SOKOINE UNIVERSITY OF AGRICULTURE

DIRECTORATE OF POSTGRADUATE STUDIES, RESEARCH, TECHNOLOGY TRANSFER AND CONSULTANCY

SCIENTIFIC CONFERENCES ON

TRANSFORMING AGRICULTURE AND NATURAL RESOURCES FOR SUSTAINABLE DEVELOPMENT TO ATTAIN INDUSTRIAL ECONOMY IN TANZANIA

BOOK OF ABSTRACTS

10th to 11th APRIL 2019

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Background

Sokoine University of Agriculture and her collaborators are committed to contribute to sustainable development to attain Tanzania National Development Priorities and Sustainable Development Goals through provision of quality Research, Outreach and Consultancy services. Researchers and collaborators of SUA conduct various applied research activities to address challenges in agricultural productivity in crops and livestock, livestock and human health, socio-economic dynamics, climate change, natural resources management, education and environmental conservation. To commemorate, celebrate and honour the life and legacy of the late Hon. Edward Moringe Sokoine (former Prime Minister of the United Republic of Tanzania), SUA wishes to share the generated knowledge, innovations, solutions, and findings to the national and international scientific community. In this spirit, SUA will hold the 2019 SUA Scientific Conference in Agriculture and Agribusiness along with the Sokoine Memorial Week.

The objective of the Conference is to showcase SUA contribution in Transforming Agriculture and Natural Resources for Sustainable Development to Attain Industrial Economy in Tanzania.

Conference Subthemes

Agro-processing and Agro-ecology for food security and economic growth

Food security is critical in economic growth to ensure access of nutritious food at all time to all people. Efforts to achieve food security starts with ensuring optimum productivity of nutritious foods, reducing food loss and adding value of food crops. Sharing experience and research findings in the areas of breeding of food crops, integrated soil fertility management, agrochemicals, integrated pest management, agro-processing to preserve and add value to food crops, agricultural machinery, agro-mechanization, unmanned aerial vehicle (UAV) or drone, and land management.

Sustaining animal health and livestock productivity

Tanzania is rich in livestock. The major challenges of livestock sector are diseases, low genetic potential and proper nutrition of livestock. Low productivity and quality of livestock and livestock products make contribution of livestock to the economy (GDP) to be low relative to high number of livestock, and in most cases leading to high pressure on the environment. We invite papers which will address issues of animal health, vaccination, skins and hides, milk and meat quality and productivity, animal nutrition, livestock breeding, human-animal disease interactions, pasture and rangeland management to improve productivity and ensure ecological health.

Sustainable environment, natural resources management and tourism

Transforming Tanzania to industrial economy may pose threat to natural resources and environment. The management of natural resources such as forest, wildlife, culture, tourism and hospitality have potential to significantly contribute to attain industrial economy. Environmental protection, pollution control, recycling of waste to sustain economic growth are essential to strike balance between environment and nature conservation and exploration or utilization of natural resources for economic growth and improving livelihood. We hereby invite papers that will address these areas.

Trade, socio-economic transformation for improved agricultural productivity and livelihood

Agriculture must be profitable to significantly transform people's livelihoods and contribute to economic growth and become dependable source of employment. Profitability of agriculture is determined by terms of trade, distribution of gross margin among value chain actors, markets and marketing, and risk management and investment. Agriculture and development influence

social wellbeing of the communities along value chain. SUA researchers strive to addresses challenges in agricultural trade, markets, socio-economics, value chain to enhance investment and hence productivities.

Education for skills development and entrepreneurship

Attaining industrial economy is highly determined by presence of skilled personnel, capable of translating knowledge to solve practical problems in the country's economy. Similarly, the medium income economy will increase the demand of high skilled labour. These anticipations require education system to be more relevant, practical oriented, problem solving and build capacity for both employability and self-employment at small, medium and large enterprises. We invite papers focusing on exploring problem-based learning, E-learning systems and blended learning education, Technology and economic transformation, ICT and communication security, Mobile Computing, E-services (e-business, e-agriculture, e-extension), E-governance, Role of ICT in development and practical training to improve knowledge and skills development for supporting industrial economy and contribute entrepreneurship.

The Organising Committee

1.	Prof. Esron Karimuribo	Chairperson
2.	Dr. Nyambilila Amuri	Co-Chairperson
3.	Dr. Doreen Ndossi	Co-Chairperson
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13	Mr. Bernard Ronald	Member
14.	Dr. Justin Urassa	Member
15.	Dr. Augustine Matondo	Member
16.	Prof. Cornellius Nyaruhucha	Member
17.	Prof. Said Idd	Member

Keynote Addresses

1. Livestock Productivity by Prof Lusato Kurwijila, Sokoine University of Agriculture, Morogoro

2. Investment opportunities by James Maziku, EPZA, Dar Es Salaam

3. Agroecology by Prof Rhodes Makundi, SUA Pest Management Centre, SUA

4. Understanding Innovation Ecosystem in Tanzania. Opportunities and Challenges. by Dr. Georges Shemdoe and Athuman Mgumia, COSTECH, Dar Es Salaam

5. Agricultural Research in Tanzania By Dr. Geoffrey Mkamilo Tanzania Agricultural Research Institute (TARI), Dodoma

6. Sustainable Water Resources by Prof Japhet Kashaigili, SUA

7. Agroecology: concepts and applications. by Prof Maulid Mwatawala, SUA

8. Research Methods for Agroecological Intensification by Nuru Kipato, CCRP, Arusha

Theme 1: Agro-processing and Agro-ecology for food security and economic growth

1.1 Nutrition status of children 0-23 months of age: comparison of pastoralist and crop farming communities in Mvomero district, Tanzania

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Abstract

A livelihood system of community is an essential first step that identify the options they have for improving food security, and hence nutrition status of all household members. This study aimed to determine nutrition status of children below two years of age among pastoralist and crop farming communities in Mvomero district. A cross-sectional study involved 348 mothers/caregivers of children below two years old from Mvomero district, Morogoro (206 from crop farming and 142 from pastoralist households). *Pro*PAN standardized research tools and procedures were adopted for data collection and analysis. Socio-demographic information was collected using caregiver survey. Nutrition status of the children was determined using anthropometric indicators. Socio-demographic and anthropometric data were analysed using *Pro*PAN software and t-test and Chi-square test were done in SPSS software to determine significant differences between socio-demographic characteristics, stunting, wasting and underweight in the two communities. Mean age of mothers/caregivers was 26 years and of the studied children was 12 months. About 35% of pastoralist and 7.3% of crop farmers caregivers had no formal education. Most of the mothers in farming community delivered at the health facility (89%) but mothers from pastoralists delivered mostly at home (50.7%) or at the traditional birth attendant house (39%) and assisted either by untrained family member or a traditional birth attendant. About one third (33.5%) of the children were stunted and there was no significant difference in prevalence of stunting in the two communities. Prevalence of underweight was 13% and wasting was 3.3%. Proportion of underweight and wasting was higher among children from pastoralists. Prevalence of stunting was similar in both communities; however, underweight and wasting was relatively higher in pastoralist than in crop farming community. Further studies to explore the factors contributing to high rates of wasting and underweight among pastoralists are warranted.

Key words: Nutrition status, pastoralist, farmers, Tanzania

1.2 Dietary intake and diversity among children of age 6-59 months in lowland and highland areas in Kilosa District, Tanzania

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Abstract

Adequate nutrition during infancy and early childhood is essential to ensure growth, health, and development of children to their full potential. Geographical location may influence dietary intake, and hence, nutritional status of the population. This study aimed to assess dietary intake among children of age six to fifty nine months in the lowland and highland areas in Kilosa district. A cross-sectional study involved 200 randomly selected households from the lowland and 141 in highland areas of Kilosa district. Socio-demographic, feeding practices and 24-hours dietary recall information was collected using a pretested questionnaire. Statistical Package for Social Sciences (SPSS) version 20 was used to analyse socio-demographic and feeding practices data. Significant difference between highlands and lowlands areas were determined at $p<0.005$. The 24-hour records were converted to nutrient intake using Nutri-Survey software and compared to recommended dietary intake.

A study involved 341 children aged 6-59 months where 51% were boys. Less than half of the children in lowland (43%) and in highland (45%) met Recommended Dietary Allowance (RDA) for protein. Inadequate intakes of vitamin A, calcium and iron were observed more in younger children of age 6-12 months where none of them met the RDA. Grains, roots and tubers were the most popular food groups consumed almost all children while eggs were the least consumed by only 1.2% of the studied children. Majority of children (80.6%) consumed less than four food groups in the last 24 hours preceding the survey. Children in lowland area had significantly more diversified diet. Low dietary diversity, limited intake of animal source foods and hence limited micronutrients intake was observed in the study population where children from the lowland areas had less diversified diet compared to those from highland. Feasible strategies are needed to address the dietary inadequacies.

Key words: Dietary intake, children, highlands, lowlands, Tanzania

1.3 Content of complementary foods for children of age 6-23 months old in Rombo District, Tanzania

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ABSTRACT

Complementary feeding is an effective strategy in reducing the levels of malnutrition among children aged 6-23 months. Less is known about preparation and nutrient content of locally made complementary foods in Tanzania. This study was carried out with the aim of analysing nutrient content of the frequently used complementary foods for children of age 6 to 23 months. A cross-sectional study was conducted in three randomly selected villages in Rombo district, Kilimanjaro region, Tanzania. Information on the types of complementary foods was collected using semi-structured and 24-hour dietary-recall questionnaires. Seven samples of frequently consumed complementary foods (banana and maize-based porridges) were collected and analysed for proximate composition, vitamin A and C as well as iron, zinc, calcium and iodine. Data were analysed using Microsoft Office Excel 2007, R software and SPSS version 20.0. Means, frequencies and percentages were calculated and Turkeys Honest Significance Difference test was used for multiple mean comparison test. The results showed that, the amount of energy, vitamin A, vitamin C, iron, zinc, calcium and iodine of the food samples ranged from 317.98 to 379.23 kcal, 195.83to 971.05 µg RE, 3.48 to 9.02 mg, 2.48 to 22.86 mg, 0.92 to9.57 mg, 73.13 to 400.58 mg and 10.18 to 200.93 µg/100 g dry-weight, respectively. Conclusively, the amount of vitamin C, iron, zinc, calcium and iodine of the frequently used complementary foods in the study area was low. It is important to develop recipes that may either fill or narrow this gap by using low-cost, locally available and culturally acceptable ingredients.

Key words: Complementary foods, Energy, Micronutrients, Porridge

1.4 Effect of Solar Drying Methods on Total Phenolic Contents, Antioxidant Activity and Vitamin C of Selected Fruits and Vegetable in Tanzania

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Abstract

The effect of different solar drying methods; cabinet direct, cabinet mixed mode and tunnel dryers on total phenolic contents (TPCs), antioxidant activity and vitamin C contents of selected varieties of mango (*Dodo, Viringe and Kent*), banana (*Kisukari, Kimalindi and Mtwike*) and tomato (*Tanya, Onyx, Cal J)* were investigated in this study using Folin-Ciocalteu

reagent, Ferric Reducing Antioxidant Power (FRAP) and High Performance Liquid Chromatograph (HPLC) methods respectively. There were significant ($p<0.05$) variations in TPC (mg GAE/100 g DM), FRAP (µmol/100 g DM) and vitamin C (mg Lasc/100g DM) among the fresh fruits and vegetable samples. The highest TPC (476.6±8.6-538.9±1.4), FRAP (44.6±1.6-46.8±0.5) and vitamin C (115.1±1.6-26.8±0.5) were in tomato and respective lowest values of 139.3±2.3-189.2±2.7, 10.8±0.1-15.8±0.2 and 28.3±0.0-29.1±0.0 were in banana. Drying methods had significant ($p<0.05$) effect on all parameters assessed. All fresh samples had higher levels but declined significantly in dried samples with exception of tunnel dried tomatoes. Among the dried samples, the tunnel dried samples had higher TPC recovery of 75-125%, FRAP of 78-96% and vitamin C of 6.9-54.4% than cabinet dried samples with respective lower values of 57-95, 44-86 and 3.2-24%. No significant ($p>0.05$) variations were observed between the cabinet dryers. Moreover, the percentage recoveries differed significantly ($p<0.05$) in all parameters between the varieties within the fruits/vegetable and drying methods. Therefore, this study has revealed that, solar drying methods have varied low to moderate effects on total phenolic contents and antioxidant activities of selected mango, banana and tomato varieties with tunnel dryer giving significantly higher percentage recovery than cabinet dryers. However, the methods have severe effect on vitamin C contents of dried fruits and vegetables. Application of solar drying technology especially tunnel dryer for processing of fruits and vegetables into shelf life stable dried products rich in antioxidant activities for household consumption and income generation is highly recommended.

