in hue angle of fruits stored at ambient ($26\pm 1^{\circ}\text{C}$) was low compared to that of the fruits stored at Cool Bolt ($16\pm 1^{\circ}\text{C}$). The shelf life of the fruits significantly increased ($p < 0.001$) with decreasing storage temperature. Cold storage (Cold Bot) further, was able to maintain marketability value by 98.9% compared to 60.1% of ambient storage. However, it has shown no influence on Titratable Acid (TA) and Total Soluble Solids/Titratable Acid (TSS/TA) ratio. Therefore, Cold Bolt ($16\pm 1^{\circ}\text{C}$) storage has greater influence in maintenance of physiochemical quality parameters of tomato fruits. The study concludes that Cool Bot treatment was able to preserve tomato color for longer periods, than ambient storage.

Keyword: Tomato, Ambient condition, Cold bolt, Shelf life, Storage



Interrelationship of Factors Affecting the Functional Response of *Telenomus remus* on Parasitism of *Spodoptera frugiperda* Eggs

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Abstract

A promising technique is the release of egg parasitoids in integrated pest management (IPM) to control pests biologically. The egg parasitoid *Telenomus* (*Telenomus remus*) is a natural control agent of Lepidopteran pests, including Fall armyworm (FAW) (*Spodoptera frugiperda*). However, studies of the factors affecting the functional response of *Telenomus* are limited, despite their significant role in selecting a biological control agent. This is particularly relevant as there has been a growing interest in using *Telenomus* in Africa. From a comprehensive review of 100 papers from reputable scientific databases (Scopus, Web of Science and Google Scholar), we selected 26 peer-reviewed studies. These studies have identified factors such as temperature, host density, parasitoid intra- and inter-specific interaction, parasitoid-host age interactions, chemical cues, host morphology, and parasitoid release distance that influence the functional response of *Telenomus*. For instance, studies indicated that the higher the egg density, the higher the parasitism rate, *Telenomus* preferred to parasitize 1- and 2-day-old eggs, and the higher searching ability of *Telenomus* was observed at



cooler temperatures (20°C-30°C), *Telenomus* females responded both kairomones and sex pheromones emanated by FAW. This paper reviews the interrelationship of factors affecting the functional response of *Telenomus* on parasitizing FAW eggs, which plays a vital role in selecting a parasitoid for biological control programs. However, it is crucial to note that further research is still needed to determine the interaction of host density and sex pheromones, the effect of temperature and artificial kairomone on the searching ability of *Telenomus* under field conditions, and the parasitoid efficacy based on the infestation level and crop stage. This underscores the importance of future well-designed studies under field conditions, providing vivid evidence and recommendations on using *Telenomus* for small-scale farmers who want to adopt this pest control technique.

Keywords: *Telenomus*, FAW, Biological control, Parasitoids, Functional response, IPM

Enhancing Cassava Disease Detection Using CNN Models Trained from Scratch: A Comparative Study with Transfer Learning Approaches

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Abstract

Agriculture is a vital sector, with farmers playing a crucial role in producing food and supporting the global population. However, plant diseases pose significant challenges, leading to substantial crop yield losses and threatening food security. Artificial intelligence models, particularly convolutional neural networks (CNNs), are widely used for object identification and image classification. Although transfer learning techniques help reduce computation time, CNNs often struggle to differentiate between highly similar images because of the limited flexibility in configuring and fine-tuning parameters. To address issues related to random configuration, feature selection, and model architecture, we present a CNN model with 15 layers, trained from scratch. This approach allows for a setup and design better suited to the task of distinguishing similar images. The proposed model is compared to two other CNN-based transfer learning models, InceptionV3 and VGG16, which are trained solely on the top layers with fixed bottom layers. Experimental results indicate that the proposed model outperformed the other models by 24%, achieving an accuracy of 84% over 50 epochs. The experimental results suggest that the proposed approach can achieve even better performance with additional training epochs, as the model's training graph was still improving.

Keywords: Convolution neural network, Cassava, transfer-learning mode



Performance of Napier grass (*Pennisetum purpureum*) cuttings under different levels of selected growth media

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Abstract

Particularly in smallholder farming systems, Napier grass (*Pennisetum purpureum*), a tropical forage, is extensively grown for animal feed. Despite its significance in agronomy, little is known about how various growing media affect Napier grass cuttings, especially when it comes to maximizing soil additives to enhance plant growth. This study examines how the growth performance of Napier grass cuttings is affected by the addition of rice husk to the soil at different concentrations. From March to July 2023, the experiment was carried out at Sokoine University of Agriculture (SUA), Tanzania. Pure soil, rice husk, and three soil-rice husk combinations (25:75, 50:50, and 75:25) were the five growth media compositions that were tested. Three replications and a completely randomized design (CRD) were used. Growth metrics such as plant height, leaf length, growth rate, and leaf width, stem girth, measurements of and were made six days after planting. For every growth parameter, the results indicated substantial differences ($P < 0.001$) among the combinations of growth media. Outperforming the other treatments, the soil-rice husk (50:50) mixture resulted in the maximum plant height (51.82 cm), leaf length (41.55 cm), and stem girth (3.53 cm). The combination of soil and rice husk (25:75) showed the fastest rate of growth and the widest leaves. According to these results, adding rice husk to soil greatly enhances its structure, nutrient availability, and plant growth in general. This study demonstrates how rice husk can be used as an efficient organic amendment to maximize the growth of Napier grass, particularly in environments with limited resources.



The long-term effects of different media combinations on soil health and crop yield under varied environmental circumstances should be investigated in future studies.

Keywords: Napier grass, growth media, planting materials, Forage.

The impacts of mercury pollution: a reflection on human health, food security and economic implications with evidence from developing countries

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Abstract

Mercury pollution poses significant threats to human health, food security, and economic stability, particularly in developing countries. Despite increased awareness and efforts to mitigate its effects, mercury contamination remains a pervasive issue with far-reaching impacts. Accordingly, the present study provides a comprehensive and evidence-based understanding of the impacts of mercury pollution in developing countries, informing decision-making and interventions aimed at mitigating its adverse effects. It systematically reviews the impacts of mercury pollution by deploying a structured and rigorous approach to gather, analyze, and synthesize available evidence on its impacts on human health,



food security, and economic sustainability, with a particular focus on developing countries. The findings reveal that mercury pollution poses a complex and pressing challenge with profound implications for human health, food security, and economic development. The impacts are presumed to be critical in developing countries where regulatory frameworks may be weak, and industrial practices often prioritize profit over environmental protection. Mercury pollution explicitly contributes to food insecurity through various mechanisms, primarily by contaminating aquatic ecosystems and disrupting the availability of safe and nutritious food sources. Consequently, it may cause severe impacts on human health, primarily through exposure to methylmercury, a highly toxic form of mercury that accumulates in fish and seafood. Despite limited studies on the economic consequences of mercury pollution in developing countries, evidence of its significant impacts on health costs, productivity losses, environmental remediation, and food security highlights the tangible economic burden it imposes. Overall, the findings underscore the urgent need for strengthened regulatory frameworks and the promotion of sustainable practices to address the complex and pressing challenges posed by mercury pollution in developing countries.

Keywords: Mercury pollution, environmental impact, human health, food safety, economic stability, developing countries, regulatory measures.



Assessing the impact of human activities on the health condition of the Lukosi River catchment using selected physico-chemical parameters as indicators of water quality, Iringa, Tanzania.

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Abstract

The Lukosi River catchment plays a crucial role in the economic and ecological framework of the country, serving as a major contributor to the Great Ruaha River (GRR). This study aimed to assess the impact of human activities on the health of the Lukosi River by analyzing key water parameters. Three sampling sites across the catchment were selected, and water samples were collected and analyzed using the American Public Health Association technique. A one-sample t-test was used to measure the significance of the difference between the measured water quality parameters and the water quality criteria established by the Tanzania Bureau of Standards (TBS) and the World Health Organization (WHO). The results revealed mean values for various parameters: pH (8.67 ± 0.57), temperature ($24.803 \pm 1.361^{\circ}\text{C}$), EC ($93.30 \pm 3.34 \text{ mgL}^{-1}$), BOD ($14.85 \pm 1.49 \text{ mgL}^{-1}$), TDS ($46.95 \pm 1.55 \text{ mgL}^{-1}$), total hardness ($27.53 \pm 1.28 \text{ mgL}^{-1}$), DO ($3.4 \pm 0.53 \text{ mgL}^{-1}$), turbidity ($109.83 \pm 40.99 \text{ mgL}^{-1}$), NO₂ (79.04 ± 0.73



mgL⁻¹), Cu (6.07 ± 0.60 mgL⁻¹), Ca (7.88 ± 0.36 mgL⁻¹), Mn (0.16 ± 0.07 mgL⁻¹), Cl (7.58 ± 3.97 mgL⁻¹), F (0.12 ± 0.0008 mgL⁻¹), SO₄ (20.42 ± 4.12 mgL⁻¹), Mg (1.92 ± 0.13 mgL⁻¹), Zn (0.14 ± 0.11 mgL⁻¹), Fe (3.56 ± 0.15 mgL⁻¹), and NH₃ (4.67 ± 0.51 mgL⁻¹). Parameters such as DO, turbidity, NH₃, NO₃, and BOD significantly (p = 0.05) exceeded the permissible limits set by the TBS and the WHO. Furthermore, elements including Fe and Cu exceeded allowable limits. Moreover, the WQI was used to indicate that the water in the catchment is unsuitable for sustaining aquatic organisms and is unfit for domestic use. Household questionnaires and direct observations identified key human activities in the catchment: gardening (78.3%), agriculture (68%), livestock keeping (50%), sand mining (21%), and brick-making (21%). Less prevalent were car washing (7%) and fishing (4%). These findings underscore the urgent need for conservation efforts and sustainable management practices to safeguard the Lukosi River catchment (LRC)

Keywords: Health condition, Human activities, Lukosi river catchment, Physico-chemical Parameters, Water quality index.

Pepper (*Piper nigrum* L.) Harvest and Postharvest Handling Practices used by Smallholder Farmers in Morogoro District, Tanzania

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Abstract

The purpose of this study was to collect baseline information on the socio-economic factors, harvesting, and postharvest handling practices among smallholder pepper farmers in Morogoro district, Tanzania. Understanding these practices is vital for developing appropriate harvest and postharvest handling techniques, but less is known about the harvesting and postharvest handling practices used by small-scale farmers in the district. The study was carried out in 10 villages of 5 wards in the Mkuyuni and Matombo divisions, using a mix of semi-structured questionnaires, key informant interviews (KI), and focus group discussions (FGD). The gathered data were analysed using the Statistical Package for Social Sciences Version 25 (SPSS, Inc, USA, IL, USA). The results revealed that a majority (86.6%) of farmers harvested pepper when at least one berry on a spike turned red, indicating that farmers primarily rely on the visual ripeness of the peppercorns for harvesting. Regarding postharvest handling, 86.2% of farmers reported drying their peppercorns under the sun on mats, a common practice for removing moisture. For storage, nearly all respondents (98.6%) stored their dried pepper in polypropylene bags, which is standard practice in the region. However, the study also identified significant postharvest losses due to mould growth, with 95.75% of farmers citing it as the primary cause of deterioration in stored pepper. These findings highlight the need for further studies to optimize drying and storage techniques to reduce mould growth and minimize postharvest losses. Implementing improved postharvest management strategies could enhance the quality and marketability of pepper, eventually benefiting smallholder farmers in Morogoro district. This study underlines the importance of context-specific solutions to improve the postharvest handling of pepper and reduce economic losses.

Keywords: *Piper nigrum*, postharvest management, black pepper drying, storage of pepper.



Predicting the current and future suitable habitats of cassava and cassava brown streak disease in Africa

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Abstract

Cassava (*Manihot esculenta*) is among the most important staple crops globally. In sub-Saharan Africa, it is cultivated mainly by subsistence farmers who depend directly on it for their socio-economic welfare. However, its yield in some regions has been threatened by several diseases, especially the Cassava brown streak disease (CBSD). Changes in climatic conditions enhance the risk of the disease spreading to other planting regions. This work aimed to identify, characterise and map the current and potential future suitable habitats for cassava and cassava brown streak disease in Africa using species distribution models (SDMs). We obtained occurrence data for cassava in Africa from the Global Biodiversity Information Facility (GBIF), and cassava brown streak disease occurrences from published literature. We used an ensemble of four species distribution models (SDMs), together with environmental covariates to characterise the current and future distribution of cassava and CBSD in Africa. Our results identified isothermality (Bio03, relative importance: 31.6%) as the highest contributor to



the current distribution of cassava, while cassava harvested area (CHA, 14.6%) contributed the most to the current distribution of CBSD outbreaks. The geographic distributions of these target species are also expected to shift under climate projection scenarios for two mid-century periods. Using the most recent climate scenarios from the Coupled Model Intercomparison Project (CMIP6) for the mid-term (2041-2060) and long-term (2061-2080) in Africa, our study highlights suitable habitats for cassava, as well as one of its economically important diseases (CBSD). For cassava, about 54.6% (16.2 million km²) of the continent is currently suitable for cassava production. These suitable habitats (i.e., suitability above 0.2) were predicted to be located predominantly in Sub-Saharan Africa. On the other hand, approximately 33.7% of Africa's land area (10.2 million km²) is currently at risk of CBSD spread. Based on our findings we propose that improved cassava varieties tolerant to CBSD should be deployed in all cassava production regions.

Keywords: Cassava; Cassava harvested area; Cassava brown streak disease; climate change; food security.



Pathogenicity of Sisal Brown Leaf Spot and Associated Fungal Species in Tanzania: A Multi-Site Investigation

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Abstract

Sisal (*Agave sisalana*) and aloe, members of the *Agavaceae* family, are economically important crops in Tanzania, with sisal primarily grown in coastal regions and aloe distributed as wild plants. Sisal brown leaf spot (BLS) disease, initially reported in 1982, poses a significant threat to the sisal industry, impacting fiber quality and productivity. This study aimed to investigate the pathogenicity of BLS and identify the associated fungal species. Eight symptomatic sisal plants and rhizosphere soil samples were collected from farms in Morogoro, Kilosa, and Korogwe, along with one wild aloe plant from Lake Eyasi in Arusha. Conventional and molecular methods were used for pathogen isolation and identification, including colony morphology, microscopic examination and ITS Sanger sequencing. Laboratory work was conducted at the plant pathology laboratory at Sokoine University of Agriculture, the results revealed the presence of *Alternaria* species in both sisal and aloe samples and *Fusarium* species in soil samples. Pathogenicity tests confirmed that *Alternaria* species induce typical BLS symptoms in inoculated sisal plants, while



Fusarium species contribute to disease severity through synergistic interactions. The study highlights the influence of environmental conditions and agronomic practices on disease incidence and severity, emphasizing the need for region-specific management strategies. This multi-site investigation provides valuable insights into the management and control of BLS disease, contributing to the development of effective control measures to enhance the productivity and sustainability of sisal plantations in Tanzania. Future research should focus on integrated disease management, soil health improvement, and collaborative efforts among stakeholders to ensure the viability of the sisal industry.

Keywords: Sisal, Aloe, Brown Leaf Spot, Fungal Pathogens, *Alternaria*, *Fusarium*

Predicament for the Sustainability of Wood-Based Industries in the Lake Zone, Tanzania

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Abstract

Wood-based industries play a significant contribution to the utilization of forest products in terms of value addition. This study established the status of the wood-based industries and their optimal productivity level, types of raw materials used, their sources and quantity, trends of consumption of raw materials for wood-based industries and the capacity of forest resources to sustain



raw materials demands for the industries. Data collection methods involve desk review, interviews, field observation, and satellite image classification for plantation types and other landcovers. The Lake zone (Mwanza, Geita, Kagera, Shinyanga, Simiyu and Mara) have has about 198 registered primary wood-based industries, which comprised only Sawmills. Most of these industries sourced wood raw materials from forest plantations (Rubare, Buhindi and Rubya) and woodlots. During the financial year 2023/24, the total allowable cut from the forest plantations was 67,988 m³ (22%), while the total annual demand was 315,800 m³, thus making a deficit of 247,812 m³ for the wood industries to operate at a normal state. Mapping of forest plantations and woodlots in the Lake Zone has revealed that forest plantation coverage and distribution was about 50,646.82 ha. These plantations contain trees of two genera, namely; Pinus species was found to cover 33,622.56 ha (66.39%) and Eucalyptus 17,024.26 ha (33.61%). The major roadblocks for facing the sustainability of forest plantation in the Lake zone were mainly; influx of primary wood-based woods industries that focused only on sawmill, livestock, wild fires, planting materials of poor quality, grazing as well as other conflicting land uses such as agriculture and rangelands. In order to sustain the primary wood-based industries, more efforts are needed to establish more tree woodlots and plantations and improving its management.

Keywords: Wood-based industries, sawmill, forest resources, Lake zone, forest plantations, woodlots



Community Health-Education Intervention Trial against Human *Taenia solium* Taeniasis/Cysticercosis in Central and Southern Zones of Tanzania

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Abstract

Poor knowledge of human *T. solium* taeniasis/cysticercosis and insufficient sanitary and hygienic practices have been associated with the persistence of human *T. solium* infections in endemic areas. Community health education intervention measures were implemented in 42 villages of Kongwa and Songwe Districts to increase knowledge, improve good practices against infection and reduce incidences of human cysticercosis transmission using a health education package. The health education package comprised of leaflet, poster and a booklet. The 42 villages were allocated into intervention group and control group, and each group consisted of 21 villages. Baseline and post-intervention information on social demography, knowledge, safe practices and incidences of human cysticercosis was collected from both village groups. The impact of the intervention was evaluated by comparing changes in knowledge, preventive practices related to human *T. solium* infections and the cumulative incidence of human cysticercosis between intervention and control villages. There was no significant difference in mean knowledge scores and preventive practice mean scores between the control and intervention groups at baseline. However, there were significantly higher knowledge mean scores in the intervention group compared to the control group at one year post-intervention (2.06 _ 1.45 vs. 0.94 _ 1.18, $p < 0.001$). There was no significant difference in the mean practice scores between the intervention and



the control group at one year post-intervention (2.49 _ 1.13 vs. 2.40 _ 1.13, $p = 0.31$). Furthermore, there was no significant difference in the prevalence of human *T. solium* cysticercosis between the intervention and the control group at the baseline (1.4% vs. 1.4%, $p = 0.97$) by Ag-Elisa, and at one year post-intervention the cumulative incidence of human cysticercosis was 1.9 and 1.2 per cent in the control and intervention group, respectively. There was no significant difference in the cumulative incidence of human cysticercosis between the intervention and the control group at one year post-intervention ($p > 0.05$). Community health-education intervention is effective at improving the knowledge of human *T. solium* infections. The improvement in preventive practices and reduction in incidences of human cysticercosis are a gradual process, they may require sanitary and hygienic improvement and more time after the intervention to see improved changes. The study recommends a sustainable public health education on *T. solium* infections using the health education package through one health approach.

Keywords: Taeniosis; cysticercosis; intervention; neglected Tropical diseases



Evaluating the Effectiveness of Low-Impact Development Practices in Mitigating Runoff Floods in the Kinyerezi River Catchments in Dar es Salaam, Tanzania

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Abstract

The impermeable areas in catchments are proportional to peak flows that result to floods in river reaches whose flow carrying capacity is inadequate. Urbanization is the major factor contributing to floods and intensifying flood risks in urban areas. The Dar es Salaam city experiences frequent floods along the Msimbazi River likely due to urbanization. The Low Impact Development (LID) practices that includes bioretention (BR) ponds, rain barrels (RB), rain gardens (RG) etc. has the potential to reduce peak flows and reduce the flood levels. This study aims to evaluate the performance of BR, RG and RB in mitigating peak runoff floods in the Kinyerezi River catchment using EPA SWMM 5.2 model. A total of 3698 RB each with 3000 L capacity, 3698 RG each with 28 m² and 0.9 depth, and 101 BR ponds of sizes ranging from 800 to 10,000 m² each with 1.2 m depth were deployed into the model. The results indicated that for the extreme historical recorded rainfall of 51.7 mm/h, the combination of BR, RG and RB would reduce the peak runoff flows and volumes by 36.8% and 24% respectively. The combination of the three LID practices offered the best performance in mitigating peak runoff floods. It was recommended that authorities should encouraged city residents to practice households' RB and residential RG at households' level. The city planning authorities should ensure that, open spaces are left in residential areas for runoff infiltration and construction of BR ponds in future.

Keywords: Bioretention ponds; Rain Garden; Kinyerezi River



catchment; Low Impact Development (LID); Rain barrel; LID performance

Climate Change Implications of Electronic Waste: Strategies for Sustainable Management at Local Government in Tanzania

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Abstract

This paper addresses the escalating the issue of electronic waste (e-waste) in Tanzania Mainland, a consequence of the burgeoning demand for electronic products coupled with their transient lifespan, especially in the context of climate change, necessitating a detailed analysis of current management strategies and the development of sustainable management practices to the Local Government. A meticulous analysis is conducted to critique the prevailing e-waste management strategies at Local Government, identifying their shortcomings and the urgent need for enhancement and globalization of these protocols. A set of strategic, sustainable solutions for e-waste management is proposed, encompassing comprehensive regulatory frameworks, advanced recycling technologies and the enhancement of consumer awareness. These solutions pivot around the circular economy concept, viewing waste as a valuable resource rather than a disposal predicament, thereby promoting sustainability. An explorative and qualitative methodology to investigate the critical issue of e-waste and its impact on climate change, current management strategies, and prospective



sustainable solutions. To begin with, the direct contribution of e-waste to climate change is associated with the generation of potent greenhouse gases (GHGs) during the improper management of e-waste. In many regions, inappropriate handling methods such as unregulated landfill disposal and open burning of e-waste are prevalent. Thus, the landfilling of e-waste represents a significant source of GHG emissions, directly linking e-waste management with climate change. The comprehensive management of e-waste, therefore, represents a significant opportunity for climate change mitigation, by reducing direct emissions from e-waste disposal and indirectly through energy savings from the recycling of valuable metals. In conclusion, the transformation towards a circular economy, where waste is minimized and the value of products and materials is maintained for as long as possible, necessitates the integration of sustainable e-waste management practices by taking decisive action on e-waste, we can contribute significantly to the broader fight against climate change, further underscoring the interconnectedness of global environmental issues and the need for integrated solutions.



Postharvest Quality Loss Causing Microorganisms of Tomato Fruits at Selected Market Segments in Dar es Salaam and Morogoro.

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Abstract

Tomatoes are among the most important economic, nutritional, and food security fruit vegetable crops cultivated and consumed worldwide. Despite the importance, its postharvest quality and shelf life are largely affected by decay and ill-causing micro-organisms, particularly fungi and bacteria. This study aimed to enumerate, isolate, and identify decay and health hazards microorganisms associated with tomato fruits along the supply chain. To accomplish this 45 tomato fruit samples were collected from farmer collection centers, retail markets, and supermarkets in Morogoro and Dar es Salaam, Tanzania. A sample portion was inoculated in Rose-Bengal Chloramphenicol Agar and plate count agar media for fungal and bacteria enumeration. Different fungi colonies obtained were identified using the slide culture technique. The indole ring and citrate utilization test a biochemical test was carried out as a confirmatory test for *E. coli* spp and *Salmonella* spp. Molecular characterization was used to confirm the identified isolates. Results indicated significant differences among the market segments in salmonella spp ($P=0.04$) and *E. coli* spp ($P=0.006$). *Salmonella* spp and *E. coli* spp were higher in retail market ($31.68E+15$ and $3.68E+15$ CFUg⁻¹) than in supermarkets ($7.95E+10$ and $4.13E+10$ CFUg⁻¹) and collection centers ($2.61E+12$ and $2.55E+11$ CFUg⁻¹) *Salmonella* spp was tested positive in all samples and 95% of evaluated samples tested positive



for *E. coli*. A significant difference was observed among the market segments in fungi isolates (*Aspergillus spp*, *Fusarium spp*, and *Penicillium spp*) ($p= 0.04$). Fungal isolates (*Aspergillus sp*, *Fusarium sp*, and *Penicillium*) were higher in retail markets with an average mean of (1606.7 CFUg⁻¹) Than in supermarkets (173.3CFUg⁻¹) and collection centers (384.4CFUg⁻¹). Also, a significant difference was observed among market segments in Fungi ($P=0.0005$) and bacteria ($P=0.003$) enumerated. Fungi and bacteria contaminants were higher in retail markets (32500 and 3.46 e+14 CFUg⁻¹) than in supermarkets (4260 and 1.55e+11 CFUg⁻¹) and farmer collection centers (4246.67 and 2.98e+12 CFUg⁻¹). Molecular characterization confirms the presence of *Citrobacter freundii*, *E.coli*, *Klebsiella pneumoniae*, *Salmonella enterica subsp. enterica serovar Typhimurium* and fungi species *Fusarium oxysporum f.*, *Aspergillus flavus*, *Fusarium equiseti*, *Aspergillus niger*, and *Penicillium spp*. Retail markets experienced higher bacterial, and fungi contamination, salmonella spp, E.coli spp, and pathogenic fungi isolate (*Aspergillus sp*, *Fusarium sp*, and *Penicillium*) compared to supermarket and farmer collection centers in this study. *Salmonella spp* and *E.coli spp* were also observed across all market segments. Molecular characterization confirms the presence of this decay and health illness microorganisms. Therefore, we recommend Improved post-harvest handling practices, safe production techniques, and Enhanced sanitation to significantly improve the safety and quality of the tomato fruit.



A Designed Framework on Perceived Privacy Preservation of Electronic Medical Records in Government Hospitals in Tanzania.

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Abstract

Maintaining security, privacy, and confidentiality of health data is a global issue. As digital systems now record and store health data, issues relating to data privacy assume a much greater importance than before. Electronic Medical Records (EMR) have greatly improved the safety and quality of health care delivery by increasing access to health information, reducing illegibility, and enabling closer overseeing of clinical care processes, understanding the state of patient medical record privacy, the privacy mechanism used, will help patients to disclose their health information freely to get the right and best treatment. This study develops a privacy-preserving framework based on blockchain technology that maintains the privacy of the EMR. This study was conducted by using purposeful sampling technique and a sample size of 210 data was collected from patients and hospital workers from Dodoma Regional Referral Hospital. Data was analysed through the SPSS statistical package. The study has had found that the hospital uses a modern firewall to secure data privacy of their patients but it contain weakness that can breach patient privacy. Therefore, due to the weakness of the firewall system exist, the researcher designs a blockchain framework, which shows a promising solution to achieve data sharing privacy



preservation.

Keywords: Privacy, Electronic medical records, Health information, Blockchain technology, Government hospital.

Assessment of Water Quality and Community Perception on Cave Water at Shehia of Mangapwani in Unguja- Zanzibar: The Case of Mangapwani Historical Caves

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Abstract

Groundwater has become a significant resource in recent decades for drinking, irrigation, and industrial purpose due to rapid population growth, industrialization and surface water degradation. The increased water demand has led to increased groundwater extraction in sensitive areas such as coastal areas, caves, where aquifers may be exposed to seawater intrusion, resulting in deteriorating quality. Thus, this study focused on the assessment of water quality and community perception regarding cave water in Mangapwani, Zanzibar. The cave comprises three springs and a pool, where springs are used for domestic purposes and the pool for recreational activities. The study employed questionnaire and interviews among residents and community leaders. Water sampling was done using 1L plastic materials and transported to Ardhi University for laboratory analysis. Findings of this study indicated



variations of water quality parameters where by EC ranged from 601 to 6415 μ S/cm, calcium ranged from 59mg/L to 668mg/L while sodium ranged from 147mg/L to 613mg/L. Hydro geochemistry revealed mixed type of water in spring water. The water quality index indicated the variations of water quality categorized into excellent, good, fair and poor for spring one, spring two, spring three, and the pool, respectively. This study, generally reveals the variations of water quality among water sources and hence water treatment at household level is of paramount important.