Key words: *Solar drying, Phenolic, Antioxidant, Vitamin C*

1.5 Nutrient status in soil and site-specific fertilizer demand in maize producing areas of Morogoro rural, Tanzania

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ABSTRACT

Appropriate fertilizer uses in maize production based on soil fertility status has potential to improve food security at cost-effective input use. The objective of this study was to establish cost-effective site-specific fertilizer recommendations and demand for fertilizer to improve increase maize yield and preserve soil quality. The study was conducted in Morogoro Rural from 2014 to 2016 using randomized controlled trial (RCT) involving 1050 maize-growing farmers randomly selected from 47 villages. The RCT treatments were: provision of soil information only (control), site-specific recommendation + voucher, voucher only, and recommendations alone to farmers. Baseline survey, soil sampling, soil analysis using Soil Doc Kit from each farmer's main maize plot were conducted in 2014, and established site-specific fertilizer recommendations. An end-line survey was conducted in 2016, with 5% attrition. The results showed that the major nutrient deficiencies in soils were N in 85%, S in 95%, P in 28% and K in 11%, of farms. Required fertilizer combinations were N alone (3.5% of farms), NP (0.5 % of farms), NS (64% farms), NPS (21% of farms) and NPKS (5% of farms). No change of farmers' decision to purchase fertilizers due to provision of soil test results alone. Provision of site-specific fertilizer recommendation + input voucher increased amount of fertilizer applied (21 kg per 0.40 ha), followed by voucher only (10 kg per 0.40 ha) compared to recommendation only (0.30 kg fertilizer) and control (0.80 kg fertilizer). Farmers that received the site-specific recommendation + vouchers were more likely to respond to the information that sulfur is limited and 49% applied SA and urea. Farmers with only vouchers were more likely to redeem the voucher for cash (69%) or purchase only urea. Production function analysis indicate that application of SA + urea increases yields by 200%. It was concluded that most farms require combinations of nutrient fertilizers.

Key words: Soil quality; Soil Doc kit; fertilizer investment decision; maize productivity; food security

1.6 Natural antioxidants from clove for protecting nutritionally valued omega-3 fatty acids in sun-dried and deep fried sardines (*Rastrineobola argentea*).

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Sardines (*Rastrineobola argentea*), popularly known as "*dagaa"* is one of the leading commercial species of Lake Victoria. The fatty fish species are attracting great attention

because they are good source of omega-3 polyunsaturated fatty acids which are vital for a wide range of biological functions and are implicated in the prevention of numerous diseases. While nutritionally valued these fatty acids are highly susceptible to oxidation during fish processing due to their unsaturated nature. Synthetic antioxidants may be used to prevent lipid oxidation but have been claimed to be carcinogenic at higher levels. The replacement of synthetic antioxidants with ones of natural origin is now in demand. Open sun drying and deep frying are common sardine processing and preservation methods. The processes promote lipid oxidation reactions resulting in loss of omega-3 fatty acids and production of undesired off-flavours which discourage consumption and limit diversification of sardine products. In this study, natural antioxidants rich extracts from clove buds were applied on sardines in a bid to impede lipid oxidation during the two processing methods. Lipid oxidation was assessed by peroxide value (PV), volatile compounds by GC-MS and fatty acid analysis by GC-FID. The results showed that natural antioxidants from clove buds reduced peroxidation and were more efficient in protecting highly unsaturated omega-3 fatty acids from oxidation during sun-drying than deep frying process. Total polyunsaturated fatty acids amounted to 29 and 7.30 % in sun dried and deep fried sardines respectively indicating pronounced oxidative damage during deep frying. Retention of omega-3 fatty acids was 7.56 and 0.70 % more in pre-treated sun dried and deep fried sardines respectively than in untreated fish. Significantly lower amounts of volatile compounds were produced in sardines pre-treated with clove extracts. The study demonstrated feasibility to pre-treat sardines with natural antioxidants for protecting omega-3 fatty acids against oxidation during processing.

1.7 Predicting soil ece based on values of ec1:2.5 as an indicator of soil salinity in Magozi irrigation scheme, Iringa, Tanzania

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ABSTRACT

Soil salinity is one of the limitations to sustainable production of rice and other crops in many irrigation schemes of Tanzania. Soil salinity can be assessed from electrical conductivity (EC) measurements. Most soil laboratories in Tanzania appraise soil salinity from measurements of electrical conductivity of 1:2.5 soil:water suspensions ($EC_{1:2.5}$) by virtue of their simplicity. However, the influence of soil salinity on plant growth is mainly based on electrical conductivity of saturated paste extract (EC_e), so it is necessary to convert $EC_{1:2.5}$ to EC_e in order to assess plant response to salinity. This study was conducted at Magozi Irrigation Scheme, Iringa, Tanzania to establish regression model for predicting EC_e from $EC_{1:2.5}$ values. A total of 60 soil samples (45 samples for model training and 15 samples for model validation) were collected and analyzed for soil $EC_{1:2.5}$, EC_e and soil texture. $EC_{1:2.5}$ ranged from 0.1 to 9.2 dS m^{-1} with a mean value of 0.85 dS m^{-1}. EC_e ranged from 0.3 (non-saline) to 33.3 dS m^{-1} (strongly saline) with a mean of 2.9 dS m^{-1} (slightly saline). In order of dominance, soil textural classes were sandy clay loam, clay, sandy clay, sandy loam and clay loam. Strong linear relationships between EC_e and $EC_{1:2.5}$ were observed in the developed linear regression equations. After

validation, the study selected equation **$EC_e = 3.4954EC_{1:2.5}$** with R^2 of 0.956 for combined soil textures to be used for prediction of EC_e from $EC_{1:2.5}$ at Magozi Irrigation Scheme. This model can be tested for its applicability to other similar soils in Tanzania in further studies.

Keywords: Soil salinity, EC_e, $EC_{1:2.5}$, Magozi Irrigation Scheme, soil salinity prediction

1.8 Soil seed bank and mapping Chromolaena odorata an invasive weed in Serengeti district and its surrounding areas, Tanzania

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Abstract

The spread of *Chromolaena odorata* in some parts of Serengeti district has stimulated interest in the prediction of their soil seed bank and distribution. Thirty sites from fallow, grazing and cultivated land were sampled for soil seed bank assessment. Each site was randomly demarcated into five 20m^2 plots. Soils were collected from 0–5cm, 5–10cm and 10–15cm depths using a 10cm diameter and 5cm length cylinder. Coordinates were taken using GPS along transects while cover was estimated in percentage. Each soil sample was soaked for a minimum of 30 minutes in a solution of sodium hexametaphosphate (50g/L) and sodium bicarbonate (25g/L) and poured over a set of three different sieve sizes to remove debris. The results were converted to number of weed seeds per square meter, and statistically analyzed using Genstat 5 Statistical package. Quantum GIS (1.8.0) was used to map the distribution of the weed. Percentage cover was computed as the length intercepted by each species within 10m transects line. The results showed that, the soil seed bank in all land uses decreased significantly ($P<0.05$) from the top soil (0-5cm) to the bottom soil (10-15cm). Mean weed seed densities varied depending on land use but generally were highest in fallow land followed by cultivated land. The top 0-5cm soil had slightly more than twice Siam weed seed densities (1254 seeds/m^2) than twice that in the 5-10cm soil layer (597seeds/m^2). Soil seed bank and distribution map of *C. odorata* in Serengeti district and surrounding areas provide insight on the aggressiveness of the weed according to its spread and infestation. Knowledge base of *C. odorata* to land managers and other stakeholders in order to restore invaded areas and protect non-invaded ecosystems for sustaining agricultural productivity in Tanzania is decisive.

Key words: Siam weed, distribution, land uses

1.9 Comparative efficiency of Robusta coffee varieties in utilizing applied nitrogen, phosphorus and potassium at varied soil fertility status in Kagera, Tanzania

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ABSTRACT

The study aimed at identifying the best varieties among the four Robusta coffee varieties in terms of N, P and K nutrients use efficiency, absorption efficiency and translocation efficiency. A survey was conducted to determine the fertility status of the coffee growing areas in eight villages namely Igomba, Kiilima, Katangalala, Mishozi, Katale, Bugabo, Bulinda and Bugaruka. Then, a screen house pot experiment was conducted in a Completely Randomized Design in a 3 x 4 factorial scheme with three rates of N, P and K and four Robuster varieties. The N, P, and K rates were 0, 75, 150 mg N/kg, 0, 37.5, 75 mg P/kg of soil, and 0, 75, 150 mg K/kg of soil. The four Robusta coffee varieties MR 10, BK 27, ML 2 and 13/61. Six-months old coffee plants were uprooted, washed and separated roots from the aerial parts for determination of shoot dry matter and root dry matter, and N, P and K concentration was determined in the whole coffee plants. Nutrient use efficiency, nutrient absorption efficiency and nutrient translocation efficiency for N, P and K were calculated. Results indicated that the overall soil fertility status of the surveyed areas were generally low, with low pH ranged from 4.12 to 5.53, organic carbon ranged from 0.09% to 2.25%, total nitrogen range from 0.056 to 0.192 %, available P ranged from 20.21 to 68.29 mg/kg and potassium ranged from 0.11 to 1.81 cmol (+) kg^{-1}. Varieties BK 27 and 13/61 were most efficient in low soil P and K soils. Varieties which are more responsive and efficient to absorb, translocate and use the added nutrients' elements are in the order BK 27, 13/61 and MR 10. Use of most responsive coffee varieties in low nutrient soil is recommended to improved production level of coffee in Kagera.

Key words: Robusta coffee; absorption efficient; translocation efficient; yield; Kagera;

1.10 Sustainable maize and rice production using recycled urban green biowastes from open markets in Dar es salaam Tanzania

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ABSTRACT

A pot experiment study was carried out from October 2018 to January 2019 to assess the potential of pelletized and non-pelletized urban green biowastes from open markets in Dar es Salaam as organic fertiliser. A split plot design was adopted whereby pelletized and non-pelletized biowastes were used as the main plots and their rates were treated as subplots. Four rates of pelletized and non-pelletized biowastes were used (0, 150, 300 and 600 mg N kg-1 soil. Complementary application of 300 mg N of biowaste mixed with 300 mg N of urea per kg soil as well as treatment with recommended rate of 600 mg N of urea kg-1 soil were used as reference treatment. Plant growth and yields were used to evaluate response of rice and maize. Application of pelletized biowaste from 0 to 600 mg N kg-1 soil increased maize height from 59.19 to 82.52 cm and rice from 80.43 to 84.87 cm. Maize dry matter yield increased from 3.8 to 8.77 g pot-1 and rice grain weight per pot increased from14.84 to 26.19 g. However, the highest maize and rice plant heights of 92.61 and 100.43 cm, respectively and maize dry matter yield of 14.46 g pot-1 and rice grain weight per pot of 68.16 g were recorded in the treatment combination of 300 mg N of biowaste and 300 mg N of urea kg-1 soil. Results of non-pelletized biowaste followed the same trend as those of pelletized biowaste for both maize and rice crops. The increase in all cases was statistically significant (P = 0.05). The overall results indicated that use of both biowaste and inorganic fertilizer was the best in improving crop yield. It also reduces the use of inorganic fertilizer and assists in recycling of biowastes. However, these results should be verified in the field.

Key words: Maize, Rice, Organic fertilizer, urban green bio waste

1.11 Optimizing nutrient availability and utilization for improved agronomic yield through micro dose fertilizer in moisture-deficit conditions of semi-arid central Tanzania

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Inherent low nitrogen (N) and phosphorous (P) coupled with inadequate and unreliable natural precipitation culminate into low maize yields in semi-arid. To address this problem field experiments were carried out to establish microdose phosphorus (P) and Nitrogen (N) fertilizer for semi-arid areas of Kongwa and Kiteto districts in a sole maize cropping system. The experiments were carried out using Minjingu Mazao (MM) as source of P and Urea as source of N. The P treatments were application rates of 0, 7.5, 15 and 30 kg P ha^{-1}; and N treatments were rates of 0, 15, 30 and 60 kg N ha^{-1} factorial structure in Randomized Complete Block Design (RCB) with three replications. Results showed that soils were deficient in P, N and Ca; and had very low organic matter contents in all sites. The microdose fertilizer rate of $P_{15}N_{30}$ kg ha^{-1} increased maize grain yield by 55 to 60% at Njoro site, 50 to 60% at Mlali site and 51 to 54% at Moleti site, relative to the control. Maize yield obtained with fertilizer rate of $P_{15}N_{30}$ kg ha^{-1} was similar to the maximum yield obtained under $P_{30}N_{60}$ kg ha^{-1} fertilizer rate. Phosphorus rate at 7.5 kg P ha^{-1} and 15 kg N ha^{-1} had in highest agronomic efficiency (AE) of >50% and >25%, respectively, in all sites. Therefore, $P_{15}N_{30}$ kg ha^{-1}, which is 50% less than the recommended rate in maize production was the best option for the marginal farmers without losing yield. Microdose fertilizer rate improve crop production and reduce production cost by using less fertilizer in maize production in low rainfall conditions.

1.9 The role of indigenous knowledge for seasonal weather and climate forecasting in climate change adaptation in Tanzania.