Key words: Aquifer; Hydro geochemistry; Recreational areas; Water Pollution, Water Quality Index

Heavy metal analysis in fresh water fish at Dodoma region

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Abstract

This study provides valuable insights into the extent of heavy metal pollution in fresh water fish populations and high lights the urgent need for effective environmental policies and practices to safeguard the health of both aquatic organisms and human consumers. Further research is warranted to investigate the sources of contamination and develop sustainable solutions. The contamination of fresh water environments with heavy metals possess a significant threat to aquatic ecosystems and public health. This study is conducted for comprehensive analysis of heavy metal concentrations in fresh



water fish samples collected from Dodoma region. Samples were analyzed for the presence of commonly found heavy metals such as lead, cadmium, chromium and arsenic using sample digestion and atomic absorption spectroscopy. Heavy metals as mercury, lead, cadmium, and arsenic, chromium, copper, nickel, cobalt are introduced into aquatic systems through various anthropogenic sources, including industrial effluents, agricultural runoff, mining activities, and urbanization. High concentrations of these heavy metals are toxic to the water, soil and air. The accumulation of heavy metals in freshwater fish depends on many factors. These factors can be either environmental (water chemistry, salinity, temperature, and levels of contamination) or biological (species, size, age, gender, sexual maturity, and diet). Fishes are more affected by these heavy metals because they are vertebrates, which are at the top of the food chain. The results obtained will be compared with the Tanzania Bureau Standard (TBS) limits for heavy metals 2021. This study determines the quantity of heavy metal in fresh water fish samples collected from Mtera Dam which are (*Oreochromis niloticus* and *Clarias guriepinus*) and fishes from Lake Victoria (*Tilapia zilli* and *Lates niloticus*) that are sold and commonly consumed in Dodoma. The outcome of this research is expected to provide critical insights into the status of heavy metal contamination in freshwater fish and contribute to the scientific foundation for environmental monitoring and public health interventions.

Keywords: Heavy metals, freshwater fish, contamination, analysis, environmental health, pollution, risk assessment.



Assessment of heavy metal contamination in vegetables in Dodoma: Implications on human health

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Abstract

Heavy metal contamination in vegetables possess significant risks to human health, as recognized by international organizations such as the World Health Organization (WHO) and the Food and Agriculture Organization (FAO). This research aims to comprehensively assess the extent of heavy metal contamination in commonly consumed vegetables within the Dodoma Region of Tanzania, a critical step towards ensuring food safety and protecting public health. The study will focus on investigating the presence and levels of Cadmium (Cd), Lead (Pb), Arsenic (As), Nickel (Ni), Copper (Cu), Zinc (Zn) in a variety of vegetables which include Tomato (*Solanumlycopersicum*), Spinach (*Spinacia oleracea*), Carrots (*Daucus carota*), Bell Pepper i.e Hoho (*Capsicum annum*). These vegetables are staple food in the region and are consumed by the local population on a regular basis, making them a priority for monitoring and evaluation. To achieve this objective, a systematic sampling approach will be employed to collect vegetable samples from diverse locations within the Dodoma Region. Samples will be collected from urban area and each sample will be carefully processed and analyzed for heavy metal concentrations using Atomic Absorption Spectroscopy (AAS), a widely recognized and precise analytical technique for heavy metal analysis. The findings of this research will offer critical insights into the level of contamination, sources, and distribution of heavy metals in vegetables within the Dodoma Region. By aligning with the guidelines and recommendations set forth by WHO and FAO, this study aims to inform evidence-based strategies for mitigating risks to human health and promoting food safety in the region. Additionally, the results will contribute to the existing body of knowledge on heavy metal contamination in vegetables, facilitating



informed decision-making and policy development to address this pressing public health issue.

Keywords: Heavy metal contamination, Vegetables, Dodoma, Atomic Absorption Spectroscopy and Food safety.

Uncovering Spatiotemporal Pattern of Floods with Sentinel-1 Synthetic Aperture Radar in Major Rice-Growing River Basins of Tanzania

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Abstract

In Tanzania, 71% of rice is grown in a rainfed lowland rice production ecosystem, primarily in river basins where extreme weather events like floods are frequent. For a six-year period (2017–2022), flood mapping was conducted using Sentinel-1 data in the Google Earth Engine (GEE) platform, utilizing change detection and thresholding methodology. In addition to flood mapping, land use and land cover (LULC) were also analyzed using Sentinel-2 data in GEE, employing



the Random Forest (RF) algorithm for classification. The aim was to understand the spatiotemporal extent of floods in two study locations. The resulting flood maps achieved an overall accuracy (OA) greater than 90% for all sites and study years. The findings revealed that agricultural land was the predominant land use/cover in both sub-basins, and floods were widespread in both regions. The study highlighted the interannual variability in flood extent, both spatially and temporally. Specifically, at the Ikwiriri site, floods were more extensive in 2020, covering 54.95% of the cultivated area, while in 2017, the minimum flood extent occurred, affecting 14% of the cultivated area. Similarly, at the Mngeta site, extensive floods were observed in 2020, with floods impacting 5.53% of the cultivated areas, while lower flood extents were observed in 2017, affecting 1.49% of the cultivated areas. Furthermore, the study demonstrated distinct spatiotemporal patterns of floods in both locations, with areas in proximity to rivers and wetlands experiencing more frequent floods. The research showcased the capabilities of the GEE cloud computation platform for flood inundation mapping, emphasizing its potential for enhancing our understanding of rice-producing environments. The generated flood maps can be utilized to guide the selection of areas for trials of flood-tolerant rice varieties and the dissemination of technologies such as flood-tolerant rice varieties, contributing to the resilience of rice farmers in these two floodplains.

Keywords: Rice submergence, Floodplains, Synthetic Aperture Radar, Google Earth Engine, Flood maps



Isolation and Identification of Gut Bacteria of Honeybees and Stingless bees from Coastal Forests

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Abstract

Microorganisms like bacteria develop symbiotic relationships with different multicellular organisms like humans, animals and insects, that inhabit different parts of the body like the skin and gut. Insects like bee's harbor gut microorganisms serving digestive, detoxification and immune modulation functions. Bees acquire these microorganisms from their habitat environment and forage. They harbor almost 99% of gut bacteria, beneficial for their ecological success and health. However, gut microorganisms' diversity can be affected by climate change, habitat loss and agricultural intensification. The available knowledge on the composition and diversity of these gut bacteria in honey bees and stingless bees is limited in Tanzania. In this novel study, gut bacterial microbiota of honey bees and stingless bees from Coastal forests of Dar es Salaam were surveyed. Bees were sampled from the University of Dar es Salaam apiary between August and September 2023 exhibiting average temperatures in the daytime between 28.1°C to 30°C, and average low temperatures in the night time between 21.5°C to 22°C. Honey bees and stingless bees were collected at hive entrances, and then dissected to remove guts, followed by the isolation of microbes in Nutrient Agar at the temperature of 37°C in aerobic conditions. The colonies were selected according to their colony morphology and identified using microscopic and biochemical tests. The organisms identified were *Bartonella* spp, *Lactobacillus* spp, *Snodgrassella* spp, *Frishella*



spp, *Bifidobacterium spp* and *Bacillus spp*. Apart from the functions that these organisms play in bees, some of them can be used for industrial uses and also as environmental indicators.

Projected changes in climate extremes over Tanzania

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Abstract

The analysis to understand projected changes in climate extremes at local and regional scales is critical for reducing society's vulnerability to such extremes as it helps to devise informed adaptation strategies and contributes to informed decisions making processes. In this paper, we analyze projected changes in climate extremes across regions in Tanzania using outputs of high- resolution regional climate models from the Coordinated Regional Climate Downscaling Experiment program (CORDEX-Africa). The indices analyzed here are those recommended by the Expert Team on Climate Change Detection and Indices (ETCCDI) to characterize climate extremes over different regions. Results reveal that Tanzania would experience an increased number of warm days and nights during the present, mid,



and end centuries under RCP 4.5 and RCP 8.5 emission scenarios. The consecutive wet days (CWD) and consecutive dry days are likely to increase across regions. Areas along coastal regions would experience increased intensity and frequency of extreme rainfall events in the present, mid, and end centuries under RCP 4.5 and RCP 8.5 emission scenarios. These increases in extreme climate events are likely to pose significant damage to properties, destruction of infrastructures, and other socio-economic livelihoods of people over many regions in Tanzania. It is therefore recommended that appropriate policies are put in place to help different sectors and communities at large to adapt to the impacts of projected increases in extreme climatic events.

Keywords: Climate extreme, climate indices, Regional climate models, CORDEX, Tanzania

Towards a climate smart community: A Web based GIS App for Multi-hazard Early Warning against Climate-based Disaster Risks

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Abstract

The growing frequency and severity of climate-related hazards, such as floods and droughts due to climate change have made disaster risk reduction and management an urgent priority. Early warning of the likely occurrence of climate related disaster risks and impacts could assist in decision making to support proper disaster risk responses and formulation of climate change adaptation and mitigation strategies for enhanced resilience. Early warning systems that make use of geospatial data and technologies, such as GIS, can provide critical information for effective disaster risk reduction and management by enabling communities to prepare for and respond effectively. Globally, various initiatives and innovations of multi-hazard early warning systems based on web and mobile information platforms have been developed, however, none fit in the Tanzanian and East Africa environment. Normally, global early warning systems fail to provide timely and accurate information, especially in complex, multiple-risk situations in the local environment. To address this problem, there is a need for a localized Web-based GIS App that incorporates real-time data from multiple sources, such as weather stations, satellite imagery, and other relevant sources to provide a comprehensive and accessible platform for multi-hazard early warning. Such an application would allow communities to prepare for and respond to climate-related risks in a proactive manner and minimize the impact that may be caused by these hazards on people's lives and livelihoods, through the access of timely, accurate and complete information on climate-related risks, enabling them to make informed decisions. This research aims at piloting on developing an innovative multi-hazard early warning



Web based GIS App for Climate-based Disaster Risks in Africa, Case of Tanzania.

Keywords: Climate Change, Climate Smart Community, Web GIS App, Early Warning, Disaster Risks, Disaster Risk Reduction

Improving Crop Water-limited Productivity of Rainfed Maize in a Semi-Arid Catchment: Field Experiment and Modeling in Varied Soil Fertility and Climate Conditions

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Abstract

In rainfed agriculture, where over 80% of crop production relies on unpredictable rainfall, water scarcity adversely affects crop yields in semi-arid regions. This study aimed to assess the impact of various field management practices on maize cultivation yield and water productivity in the Makanya catchment, located in northern Tanzania. The research was conducted over three consecutive seasons (Masika and Vuli 2018, Masika 2019) and compared three cultivation methods: flat cultivation with mulches (FCM), flat cultivation without mulches (FC), and deep tillage (also known as 'double digging' - DD). Crop water productivity was evaluated through manual field measurements and AquaCrop model simulations. The findings revealed that FCM significantly reduced non-productive water loss, resulting in a 30% increase in crop yields and a 41% improvement in water productivity. Conversely, DD had minimal effects on these variables. The AquaCrop model accurately predicted final yields for different cultivation practices and climate scenarios spanning 22 years. Although the model slightly underestimated evapotranspiration in one treatment and season, it provided reasonably accurate estimates for water productivity. Statistical analysis demonstrated good agreement between observed and simulated canopy cover, biomass, and soil water content during the Vuli season. However, the model exhibited poor performance in simulating soil water content during the Masika seasons of 2018 and 2019. Adopting water-conserving practices, such as FCM, has proven effective in increasing maize yield in semi-arid regions. While the AquaCrop model is a valuable tool for yield predictions, further refinement is necessary to simulate soil water content accurately under specific conditions. We recommend implementing FCM practice as a sustainable approach for rainfed agriculture in similar regions.

Keywords: *Climate condition, Rainfed maize, Semi-arid catchment, Scenario analysis*



Analytical design of a portable surface plasmon resonance sensor by using a divergence beam for measuring multiple heavy metals and other contamination simultaneously

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Abstract

The study proposes a surface plasmon resonance (SPR) sensor for measuring water quality by detecting the presence of heavy metal ions and other contamination. The proposed SPR sensor operates in the Kretschmann configuration, which employs the divergence beam produced by the Powell lens. The beam is diverged to eliminate mechanical scanning, indicating that the sensor can measure water quality from deionized water (DIW) with refractive index (RI) of 1.3317, diluted DIW with multiple heavy metal ion such as Hg[II], Pb[II], Ni[II], Zn[II], Cu[II] at concentration of 100 μM and other pollutant with the RI of 1.34 without any mechanical movement. The proposed SPR sensor has theoretical sensitivity of $399.45^\circ/\text{RIU}$ and resolution of 1.3456×10^{-8} and $8.3790 \times 10^{-10} \text{RIU}$ with 8-bits (ATmega1284) and 12-bits (STM32F401RE) ADC of the controller, respectively. The CCD sensor (TCD1304AP) and microcontrollers data sheets were used to calculate the theoretical in which all these components are very chip. The reported sensitivity and resolution were achieved because of proper application and optimization of TiO₂ and BaTiO₃. In comparison to a convectional SPR sensor, the proposed SPR improved sensitivity and figure of merits by 50.98 % and 13.93 %, respectively. Furthermore, the proposed SPR sensor outperforms recently published research in terms of performance.



Characterization of phenotypic traits associated with anthracnose resistance in selected common bean (*Phaseolus vulgaris* L.) breeding material

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Abstract

Anthrachnose caused by *Colletotrichum lindemuthianum* is the major common bean disease worldwide causing complete yield loss under favourable disease conditions. This study aimed to determine phenotypic traits associated with anthracnose resistance for future use in breeding programmes. Twenty-two common bean varieties (CBVs) were selected basing on susceptibility to anthracnose, advanced breeding lines, and improved variety resembling advanced breeding lines and the farmer variety widely grown in Tanzania. Selected varieties were planted in anthracnose hotspot fields and the same CBVs were planted in a screen house to validate resistance to anthracnose. Anthracnose infection score, leaf length,



leaf width, length of fifth internode, length of petiole, plant vigour, canopy height and canopy width were recorded. Data on number of plants emerging; days to flowering; days to maturity; plant stands at harvest; and grain yield were also collected and analysed using R software. Phenotypic traits evaluated differed significantly among genotypes, environment and genotype by environment interaction. Seventy-five per cent of phenotypic traits evaluated were positively correlated to anthracnose resistance. Highly strong correlations to anthracnose were observed on number of days to maturity, plant stands at harvest, plant vigour and grain yield. Leaf length, leaf width, length of fifth internode, length of petiole and number of stands emerging were strongly correlated to anthracnose resistance. Additive main effects and multiplicative interaction analysis (AMMI) revealed highest contribution of environment on anthracnose infection-58.9% and grain yield -84.9% compared to genotype effects on anthracnose infection -32.7% and grain yield-15.7%. Based on these results, four traits – plant vigour, number of days to maturity, number of plant stands at harvest and grain yield – are recommended for selecting anthracnose-resistant varieties. NUA 48, NUA 64 and RWR 2154 were superior varieties, resistant to anthracnose and high yielding, while Sweet Violet and VTT 923-23-10 were most stable varieties across environments. Further on-farm research is suggested to assess their performance and identify traits preferred by farmers.