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Abstract

This paper review the variety of natural indicators, associated with weather forecasting and climate prediction as used by farmers in Tanzania. By accessing academic portals, such as Springer Open, InTech Open, Elsevier and academic publications including peer reviewed journals, books, working papers, reports, etc. were critically reviewed. It was found that there is lack of documentation of IK, hence need for review to put together finds from different sources. Result shows that subsistence rain fed agriculture underpins rural livelihoods in the Sub Saharan Africa. The overdependence on rainfall suggests the need for more reliable climate and weather forecasts to guide farmers in decision making. Traditionally, Tanzanian

farmers have used indigenous knowledge (IK) to understand weather and climate patterns and make decisions about crops and farming practices. These IK includes observing the behavior of large animals, birds, plants, insects, and the solar system. However, increased rainfall variability in recent years associated with climate change has reduced their confidence in indigenous knowledge, hence reducing their adaptive capacity and increasing their vulnerability to climate change. Thus integration of indigenous knowledge and scientific seasonal forecast seems to be a key possible thrust to reduce vulnerability, enhance resilience of rural farmers and increase their adaptive capacity. This review paper reveals that rural farmers can use indigenous knowledge to cope and adapt to climate change. Availability and access to scientific weather information to make cropping and other decisions at the local level remain key issues to usage of climatic data by rural farmers.

Key words; *Indigenous knowledge, weather, climate change, forecast and farmers*

1.12 The synergetic effect between sitophilus zeamais, and prostephanus truncatus, on storage of maize in hermetic and non-hermetic conditions

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Abstract

Sitophilus zeamais Mostschulsky, the maize weevil, and *Prostephanus truncates* (Horn), the larger grain borer are two notorious insect pests in farm-stored products in sub-Saharan Africa. The goal of this study was to determine whether there is a synergistic interaction between *P. truncatus* and *S. zeamais* during storage. The numbers of live population, percent damage grain, weight of powder (flour) produced, and percentage seed weight loss were assessed at the end of storage. Higher damage of maize was observed in non-hermetic storage with *P. trancatus* and mixed combination of *P. trancatus* and *S. zeamais*. A significant difference ($P<0.05$) and positive correlation were observed between the number of live population, percentage grain damage, the weight of powder produced, and percentage seed weight loss on infestation by *P. truncates*, *S. zeamais*, and mixed combination. *S. zeamais* dominate populations in the early stage, but outnumbered by *P. trancatus* after 60 days of storage in the individual and mixed combination. High percentage grain damage was observed in non-hermetic storage after 60 days in *P. trancatus* and mixed combination treatments were 58 and 54% respectively. The weight of powder produced range from 0-30 g per 250 g of maize. Percentage seed weight decreased after 60 days for *P. trancatus* and mixed combination, but increases for *S. zeamais*.

Both insects and mixed combination cause significant damage. However, *P. trancatus* play significant role and cause severe damage of maize in non-hermetic storage.

Key words: Maize, maize weevil, larger grain borer, grain damage, hermetic storage.

1.13 Postharvest practices, awareness and levels of mycotoxin in maize in three agro-ecological zones of Tanzania

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Abstract

Maize is a main cereal crop in Tanzania, and it is grown in all agro-ecological zones. Like other sub-Saharan countries, postharvest losses of maize during storage in Tanzania remain significantly high, especially for smallholder farmers. Unpredictable weather and poor postharvest practice contribute to rapid deterioration of grain and mold contamination, and subsequent production of mycotoxins. The purpose of this study was to assess awareness and knowledge regarding mycotoxin contamination in maize grain in three agro-ecological zones (Eastern, Central, and Northern) of Tanzania. A survey using questionnaires were administered to farmers, traders, and consumers of maize. A total of 90 people (30 from each zone) were surveyed with a response rate of 96%. In addition, several samples of maize were collected and analyzed for mycotoxn contamination (aflatoxin, fumonisin, and zearalenone) to validate the awareness of mycotoxin contamination of maize. The result shows a high level of postharvest losses of maize mainly through insect infestation. Moreover, over 80% of the farmers, traders, and consumers of maize were unaware of mycotoxins contamination. All maize samples collected contained detected levels of mycotoxins. The maximum concentration of aflatoxins, fumonisin, and zearalenone in maize samples was 19.20 ppb, 7.60 ppm, and 189.90 ppb respectively. Education intervention is necessary to decrease the disconnect observed between actual mycotoxin contamination and the awareness and knowledge of farmers, traders, and consumers of maize in Tanzania. Enhancing awareness and knowledge provide the opportunity to educate on post-harvest practices that reduce postharvest losses and mycotoxin of maize in Tanzania.

Keywords: Maize, post-harvest, mycotoxins, food safety and Tanzania.

1.14 Extent of fertilizer use and its effect on physico-chemical properties of soil and water melon nutrient concentrations in Wami Dakawa.

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ABSTRACT

A study was conducted at Wami Dakawa village in Morogoro, Tanzania to assess the extent of fertilizer use in vegetable production and its effect on physico-chemical properties of the soils and nutrient concentrations in plant tissue. The study mainly involved a survey coupled with sampling and analysis of representative surface (0-20 cm) soil samples, and plant samples from farmer managed tomato and water melon fields. Results indicated that 82% of farmers use fertilizers whereas 18% do not use any type of fertilizer in crop production. Of the population using fertilizers, 87% use inorganic forms whereas only 13% use animal manure mainly for vegetable production. Results also indicated that both ground applied fertilizers, foliar applied fertilizers and combination of the two forms of fertilizers are used in the area. Soils in the study area had low levels of organic carbon, N, P, Zn and Cu while concentrations of exchangeable Ca, Mg and K in the soils were high, indicating possibilities of their imbalanced supply. Plant tissue analysis indicated high, medium and low concentrations of total N, P and K, respectively while Ca, Mg, and S were in the low range. The general disagreement between plant analysis and soil test results was attributed to the effect of foliar applied fertilizers and imbalanced concentrations of exchangeable bases in the soils. Further studies are recommended to investigate the effect of applying ground, foliar and combinations of ground and foliar fertilizers on plant response and economics of vegetable production in the village. Furthermore, balanced application of different types of fertilizers and animal manure is recommended for improved vegetable production.

Key words: Fertilizers, Soil fertility, water melon

1.15 Land use management involving local people in Butuguri area, Butiama district in Mara Region, Tanzania

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Local people have developed knowledge of their lands based on soil and land characteristics that remain largely unknown to the scientific community because they cannot be easily quantified. Scientific community use methods for soil and land suitability evaluation that often perform poorly when predicting land productivity at local level because their approach exclude social and cultural aspects. Adaptation of land use systems used by local people with the help from scientific community is a key principle for sustainable land use management. This study documents the role of farmers and extension officers in quantifying land use requirements for sustainable production of cassava, maize and sorghum in Butuguri area, Tanzania. Five criteria important for the three crops production were identified through literature and discussion with local farmers and extension officers. Analytic Hierarchy Process (AHP) method was used to analyse and rank the criteria. Results indicated that soil chemical fertility scored the highest value for cassava and sorghum production while rainfall scored the highest for maize production. Topography was ranked the lowest for maize and sorghum production while temperature was ranked the lowest for cassava production. The score weights for production attributes are not uniform for all land use types in an area. This type of information generated by local farmers with assistance of scientific tool provides key inputs when doing area and crop specific land use planning and management, thus increasing land and crop productivity.

Key words: Analytic Hierarchy Process (AHP), Butiama District, Butuguri area, Land evaluation

1.16 The role of biological control on Leucaena psyllid in Eastern Tanzania

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Abstract

Biological control offers economical feasible and environmental desirable solutions against notorious insect pests. This study was aimed to quantify mummies of biocontrol agents (Tamarixia leucaenae and Psyllaephagus yaseeni) of Leucaena psyllid (Heteropsylla cubana Crawford) and indigenous predators of H. cubana in Morogoro and Tanga regions. Infested Leucaena leucocephala stems were sampled using a Point Centre Quarter method. Terminals of growing shoots (~ 15 cm) were collected and washed using a brush and ethanol (70%) in a petri-dish to remove indigenous predators associated with H. cubana. The arithmetic mean abundance of mummies, indigenous predators and the percentage parasitism of H. cubana were quantified using R-Software. The mean number of T. Leucaenae and P. yaseeni mummies were 2.33 and 1.68 in Tanga and 2.64 and 2.10 in Morogoro per terminal shoot of L. leucocephala. The rate of parasitism of P. yaseeni and T. leucaenae were 0.16% and 0.11% in Tanga and 0.15% and 0.14% in Morogoro respectively. The dominant indigenous predators found were spiders (Neoscona theisi and Araneus inustus) by 71.11% of which about 60.44% were observed in Tanga and 10.67% in Morogoro, followed by ladybird beetles (Coccinella transversalis, Chilocorus circumdatus, Coelophora inequalis, Menochilus sexmaculatus, Synonycha grandis and Harmonia species) by 22.67% of which 14% in Morogoro and 8.67% in Tanga and the rest were unidentified dragonfly by 5.11% and lacewing (Chrysoperla sp.) by 1.11%. Therefore, introduced biological control agents and indigenous predators play a vital role in controlling population density of H. cubana. However, there is a need to understand the interactions between indigenous predators and H. cubana in order to advice farmer on appropriate biological control measures.

Key words: Heteropsylla cubana Leucaena leucocephala, Tamarixia leucaenae, Psyllaephagus yaseeni, Parasitism, and Mummies

1.17 Optimizing nutrient availability and utilization for improved agronomic yield through microdose fertilizer in moisture-deficit conditions of semi-arid central Tanzania

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ABSTRACT

Inherent low nitrogen (N) and phosphorous (P) coupled with inadequate and unreliable natural precipitation culminate into low maize yields in semi-arid. To address this problem field experiments were carried out to establish microdose phosphorus (P) and Nitrogen (N) fertilizer for semi-arid areas of Kongwa and Kiteto districts in a sole maize cropping system. The experiments were carried out using Minjingu Mazao (MM) as source of P and Urea as source of N. The P treatments were application rates of 0, 7.5, 15 and 30 kg P ha^{-1}; and N treatments were rates of 0, 15, 30 and 60 kg N ha^{-1} factorial structure in Randomized Complete Block Design (RCB) with three replications. Results showed that soils were deficient in P, N and Ca; and had very low organic matter contents in all sites. The microdose fertilizer rate of $P_{15}N_{30}$ kg ha^{-1} increased maize grain yield by 55 to 60% at Njoro site, 50 to 60% at Mlali site and 51 to 54% at Moleti site, relative to the control. Maize yield obtained with fertilizer rate of $P_{15}N_{30}$ kg ha^{-1} was similar to the maximum yield obtained under $P_{30}N_{60}$ kg ha^{-1} fertilizer rate. Phosphorus rate at 7.5 kg P ha^{-1} and 15 kg N ha^{-1} had in highest agronomic efficiency (AE) of >50% and >25%, respectively, in all sites. Therefore, $P_{15}N_{30}$ kg ha^{-1}, which is 50% less than the recommended rate in maize production was the best option for the marginal farmers without losing yield. Microdose fertilizer rate improve crop production and reduce production cost by using less fertilizer in maize production in low rainfall conditions.

1.18 Harvesting vegetables from the kitchen garden: An educative and sustainable approach to improve dietary practices and nutritional status among rural families in Tanzania

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Abstract
Undernutrition continues to inflict significant social, health and economic consequences in developing countries, Tanzania inclusive. The aim of the present study was to implement, monitor, establish and assess the impact of sack gardening and household nutrition education on dietary practices and nutritional status in rural villages in Chamwino and Kilosa districts of Tanzania. Nutrition education covered various gaps observed in a preceded nutrition survey (baseline). Sack gardening practical demonstrations and hand on implementation skills were carried out to the participating 120 households. Data on demographic, vegetable consumption patterns, dietary diversity and nutritional status were collected at baseline (February, 2015) and endline (May, 2016) periods. Data were presented in form of frequencies, percentages frequencies, means and standard deviations. McNemar and marginal homogeneity tests were conducted to compare the baseline to endline results for each section of the questionnaire. Paired-t test was used to evaluate change in nutritional status of children and their caregivers. Results indicated that 75.8% of the caregivers had never heard about sack vegetable gardening at baseline but at endline all the caregivers (100%) had heard about this type of gardening. Whereas, 77% of the caregivers had never received any kind of nutrition education and 85.2% did not know anything about food groups at baseline, but during the endline study, 82% had ever heard about basic nutrition facts and 95% knew about food groups. At baseline only 27% of households had a high Dietary Diversity Score as compared to 52% at endline. For the vegetable types that were introduced in the sack gardens, daily and weekly consumption rates increased by 10-50% from baseline to endline periods. There was significant differences in knowledge aspects of factors influencing inclusion of vegetables in a meal, knowledge of vegetables available in the locality, knowledge of sack and cultivation of vegetables in a sack garden, receiving nutrition education before, knowledge of foods that increase intake of fibre, knowledge of food groups and iron deficiency anemia between the baseline and endline time points with $p<0.05$. Water shortage, pests, diseases and insects were reported as major factors constraining the sack garden intervention. The intervention increased consumption of green leafy vegetables, dietary diversity and nutrition knowledge of participants in the topics covered including general nutrition, nutrition requirements for specific groups, preparation and preservation of foods, improving nutrition through kitchen gardens and tips for improving health. We recommend progressing this type of intervention further by selecting foods containing high vitamin A and other specific nutrient amounts to be included in sack gardens.
Keywords: Kitchen garden, sack kitchen garden, green leafy vegetables, consumption patterns, household, nutrition education

Theme 2: Sustaining animal health and livestock productivity

2.1 Benchmarking disease outbreaks reporting and response values in Tanzania

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The fact that disease outbreaks typically erupt at community level, suggests that community-based participatory disease surveillance strategies could enhance their early detection, timely reporting and prompt control. The study aimed to determine practices related to notification and response to human and animal disease outbreaks and technology capacities to enhance performance of surveillance system. From 2016 to 2017, interviews were conducted with Community Health Reporters (CHRs) (135), Livestock Field Officers (70), and Clinicians (31) from Ngorongoro, Morogoro Urban, Ulanga and Kilosa districts. A benchmarking cycle in this study included practices and timelines on disease outbreak detection, recording, reporting and feedback loops. The mechanisms of outbreak data capture at community level was largely paper-based. The number of days between the onset of outbreak and reporting to primary health care facility ranged from one to seven. Outbreak reports reached the district and national levels within 24 and 48 hours, respectively via phone calls and up to 30 days for paper-based reports. The mechanism of outbreak report submission (in decreasing order) included walking by foot, use of public transport, short message service and telephone call, while electronic reporting system for routine data was used from primary health facilities upwards on weekly and monthly basis. Feedback from higher levels to primary data source was infrequently reported. The number of days between reporting of disease outbreak and response/feedback from higher levels ranged from one to 30. Almost all (134/135) CHRs owned mobile phones of which 13 were smartphones. The study has identified benchmark values and gaps to provide guidance on early warning applications to enhance disease outbreak notification and response.

Key words: Mechanisms of data capture, outbreak reporting, response/feedback, CHRs

2.2 Exploration of a sustainable two-way mechanism in reporting and receiving animal disease related information in Tanzania

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Veterinary services need to monitor the situation of diseases in the field to be able to plan and implement intervention in a timely manner. The lack of/underreporting by livestock keepers is a gap in animal disease surveillance strategy. Interviews were conducted with livestock keepers from Kilosa, Ngara and Wete districts in Tanzania to seek sound, acceptable and adaptable approach for informing veterinary officers about animal health events. The study was conducted from December 2017 to December 2018 and the information collected included practices of recording and reporting animal health events and ownership of mobile phones. Based on the results, a surveillance model was developed and deployed in the study areas. A total of 79 livestock keepers participated in the study and they were from Kilosa (22), Ngara (30) and Wete (27). Eleven livestock keepers from Wete (7) and Ngara (4) reported to keep animal health information in notebooks. The mechanism recommended most frequently to enhance sharing of information between veterinary officers and livestock keepers was use of mobile phones. Majority (95%) of livestock keepers owned mobile phones of which 83% were feature phones and 17% were smartphones. A mobile phone-based passive surveillance model was developed using Unstructured Supplementary Service Data and A*fyaData* platforms. Overall, from October to December 2018, a total of 1,149 livestock cases were reported from a total population of 3,265 animals. Automated feedbacks were provided on near-to-real time basis to an individual submitting data with guidance on the actions to be taken. Livestock keepers can assume active role in the frontile position to eanhance disease surveilance, which is important to control outbreak to spread further from the source of origin.

Key words: Livestock keepers, animal health events, surveillance model, recording, reporting

2.3 Strengthening of event-based surveillance in the cross-border ecosystems; challenges and opportunities

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A study was conducted on human and animal health events reporting mechanisms and structures that exist within cross-border areas to promote innovations that strengthen Event-based surveillance (EBS). It was conducted at national and regional levels with a focus in the cross-border ecosystems in (i) Misenyi (Tanzania) - Kyotera (Uganda), (ii) Kyerwa

(Tanzania) – Isingiro (Uganda) and (iii) Ngara (Tanzania). The study found that EBS existed at national, regional, district and community levels, mainly for specific human health programmes. The coordination units were in place at national level but not at the district and community levels. The recording systems at all levels could not support abstraction of outbreaks detected by EBS. Community Health Attendants existed at community level and were working for specific public health programmes. While data capture mechanism at national and district levels was of electronic format; at community level it was almost entirely the paper-based format. There was no evidence on the existence of standard operating procedures and One Health approach in EBS. There was no collaborative surveillance operating in the cross-border ecosystem. There was no evidence of data sharing practices between the neighbouring countries. Cross-border disease surveillance committees were in place but not operational. The relatively well established EBS at national level was not reflected at district and community levels. The study considers the lack of standard operating procedures and One health approach to EBS, in addition to poor intersectoral collaboration as key challenges whilst the presence of coordination units and dedicated staff coupled with clear objectives for EBS as an important opportunity to strengthen event-based surveillance in the communities of cross-border ecosystems.

Key words: EBS, cross-border ecosystems, surveillance system, Uganda, Tanzania

2.4 Participatory One Health surveillance enhanced by digital technology in Tanzania

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Abstract

Disease outbreaks typically erupt at community level, suggesting that community-based participatory disease surveillance strategies are instrumental to enhancing their prompt control. Large distances and unavailability of transport are among the key challenges contributing to delays of submission of such surveillance reports. This study aimed at enhancing community reporting of health events using digital technology. A digital disease surveillance app, branded *"AfyaData"* was developed and piloted in Morogoro Urban and Ngorongoro districts from 2015-2016. It was deployed to capture health events in human and animal populations in Kilosa, Malinyi, Ulanga, Ngara and Wete districts in 2017-2018. Community health reporters

were provided with smartphones installed with *AfyaData* and trained on its use. *AfyaData* was powered by One Health Knowledge Repository (OHKR), a decision-making system that predicts most likely diseases based on the reported clinical manifestations. The most probable diseases detected by OHKR in humans included (likelihood percentage in parentheses) cholera: (70%), typhoid fever (50%) and malaria (50%). The most probable disease in chicken was New Castle Disease (75%). In sheep and goats Peste des Petits Ruminants (80%) and Contagious Caprine Pleural Pneumonia (80%) were the most probable diseases. In cattle, they were Foot and Mouth Disease (70%), Malignant Catarrhal Fever (60%), Contagious Bovine Pleural Pneumonia (80%), brucellosis (80%), Lumpy Skin Disease (50%), anthrax (50%) and Rift Valley fever (50%). Timelines of reporting improved from an average of 30 days to less than seven days. Automated feedbacks were provided to individuals submitting data. Response to reported health events was made by district authorities. Stakeholders acknowledged the usefulness of *AfyaData* on early detection of cases and control. Participatory community-based disease surveillance powered by digital technology is a useful strategy to enhance early detection, timely reporting and prompt containment of health events at the source.

Key words: community-based disease surveillance, AfyaData, One Health Knowledge Repository

2.5 Estimating the contribution of brucellosis to abortions in humans and domestic ruminants in Kagera ecosystem, Tanzania.

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Abstract

Brucellosis is a worldwide zoonotic disease with socio-economic importance. Understanding the association of this disease with pregnancy outcome has potential of contributing to reduction of its reproductive burden in humans and animals among pastoral communities in Tanzania. A prospective study was conducted in Kagera Region on pregnant women (n=76) and gravid ruminants (121 cattle, 125 goats and 111 sheep). Exposed and non-exposed groups to brucellosis were followed for six months (from 15th November 2017 to 15th April 2018). Sera were collected and analyzed using Rose Bengal Test (RBT) and Fluorescence Polarization

Assay (FPA) test. Measures of effect, univariable and multivariable logistic regression analysis were computed. Positivity to both RBT and FPA tests was 21% (95% CI: 12.54-32) in pregnant women and 5.04% (95% CI: 3.1-8%) in gravid ruminants. In aborted cases, the prevalence was 44.5% (95% CI: 13.7-78.8) in humans while it was 28.6% (95% CI: 0.95-25.13) in cattle; 7.7% (95% CI: 3.67-70.96) in goats and 0% (95% CI: 0.00-28.49) in sheep. Abortion rate in humans was 11.8% and 12.3% in ruminants. Positivity to brucellosis was similar in aborted and non-aborted cases in humans (p=0.08) and in ruminants (p=0.2). The population attributable risk (PAR) of abortion due to brucellosis was 3.5% in pregnant women and 0.5% in gravid ruminants in the study area. Infections to brucellosis were increased in exposed pregnant women (OR=19; 95% CI: 1.8-203, p=0.01) and in cattle (OR=11; 95% CI: 1.3-88, p=0.02). However, absence of malaria like symptoms in pregnant women (OR=0.12; 95% CI: 0.013-1.24, p=0.07) and the good disposal of aborted material in gravid ruminants (OR=0.2; 95% CI: 0.05-1.1, p=0.06) were protective for *Brucella* infections. Brucellosis is slightly contributing to abortions in pregnant women and ruminants in Kagera. A multidisciplinary approach is required to control and eradicate this important zoonotic disease in Tanzania.

Keys words

Association, Brucellosis, Spontaneous Abortions, Ta

2.6 Growth performance of nile tilapia, *oreochromis niloticus*, chinese cabbage and its economic benefit in integrated system

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Abstract

A study aimed to evaluate the growth and economic benefit of Nile tilapia and Chinese cabbage under integrated system. The experiment comprised of three treatments replicated three times making a total of nine ponds. The treatments were feed only, chicken manure only and chicken manure with supplementary feed. Water from fish ponds was used to irrigate nine vegetable plots corresponded with pond treatments. Plankton collected from fish ponds were counted using sedge wick rafter under microscope using magnification of x40. Fish were weighed monthly using weighing balance. Growth of Chinese cabbage was monitored by measuring diameter and length of leaves using a ruler and counting the number of leaves after every two weeks. Cost benefit analysis was carried out at the end of the experiment using the revenue and variable cost information. Results showed that fish in ponds received manure and supplementary feed had significantly higher final weight, weight gain, specific growth rate and yield. Fish yield from ponds that received manure with supplementary feed was two times higher than yield from ponds that received feed only and almost three times higher than yield from ponds that received manure only. Four groups of phytoplankton and three groups of

zooplankton were recorded from fish ponds. Zooplankton abundance was significantly higher in ponds treated with manure with supplementary feed than manure and feed only (P<0.05). Furthermore, results showed that generally, vegetable plots irrigated with water from fish ponds had significantly higher leaf diameter, length, number of leaves and yield compared to those irrigated with stream water (P<0.05). The highest net benefit was recorded from ponds received manure and supplementary feed. The results suggested that application of chicken manure and supplementary feed contribute significantly on plankton abundance, fish and Chinese cabbage growth performance; and net profit of integration system.

Keywords: Fertilization, resource poor farmers, semi-intensive, supplementary feed
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2.7 Assessment of pond productivity in african catfish farms

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Abstract

The study was conducted in Kibaha, Kisarawe and Bagamoyo Districts in Tanzania aimed determining water quality parameters, pond characteristics and productivity in African catfish farms. Nutritive values of feeds used by catfish farmer were also evaluated. Water quality parameters were measured using portable multi-parameter meter HANNA MODEL (H198194). Feed samples were collected from catfish farmers and proximate analysis conducted according to standard procedures. Pond characteristics and productivity data were collected using self-administered questionnaires. There were significant variations in most variable examined among the study sites (P<0.05) with the highest stocking density, fish yield, revenue and profit recorded in Bagomoyo. The highest and lowest feed conversion ratios (FCR) were recorded in Kibaha (1.119) and Kisarawe (0.794) respectively. The results indicated that fish ponds in Bagamoyo had highest temperature (29.94◦C±1.70), pH (7.58±0.86) and DO (6.16 ±0.76 ppm). Kisarawe showed highest TDS (1536.12 ±2236.183 ppm) and salinity (0.74±0.03ppt). Kibaha ponds indicated highest conductivity (1832/Ω/cm±60.69) and total dissolved solids. The crude protein content was highest in feed sample A (32.96%) and lowest from feed sample E (16.85%). Feed C and A had the highest (11.04%) and the lowest crude fiber (0.36%) respectively. Feed A and C had the lowest (3.23%) and the highest ether extract (9.76%) respectively. Generally results indicate that pond management should be improved so that productivity can also increase. According to the farmers interviewed, the main source of

fingerlings and water were wild and rivers respectively and; the most used form of feed was flake (powder). It is concluded that African catfish farm productivity is determined by water quality, location and feed quality.