Keywords: Common bean, phenotypic traits, anthracnose resistance



PAPERS UNDER SUBTHEME 3: LEVERAGING STI AND INDIGENIOUS KNOWLEDGE TO ADDRESS CLIMATE CHANGE CHALLENGES





Enzyme Activities and Wheat Growth Response in Soils Amended with Coal Ash from the United Kingdom and Tanzania

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Abstract

Due to the presence of essential plant nutrients and either acid or alkaline properties, coal ash can be a valuable amendment in improving characteristics and crop productivity of alkaline or acidic soils. This study aimed to evaluate the effects of coal ash application to woodland and arable soils on soil pH, selected soil enzyme activities (dehydrogenase, acid phosphatase, alkaline phosphatase, urease and β -glucosidase) and on vegetative growth of wheat. Two pot experiments were conducted in which wheat (*Triticum aestivum* var. Willow) was grown in woodland and arable soils amended with ash collected from either the UK or Tanzania, at concentrations of 0, 2, 4, 8 and 16% (w/w). Wheat was grown for 50 days. Soil amendment with UK ash at 0-16% increased significantly ($p < 0.001$) the pH of woodland and arable soils while amendment with Tanzanian ash at 0-16% reduced the pH of both soils ($p < 0.001$). Application of low concentrations (0-4%) of UK ash to both soils increased dehydrogenase and urease activities and wheat growth, but these ash concentrations did not show any significant effect on alkaline and acid phosphatase activities. Glucosidase activity increased significantly ($p < 0.001$) when the woodland soil was amended with 2% of UK ash, then decreased significantly with increasing ash concentration. Application of 16%



UK ash also inhibited acid and alkaline phosphatase activities. Application of the Tanzanian ash at low concentration did not have any significant effect on the activities of enzymes studied while application at 8-16% inhibited all enzyme activities. Tanzanian ash did not affect wheat growth parameters when applied to both soils while UK ash improved wheat growth. This study demonstrates that soil amendment with coal ash may result in either beneficial or detrimental effects, depending on the nature of the ash and soil characteristics thus, strategic agronomic use of coal ash is recommended.

Keywords: Coal ash, enzyme activities, soil amendment, wheat growth.

Evaluation of elite cashew hybrids developed in 1998 under the agro-ecological conditions of Nachingwea in Southern Tanzania

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Abstract

Performance of the cashew hybrids developed in 1990s was very good in terms of yield and nut quality compared to varieties released for commercialisation in Tanzania. Based on these results, breeders in Tanzania directed their efforts toward improving nut quality to cope with modern cashew processing machines, which required medium to large nuts. In 1998 fifty-eight crosses were developed involving a number of parents with contrasting but useful traits. These hybrids were evaluated at Naliendele for seven years from 1999 to 2006. 26 elite hybrids were selected for advanced genetic trial. The hybrids were evaluated at Nachingwea, one of the major cashew growing districts in the Southern zone of Tanzania to find out if they were suitable in the area. The data on yield and nut quality were recorded for a period of twelve years. Commercial variety AC4 was used as a control. Screening of the hybrids against Cashew Leaf and nut blight disease was another parameter under study. Analysis showed that 23 hybrids out of 26 had good nut quality than AC4 and most gave higher yields compared to control. Screening of the hybrids against the disease demonstrated that majority of the hybrids were tolerant to the disease opening an opportunity to get new cashew varieties resistant to the disease. These hybrids are therefore recommended for multiplication and distribution in Nachingwea and areas, which have similar environmental conditions.

Keywords: cashew, hybrid, yield, nut quality, cashew leaf and nut blight disease.



Factors Influencing Traders Participation in Rice Export Market in Tanzania

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Abstract

The participation of rice traders in export markets is influenced by a complex interplay of socio-economic, product attributes, markets forces and institutional factors. Despite of many studies on rice traders export markets participation, the challenge on rice traders' engagement in rice trade and export activities particularly in developing countries is context specific. This paper analysed specific socio-economic and institutional factors affecting rice trader's decisions regarding export markets participation in Tanzania. Utilizing survey data from 150 randomly selected rice traders across eight distinct trading zones, the study employs binary regression analysis to examine these factors. Results indicate that gender, years of experience in rice trading, capital availability and access to market information significantly impact traders' decisions to enter export markets ($P < 0.05$). The findings highlight that inadequate market information and insufficient capital are primary barriers to participation. The study concludes with a recommendation for government intervention to enhance access to market information and credit facilities, thereby boosting rice traders' involvement in export markets to meet the demand in neighbouring countries.



Also, the government should embrace multi-stakeholder innovation platform for building and strengthening partnerships and collaborative learning among both public and private actors to improve marketing decision among rice traders for attaining the Sustainable Development goals in the country.

Keywords: Tanzania, rice traders, market participation, export markets and market information

Harmonizing Indigenous Knowledge and Cutting-Edge Tech: A Blueprint for Carbon-Neutral Energy

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Abstract

This study explored using indigenous knowledge and emerging technologies to reduce carbon footprints and GHG emissions in Africa's climate hotspots in sub-Saharan countries. Numerous studies show that the operating institutions utilize various applications to ensure that energy management resources can mitigate the effects of carbon emissions. The study revealed that the most efficient use of natural resources for energy production requires collaboration among governments, private sectors, NGOs, and local communities. By adopting a holistic and inclusive approach, one can work toward a more sustainable and low-carbon energy future. This paper focuses on carbon footprint analysis and proposes solutions to address environmental issues in implementing sustainable energy solutions in sub-Saharan countries. A multifaceted approach involving effective strategies is needed to lower the carbon footprint. The contribution



of this study is to improve energy consumption in communities in Africa by integrating climate resilience considerations into sustainable energy projects to ensure long-term viability. This will involve planning for changing climate conditions, such as extreme weather events, and designing infrastructure that can withstand and adapt to these challenges. It has been concluded that carbon footprint analysis is useful for determining the impacts of carbon particles in the world's atmosphere. The role of energy management operations seeks to improve the assessment and analysis of carbon footprints by allowing atmospheric measurements of carbon. The study highlights the rise in global temperatures and carbon levels, particularly in the northern hemisphere, due to temperature-induced carbon particle binding. It suggests that extension services, more productive indigenous knowledge systems, youth and women's participation in knowledge-based activities, reduced greenhouse gas emissions, optimal resource use, cross-cultural learning, and rangeland recovery are potential benefits.

Keywords: Indigenous Knowledge; Emerging Technologies; Carbon Footprints; GHG Emissions; Alternative Energy.

Impacts of Gibberellic Acid (Ga3) on Growth and Yield of Green Beans (*Phaseolus Vulgaris* L.) in Northern Tanzania

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Abstract

Green bean production in Tanzania ranges from 6 to 8 t/h which is far below the potential yield of 15 to 20 t/ha, which is largely caused by poor soil fertility of most of Tanzania's land. Gibberellic acids (GAs) are naturally occurring growth-stimulating substances used to promote the growth and development of many plant species. Therefore, the study was carried out to determine the effects of Gibberellic acid growth hormone on the growth and yield of green beans at field conditions. The experiment was conducted using Randomized Complete Block Design with four replications and five treatments at TARI - Tengeru research farm from May to August 2023. Treatments were negative control, with three rates of Gibberellic acid (6.25 g/ha, 12.5 g/ha, and 18.75 g/ha) and Snow Paushak (500 ml/ha) as positive control. Data on growth and yield variables were collected at 33, 40, 47, 54, and 62 days after planting (DAP). The results showed that the application of GA₃ significantly ($p < 0.05$) increased the leaf area index of green beans at 33 DAP. Also, the application of GA₃ at 40, 47, and 54 DAP significantly ($p < 0.05$) affected the plant height of green beans whereby GA₃ (18.75 g/ha) showed the highest. The highest plant fresh weight was recorded at GA₃ at 12.5 g/ha (13.39 t/ha) with the equivalent of 11.86% yield increase, followed by GA₃ at 18.75 g/ha (12.72 t/ha) with the equivalent of 6.27% yield increase. This study concluded that the use of 12.5 g/ha up to 18.75 g/ha GA₃ can be used as an alternative foliar organic fertilizer since it has shown a significant improvement in the yield of green beans. This will contribute to economic development and livelihood by engaging communities in the production of green beans. Further



study particularly on economic aspects is recommended before upscaling of this practice.

Keywords: Foliar fertilizer, Gibberellic acid, green beans, growth parameters, yield attributes

LC-MS/MS Detected Lower Values of Dexamethasone and Prednisolone in Powdered Herbal Medicines Sold in Tanzania

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Abstract

As a consequence of perceived quality and safety of herbal medicines in varied communities, adulteration of such medicines with synthetic drugs has become a growing global concern. This study assessed the adulteration of herbal medicines with dexamethasone and prednisolone using LC-MS/MS. The optimized method was used to confirm presence of conventional drugs (dexamethasone and/or prednisolone) in the fourteen samples suspected to be adulterated after screening with TLC. This method was validated by determining coefficient of determination, limit of detection and limit of quantitation. Coefficient of determination for dexamethasone and prednisolone were 0.95 and 0.97 respectively. The limit of



detection for dexamethasone and prednisolone were 13.79 ppm and 10.81 ppm respectively. The limit of quantitation was 41 ppm and 32 ppm for dexamethasone and prednisolone respectively. The results indicated that all 14 samples were adulterated with either all or one of the two suspected adulterants. It was observed that, while both prednisolone and dexamethasone were detected in nine herbal medicines samples, one (1) sample was adulterated with dexamethasone alone and four (4) samples were adulterated with prednisolone alone. However, the dexamethasone and prednisolone adulterants were only detected but could not be quantified because they were below quantification limit. The optimized method meets the International Council for Harmonization (ICH) standards therefore can be used to confirm the presence of dexamethasone and prednisolone in herbal medicines.

Keywords: Dexamethasone, Prednisolone, LC-MS/MS, Herbal medicines, Adulteration.

Leveraging Pandemic Lessons for Long-Term Resilience: Integrating WASH, COVID-19 Response and Climate Action for a Sustainable Future

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Abstract

The study explores the relationships among the COVID-19 pandemic, clean water, sanitation and climate change, emphasizing the necessity of a comprehensive strategy to tackle these problems.



The study gathered information from 266 papers overall while adhering for Systematic Reviews and Meta-Analysis (PRISMA). The study demonstrates the variety of consequences these changes have, some of which are beneficial and some of which exacerbate pre-existing conditions. The pandemic highlights the significance of having access to clean water, a hygienic environment and proper hygiene, especially in nations like Tanzania. The fact that COVID-19 spreads more easily in places without access to clean water, sanitary facilities or proper hygiene highlights the need for comprehensive water, sanitation, and hygiene policies. Moreover, the co-existence of water scarcity, sanitary infrastructure deterioration, and disruption of hygiene routines are worsening by climate change. The results found that the COVID-19 pandemic has had a substantial impact on both climate change and the sustainability and continuity of WASH services. In that regard, this paper highlights the significance of tackling these related issues head-on and stresses the need for a thorough plan to address them for long-term resilience among individuals in Tanzania and other locations. The study concludes that, to effectively address the pandemic, WASH, countries (particularly developing countries) should actively promote action on the far more pressing issues of WASH and climate change for both the present and the future generations, even as they address the pandemic and its limits.

Keywords: COVID-19 pandemic; Water sanitation hygiene; Climate change; Global issues; interconnected challenges.



The Use of Comfrey as Soil Amendment to Improve Growth of Maize and Amaranth Vegetable

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Abstract

Being an organic material enriched with essential nutrients, comfrey plant (*Symphytum spp*) can be used as a soil amendment to improve soil characteristics and crop productivity. This study aimed to evaluate the potential of comfrey plant on growth and yield of maize (*Zea mays*) and amaranth (*Amaranthus spp*). Two pot experiments were conducted where in first experiment, maize was grown in soil amended with Comfrey leaves powder (CLP) at 0, 2, 4 and 8% (w/w) for 6 weeks and in second experiment, Amaranthus was grown in soil amended with Comfrey roots powder (CRP) at 0, 2 and 4 % (w/w) for 5 weeks. Application of 8% of CLP to the soil increased maize height significantly (by 29 cm, $p = 0.045$) compared to maize in control treatment. Maize leaves number increased significantly (from 5 to 8 leaves, $p = 0.001$) following soil amendment with 2% of CLP. Stem diameter increased significantly with increasing CLP from 0 – 4% (diameter from 0.7 to 1.2 cm, $p < 0.001$) compared to control, further increase in CLP up to 8% had no further significant effect. Total maize plant biomass increased significantly (from 8.21 to 28.25 g, $p < 0.001$) following the soil amendment with 0 –



8% of CLP. Soil amendment with 2% of CRP increased significantly Amaranthus shoot biomass (0.48 to 1.31 g, $p = 0,048$) and total plant biomass (0.66 to 1.48 g, $p = 0.018$), further increase in CRP had no further significant effect. Positive growth responses noted in both crops following soil amendment with comfrey could be linked to high nutrients composition noted in comfrey powders. From this study, the use of 2 to 8 %(w/w) comfrey powders is recommended to improve vegetative growth of amaranth and maize, however further studies on use of comfrey as soil amendment are highly recommended.

Keywords: Comfrey plant, Comfrey leaves and roots powders, soil amendment, Maize, and Amaranth spp.