Keywords: African catfish, water quality parameters, pond productivity, fish feeds

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2.8 Situational Analysis on Constraints and Opportunities for Development of Aquaculture in Kilolo District, Iringa Region, Tanzania

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Abstract

Fish is an important food for over 400 million people in Africa but consumption of fish in sub-Saharan Africa is the lowest in the world. Aquaculture in Tanzania is dominated by fresh water fish farming where farmers practice both extensive and semi intensive farming systems. The aim of this study was to investigate the status, management practices, opportunities, and production and health constraints of aquaculture in Kilolo District, Tanzania. The majority of the fish farmers were at the age range of 31-50 years. All fish farming households used the dug-out-ponds and the main fish species cultured was tilapia. Majority of these ponds (98%) were less than 100m2 in size. Water for fish farming in most areas of Tanzanian southern highlands is from numerous streams flowing from Udzungwa and Eastern Arc mountains. Fish farmers use animal manure from cattle (39%), pigs (33%), goats/sheep (15%), poultry (10%) and guinea pigs (3%) as the main source of fertilizer for their fish ponds. Farmers were not aware on proper methods and regimes for fertilization of their fishponds. Most farmers (87%) fed the fish once or twice a week. Inadequate access to information on inputs, pond

management and biosecurity protocol among fish farmers significantly limit the growth of the sector in the study area. Despite lack of Veterinary interventions, important diseases and infections were not detected. Predators was reported as the main constraint by most of the farmers. Training of fish farmers on fish pond management and fish feeding should be done taking advantage of existing farmer's groups and train them on fish feed formulation and production of quality fingerings which will in turn be purchased by individual farmers.

Key words: Challenges, Eastern Arc, Fish farming, Udzungwa

2.9 Genetic analysis of the giant tiger prawns reveals priority areas for the establishment of marine protected areas in Tanzania

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Rapid growth of the human population along the Tanzanian coast has led to overfishing and habitat degradation, which might disrupt connectivity patterns and influence genetic diversity and population structure. Since knowledge about this is essential for sustainable management, this study analysed fragments of the mitochondrial control region (582 base pairs) from 125 giant tiger prawns (*Penaeus monodon*) collected at the Tanzanian coast. The sequences showed high haplotype (h = 1 ± 0.024) and low nucleotide diversity (θ_π = 1.94 – 2.35 %). Results of neutrality and mismatch analysis showed that the studied population experienced a bottleneck followed by periods of population growth in its recent history. Analysis of molecular variances did not detect significant genetic differentiation among sites (F_{ST} = -0.0003, $p > 0.05$; Φ_{ST} = -0.0038, $p > 0.05$), suggesting that although the decline in prawn abundance is reported in some

areas, the fishery is panmictic and it is capable to replenish overexploited areas. The estimates of the number of migrants showed that the estuarine mangroves at Pangani, Saadani, and Rufiji are the net exporters of migrants, implying that if they are well protected, they have a potential to replenish depleted areas and improve the resilience of the fishery. Since the country is targeting to increase marine protected areas from 6.5 % to 10 % by 2020, priority should be given to the above mentioned estuaries.

Key words: Giant tiger shrimp, D-loop, Western Indian Ocean, East Africa

2.10 Influence of seed treatment methods on germination and growth performance of Acacia nilotica

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Abstract

With increasing shortage of forage resources in dry land ecosystems, indigenous fodder trees and shrubs are now receiving increased research attention. Despite the fact that, *Acacia nilotica* is one of the highly recommended fodder trees as potential source of animals feeds, it germination potential is poorly studied. Three on-station trials were carried out at Magadu farm at Sokoine University of Agriculture (SUA), to test the effectiveness of three different seed treatment methods on germination characteristics and growth performance of *A. nilotica*. The first and second trials involved incubation of *A. nilotica* seeds in liquid slurry and in the compost manure for 14 and 30 days respectively. In the last trial, *A. nilotica* seeds were fed to dairy cattle to test viability upon passing through digestive tracts. All treated seeds were transferred to the laboratory for determination of germination characteristics and growth performance of seedlings. The study established that, seeds passed through digestive tracts of dairy cattle performed significantly better in terms of germination rate and growth performance of seedlings compared to those from compost manure and liquid slurry. Such good performances were attributed to effective seeds' scarification through microbial attachment found in the alimentary canals. On the other hand, the significantly poor germination rate and low growth performance of seedlings from seeds treated with liquid slurry and compost were associated to excessive temperature and extended incubation period. Therefore, cattle are recommended as effective, simple and natural means of scarification of hard coat seeds as well as efficiency dispersal mechanism.

Keywords: Bio-slurry; Compost, Germination rate; Incubation; Seed viability

2.11 PREDICT – A Flexible and Cost-effective Disease Detection Platform to Strengthen Health Security in Tanzania

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Abstract

In Tanzania, many communities are vulnerable to zoonotic pathogens and emerging infectious diseases (EIDs), especially at high-risk human-animal interfaces. Through PREDICT, a global capacity building project conducting surveillance for zoonotic viruses that can spillover from animals to people, investments have been made in national laboratory systems to improve health security by strengthening viral detection capabilities. PREDICT's viral detection platform utilizes molecular techniques that enable screening for a broad array of known viruses, such as Ebola and Influenza, as well as the discovery of viruses new to science. Findings inform national surveillance priorities and promote cross-sectoral communication, contributing to Tanzania's One Health Strategic Plan. Wildlife, domestic animals and humans were concurrently sampled at high-risk interfaces. Samples were screened for corona-, filo-, paramyxo-, flavi-, and influenza viruses using consensus polymerase chain reaction (PCR). Positives were confirmed by genome sequencing and phylogenetic analyses were performed to classify and compare sequences detected in humans and animals. Among 901 humans, 5,515 wildlife, and 398 domestic animals sampled, 901 human, 4,891 wildlife, and 374 domestic animal samples were tested. Although lab testing is ongoing, we have detected 70 viruses in wildlife, 51 of which are novel, and two known viruses in humans. PREDICT's flexible viral detection platform enables surveillance of known and unknown viral threats, while being cost effective and easily adoptable. Our platform extends the reach of a laboratory system to better identify, assess, and respond to health threat.

2.12 Seroprevalence and risk factors of *porcine cysticercosis* in Kongwa District, Tanzania

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Abstract
The aim of this study was to investigate the seroprevalence of porcine cysticercosis (PC) and associated risk factors in four villages in Kongwa District. One hundred and two pig-keeping households were surveyed during the dry season between July and August 2017 and 126 households were surveyed in the rain season between March and April 2018. Seropositivity of PC was analysed from auricular venous blood collected from pigs and potential risk factors were determined using structured questionnaires, supplemented by direct observation. Of 447 examined pigs, 77 (17%, 95% C.I. 13.52% – 20.48%) tested positive for PC using apDia Cysticercosis antigen ELISA. PC seroprevalence was higher in pigs examined during the rain (21%, 95% C.I. 16.13% - 25.87%) than dry (12%, 95% C.I. 7.23% - 16.77%) season and this difference was statistically significant. The potential risk factors for PC were origin of piglets or pigs (OR = 0.272, 95% C.I. 0.127% - 0.418%, p = 0.001), pig production system (OR = 0.222, 95% C.I. 0.070% - 0.374%, p = 0.005) and presence of open defecation (OR = 0.187, 95% C.I. 0.038% - 0.335%, p = 0.014). This study has recorded a high seroprevalence of PC in Kongwa District, which have huge economic burden to the smallholder pig farmers. In addition, PC poses a major public health burden not only to the smallholder farmers but also to people in urban areas were pigs from Kongwa are consumed. Further studies are obligatory to ascertain the magnitude of *T. solium* human infection and level of environmental contamination in order to define appropriate control strategies and prevent future cases of PC.

Key words: *Taenia solium*, Porcine Cysticercosis, Seroprevalence, Kongwa, Tanzania

2.13 Supply and commercial viability of forage in Tanzania

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Sub-theme: Sustainable Animal Health and Livestock Productivity

ABSTRACT

This study aimed at understanding the forage potential and current dynamics in Tanzania so as to improve forage supply chains that would in turn increase availability, accessibility and affordability of forage to smallholder dairy farmers in North Eastern Tanzania. The study was a cross sectional in design and data were collected from review of literature and from 85 respondents using key informant interviews and focused group discussions. The data collected was summarized using Microsoft Excel and market system/sub sector analytical tools. Sub-sector mapping analysis was used to map the core forage actors, product flows and interrelationships. Results indicate that forage sub-sector growth is pinned down by several systemic constraints associated with availability, accessibility and affordability including climate change effects, relative small land availability for grazing and for forage producers, inadequate quality and certified forage seed supply, inadequate extension services, relative high capital investments and inadequate market development in support of whole forage market system. Furthermore, results indicate that forage market system in Tanzania is still at its infancy stage as forage commercialization practices is dominated by a very limited large forage businesses. Main commercial forage farms in Tanzania produce essentially hay. Pwani and Tanga regions account for about 62% of the total hectares under forage production. The supporting functions by public and private sector are scattered and no clear policy and regulatory environment in place to promote the forage industry, yet the main driver in animal husbandry is proper feeding regime. In 2016/17, about 1,150,916 bales of hay were produced by both public and private farms. Price of forage varied per season and the variation depended mainly on the availability and cost of transportation. In conclusion, improvement is needed in the production, preservation and commercialization of forage in order to meet the growing demand.

Key words: Forage, Market System, Availability, Commercialisation

Theme 3: Sustainable environment, natural resources management and tourism

3.1 Opportunities and Challenges of Decentralized Natural Resources Management: A Case of Wildlife management Areas in Tanzania

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Abstract

Since 1990s, Tanzania's policies guiding natural resources management in Tanzania have shifted from centralization to decentralization. This paper which is based on desk research was undertaken by reviewing relevant literature whereas analysis of data was done qualitatively by relating ideas from literature with abstract concepts to examine opportunities and challenges of Wildlife Management Areas (WMAs) after adoption of the new policy in wildlife sector. Decentralization has been justified on the grounds of improving equity in benefit sharing, good governance, democracy, resource conservation and livelihoods. In developing countries like Tanzania, decentralization policy in wildlife sector was adopted initially in response to natural resources depletion. In Tanzania, decentralization policy in the wildlife sector was adopted in the form of WMAs. The WMA approach aimed to improve both the conservation of wildlife resources and livelihoods of the local communities. Existing literature has tried to investigate the performance of WMAs in Tanzania elucidating improvement in conservation of wildlife, improvement in people's livelihoods including development of income generation projects, supporting social services and capacity building of actors practicing WMAs. However, there has been inadequate attention paid to challenges undermining the progress registered in WMAs. This paper fill information gap by broaden understanding of knowledge on challenges facing WMA in Tanzania. Findings indicate that opportunities of WMAs include existence of Wildlife Policy and Wildlife Management and Conservation Act, supporting income generation for local communities as an alternative to direct dependency on extraction of wildlife resources and institutional capacity building. Challenges faced by WMAs include conflicting interests of stakeholders, human and livestock conflicts and land use conflicts. Findings from this study will be useful for practitioners and decision makers in setting strategies for addressing the challenges given existing opportunities in the near future.

Keywords: Challenges, Decentralization, Recentralization, Wildlife Management Areas (WMAs), Natural Resources Management, Tanzania

3.2 Policy process, institutional framework and outcomes of Wildlife Management Areas in Serengeti and Meatu Districts, Tanzania

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ABSTRACT

Since the adoption of community-based wildlife conservation (CBC) approaches in wildlife sector there have been increased studies exploring the impacts of CBC interventions on wildlife conservation, livelihoods enhancement of the local communities, the extent at which policy results in increased control of local people over wildlife resources and human-wildlife conflicts. However, there is still insufficient attention aiming at examining the linkage between engagements of stakeholders such as the local people in policy processes, existing wildlife management institutions and outcomes of CBC. To fill this knowledge gap the study was undertaken in IKONA Wildlife Management Area (WMA) in Serengeti District, and Makao WMA in Meatu District. Four villages were purposefully selected, two from each WMA, one considered as more successful and another less successful. The study adopted a case study and survey designs whereby qualitative data was collected using focus group discussion and key informant interview, whereas quantitative data were collected using semi-structured questionnaire. Qualitative data were analyzed by content analysis whereas quantitative data were analyzed using percentage and frequency. Findings show a mismatch between policy formulation and WMA establishment processes, and institutions and practices which tended to enhance government control. Disharmony between WMA institutions with other government institutions was found a threat to sustainability of WMA. Moreover, authorized association (AAs) had less capacity to hold WMA management committees accountable. The need for AA to become more accountable to village authorities was recommended. Moreover, the government needs to harmonize conflicting institutions. Moreover, local people access to wildlife resources for their livelihoods, livestock grazing during difficult seasons, protection of local people lives and their properties against wildlife and sufficient compensating following wildlife damages is required.

Keywords: Policy process, institutions, community based conservation, wildlife management areas, Tanzania.