Assessing Farmer's Perception of Conservation Status of Agrobiodiversity in Selected Agroecological Zones of Tanzania

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Abstract

Agrobiodiversity serves as the foundation for resilient agricultural systems, sustainable food availability and nutritional diversity, and ecologically sound livelihoods of the community. Ecological services provided by rich agrobiodiversity ensure that people earn their livelihood and the sustainability of the coming generations is certain. Understanding how communities depend on agrobiodiversity



may be well captured on the merit of agroecological landscapes because they entail how each species accrues to the agroecosystem thus enabling accurate judgment on the importance of such agrobiodiversity from the collective view of farmers, ecologists and agricultural scientists. The participatory four-cell assessment was employed in gender disaggregated focus group discussions (FGD) conducted in three contrasting agroecological zones of Tanzania to assess the status of agrobiodiversity conservation and utilization in rural farming communities. Diversity indices were calculated to determine relative species richness and abundances across AEZ, Species Threat Index was calculated using modified IUCN formula to determine the influence of each farming systems, topography and gender roles on collective farmer's perception of conservation and use of agrobiodiversity, t-test and analysis of variance (ANOVA) was used to infer the observed index score. The results show that species abundance and distribution were lowest in semi-arid agroecology and highest in the coastal zone despite showing highest similarity in species composition. Generally, farmers perceived the status of agrobiodiversity as fairly secure with species threat index ranging from 0.39 to 0.59, mean = 0.48 (s.d =0.06). Interesting pattern of variations in perception was observed across AEZ, along topographies and between genders despite statistical insignificances. Nevertheless, these findings emphasize the importance of understanding the human-environment interaction that determine sustainability of agrobiodiversity. This paper serves as base information on the quest to understand underlying factors determining farmers' constant need to decide on the utilization and conservation of agrobiodiversity.

Keywords: Species Threat Index, Modified IUCN equation, Conservation, Agrobiodiversity



Solid Phase Extraction and Ultrasonic Assisted Extraction methods for determination of non-opioid analgesics in adulterated Herbal Medicines: A comparative LC-MS/MS study

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Abstract

This study aimed to compare the effectiveness of solid phase extraction (SPE) and Ultrasonic assisted extraction (UAE) methods for extraction of five (5) non-opioid analgesics (NOA) including acetaminophen, caffeine, acetylsalicylic acid, diclofenac, and ibuprofen adulterants in herbal medicines. The two procedures were compared in terms of extraction time, absolute recoveries, costs in terms of time and consumables used, and complexity. The analysis was done using a Liquid Chromatography coupled by Triple Quadrupole Tandem mass spectrometer (LC-MS/MS). Waters OASIS Hydrophilic-lipophilic balance (HLB) 200 mg 6 mL, a C18 sorbent was used in SPE. It was observed that, the relative recovery for SPE ranged from 0% to 83% and UAE from 60% to 107%. The matrix effects for UAE were at accepted range of $\geq 80\% \leq 120\%$ (70% – 122%), while that of SPE was poor (0% - 124%) with exceptional to ibuprofen (101%). It was found that UAE is economical in terms of time and consumables, simple method to operate, the LC chromatogram have good separation with good peak shape and have good recoveries at acceptable range. In SPE method showed to be expensive in terms of



consumables and time, complex method, and the LC chromatogram have poor peak shapes, tailing and interfering peaks observed. From the results it was shown that, the UAE is superior to SPE for extraction of five NOA from liquid HM. Further studies using other types of comparable methods are recommended to explore more extraction methods of NOA from herbal medicines.

The Status of Coral Reefs in Tanzania

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Abstract

While covering less than 1% of the oceanic area, coral reef support almost one third of marine fish species, providing around 10% of the total fish consumed by humans worldwide. Coral reefs face both natural and anthropogenic pressures, it is estimated that 20% have been destroyed and more than 20% at high risk. In Tanzania, 70% of artisanal fisheries of Tanzania come from the coral reef ecosystems, supplying 90% of the animal protein consumed and the primary source of income for the people. Based on this a thorough review and updates on the latest coral reef survey reports was done. A study by WCS (2021) carried out by to assess coral reef status and reports



on monthly monitoring done by TCMP in community-controlled reefs, marine reserve and The Tanga Coelocanth Marine Park located in Tanga region indicated that reefs within marine reserves and marine park were significantly in better condition especially for the park when compared to community reefs. The 2021 study in Dar es Salaam Marine Reserves by Pagu et al., indicated that the mean live coral in the northern reefs (Mbudya, Bongoyo and Pangavin) was higher (52%) than in the southern reef (Sinda and Makatube) at 48%. Likewise, the mean fish biomass was significantly higher in the northern reefs (5.4 kg/500 m²) than southern (2.6 kg/500 m²) dominated mostly by juveniles. A very recent study by Marine Park under the support of WWF within Mafia Island Marine Park indicates that average coral cover to be 50.89% ± 0.4 where Kitutia reef and Utumbi had 69.50% ± 1.82 and Utumbi 68.02% ± 1.37 respectively with a total of 41 genera were identified were fish populations were dominated by 35 families. Southern Tanzania reefs within the Mtwara and Ruvuma Esuary Marine Park, a 2018 study shows that Matenga had the highest coral cover (66.4% ± 7.2) The fish community was dominated by members of small sized non-target fish in all sites. By conclusion, generally from north to south, several parts of the studies reefs are remain intact despite fishing pressure exerted to them. However, uncontrolled access to these reefs, both open access and protected, associated with the use of fishing gears some of which are destructive has decimated some portion of the reefs. The intervention include among others things, community based temporary closure of reef areas. The involvement of local trained local fishermen (communities) together tourists who are willing to pay for service can significantly return the reef to their original state.



Sympytm officinale and Moringa oleifera potential for management of stem wilt and spike shedding on pepper (*Piper nigrum* L.)

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Abstract

Pepper (*Piper nigrum* L.) production is an important source of income to many smallholder farmers in Tanzania. Unfortunately, 30 - 40% of pepper production is lost due to premature spikes shedding and stem wilting. This research was conducted to evaluate *Sympytm officinale* and *Moringa oleifera* for their effectiveness in management of yellowing, wilting and spike shading in *Piper nigrum*. The trial was set as one factor experiment arranged in completely randomized design (CRD) with three replications under laboratory condition. Liquid extracts of *Symphytum officinale* and *Moringa oleifera* at 20% concentration were tested for their effects on in-vitro growth of *Fusarium oxysporum*. The study indicated that *Sympytm officinale* has high inhibitory effects measured by its inhibition zone (0.21cm) that was far much higher than *Moringa oleifera* (-0.21cm). The data show that there was significant difference ($p = 0.048$) between the two plant extracts. In the second experiment, effects of *Symphytum officinale*, *Moringa oleifera* on disease incidence and severity of yellowing and spike shading on pepper in *Piper nigrum* was investigated. The experiments were laid out in Randomize completely block design (RCBD) whereby zero application (Control), *Symphytum officinale*, *Moringa oleifera* and farmyard manure were tested. The study shows that the highest



incidence of yellowing was in plants treated with *Moringa oleifera* (16.25%), then farmyard manure (12.50%) and finally *Sympytm officinale* (11.25%). The differences in these results were significantly differences ($p=0.008$). The highest severity of yellowing percentage was observed in *Sympytm officinale* (2.969%), then *Moringa oleifera* (2.344%) and finally farmyard manure (1.719%) and the differences were significant ($p=0.005$). Spike shading in paper plants treated with *Moringa oleifera* (2.5%), then farmyard manure (0.00%) and *Sympytm officinale* (0.00%) were not statistically different ($p=0.346$). Severity of spike shading in paper plants treated with *Moringa oleifera* (0.025%), farmyard manure (0.00%) and *Sympytm officinale* (0.00%) were also statically the same ($p=0.284$). Generally, *Sympytm officinale* has shown great potential of being good natural plant product for management of Spike shedding and yellowing of *Paper nigrum*.



Antifungal potential of comfrey leaf powder and liquid extract against *Fusarium verticillioides* and *Aspergillus flavus* phytopathogens

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Abstract

Comfrey (*Symphytum officinale* L.) is a known natural product with potential uses as organic manure, pesticide, medicine and food supplement. Two experiments were conducted to evaluate effects of leaf powder and liquid extract of comfrey on invitro growth of *Aspergillus flavus* and *Fusarium verticillioides*. These two fungal species are phytopathogens causing yield losses of various crops but also contaminate food and feed with mycotoxin posing a health risk to human and animals. The first experiment laid out in a Completely Randomized Design (CRD) evaluated comfrey powder at 10g/100ml, 30g/100ml, and 50g/100ml. In the second experiment, comfrey leaves were air-dried in a cool environment for seven days followed by grinding to get powder then soaked in water to extract liquid. The powder weighing 15g, 25g, and 35g was then reconstituted by dissolving in 100ml of distilled water and left to soak overnight. After soaking overnight, the extract was purified by filtering through cheesecloth to reduce large particles, then into filter paper to get the finer liquid extract, and finally through a Sartorius filter to remove the microorganisms from the extract and dropping the extract into the well-labelled Petri dishes containing PDA media in a lamina



flow. Both liquid and powder extracts were applied in PDA growth media using poisoned food technique. Monosporic isolates of *F. verticillioides* and *A. flavus* were inoculated by using an inoculation loop in the Petri dishes containing poisoned PDA medium. Comfrey leaf powder at 0.5g/ml reduced the growth of both fungi. The concentrations at 0.1 and 0.3g/ml of Comfrey powder inhibited the growth of the *A. flavus* by 10.78% and 13.53% which were not significantly different, whereas the concentration at 0.5g/ml of comfrey powder inhibited this fungal growth at 21.10%. The growth of the *F. verticilloides* was reduced by 8.82%, 17.16% and 32.36% with 0.1, 0.3 and 0.5g/ml respectively. In both experiments, these treatment effects were significantly different from the untreated control ($p < 0.05$). These results have shown that all the plant extracts at different concentrations possess antifungal capability of inhibiting mycelial growth of the two fungal phytopathogens. This sets the first stage of a journey towards development and commercialization of a comfrey plant-based bio fungicide product.



Effectiveness of a homemade bio-pesticide in controlling pests of common bean (*Phaseolus vulgaris* L.) grown by smallholder farmers in Northern-Tanzania

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Abstract

An experiment was set at farmer's field in Arusha district, under a randomized complete block design. The experiment was replicated three times during 2022 cropping season. The experiment aimed at assessing an efficacy of a homemade bio-pesticide (a mixture of pepper, *Tephrosia vogelii* and Neem leaves) in order to minimize pest damage on common bean (*Phaseolus vulgaris* L.). A plot size of 3 m x 3 m, each spaced 2 m was used as an experimental plot. Common bean (Njano variety), as test crop, was planted at a spacing of 50 cm between rows and 20 cm within rows. Six (6) treatments namely; control (T1), half recommended rate of bio-pesticide (T2), recommended rate of bio-pesticide (T3), double recommended rate of bio-pesticide (T4), half recommended rate of synthetic pesticide (T5) and recommended rate of synthetic pesticide (T6), were sprayed to each experimental plot for pest incidence control throughout the growing season after every seven days from the first week after seedlings emergence. Data on number of pods per plants, number of seeds per pod, biomass, and grain yields were collected and subjected to one-way analysis of variance using GenStat software. The number of pods per plant (9.92) and biomass (4379 kg ha⁻¹)



in a plot applied with synthetic pesticide at recommended rate (T6) showed significant ($p < 0.01$) differences across treatments. The lowest pods per plant (6.17) and biomass (1692 kg ha⁻¹) were recorded in the control treatment (T1). The bio-pesticide treatments did not differ significantly amongst themselves, except with the control and synthetic pesticide treatments. With regard to number of seeds per pod, results revealed that the bio-pesticide treatment, especially at the double recommended rate (T4) resulted a significantly ($P \leq 0.05$) higher number of seeds per pod (6.25), while the lowest number of seeds per pod (2.33) was recorded in the control treatment (T1). Further, results indicated that the synthetic pesticide, especially at the recommended rate (T6) and the bio-pesticide at the recommended rate (T3) resulted in significantly ($P \leq 0.05$) the same, higher grain yields while the lowest grain yield of 750 kg ha⁻¹ was recorded in the control treatment (T1). Therefore, the finding of our study indicates that the application of the homemade bio-pesticide is evidently effective in controlling field pests for common bean crop. We advise farmers to utilize the homemade bio-pesticide, as a sustainable and environmentally friendly practice for controlling pests of various crops within their farms for enhanced yields and safety of the common bean produce.

Keywords: Bio-pesticide, Neem leaves, pepper, *Tephrosia vogelii*, Common bean, pest control, synthetic pesticide.



Omega-6 and Omega-3 Fatty Acid Content of selected foods consumed by pregnant and breastfeeding women in Morogoro Municipality, Tanzania

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Abstract

Omega-3 and omega-6 acids are very critical for proper brain development, healthy cardiovascular system, strong joints of unborn child and good vision later in life. Despite the presence of different types of fish and other sources of omega 3 and omega 6 fatty acids in Tanzania, it is not clear which specific food contain high amount and can be recommended for pregnant and breastfeeding women. The present study aimed to assess the omega 3 and omega 6 content of the selected fish, nuts, oil seeds and leafy vegetable. A cross sectional study was conducted in Morogoro Municipality, Tanzania and about 318 pregnant and breastfeeding women were involved in the identification of the frequently consumed fish, seeds, nuts and leaves. A total of 29 samples were selected for laboratory analysis of omega 3 and omega 6 fatty acids contents. In the laboratory, the lipids were extracted using Soxhlet method and converted to fatty acid methyl esters (FAMES) through methylation process and thereafter were quantified using Gas Chromatography Mass Spectrometer (GC MS). This was done using R Software and Tukey's Honest Significant Difference (Tukey's HSD) test was used for multiple mean comparison tests. A total of twelve fatty acids were



detected in which three of them were saturated fatty acids (SFA), two were monounsaturated fatty acids (MUFA) and eight were polyunsaturated fatty acids (PUFA). For SFAs, the highest percentage content of palmitic acid was detected in shrimps (*Peneus setiferus*) (14.1%) while stearic acid was high in Zanzibar anchovies (*Stephorus commersonii*) (9.2%) and Arachidic acid was high in sesame seeds (10.4%). For the case of MUFAs, the highest percentage content of oleic acid was detected in Indian Mackerel (*Restrelliger kanagurta*) (62.3%) while palmitotenic acid was high in Zanzibar anchovies (*Stephorus commersonii*) (8.72%). Short chain omega 3 (Alpha-Linolenic acid (ALA, 18:3n-3) was detected mostly in plant-based samples. The foods that had overall higher percentage composition of omega 3 fatty acids were tuna (*Euthymus pelamis*), red mullet (*Mullus surmuletus*) and East African Sardinella (*Sardinella albella*). Walnuts had the highest percentage composition of short chain omega 6 fatty acids Linoleic Acid (LA, 18:2n-6) that was 12.72%. Arachidonic acid (ARA, 20:4n-6), a long chain omega 6 fatty acid was high in red mullet (*Mullus surmuletus*) (14.81%) and Tuna (*Euthymus pelamis*) (14.72%). The present study provides insightful information about omega 3 and omega 6 polyunsaturated fatty acid of different types of fish, seeds and nuts that are locally available in Morogoro. Walnuts has high alpha linolenic acid when compared to other nuts and seeds. Long chain omega-3 fatty acid is high in tuna, red mullet and East African Sardinella. The findings have cleared the confusion about what type of fish or seeds that can be recommended to people with different health conditions such as non-communicable diseases, pregnant and breast-feeding women, brain-related issues among others.