3.3 Stakeholders Mapping and its relevance in Mangroves Conservation along the coast of Tanzania

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Mangrove ecosystems in Tanzania are adapted to the natural environment, yet they are being degraded. Causes of mangroves loss and degradation are many but the major cause is livelihoods' dependence of local communities on the mangrove ecosystems. Over the years there have been efforts to conserve wetlands ecosystems along the coast of Tanzania with minimum success. Following this, efforts to minimise such degradation through engaging stakeholders in conservation and management of the mangroves along the coastline of Tanzania is important. Based on this background, this study on mangroves stakeholders mapping and analysis was designed, to understand the livelihoods pattern and their relevancy in the sustainable conservation of the ecosystems. The analysis along the coast shows that there are a number of stakeholders whose potential and relative importance varies in many aspects. To this end, stakeholders were categorised into primary, secondary and tertiary levels through standard stakeholders' analysis method. Primary stakeholders were found to form the base and important group to be understood. They are those who directly utilise the resources wherein their actions have direct impact to the resources. These in this case are local communities who are subdivided into several stakeholder groups based on their respective livelihood types including fishers, farmers and salt makers. Secondary stakeholders are not directly involved in the mangrove resource utilisation, but have influence on sustainable management. These include Ward councillors, district councils, Non- Governmental Organisations (NGOs) and Community - based Organisations (CBOs), and some of the government organisations including TFS, and development partners. Tertiary stakeholders were found to be high level stakeholders who are involved in neither resource utilisation nor management, but have interest in the resources and some of them are decision makers at higher government level. These include government ministries, research and academic institutions and businesses.

Key words: Stakeholders, Mangroves, Coat of Tanzania

3.4 Valuation of Eastern Arc Mountain ecosystem services for enhancing water security

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Forests and natural ecosystems supply a vast of benefits to the environment, such as purification of air and water, mitigation of effects of climate change, generation and

preservation of soils and renewal of their fertility. These services function dependently in such that if one function is impaired the efficiency of the other also gets weak. The Udzungwa Scarp is recognized globally as Africa‘s most unique biodiversity spot. Human society has for long taken for granted the services provided by ecosystems, as they are not formally traded and are therefore dissociated from pricing that reflects changes in supply or demand conditions. Therefore, this study reveals the total economic value carried by ecosystem services around the Mountain and how the water security is impaired through wrongly perceived ecosystem’s values. The study through social and market surveys revealed that, the water service contributes about USD 834M in terms of crop farming (USD 135M), hydro-electricity production (USD 658M) and fish catches (USD 41M per year, all in gross values into the nation account. While these benefits are enjoyed by the Tanzanians yet there is no framework for Paying for Environmental Services (PES) that would have served in conservation of water catchment forests. With continued degradation of ecosystems through a variety of human-led pressures, a better understanding of the extent of human dependence on ecosystem services, and hence the vulnerability of human welfare to ecosystem changes, is essential for ensuring sustainable development. Lack of this understanding and failure of markets in reflecting the true value of ecosystems have resulted in misinformed decisions. Typically, the full social and environmental benefits and full cost of their degradation are not translated in a way that ensures optimal decisions. The results of this study inform decision makers how it is important to pay attention to the conservation of catchment forest to enhance water security.

Keywords: Valuation, Ecosystem services, Udzungwa Scarp

3.5 Influence of Wood Resources Revenue Collection on Forest Degradation in Geita Forest Reserve, Tanzania

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Abstract
Wood resources revenue collection is widely claimed to have influenced forest degradation. While this has been said, the quantities of degraded forest area are not known. In an attempt to unlocking the understanding, a study was conducted to assess the wood resources revenue collection and estimated the quantity of forest degradation in Geita Forest Reserve (FR) from the year 2013 to 2015. Available secondary data on revenues and quantities of wood resources were collected from the District Forest Office in Geita. The amount of wood

resources harvested by volume was related to a chart (Area and distribution of growing stock by main vegetation type) so as to get the degraded forest area (ha). The data was then analysed using multiple regression. The results showed that wood resource revenue collection (forest charges) increased, on average, by TZS 22,688.1 per year for each volumetric increase in harvested wood resources in Geita FR. From the year 2013 to 2015, a total of TZS 582,917,357 was collected from wood resources (charcoal, timber, poles and fire wood) which contributed about 419.3ha (0.88%) of the forest area being degraded within a period of three years at a rate of 139.8ha (0.29%) per year. The study concludes that wood resource revenue collection has influence on forest degradation. It is thus recommended to restore the degraded area with the indigenous species and or to replace degraded areas with another, using simple species assemblage. Furthermore, there is a need for halting down the rate of wood resources harvest by ensuring compliance with the forest management plan.

Key words: *Geita Forest Reserve, forest degradation, Tanzania, Wood resource revenue collection*

3.6 Planning for Sustainable Natural Resource Management: Experiences from Ihemi Agricultural Development Cluster, SAGCOT, Tanzania

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Abstract

Understanding the trade-offs between natural resource use, economic development and resilience by the planners and users of natural resources is a key prerequisite for planning for sustainable natural resources management (SNRM). To plan for SNRM, information on natural resource base and utilization must be established. Extensive consultations and field surveys were conducted involving 607 respondents, 19 focus group discussions and key informants interviews. The findings revealed that the agricultural practices and utilization of natural resources are unsustainable resulting not only in low crop yields, but also ecosystems degradation and limit their ability to function properly thereby affecting provision of essential services. Key lessons drawn from the findings towards SNRM include: i) information on natural resource base and utilization should be available to the planners and other stakeholders, (ii) cultivate a common shared vision on NRM by all stakeholders through participatory stakeholders engagement at various levels, (iii) NRM should be well anchored in the national/regional/cluster development plans and in village land use plans, (iv) NRM framework should have good governance mechanisms with clear create feedback loops, (v)

security of land tenure (title deeds/certificates of customary rights occupancy(CCROs) is a key aspect in SNRM, (vi) there is need to enhance gender equity in NRM, (vii) promote agricultural investments which pay adequate attention to sustainable use of natural resources, (viii) promote and support diversification of income sources for smallholder farmers to reduce over-dependency on one farm enterprise, (ix) foster community–investor linkage, whereby large-scale farmers adopt investment models that are socially inclusive, and (xii) farmers should be helped to improve productivity and become commercial producers by intensifying crop production with the right technical support, right seeds, storage facilities and competitive markets. Therefore, planning for sustainable natural resource management requires the integration of sound policy, innovative solutions and effective institutional framework.

Key words: *Ihemi Agricultural Development Cluster, Sustainable natural resources management, SAGCOT, Tanzania*

3.7 Impact of habitat degradation on the assemblage of riparian ground beetles (*Coleoptera: Carabidae*) in the Morogoro Municipality, Tanzania

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Abstract

This study was carried out to assess the impact of habitat degradation on the assemblage of riparian ground beetles in the Morogoro Municipality, Tanzania. The beetles were collected from three degraded (Bigwa, Vituli and Lukuyu) and three relatively pristine streams (Ngerengere, Morogoro and Kikundi) during the rainy season between January and April 2013. The beetles were collected by active searching on the ground, in leaf litters, under logs and stones. The abundance, species richness, and diversity of the beetles were analyzed using Diversity and Richness ver. 2.65, PRIMER ver. 6 and SYSTAT ver. 10. The highest abundance of beetles was recorded in relatively pristine streams (n=143; 65.6%) compared to the degraded streams (n=75; 34.4%) and this difference was statistically significant (Mann-Whitney U=4396.500; $p<0.05$). *Metagonum sp.2, Peryphus sp.3, Boeomimetes ephippium, Abacetus sp.2* were the most abundant in relatively pristine sites while Diatypus uluguruanus, Metagonum mboko, Peryphus sp.3 were the most abundant in degraded streams. The highest species richness (S=21) was recorded in relatively pristine streams (s=21) while the lowest species richness (S=13) was recorded in the degraded streams. Furthermore, relatively pristine

streams showed the highest average diversity (H′ = 2.5359) compared to the degraded streams (H′ = 2.0662). The fact that degraded streams showed low abundance, species richness, and average diversity of the beetles, indicates that the ground beetles are good indicators of habitat quality. These results call for strengthened measures to control degradation of the riparian areas in the Morogoro municipality.

Key words: Ground beetles, Carabidae, habitat degradation, Tanzania

3.8 Effects of the abundance of parthenium hysterophorus on the composition and diversity of other herbaceous plants in Simanjiro rangeland, Tanzania

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Abstract

Parthenium hysterophorus L. (Asteraceae) is an aggressive annual herbaceous plant native to tropical America. It is known to cause distressing effects on natural ecosystems including rangelands in many parts of the world. It has been recently introduced in Tanzania but its effects are not yet quantified, a situation impeding development of mitigation strategies against its spread and effects. Therefore, a study was developed to investigate the effects of *P. hysterophorus* abundance on the composition and diversity of other herbaceous plant species in Simanjiro rangeland, Tanzania. Vegetation data were collected from 60 quadrats of $1m^2$ each to study the effects of abundance of *P. hysterophorus* on the composition and diversity of other herbaceous plant species. A total of 14 herbaceous plant species belonging to 13 genera and 10 families were recorded in the study area. *Parthenium hysterophorus* was the most dominant species recorded with greater Importance Value Index (IVI). Generalized linear models (GLMs) showed that the abundance of *P. hysterophorus* was related negatively to the abundance and diversity of other herbaceous plant species. Moreover, Jaccard's similarity index (0.6) showed a slightly significance difference between the infested and non-infested areas. These findings suggest that *P. hysterophorus* has a potential threat to other herbaceous plant species which are sources of food and nutrients to livestock and wild animals in the area. Thus, integrated management strategies are required sooner than later to control the weed from spreading to other nearby rangelands.

Key words: Dominant species, Evenness, Invasive weed, Richness

3.9 Salt farming along the coastal area, an economic activity affecting mangrove ecosystems

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Salt farming has been important economic activity that contributes to income generation to the inhabitants along the coastal areas. Despite the importance that salt farming has to the people along the coastal areas, the production of salt in many areas does not consider the well-being and sustainability of the mangrove ecosystems. Mangrove ecosystem provides a nursery ground and breeding area for many marine species and therefore promotes fisheries that benefit the human population through food security and economic gains. Salt farming involves clearing and selective logging of trees to build ponds, dykes and houses and has influence on the tidal flow in the area. The assessment of impacts of agriculture activities on ecosystems in Tanzania has been largely based on farming systems involving staple foods and cash crops like rice and coconuts. But less has been done to investigate the negative impacts posed to mangrove ecosystem by salt farming. In this study samples of macroinvertebrates (bio indicators) were sampled along the coast of Tanzania mainland and Zanzibar to assess the impact of salt farming on morphometric and abundance of macro fauna residing in mangrove ecosystem. Sediments were also collected to assess the impact of salt farming on the sediment particle size and organic matter content. The results indicate that the industry of salt farming has negative influence on the mangrove ecosystem and therefore the need for restoration and conservation of this ecosystem through planting of mangroves in the area where trees are cleared and selectively logged for salt ponds and where ponds have abandoned.

Keywords: Arboreal snails, crabs, scale mass index, salt works, population distributions and conservation

3.10 Community Based Forest Management model in Tanzania; where are we missing a point? A case of Ludewa Forests

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Ludewa is one of the prominent districts with abundant and diverse natural forests in Njombe region in Tanzania. Natural forests in the district cover about 42,040 ha, of which 24% are non-reserved forests. Of the total reserved forests, 62.1 % are village land forest reserves which are managed under Community Based Forest Management (CBFM) framework. CBFM model replaced the conventional central approach of forest management which failed to sustain forestrys. This study used qualitative and quantitative social surveys to elucidate the snags of adopted CBFM model in alleviating the ongoing deforestation, using Village Land Forest Reserves of Ludewa as a case study. The findings revealed that over the years there had been efforts under the Forest and Beekeeping Division (FBD), which was the authority before the recent reforms in the forest sector, to increase public participation through decentralization of power in forestry. The intention was to specifically empower the communities' on four main aspects of forestry that are; forest protection, conservation, development and sustainable utilization. However, despite such efforts, to date the objective of development and sustainable utilization of forest resources are not achieved to the appreciated levels. The major cause is non-compliance of the communities to the established CBFM model and the narrow streams of benefits due to limited knowledge of how much of the values can be taped from the forests for the welfare improvement of the dependent communities. The study concluded that the surveyed forests are important habitats for biodiversity. However, an improved CBFM model is recommended to rescue these forests which are considered to be Key Biodiversity Areas. The proposed CBFM framework which has inputs from lessons learnt in its more than 20 years of practice in Tanzania will provide equitable and wide scope of incentive to local communities to conserve and manage forests sustainably.