Exploring the opportunities, challenges and the way forward for biomass briquettes in Tanzania

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Abstract

Conventional charcoal and firewood are the main domestic sources of cooking and heating energy in many developing countries, particularly in sub-Saharan Africa. Heavy reliance on fossil fuels in this region contributes significantly to the loss of forest cover, affects human health and exacerbates the impacts of climate change. The use of biomass briquettes as an alternative source of energy could potentially address the problems above. However, the adoption of biomass briquette technology remains underdeveloped in this region. The reported study highlights the potential for biomass briquettes as a cleaner and more sustainable alternative to traditional fossil fuels in Tanzania. Both challenges and opportunities existing in the briquettes sector were evaluated through focus group discussions and key informant meetings involving participants from 16 regions of Tanzania's mainland. Our analysis showed that briquette technology can contribute to increasing energy independence, creating employment among youth, and enhancing forest conservation. Additionally, it is a friendly technology among women in terms of handling, cost-effectiveness and reduced air pollution. However, briquette technology has various challenges, including market incompetency, community misconceptions about briquettes, and a lack of political support. To mitigate these challenges and promote the briquette sector in Tanzania, the study suggests various interventions, particularly providing technical training and resources to accelerate production and quality assurance and engaging with



policymakers to advocate for supportive policies and incentives. Additionally, develop effective marketing and distribution strategies. In conclusion, the study indicates that Tanzania has the potential to advance the biomass briquette sector, which has positive social, ecological and economic impacts. However, addressing these challenges and realizing their potential benefits will require holistic and participatory approaches involving various stakeholders, like government agencies, researchers, development partners, NGOs, and local communities.

Keywords: Briquettes, biomass, challenges, opportunities, alternative energy

Unlocking National Competitiveness through Knowledge Management

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Abstract

This article investigates the role of knowledge management (KM) in driving innovation acceleration within organizations. It aims to address the limited awareness among organizations regarding strategic knowledge management for innovation, emphasizing the significance of both tacit and explicit knowledge in fostering innovation and competitiveness. Employing a systematic literature review (SLR) methodology, this study gathers relevant publications



from journals between 2006 and 2023, following the PRISMA guidelines. A total of 54 articles were selected for inclusion, evaluated using a six-criterion quality assessment checklist. The findings affirm the pivotal role of knowledge management (KM) in driving innovation and enhancing organizational performance, with implications for national competitiveness. Organizations equipped with robust KM capabilities demonstrate heightened levels of innovation acceleration, as evidenced by their efficient utilization of resources. This innovation acceleration not only enhances the competitive advantage of individual organizations but also contributes to the broader economic growth and competitiveness of the nation. By fostering a dynamic ecosystem of innovative organizations, effective KM practices can attract investment, create job opportunities, and bolster the nation's reputation on the global stage. Thus, the findings highlight the central link between KM, organizational innovation, and national competitiveness, emphasizing the importance of strategic knowledge management for sustainable economic development. In conclusion, KM emerges as a pivotal driver of organizational innovation acceleration, contributing significantly to economic growth. Strategic KM practices not only enhance service quality but also exhibit a strong correlation with organizational performance and growth. The review underlines the critical role of KM processes in effectively leveraging ideas generated by the workforce. Furthermore, it identifies current research trends in innovation-centric KM processes, signalling avenues for further studies beyond the examined databases.

Keywords: Knowledge Management, Innovation Acceleration, Strategic Knowledge Management Practices, Organizational Competitiveness.



Investigation of the Medicinal Potential of Culturable Marine Microalgae from the Dar Es Salaam Coastline

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Abstract

The appearance of bacteria that are resistant to antibiotics makes it necessary to investigate novel, affordable, secure, and powerful bioactive chemicals derived from microalgae. In terms of medicinal and industrial uses, microalgae are attractive sources of bioactive chemicals. Hence this study aimed to investigate the medicinal potential of culturable marine microalgae from the Dar es Salaam coastline. The streaking plate method was used in isolation of microalgae while the disc diffusion method was used in an antibacterial activity test. Algae methanol extract (AME) and Algae hexane extract (AHE) were prepared and tested against Gram-positive and Gram-negative bacteria species. The methanol extracts of *Oedogonium* sp. were tested and showed excellent activity against *P. aeruginosa* (15 mm), *S. aureus* (19.66 mm), and *B. subtilis* (14.33 mm) except it did not show any activities in *E. coli* (00 mm). Also, algae hexane extract (AHE) of *Oedogonium* sp show good activities against all tested bacteria: *E. coli* (16 mm), *P. aeruginosa* (15.33 mm), *S. aureus* (18.33 mm), and *B. subtilis* (20.66 mm). Both species in methanol extracts shows promising result towards gram positive bacteria since their minimum inhibitory concentrations (MIC) were in the range of 3.12 to 3.125 $\mu\text{g/ml}$ for *Oedogonium* sp and 0.78125 to 1.5625 $\mu\text{g/ml}$ for *Chlorella* sp. More comprehensive studies are required to purify these antimicrobial compounds.



Assessing the role of Nature-based solution for Improving Agricultural Production and Biodiversity Conservation

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Abstract

Invertebrates play an integral role as pollinators and biocontrol in both natural and managed ecosystems. However, intensive use of synthetic pesticides for controlling plant pests has affected biodiversity abundance invertebrates including bees, spiders and beneficial microbes. The use of natural based solutions is believed to effective and sustainable in the continuous climate changing decade. This study was conducted to evaluate the impact of pest management practices on abundance and diversity of bees. The study was conducted in Cotton Plantations (REMEI), Meatu, Simiyu under three treatments; untreated plots (control), Vuruga Biocide (biocontrol), observed for 8 weeks consecutively. Beneficial insects; bees and spiders were trapped by using Sweep nets, pit fall, direct search and data recorded on weekly basis in each treatment. The data were analyzed using insect guide Books and R Studio software, where the vegan package to determine the abundance and diversity. Results showed that there was high abundance in Vuruga biocide plot with 16.2 bees and 19.7 spiders, followed by untreated plots with 15.3 bees and 17.4 spiders whereas as chemical pesticide plots were observed with least abundance of 7.1 and 5.4 bees and spiders respectively. The results showed a significance difference in both diversity and abundance of bee's species between Chemical



treatments and other treatments whereas no significant difference in Biocontrol and Control plots. Therefore, the use of biocontrol for management of pest is economical and ecologically beneficial as it protects crops from damage while attracting beneficial insects that increases yield by aiding in pollination.

A Systematic Review of Indigenous Climate Knowledge in East Africa

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Abstract

Indigenous communities across East Africa rely on their traditional knowledge systems to forecast weather patterns and navigate climate change impacts. This study conducts a systematic review to investigate into the depth of indigenous knowledge concerning climate change adaptation in the region, covering the period from January 1, 2009, to December 31, 2023. A thorough search strategy was devised, incorporating key terms such as “indigenous knowledge,” “climate change,” “climate change adaptation,” and “indigenous innovations,” resulting in the inclusion of 43 relevant articles. The findings reveal a predominant focus on Tanzania, Kenya, and Uganda, which collectively accounted for the majority of studies (27.9%, 25.5%, and 25.5% respectively). Employing a mixed-method approach, 70% of the studies highlight the importance of integrating



qualitative and quantitative methodologies. Key indicators employed by indigenous communities include the movement patterns of certain insects like butterflies and red caterpillars, the arrival of migratory birds such as cattle egrets and black eagles, alterations in wind direction, celestial observations including stars and moon phases, and shifts in plant and animal behaviours. Despite the reliability and relevance of indigenous knowledge in forecasting weather and climate changes across East Africa, significant challenges persist. These encompass the dearth of documented indigenous information and the inherently qualitative and context-bound nature of indigenous knowledge, posing obstacles to its sharing and preservation. Furthermore, the review accentuates a notable concentration of research efforts in Tanzania, Kenya, and Uganda, leaving a substantial gap in understanding indigenous knowledge among other East African nations such as Rwanda, Burundi, South Sudan, and the Democratic Republic of Congo. This fragmentation impedes the attainment of a comprehensive understanding of indigenous knowledge for climate change adaptation within the East African context. Efforts to bridge this gap and integrate diverse indigenous perspectives are imperative for fostering resilience and sustainable adaptation strategies across the region.

Keywords: Climate change, Indigenous knowledge, East Africa, indigenous innovations



Enhancing effective faecal sludge management in urban settings using stakeholders' engagement and social network mapping approach: A case of Arusha city, Tanzania

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Abstract

About 75% of the Tanzanian population rely on unsafely sanitation management services. The issue is critical in urban settings where massive generated amount of faecal sludge (FS) is inappropriately handled leading to contamination of water receptors, that jeopardizes public health. The same trend has been observed in Arusha city, where over 70% of its population depends on onsite sanitation systems, generating a tremendous amount of FS that outpaces the capacity of the available treatment systems. This study aimed at investigating the significance of stakeholder's engagement and social network mapping in enhancing adequate faecal sludge management (FSM) in urban settings, taking Arusha city as a reference area. Identification of key stakeholders in FSM was done by interviewing the key interlocutors and through revision of relevant public documents. The level of influence and interest by stakeholders was analyzed by ranking method using Power Vs. Interest matrix tool. Furthermore, the social relationship network mapping between stakeholders was analyzed using Social Network



Visualizer version 3.1 software. The findings show that the supreme power and interest (>80%) in FSM rests on ministry of water (MoW), president's Office - Regional Administration and Local Government (PO – RALG), the ministry of health (MoH), the ministry of education (MoE) and ministry of finance and planning (MoF). However, the Arusha urban water and sanitation authority (AUWSA) and the Arusha city council (ACC) stands as focal stakeholders in ensuring the FS is adequately managed in the city. Furthermore, 97% of the interlocutor in the FSM service chain revealed that an effective social relationship between key stakeholders plays a vital role in ensuring that quality of faecal sludge management within the city is improved with adequate planning and implementation of the FSM interventions.

Keywords: Faecal sludge management, stakeholder's engagement, faecal sludge management service chain, social network mapping

Effect of Shootlet Size and Rooting Medium in Multiplication of Cassava Planting Material

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The low cassava seed multiplication ratio by traditional propagation method cause limited availability of improved and clean cassava planting material for use by farmers. Use of modern propagation technologies result into massive production of high-quality planting material within a short period of time. However, high investment and need of trained personnel limits its adoption and application



in many developing countries. The technology is also subjective to type of explant, media composition, genotypes and regeneration method. Therefore, this study was conducted to evaluate suitable shootlet size and rooting medium for maximum production of cassava plantlets. Two separate screen house experiments were laid out at TARI Naliendele. In the first trial five sized shootlets were laid out in a Completely Randomized Design. The second trial involved shootlets of six cassava varieties and four rooting media laid out in a Split Plot Design and in a Complete Randomized Design arrangement with three replications. Data on number of rooted shootlets, number and length of roots formed; survival percent of shootlets, plant height and vigour were collected and analyzed using R software. Shootlets of 15 cm length produced many plantlets than other size of shootlets. Rooting of shootlets in water medium had increased survival rate of shootlets by 25% as compared to direct planting of un-rooted shootlets. The large number and longest roots developed had positively contributed to high survival of shootlets to the succeeding multiplication stages. To improve accessibility of improved and clean seed, cassava shootlets of 15 cm should be rooted first in tap water then grown in polythene bags in the field with the mixture of forest soil and vermiculite before being planted in the field.

Evaluation of elite cashew hybrids developed in 1998 under the agro-ecological conditions of Nachingwea in Southern Tanzania

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Abstract

Performance of the cashew hybrids developed in 1990s was very good in terms of yield and nut quality compared to varieties released for commercialization in Tanzania. Based on these results, breeders in Tanzania directed their efforts toward improving nut quality to cope with modern cashew processing machines, which required medium to large nuts. In 1998 fifty-eight crosses were developed involving a number of parents with contrasting but useful traits. These hybrids were evaluated at Naliendele for seven years from 1999 to 2006. 26 elite hybrids were selected for advanced genetic trial. The hybrids were evaluated at Nachingwea, one of the major cashew growing districts in the Southern zone of Tanzania to find out if they were suitable in the area. The data on yield and nut quality were recorded for a period of twelve years. Commercial variety AC4 was used as a control. Screening of the hybrids against Cashew Leaf and nut blight disease was another parameter under study. Analysis showed that 23 hybrids out of 26 had good nut quality than AC4 and most gave higher yields compared to control. Screening of the hybrids against the disease demonstrated that majority of the hybrids were tolerant to the disease opening an opportunity to get new cashew varieties resistant to the disease. These hybrids are therefore recommended for multiplication and distribution in Nachingwea and areas, which have similar environmental conditions.

Keywords: cashew, hybrid, yield, nut quality, cashew leaf and nut blight disease.