Keywords: Community Based Forest Management, Livelihood

3.11 Surveillance of bush meat activities around Serengeti Ecosystem in Tarime District, Tanzania using High Resolution Melting Analysis

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ABSTRACT

The current molecular forensic evidence admissible in court for wildlife species identification requires the use of standard forensic procedures based on DNA barcodes sequences developed on 650bp region of Cytochrome C Oxidase subunit 1 (CO1) gene which is widely used as standard barcode region distinguishing species with taxa specific-standardized gene sequence. This method is time consuming and costly since it requires a DNA sequencing step on each evidence submitted. Wildlife exhibits submitted in courts comes in diverse manner in nature and number and this method approach can become very costly when large numbers are analyzed and found to be of non-wildlife origin. To overcome this, scientists have started designing faster, cheaper and more robust molecular forensic approach based on qPCR-High Resolution Melting Analysis (qPCR-HRMA) a non-sequencing tool which can easily separate exhibits originating from domestic versus wildlife species. We have used this approach in Tanzania for the first time to assess bush-meat dynamics in the western part of Serengeti ecosystem (Tarime District) for 4 months (October 2017- January, 2018) using both social and molecular approaches. Semi-structured questionnaires were administered to 300 respondents to collect information on socio-demographic and other social factors leading to illegal bush-meat hunting, preference and consumption in the area. This was augmented by collecting 280 sundried or smoked assumed to be bushmeat samples and analyzed by qPCR-HRMA using three short primers adopted for HRMA analysis from 16S, Cytb and COI genes. The results indicated that hunting occurs mostly in the dry season primarily using snares, and wildebeest was revealed to be the most hunted. Furthermore, young (≤ 20) demonstrated high bush-meat consumption, whereas, immigrants, highly educated young respondents showed high bush-meat preference. HRMA analyses identified 20 species which are being poached, zebra being mostly identified (49.5%) followed by hartebeest (9.7%) and least were grant gazelle, reedbuck and Impala (2.9%). It was also apparent that endangered species like elephant and giraffe and un-normal species like Y. Baboon, Spotted Hyena, Civet and genet and lion are also identified

presumably being hunted and consumed by local inhabitants. In conclusion, wildlife poaching was found to wildly practiced in the area which require more government mitigation measures. HRMA was used successfully as a surveillance tool in these studies and provide a new tool which should be promoted, standardized, certified and used in routinely as a screening tool in bushmeat forensic analysis in this country

3.12 The impact of managing Selous-Niassa wildlife corridor on socio-economic activities

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Eastern and Southern African countries' authorities managing protected areas have made an effort to establish wildlife corridors as a response to ecological and socioeconomic benefits of connected ecosystems. However, these corridors face various socio-economic activities which degrade and fragment the wildlife habitats as an outcome of malfunction of corridors' management. This study aimed at examining socio-economic activities impacting management of Selous-Niassa wildlife corridor (SNWC). Data were collected using questionnaire survey, key informants' interviews, focus group discussions, direct field observations and secondary materials. Collected data were contently and statistically analysed. Findings indicated that 86.7% of respondents claimed that land allocated for settlement, agriculture and livestock keeping is not adequate as result of human-wildlife conflict. However, protected areas (PAs) within SNWC have insufficient involvement of local communities (81.7%) as a result of insufficient sense of ownership to natural resources in PAs. The study concludes that, management of SNWC is fairly sustainable. It is recommended that, more understanding on resource use values to local communities is imperative. Furthermore; man power, field gears and financial support to SNWC are vital for effective management of biodiversity and sustenance of ecosystem services.

Keywords: Socio-economic activities, Management of SNWC

3.13 Impact of Land-use and Land-cover changes on Surface runoff and Sediment yield in Little Ruaha River Catchment

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Abstract

Little Ruaha River catchment (LRRC) in Tanzania, is one of the country's most significant waterways due to its ecological composition and economic value. Regardless of its ecological importance, the hydrologic condition is said to have been greatly affected by land uses and land cover alterations and the present rates of change are unprecedented as compared to the past years. Therefore, a study was done to understand the extent and rates of LULC changes and their impacts on surface runoff and sediment yield in the LRRC. Remote Sensing and GIS techniques were applied to analyse the spatial and temporal changes of LULC using Landsat imagery and the stochastic CA–Markov chain analysis. Hydrological modelling using Soil and Water Assessment Tool (SWAT) was done to quantify the impact of land use and land cover dynamics on catchment water balance and sediment loads. The calibration and validation of SWAT model were performed using sequential uncertainty fitting (SUFI-2). The results showed that, forest, woodland and wetland has decreased by 60%, 46% and 70% respectively while cultivated land and built up area increased by 34.36% and 46.31% respectively in the year 2015 relative to 1990. Given the LULC, the average annual surface runoff increased from 48.84 mm to 137.77 mm while average annual total sediment loading increased from 2.214 t/ha to 9.984 t/ha. The model predicts an increase in both surface runoff and sediment loading in the future. The study concludes that the modification of the LULC has resulted in the increased surface runoff generation and sediment loading of LRRC which is likely to jeopardize the proper functioning of the river. The study recommends a need for integrated river catchment management approaches for the sustainability of the catchment resources.

Key words: *Land-cover, Land-use, Little Ruaha River Catchment, Surface runoff, SWAT Model*

3.14 Unrecovered disposal options of brewing by-products as additional benefits to investors, government, scientists, and environmental sanitation in Tanzania

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Abstract

The valorisation of raw materials including grain barley, hops, and yeasts, consumption of natural resources like water and energy (solar and electric), use of fertilizers and/or organic substrates, and pesticides in brewing is a global concern. The disposal benefits associated with the spent/surplus grains and yeast and importation of hops is economically and environmentally unrecovered in Tanzania. Literature synthesis showed that Tanzania is the 8th worldwide in brewing (over 4.3 million hL or 430 million litres) but depends largely on the imported raw materials such as barley, yeast, hops, and worts. Breweries (TBL and SBL) import 10,500–11,500 tons of barley annually, and hops, yeast, and worts. In the brewing process, every 100 L of beer produce 20 kg of spent grain equivalent to 85% of all by-products hence 15% is for surplus yeast. Much water and electrical energy are consumed in brewing. In fermented surplus yeast H2S and NH3 gases are released where S and N are nutrients to plants and it has biogas importance. Over 4.3 × 105 hL or 4.3 × 107 L of beer produced in 2016, for example, required total thermal energy of 1,505,000 kWh but only 1,333,000 kWh would have been consumed since biogas would have produced 172,000 kWh. Total of TZS 364,526,050/= or $ 161,295 was incurred only in brewing energy but inclusion of biogas technology would have saved TZS 41,960,120/= or $ 18,566 based on the TANESCO tariffs of TZS 286.28/= per kWh. The Government also gained over TZS 345 billion as corporate, excise, and value added taxes. These disposal options display alternatives to environmental conservation, utilization of natural resources and overcoming carbon-pint (CO2) emission into the atmosphere. It is recommended that the significances of these by-products for food, feed, pharmaceuticals, biogas, and soil fertility are scientifically evaluated.

Keywords: Environments; Natural resources budget; Tanzania.

3.15 Development and assessment of nutritional composition, sensory profile and consumer acceptability of jackfruit seed flour buns from locally grown jackfruit

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ABSTRACT
The purpose of this study was to develop buns (*Mandazi*) based on wheat and jackfruit seeds flour and assess their chemical composition, sensory profile and consumer acceptability. Samples of jackfruit seeds were obtained from Tanga, Morogoro, Coast region and Zanzibar. Seeds were sorted, washed, pre-dried, seed coat peeled, sliced, dried and milled to flour. The developed jackfruit seed flour from each location was blended with wheat flour at different levels of substitution (10%, 20%, and 30%) to form composite flour which was developed into buns. Factorial experimental design was used to determine variability of the response variables. Jackfruit seed flour, composite flour and the buns were chemically analysed for proximate and mineral composition. The buns were subjected to sensory evaluation both Qualitative Descriptive Analysis (QDA) and consumer acceptability using 1 – 9 Hedonic scale method. Results showed that jackfruit seed flour had higher amount of protein, ash and fibre contents of 12.6 – 15, 3.3 – 3.0 and 3.7 – 5.1 respectively than their respective lower value of 8.5, 0.4 and 1.4 g/100 g in wheat flour. Potassium was found to be the most abundant in jackfruit seed flour followed by phosphorus, magnesium and calcium. Substitution of wheat flour with jackfruit seed flour enhanced the nutrients content in the composite products. Sensory evaluation showed no significant ($p<0.05$) differences in all attributes between control and 10% composite bun (10% WJB). Therefore, the findings suggest that jackfruit seed flour can be incorporated into wheat flour up to 10% to enhance nutrient contents and to improve the quality of its final products without compromising its sensory attributes. The findings serve as basis for production, promotion and consumption of jackfruit so that population can enjoy the nutritional and, health benefit as well as to capture business opportunities available from jackfruit.
Key words: Jackfruit, Composite buns, flour substitution, Quantitative Descriptive, consumer acceptability

3.16 Benefits from Water Related Ecosystem Services in Africa and Climate Change

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Abstract

The present study collects original monetary estimates for water related ecosystem service benefits on the African continent from 36 valuation studies with a special focus on ecosystem services value in Tanzania. A database of 178 monetary estimates is constructed to conduct a meta-analysis that, for the first time, digs into what factors drive water related ecosystem service values in Africa. We find that the service type, biome and other socioeconomic variables are significant in explaining benefits from water related services. In order to understand the importance that benefits from water related ecosystem services have for climate change, we explore the relationship between these benefits and the countries' vulnerability and readiness to adapt to climate change. We find that countries face synergies and trade-offs in terms of how valuable their water related ecosystem services are and their potential vulnerability and adaptation capacity.

3.17 Nitrous oxide emission from soils under smallholder organic and conventional cotton farming systems in Tanzania

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ABSTRACT

The effort to simultaneously sustain natural resources and supply of food and fibre is challenged by climate change linked to increased greenhouse gases (GHG) emissions. This two-growing season study in semi-arid cotton producing areas in Meatu, Tanzania aimed at quantifying and comparing N2O emission, a potent GHG, from soil under smallholder organic and conventional cotton production practices. The current practices were tested against a medium input scenario and alternative practices for both organic and conventional cotton production. In-situ measurement of N2O emission from soil was done using static chambers and gas analysis by gas chromatography. The results show that the current organic and conventional cotton farming practices had similar ($P < 0.05$) cumulative area-scaled N2O emission. However, yield scaled emission were significantly higher in conventional than organic farming systems. Medium input scenario conventional cotton showed higher area-scaled and yield-scaled N2O emission than organic cotton in higher rainfall (759 mm) season 1, but not in less rainfall (522 mm) season 2. Combination of manure and inorganic fertilizer as alternative practice reduced yield-scale N2O emission by 17%. Intercropping cotton with legumes reduced area-scaled emission by 27%. The emission factor for both conventional and organic systems were < 1% of applied total N. The N2O emission in organic and conventional smallholder farming practices varied between season 1 (0.24 and 0.31 kg N2O-N ha-1) and season 2 (0.52 and 0.60 kg N2O-N ha-1), which is lower than the emissions from cotton fields in medium input farming system (0.78 - 10.6 kg N2O-N ha-1). Combining manure and inorganic fertilizer, and intercropping cotton with grain legumes has potential to for increasing yields while maintaining low N2O emission from cotton fields.

Key words Greenhouse gases; N2O emission; cotton; organic farming; conventional farming; smallholder farmers; fertility management.

3.18 Impacts and Challenges in Agritourism Development in Kilimanjaro, Tanzania

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Abstract

Agritourism is increasingly recognized as an important alternative farming activity that can contribute to agricultural sustainability through diversification of the economic base, provision of educational opportunities to tourists, and the engendering of greater community cohesion. Farm tourism activities can include farm markets, wineries, farming interpretive centers, farm-based accommodation and events, and agriculture based festivals. Agritourism has received

increasing attention in academic literature as it has been widely promoted both in developed and developing countries. Kilimanjaro is well positioned to offer a competitive agritourism product given its rich farming activities and increasing pressure on farmers to diversify, however it is apparent that certain barriers exist to develop market ready agritourism related products in Kilimanjaro region. The study will try to give a perspective on the development of agritourism in Kilimanjaro region. Data will be collected through mixed methods which will involve in-depth interviews with local farmers, government departments, quasi-government organizations' and the tourism stakeholders. In addition, focus group discussion with local communities will also be conducted.

Key words: Agritourism, local communities, tourism, rural tourism, social economic impacts

Theme 4: Trade, socio-economic transformation for improved agricultural productivity and livelihood

4.1 Agriculture and wellbeing of communities in Emerging Urban Centres

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ABSTRACT1

This paper is based on a study of selected Emerging Urban Centres (EUC) in Mufindi, Kilolo, Kongwa and Mvomero Districts. A survey of 720 of households was conducted to determine rural transformation and diversification of economic activities from agriculture. This paper focuses primarily on how economic activities in EUCs have been transformed from largely being own agricultural based to diversification into non---agricultural activities. Both government and non---government institutions have influenced rural transformation. We adopt the term Emerging Urban Centers (EUC) to define rural areas that are transforming rapidly in terms of population as well as economic activities. While such areas may not cover the whole areas of formally identified townships or urban centers but are often part of a designated area(s) for a township. Findings from the study show that rural transformation has contributed into conversion of agricultural land into residential and other non---agricultural uses in the EUCs. The long---term effects of the land use changes are to be considered in terms of wellbeing of most of the rural population. Transformation does also contribute to cultural and social changes resulting for immigration. Migration in this study is observed as a

two---way scenario. Where most literature focus on rural to urban migration this study identify urban to rural migration as an important phenomenon. Where people from EUC migrate seasonally to rural areas for agricultural purposes. The key messages from the paper is that during the transformation of villages to EUC agriculture plays an important role as a source of start---up capital for more diversified economic activities. At the same time, rural---urban linkages in terms of flow of goods and migration/mobility of people play an important role. It is suggested from these findings that lit requires dedicated economic planning initiatives likely from the local government authorities to ensure that the economic potential of the EUCs is exploited for improvement of wellbeing.