Factors Influencing Traders Participation in Rice Export Market in Tanzania

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Abstract

The participation of rice traders in export markets is influenced by a complex interplay of socio-economic, product attributes, markets forces and institutional factors. Despite of many studies on rice traders export markets participation, the challenge on rice traders' engagement in rice trade and export activities particularly in developing countries is context specific. This paper analysed specific socio-economic and institutional factors affecting rice trader's decisions regarding export markets participation in Tanzania. Utilizing survey data from 150 randomly selected rice traders across eight distinct trading zones, the study employs binary regression analysis to examine these factors. Results indicate that gender, years of experience in rice trading, capital availability and access to market information significantly impact traders' decisions to enter export markets ($P < 0.05$). The findings highlight that inadequate market information and insufficient capital are primary barriers to participation. The study concludes with a recommendation for government intervention to enhance access to market information and credit facilities, thereby boosting rice traders' involvement in export markets to meet the demand in neighbouring countries. Also, the government should embrace multi-stakeholder innovation platform for building and strengthening partnerships



and collaborative learning among both public and private actors to improve marketing decision among rice traders for attaining the Sustainable Development goals in the country.

Keywords: Tanzania, rice traders, market participation, export markets and market information

1



PAPERS UNDER SUBTHEME 4: RESILIENT SYSTEM FOR FOOD SAFETY AND SECURITY (PRODUCTIVE SECTORS)





Economic Analysis of Broiler Production using Black Soldier Flies Larvae Meals in Tanzania

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Abstract

Poultry is normally fed with fish meal protein feeds which competes with human food requirements leading to unsustainable fish harvests. Coupled with huge costs feeds in poultry production and increasing animal protein requirements due to increasing human population; it is necessary to assess alternative cheap diet components to replace traditional protein meals. This paper analysed economics of Broiler Production using Black Soldier Larvae Meals (BSFLM) (*Hermetia illucens*) in Tanzania. The study employed experimental research design with Three hundred one day old broiler chicks from Silver Land Company Ltd fed with T1(0:100), T2(25:75), T3(50:50), T4(75:25) and T5(0:100) BSFLM:Fishmeal inclusion levels for 35 days. Performance analysis was done using profitability ratios including Gross Profit Margin (GPM), Returns on Investment (ROI) and Benefit Cost Ratio (BCR). Results revealed that profitability of broiler chickens declined as BSFL inclusion increased without significant differences. The declining pattern of profitability as BSFLM inclusion increases was attributed with higher costs of importing BSFL whose cost was twice the costs of fish-based protein meal. It is recommended that, farming of BSF in the country be promoted to reduce costs of imports since Tanzania's agroecological



condition is favourable for flies production throughout year.

Keywords: Black soldier flies, Broiler production, Feed Costs, ROI for broiler production, Tanzania.

Inefficiency of rice production in Kilombero-Tanzania from stochastic profit frontier model: Farming household as a unit of analysis

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Abstract

Rice grain is substantially touching livelihoods of majority in the word since half of the world's human population relies on the grain for food. Tanzania as a country has been trying to produce rice tremendously in an effort to make livelihoods of its people, making the country in first ranking for East African region in rice production. However, such a good position of the country in rice production has not been reflected in the profit that farming households accrue. This study surveyed 100 farming households in Kilombero district as a showcase to understand why there has been such economic inefficiencies. This research paper used Stochastic Profit Frontier Model (SPFM) to test the hypothesis that socioeconomic aspects do not explain profit inefficiencies of farming households. Results from SPFM showed that farming households in the study area experiences



economic inefficiency of 24.1% which has been caused by their state of not being technically and allocatively efficient. Further, labor cost was found leading influencer of economic efficiency among other factors. Inefficiencies in profit were eventually found being attributable to socioeconomics specifically irrigation technology used, participation to off-farm economic activities and access to support services like extension and credit facilities. Finally, findings suggest that labor sharing cooperative society could be formed in the study area for labor expense minimization and the conduction of technical trainings to farmers is generally vital to make them producing efficiently especially from economic sense.

Keywords: Stochastic, Profit Frontier, Kilombero, Gross Margin, Farming Household

Horticulture Value Chain Mapping: An Illustration of Participating Youth in Tabora Municipality

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Abstract

Youth participation in Tanzanian agriculture sector especially in horticulture subsector is not satisfactory in spite of promising prospects unveiled in the subsector. The understanding on participating status of the youth along horticultural value chains is crucial to design strategies for attracting more youth in the subsector. Such understanding is not well known despite its essentiality



stated. This study used the youth from Tabora Municipality as a case to understand horticultural value chain maps and respective coordination mechanisms along the chains. The study adopted a mixed data collection techniques of youth survey and focus group discussions with descriptive and content analysis as methods of analysis used. It was then found that the youth participate in value chain nodes such as production, processing, storing, local trading, transporting, wholesaling, retailing and consumption with differing participation frequency. For instance, none of the studied youth farmers were found operating registered processing firm due to capital limitation at their disposal. Youth farmers were also found to perform activities beyond one node (multitasking) of value chains with little efficiency. Another notable finding was that youth farmers were missing reliable extension, credit and quality accreditation services that jeopardize productivity and their operating business environment. Coordination was eventually found miserable as youth actors along the chain were not trusting each other. Finally, for attracting more youth into the subsector, the study recommended institutional arrangements like contract farming being adopted in the subsector given the prevailing nature of horticultural crops and status of the actors along the chains.

Keywords: Mapping, Tabora Municipality, Coordination, vegetable produce and Youth



ECONOMIC POTENTIALS OF HYDROPONICS FODDER FARMING TO REDUCE INCOME POVERTY AND FOOD INSECURITY AMONG TANZANIA'S URBAN SMALLHOLDER DAIRY FARMERS

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Abstract

Pastures are major resource in Tanzanian ruminant production since time in memorial. Currently, available pastures meet less than one-third of national pasture requirements; that is projected decline by 15% in 15 years to come under Business-as-Usual condition. Prevalence of climate change aggravates little pasture available and threatens its sustainability. Insufficient pastures lead to low milk productivity accounting for only one-fifths of animal productivity potentials and impair attainment of Sustainable Development Goal 1 (poverty eradication) and 2 (half food and nutrition insecurity); African Agenda 2063, African Adaptation Initiatives, Africa Climate Change Strategy 2020 – 2030; and several National Development initiatives including Tanzania Climate Smart Agriculture programme (2015 – 2025), Tanzania Livestock Master Plan 2017/18, National Environmental Policy 2021 and the Tanzania Five-year Development Plan III (2021/22 – 2025/26). Existing technologies to address insufficient pastures include crop residues, hays and silage manufacturing; and conventional fodder farming. However, adoption of these technologies is low due to residues' seasonal availability, intensive capital investments and; large sized land requirements in urban and semi-urban areas. This paper advocates the use of Hydroponics Fodder Farming Technology (HFFT) to mitigate pasture availability and improve the dairy industry. The paper employed



semi-structured literature review approach and content analysis to examine feasibility of HFFT in improving animal milk productivity among smallholder dairy farmers in Tanzania’s urban and semi-urban suburbs. Data were searched from renowned bibliographic data bases using five search queries namely ‘hydroponic fodder farming’, ‘smallholder dairy farming’, ‘ruminant milk productivity potentials’, ‘fodder production technologies’ and ‘Tanzania’. The results indicate that HFFT is a climate smart technology utilizes fewer inputs to produce the same amounts of pastures compared to conventional farming techniques; and is feasible technology to improve milk productivity in the country. It is recommended that HFFT be promoted to improve food security status and reduce poverty levels among smallholder dairy farmers.

Keywords: Hydroponic fodder farming technology, Small holder dairy farmers, Dairy farmers’ feeding regime, Regulations governing Tanzanian Rangelands

Enhancing Biocontrol Efficiency of Key Isolated Entomopathogenic Fungi against *Spodoptera frugiperda* (J.E. Smith) in Maize Crops

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Abstract

Maize is an important vegetable crop both domestically and commercially. Recently the crop is facing the problem of insect pest destruction and this causes its production to drop up to 100% if not controlled. Fall army worm (*Spodoptera frugiperda*) is one of the most destructive insects of Maize. Entomopathogenic fungi (EPF) are among the microorganisms used in biological control against *Spodoptera frugiperda*. The entomopathogenic fungus *Beauveria bassiana* and *Metarhizium anisopliae* currently used as an efficient biological control agent against different insects including *Spodoptera frugiperda*. In this study ten entomopathogenic fungi isolated from soil samples collected from Maize farms infested by *Spodoptera frugiperda*. The efficacy of EPF was tested against *Spodoptera frugiperda* second larvae instars at different conidial concentration and incubation time. The results showed that *Metarhizium anisopliae* had high pathogenicity and recorded high percentage of larvae mortality rate (98.2%), followed by *Aspergillus* spp which recorded 71%. Other EPF recorded lower percentage, which implies lower pathogenicity. Based on this observation *Metarhizium anisopliae* have the potential to be used as effective biological control of *Spodoptera frugiperda* in Maize production.

Keywords: Biological control, Entomopathogenic fungi, *Spodoptera frugiperda*, and *Aspergillus* spp



Cost-Benefit Analysis of Fruit Blended Yoghurt in Mbeya City, Tanzania

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Abstract

Milk is among the livestock produce with higher postharvest loss in Tanzania. However, value addition has the potential to reduce these losses through product development and innovation while accelerating entrepreneurship among women and youth, including university graduates. One innovation that reduces postharvest loss in milk is making yoghurt blended with fruits or their pulps. However, the challenge is whether the market will accept this innovation. This study, therefore, tested the acceptability of mango pulp blended yoghurt in a community of Mbeya University of Science and Technology in Mbeya City and its neighbouring streets. The results show that the product was highly acceptable outside the targeted market, which encouraged and stimulated more production of fruit-blended yoghurt using other jackfruit and grapes. The study also analysed the cost and benefit of developing such products at micro-scale levels to see whether the venture would be profitable and found that it was at TZS 100,000/- when used as initial capital



to start such an enterprise. However, the challenges the study experienced include a shortage of quality raw milk supply from the surrounding livestock keepers, who are earmarked as a source of supply. Therefore, the stakeholders in promoting youth and women enterprises should adopt innovative value addition projects since their initial capital requirement is small and can be obtained and repaid with affordable loan schemes. This, in turn, will increase product variety in the market and reduce postharvest loss, especially in Mbeya, where the milk market is unreliable while creating employment and improving youth and women's livelihoods.

Keywords: Consumer, entrepreneurship, postharvest loss, product development, value addition, yoghurt

Effects of Storage Conditions and Packaging Materials on Physico-Chemical, Sensory and Microbial Properties and Shelf-Life of Extruded and Non-Extruded Nutritious Composite Flour

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Abstract

The storability of composite nutritious flour is affected by many conditions, such as storage temperature and packaging materials. In this study, white maize, soybeans, millets, biofortified common



beans, sesame, and sugar were used to prepare a composite nutritious flour (extruded and non-extruded). The flour was stored at two different temperature conditions (4°C and 25°C) and in three packaging materials (i.e., pineapple film bags, paper bags, and polyethene bags). Then water activity, bulk density, moisture content (MC), and color, as well as total coliforms, moulds and yeast, were evaluated after every 15 days for five months. The physico-chemical and sensory properties of the flour samples were significantly ($p < 0.05$) affected by the storage temperature and packaging materials during the storage period. The higher moisture content (14.97 ± 0.01) was recorded on the 90th day of storage for extruded flour packaged in a polypropylene bag at 4°C. The highest aw (0.79) was recorded from flour packed in paper bags stored at 4°C for 30 days and flour packed in paper bags at days 30 at 23°C. The bulk density decreased as storage time increased in all storage conditions. A microbial test shows non-extruded samples stored at room temperature in polyethene bags after 90 days of storage contain a higher amount of yeast compared to other samples. However, none of the treatments had a microbial load exceeding the set requirement. The highest aroma and color liking scores were recorded after 45 days of storage for paper-packed flour at 4°C. The predicted shelf life was 12, 9, and 7.5 months for extruded samples packed in polyethene, pineapple film, and paper bags at 25 °C, respectively, and 6 to 6.5 months for non-extruded samples stored at 25°C. Proper sealing or lamination of pineapple film with paper may reduce the absorption of moisture and extend its shelf life. The shelf study can help in the marketing and distribution of extruded and non-extruded composite flour.

Keywords: Extruded composite flour, shelf-life, physico-chemical, sensory and microbial properties



Seedling Stage Phenotypic Screening for Salinity Tolerance in Rice Genotypes from Eastern and Southern Africa

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Abstract

Soil salinity significantly impacts rice production globally, necessitating breeding for improved varieties resilient to salinity stress. In this study, 13 genotypes selected from a pool of 206 rice genotypes were characterized to evaluate their tolerance to salinity (12 dS m⁻¹) during seedling stage. Salinity stress reduced both root and shoot dry weights of most rice genotypes and Spearman's correlation indicated that sodium content, sodium to potassium ratio and canopy temperature at later stages of salinity stress were the variables most strongly associated with salinity tolerance in the rice genotypes tested. Principal component analysis (PCA) was used to reduce the dimensionality of the variables to identify the key variables and sources of variation for salinity tolerance. Sodium to Potassium ratio (Na⁺ K⁺), root dry weight, shoot dry weight and shoot length were the most important variables for salinity tolerance, as they had high loadings on the first principal component (PC1), explaining 56.95% of the total variation in the data. Based on the PCA results, the genotypes were classified into three categories: tolerant, moderately tolerant, and sensitive. This study identified six moderately tolerant genotypes (Intsingagira Bigega, K5, SATO



1, Sukari, Terembele (LL 29), and ZX 117) that showed promising phenotypic tolerance. These genotypes could be potential candidates for future breeding programs aimed at enhancing salinity tolerance in rice varieties. Further research, including genotypic screening and field evaluation, is recommended to deepen the understanding of the underlying mechanisms in order to validate the current results for further applications.

Keywords: Salinity, Tolerance to salinity, Phenotyping, Principal Component Analysis, Rice Breeding, Spearman's correlation

Variation for Phenological and Agronomical Traits of Selected Mungbean [*Vigna radiata* (L.) R. Wilczek] Genotypes in Different Agro-ecologies of Tanzania

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Abstract

Mungbean [*Vigna radiata* (L.) R. Wilczek var. *radiata*] also referred to as green gram is a key crop especially in the marginal areas of East Africa. Its short maturity period, low input requirements, drought tolerance and ability to improve soil fertility through nitrogen fixation makes it an ideal crop for low input production systems. This study was conducted to evaluate the performance of 10 best selected mungbean genotypes for phenological and agronomic traits across different location in Tanzania. The genotypes displayed significant variability for both phenology and agronomic traits across tested environments. Significant ($P < 0.05$) genotype effects were observed for most of the traits except for the GXE interaction of 100 seed weight. Environment Miwaleni were found to be discriminating and representative of phenological traits. Genotypes AVMU 2007, AVMU 2008 and AVMU 2015 combined both stability while the high yielding was AVMU 2007 and AVMU 2014 with average yield of 1871.00 - 1974.62kg/ha and 1533.67 – 1756.67kg/ha respectively. Additionally, these genotypes will be useful in future breeding efforts as donors aimed at developing high yielding mungbean varieties.



PAPERS UNDER SUBTHEME 6: FOSTERING STEM EDUCATION FOR RESILIENT, COMPETITIVE AND SUSTAINABLE ECONOMIC GROWTH





Supportive strategies to foster Technology Integration in the Classroom: A case of ordinary level Secondary Schools in Iringa Municipality, Tanzania.

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Abstract

Teachers must adopt new technologies that encourage student participation and learning in the classroom as they become available. Students will get a deeper comprehension and mastery of the material as a result. The strategies to promote technology integration in the teaching and learning process were the main focus of the study. The study's sole goal was to identify helpful tactics for promoting the use of technology in the teaching and learning process. To gain a thorough grasp of the phenomenon being studied, the study employed a case study design and a qualitative technique. A sample of forty-four (44) participants from four secondary schools was formed through the purposeful sampling of four (4) heads of schools, twenty (20) teachers, and twenty (20) students. Focus groups, observations, and interviews were the methods used to acquire the data. The acquired data was analysed using thematic analysis. The six steps that Miles and Huberman created in 1994 served as the basis for the theme analysis. The results showed that teachers must be supported with ICT resources, computer literacy



programs, teachers' motivation, technical and administrative support in order to promote technology integration in the teaching and learning process. In order to improve technology integration in the teaching and learning process, the study recommends governmental and non-governmental organizations to assist teachers by providing in-service trainings and ICT facilities.

Keywords: *Technology integration, Computer and projector, teaching and learning*

Constructionist Learning Environment as a key Resource for fostering critical soft skills development among students through STEM Education in Tanzania

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Abstract

This study examined the effect of constructionist learning environment (CLE) for fostering skills development through STEM (science, technology, engineering, mathematics, medicine) education that will equip students with necessary skills for resilient, competitive and sustainable economic growth. Literature has shown



great potential of constructionist teaching and learning approaches for developing essential soft skills such as creativity, critical thinking, communication and collaboration. This study created the CLE and examined its effect on developing soft skills among students through STEM education. This study focused on ten soft skills needed in the fourth industrial revolution (4IR). The paper is underpinned by the Revised Bloom's Taxonomy of cognitive domain and the constructionism learning theory, which call for CLEs. The Kyomo's Model and Design Theory for creating CLEs were applied to create CLEs in experimental schools. A quasi-experimental, non-equivalent control group design (NCGD) was employed, where two experimental and two control schools were involved. Pretest-posttest student questionnaires for evaluation of effect of CLE were administered for data collection. A total of 240 form four students participated in the study. Constructionist learning objectives (CLOs) in the physics syllabus for ordinary secondary education were implemented in the CLE. Data analysis employed statistical package software for social sciences (SPSS) to generate means and standard deviations. Findings have shown that CLEs are effective in developing critical soft skills that are needed for students to be competitive in the 4IR. From these findings, it is concluded that CLEs are imperative for STEM education for developing students with critical soft skills to be competitive in local and global ecological and economic demands. Thus, the paper recommends that education responsible authorities in Tanzania provide CLEs in STEM education so that students are able to develop both technical and critical soft skills that are needed in the 4IR.

Keywords: STEM education, constructionist learning environment, constructionism learning theory, Kyomo's model and design theory for creating CLEs, constructionist learning objectives



The adoption of Digital School Based Assessment tool for improved Teaching and Learning Standard Two pupils in Primary Schools of Songwe Region, Tanzania

Seleman Chisibho Mafuru

The National Examinations Council of Tanzania

Abstract

The summative assessment of Standard Two National Assessment (STNA) for the year 2015 conducted by the National Examinations Council of Tanzania (NECTA) concerning Reading, Writing and Arithmetic's skills (3R's), identified that, 13.8% failed to master intended skills according to 2015 3Rs NECTA Report. This failure raised duplet of tool in assisting formative assessment of differentiated and overcrowded classroom namely as the Guided Handout Assessment (GHA) as a paper manual and the Digital School Based Assessment (DSBA) tool as digital application hosted on tablets. The study focusses on investigating adoption of the Digital School Based Assessment (DSBA) tool in Standard Two Primary School education at Songwe Region in Tanzania by evaluating DSBA tool acceptance, its relevance in assessing cognitive skills domain and the position of the tool in supporting of leaner centred approach of differentiated and overcrowded classrooms. This research uses Quantitative methodology whereby the online Questionnaire were designed based on triplet theory known as the Unified Theory of Acceptance and Use of Technology (UTAUT) as described by Marikyan, D. et al (2023), Learner-Centred Theory of Education (LCTE) by Jean Jacque Rousseau (1712–1778) and the Revised Bloom Taxonomy by Benjamin Bloom et al (2001). The collected data were analysed by Statistical Package for the Social Sciences (SPSS) and results from respondents reveals that, most of teachers have accepted the DSBA tool, however, most of them recommend redesigning of the supervised DSBA tool instead of classroom teacher dependent. The



results furthermore justify that designed items used in assessment complied with Learner Centred Approach (LCA). Finally, the results strongly agreed that, the DSBA System complies with the Revised Bloom Taxonomy by Benjamin Bloom et al (2001) in assessing cognitive skills domain. The study reaffirms that in mastering 3R's effectively to Standard Two pupils of overcrowded and differentiated classrooms, the supervised Digital School Based Assessment tool should be applied as far as the formative assessment is concerned for differentiated and overcrowded classrooms of Standard Two pupils.

Keywords: School Based Assessment, Overcrowded classrooms, differentiated classrooms, summative assessment, formative assessment, Applications, Standard Two National Assessment, Learner-Centred Theory of Education, and Bloom Taxonomy

Developing a User-Centric LMS Dashboard for Tanzanian Primary Schools: A Combined SCRUM and HCD Approach

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Abstract

This paper presents the development and deployment of a user-centered Learning Management System (LMS) dashboard designed to help stakeholders evaluate the effectiveness of the Teachers' Continuous Professional Development (TCPD) program implemented in primary schools in Tanzania. The development process adopted a hybrid approach, integrating SCRUM's agile framework with Human-Centered Design (HCD) principles to accommodate diverse stakeholder requirements. Using the "One Sprint Ahead" approach for the research team and the "Dual Task Development" model for government entities, the project balanced iterative feedback with adaptable development cycles to meet the distinct needs of each group. The developed dashboard serves as a monitoring tool, providing stakeholders with insights into teacher registration, module engagement, content access, and device usage. The dashboard's functionality aids in informed decision-making, enabling stakeholders to assess LMS adoption and identify areas for targeted improvements. This study reveals the challenges and benefits of applying combined SCRUM and HCD methodologies in an educational technology project with multi-regional, resource-limited constraints. The findings illustrate the potential of these methodologies in developing adaptive, data-driven solutions for educational settings, offering valuable insights for future initiatives in similar contexts.



Inconspicuous Practices Affecting Students' Enrolment and Continuation in STEM in Secondary Schools: Analysis of Teachers and Students Experiences

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Abstract

STEM is vital to industrialisation, technological advancement and scientific innovations. Despite the importance of STEM education, in Tanzania, there is a decrease in the number of students taking Chemistry and Physics subjects, poor performance, and the fact that they are optional subjects in many schools. This study examined the inconspicuous practices that discourage students from taking Physics and Chemistry subjects as part of STEM in ordinary level secondary schools. This phenomenological study purposively selected and interviewed 25 participants from twelve secondary schools in Mvomero, Mbeya, Tabora, and Nzega districts in Tanzania who consented to participate. The authors used the content analysis method to analyse data and presented them in themes with the support of direct quotations. The findings indicate that schools use standard seven and FTNA results to stream students. In contrast, teachers regard higher achievers as fit for science subjects and low achievers as unfit, regardless of their interests. The low achiever streams hardly receive additional support in STEM because teachers consider them unfit. Schools force higher achievers who are uninterested in science to study Physics and Chemistry while denying interested low achievers a chance to study them. Although teachers believe streaming motivates students to work hard, it does not help students improve their performance as it neglects the needs and interests of students. The study recommends that the government make Chemistry and Physics subjects compulsory



and ensure adequate school resources. Schools should encourage teachers to devise appropriate learning support for students to enrol and succeed in STEM subjects.

Keywords: STEM; streaming; secondary schools; learning achievement

Generation Tech Space's Role in Fostering Inclusive STEM Education and Economic Resilience: Case Studies from Tanzania

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Abstract

In today's competitive landscape, Science, Technology, Engineering, and Mathematics (STEM) education is essential for economic resilience and innovation. This study investigates the role of Generation Tech Space (GTS), a Tanzanian non-profit organization, in promoting STEM education to enhance economic resilience and inclusivity in underserved communities. In this study, it was identified that the limited access to STEM education, particularly in marginalized communities due to socioeconomic status, geographic location, and education resources create a barrier and hinders economic competitiveness and innovation. GTS addresses these barriers by providing STEM education opportunities through workshops, mentorship, and partnerships with local institutions. The methodology adopts a case study approach, using both qualitative and quantitative data collection methods, including participant



surveys, interviews, and program metrics. Data was gathered on indicators such as STEM engagement levels, skill acquisition, and career motivation among youth participants. The effectiveness of GTS's programs was evaluated using Key Performance Indicators (KPIs) to track participants' progress in STEM knowledge and skills. Results demonstrate significant and prominent improvements in STEM engagement and skills, with a marked increase in participants' confidence and motivation to pursue STEM careers. The impact extends to practical and tangible achievements, with participants successfully creating community-relevant technological solutions, like a solar-powered tomato dryer and a blood donor application which is at a prototyping stage. These results underscore GTS's success in fostering a safe, supportive and collaborative environment for innovation and inclusivity in STEM. The study concludes with policy recommendations to support and scale GTS's initiatives, advocating for increased funding and partnerships to sustain and broaden the organization's impact.

Keywords: STEM education, economic growth, innovation , Generation Tech Space(GTS), inclusivity, diversity.



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Abstract

This study examined the effect of constructionist learning environment (CLE) for fostering skills development through STEM (science, technology, engineering, mathematics, medicine) education that will equip students with necessary skills for resilient, competitive and sustainable economic growth. Literature has shown great potential of constructionist teaching and learning approaches for developing essential soft skills such as creativity, critical thinking, communication and collaboration. This study created the CLE and examined its effect on developing soft skills among students through STEM education. This study focused on ten soft skills needed in the fourth industrial revolution (4IR). The paper is underpinned by the Revised Bloom's Taxonomy of cognitive domain and the constructionism learning theory, which call for CLEs. The Kyomo's Model and Design Theory for creating CLEs were applied to create CLEs in experimental schools. A quasi-experimental, non-equivalent control group design (NCGD) was employed, where two experimental and two control schools were involved. Pretest-posttest student questionnaires for evaluation of effect of CLE were administered for data collection. A total of 240 form four students participated in the study. Constructionist learning objectives (CLOs) in the physics syllabus for ordinary secondary education were implemented in



the CLE. Data analysis employed statistical package software for social sciences (SPSS) to generate means and standard deviations. Findings have shown that CLEs are effective in developing critical soft skills that are needed for students to be competitive in the 4IR. From these findings, it is concluded that CLEs are imperative for STEM education for developing students with critical soft skills to be competitive in local and global ecological and economic demands. Thus, the paper recommends that education responsible authorities in Tanzania provide CLEs in STEM education so that students are able to develop both technical and critical soft skills that are needed in the 4IR.

Keywords: STEM education, constructionist learning environment, constructionism learning theory, Kyomo's model and design theory for creating CLEs, constructionist learning objectives

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Abstract

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Assessment (DSBA) tool in Standard Two Primary School education at Songwe Region in Tanzania by evaluating DSBA tool acceptance, its relevance in assessing cognitive skills domain and the position of the tool in supporting of learner centred approach of differentiated and overcrowded classrooms. This research uses Quantitative methodology whereby the online Questionnaire were designed based on triplet theory known as the Unified Theory of Acceptance and Use of Technology (UTAUT) as described by Marikyan, D. et al (2023), Learner-Centred Theory of Education (LCTE) by Jean Jacque Rousseau (1712–1778) and the Revised Bloom Taxonomy by Benjamin Bloom et al (2001). The collected data were analysed by Statistical Package for the Social Sciences (SPSS) and results from respondents reveals that, most of teachers have accepted the DSBA tool, however, most of them recommend redesigning of the supervised DSBA tool instead of classroom teacher dependent. The results furthermore justify that designed items used in assessment complied with Learner Centred Approach (LCA). Finally, the results strongly agreed that, the DSBA System complies with the Revised Bloom Taxonomy by Benjamin Bloom et al (2001) in assessing cognitive skills domain. The study reaffirms that in mastering 3R's effectively to Standard Two pupils of overcrowded and differentiated classrooms, the supervised Digital School Based Assessment tool should be applied as afar as the formative assessment is concerned for differentiated and overcrowded classrooms of Standard Two pupils.

Keywords: School Based Assessment, Overcrowded classrooms, differentiated classrooms, summative assessment, formative assessment, Applications, Standard Two National Assessment, Learner-Centred Theory of Education, and Bloom Taxonomy

PAPERS UNDER SUBTHEME 5: RESILIENT SYSTEM FOR FOOD SAFETY AND SECURITY (PRODUCTIVE SECTORS)