Key words: Emerging Urban Centers, Rural---Urban Transformation

4.2 Production Systems and Efficiency: The case of Tanzania Cotton Farming

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This study compares efficiencies of organic and convention cotton production systems in Tanzania due to observed low productivity. The survey was carried out in Maswa and Meatu Districts. Organic farming is only practiced in villages within a radius of 25 km from Organic company (bioRe) located in Meatu District. Our stratification of the village for the survey had to be categorized into two rings. The first ring consists of villages between 0 – 25 km and have almost similar physical and environmental characteristics and the second ring is for villages ranging from 26 – 40km to capture the rate of organic cotton adoption. We selected all villages in both rings which were found between 0 – 40km and excluded villages above 40km. Probability sampling proportion to size was employed in the village level data to select the total number of farmers to be interviewed in each village. Using Parametric Translog Stochastic Frontier model, we compared technical efficiency of randomly selected 652 and 1683 organic

and conventional farmers respectively. Preliminary results indicated that, despite the recent push by the government in conventional cotton production, the efficiency level of organic cotton production is higher than that of conventional cotton. Due to high efficiency of organic cotton there is a room to compensate the lower productivity observed in conventional cotton production. There is therefore a need for inclusion and emphasis of organic cotton in the cotton sector development strategy.

Key Words: Cotton, Production Systems, Efficiency, Tanzania

4.3 Nexus between the Need for Environmental Goods and Livelihoods Outcomes in Tanzania's Crop Production: A Case Study of Tobacco.

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Abstract

There is always a link between crop production for sustaining household income, food security government revenue through export levy and protection of environment and health. This paper explores this link based on tobacco production in Tanzania. The primary objective of the study was to reveal the truth on alternatives against economic, environmental and the social harmful effects of tobacco production. Primary data were collected in four purposefully selected districts namely; Urambo, Ushetu, Chunya and Namtumbo in Tabora, Shinyanga Mbeya and Ruvuma respectively. Thereafter 397 tobacco growing farmers were randomly selected. Secondary data were collected from Tanzania's Tobacco Board, Cooperative societies, Apex organizations, Local Government Authorities, Ministry of Health, Bank of Tanzania and Environmental bodies. Findings show that although tobacco is a source of income, however, its cultivation is associated with a serious negative impact on environment in particular deforestation and erosion of profitability. In addition, Tanzania's Human Development Index suggests that all regions which grow tobacco have low per capita income compared the average for Tanzanians. This paper concludes by suggesting that as we aim to move towards the second

economy we have to be very selective in promoting crops which fit in the nexus of income, health and environmental goods.

KEY WORDS: Tobacco, Agricultural Production, Income, Environment, Health

4.4 Governance structures in domestic value chains: The case of non-industrial timber in the Southern Highlands of Tanzania

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Abstract

Although governance structure of the value chain influences the incomes of chain actors, it has received limited attention in domestic value chains. The objective of this paper is to analyze the governance structure of non-industrial timber in the Southern highlands of Tanzania. It does so in order to bridge the gap created by a multitude of literature that has analysed the structure of global value chains creating a dearth of knowledge on structures governing domestic value chains and their implications to the incomes of chain actors. The specific objectives of the paper are 1) to examine the market governance structure of non-industrial timber value chain 2) to analyze the determinants of the governance structure and 3) to assess the implication of the prevailing governance structure to the incomes of chain actors. The research adopted an exploratory cross section study design in order to gain a deeper understanding of the relationships between the value chain actors. Purposive and snowball sampling were used to obtain respondents for interviews. Data were collected through observation, semi-structured in-depth interviews with key informants and the respondents. Analysis was done using deductive thematic analysis. Study findings show that value chain actors of non-industrial timber use vertical, horizontal or a combination of both structures in timber transactions. Although the majority use vertical structures, smallholders earn more income when a combination of structures is used. Market uncertainty, incentive to spread risk, institutional environment and financial capability of both the seller and the buyer determine the type of governance structure. The paper concludes that both vertical and horizontal governance

structures play a significant role of linking value chain actors to markets. It is therefore recommended that efforts to improve smallholders' income should be geared toward improving vertical and horizontal structures because they play a complementary role.

Key words: Domestic value chains, Governance, Tanzania

4.5 Effect of agro-pastoralists migration on rice commercialization and livelihoods of smallholder farmers in Kilombero valley: The case of Mngeta

By

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Abstract

A large part of existing literature associates pastoral and agro-pastoral migration in Tanzania and sub-Saharan Africa as a whole with conflicts and negative effects on the livelihoods of smallholder farmers in the areas where they migrate to. This paper uses survey data from 531 households in ten villages of Mngeta-Kilombero to provide empirical evidence on the effect of animal drawn technology introduced by migrant agro-pastoralists on rice commercialization and livelihoods of smallholder farmers. Results of descriptive and econometric analyses indicate that use of animal drawn technology is one of the major factors associated with rice commercialization and improvement of livelihoods among smallholder farmers in the study area. Other determinants of commercialization of rice in the study area are farm size, percentage of plot planted with rice, use of hired labour, distance from large-scale farm and use of productivity enhancing technologies such as organic manure, improved seed, and

inorganic fertilizers. In general, most users of animal drawn technology cultivated significantly more land, achieved higher paddy yields, harvested and sold more paddy and/or rice, earned more income and improved their livelihoods during the 2016/17 farming season than non-users of animal drawn technology. However, some smallholder farmers particularly women were not able to benefit from rice commercialization due to challenges that constrained them to use hired labour and productivity enhancing technologies. Therefore, it is hereby recommended that for more inclusive future rice commercialization, policies and interventions should aim at enhancing access to productivity enhancing technologies among the poor households especially female headed households.

Keywords: *Agro-pastoralists migration, rice commercialization, livelihoods, smallholder farmers, Kilombero-Tanzania*

4.6 Access to Productive Land and Choice of Migration as a Livelihood Pathway Among Rural Youth in Tanzania

By

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Abstract

The majority of sub-Saharan Africa's (SSA) poor Tanzania included depends on agriculture for their livelihood. Therefore, developing the agricultural sectors in SSA is a promising strategy to retain the youth who would otherwise migrate to urban areas in search of alternative livelihood opportunities. However, high population growth in SSA countries is increasingly

reducing access to productive land for the youth who largely depend on land holdings of their parents. This paper investigates the effects of limited access to productive land among the rural youth using descriptive statistics and logistic regression analysis applied to data from 1200 households in eight districts of Tanzania. It is hypothesized that inadequate access to productive agricultural land is one of the major factors that induce the rural youth to migrate out of their areas of residence for alternative livelihood opportunities elsewhere. The findings show existence of diverse pathways to livelihood (farming, non-farm activities, diversification, employment, migration) in rural areas, decline in youth migration with increase in parent's land holding, decline in the probability of youth to migrate with increase in land productivity. Other factors found to influence youth migration in the study districts include age, land tenure system and security of land. These findings suggest that while some people associate youth's migration out of the rural areas with the behaviour of disliking rural life or engagement in farming, they are fundamentally against being poor. Youth's decision to migrate as a livelihood strategy is affected by conditions that affect their ability to earn a decent livelihood in their home areas. Thus, interventions that will ensure access to quality land among the rural youth and/or access to land productivity enhancing technologies will change their migration behaviour and engage in farming.

Keywords: *Access to land; Livelihood Pathway; Youth; Tanzania*

4.7 Up-scaling Youth Agri-enterprises for Enhanced Youth Participation in Tanzania's Industrial Development and Employment Creation

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Abstract

Africa's population and labour force is growing rapidly but opportunities for decent employment are expanding very slowly. The gap between the number of labour market participants and available wage employment opportunities widens by approximately 8 million annually. At the same time, rapid population and income growth are expanding the demand for food and agricultural products in sub-Saharan Africa. . Enabling youth to engage in agriculture to exploit this growing food demand would expand job opportunities for youth in the agri-food system. In Tanzania, engagement of youth in agriculture will also provide opportunity for youth to participate in the country's current agenda of becoming an industrialised nation by 2025. Several youth-in-agriculture and agri-business programs have been initiated by the Tanzanian government and their development partners to expand employment opportunities for youth in the African agri-food systems, but few, if any, have been able to scale up due to various

constraining factors. The Young Innovators in Entrepreneurship and Leadership Development (YIELD) project was initiated to assist young entrepreneurs to access and maximize opportunities in the rapidly evolving agri-food system in Africa. This paper presents findings of a YIELD Project survey of youth-led agri-enterprises in Tanzania. The survey involved 60 agri-entrepreneurs identified through desk reviews and snowball techniques. Overall, the findings indicate that most of the youth-led agri-enterprises surveyed were in the category of micro and small scale enterprises but have the potential to grow into medium scale industries and create employment if the capacity of the agri - entrepreneurs is built to scale-up their operations. However, several challenges were found to inhibit growth of the agri-enterprises including but not limited to difficulties with financial resources, human resources, infrastructure and logistics, market access and bureaucracy/institutional barriers. The findings point to the need for conducive business/economic environment to enhance growth of the agri-enterprises into medium scale enterprises.

Keywords: *Youth-lead agri-enterprises, industrial development, employment creation, Tanzania*

4.8 Factors Influencing the Use of Improved Charcoal Kilns by Charcoal Producers and its implication to Deforestation in Kilindi District, Tanzania

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Charcoal production is expanding in scope and magnitude in many tropical catchments in Sub-Saharan Africa.. Charcoal is an important energy source in Tanzania whereby 90% of the population depends on. The demand for charcoal is expected to increase because of increase in population, which is estimated to be growing at the rate of 2.7% per year. The rising of urban population and price of alternatives source of energy also contribute to the growth in charcoal trade. This implies charcoal production activities will continue to be profitable business. Despite of the growing demand and trade in charcoal, there is limited number of people who consider charcoal production to be their main economic activity. Besides, the business profits are concentrated to few actors, in the charcoal value chain. However, poor technology is identified as a major factor, which limits profits to producers.. This study focuses on how the use of kilns type contributes to the charcoal productivity. Improved kilns have a potential of significantly increasing the efficiency in production and ultimately to the income received by the producers. The study used surveys technique through standard tools to collect data from

200 charcoal producers. Logistic model was used to determine factors influencing the use of improved kilns. Descriptive statistics were used to characterize charcoal production kilns and extent of usage. Results indicate that about 40% of charcoal producers use improved kilns whereas 60% use traditional kilns; majority of producers used rectangular shaped of different volume that had different sizes. Those who use traditional kiln receive about 50% less than those with improved kiln. Investment and running costs, knowledge and awareness are among the factors that limit the adoption to improved technology which if adopted could reduce the inputs by more than 60%. This implies, improved kilns could significantly reduce deforestation.

Keywords: Charcoal, Local production technology, Efficiency

4.9 Factors determining crop farmers' willingness to pay for agricultural extension services in Mpwapwa and Mvomero districts,Ttanzania

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Abstract
As a result of the rapid changing situation of agriculture in African countries, inability of public agricultural extension services (AESs) to be responsive to the needs of farmers and changing of policy environment, new paradigm is emerging. The focus of this new paradigm is pluralism, the emergence of multiplicity of actors providing AESs, and the participation of farmers in the financing of AESs. Basically this is towards making extension less burdensome to the governments and relevant to farmer needs. In Tanzania, although not formally established, experience shows that, in some areas, farmers are paying for or contributing to the cost of providing AESs. This paper examined the factors determining crop farmers' willingness to pay for AESs in Mpwapwa and Mvomero districts. Specifically the services farmers are willing to pay for were identified and how much farmers are willing to pay for such services were determined. A random sampling technique was used in selecting 292 crop farmers' households

from which primary data were collected between December 2017 and February 2018 using interview schedule based on a semi-structured questionnaire. Data were analyzed using frequency counts, percentages and Tobit regression model. The study found that 88.4 percent of the respondents are willing to pay for AESs. The Tobit regression analysis showed that farmer's age, education attainment, farming experience, distance from farm to the nearest important road, income (both farm and nonfarm) and attitude towards AESs are significant determinants of farmers willingness to pay for AESs. The study recommends that these variables be given proper policy consideration by the government and other stakeholders in the design and the implementation of a workable fashion of privatizing extension services for the expected impact of improving extension services and farmers' productivity.

Key words: extension services, willingness to pay, farmers, Mpwapwa, Mvomero

4.10 Accelerating Industrialization through Agro-Processing: Access and use of Knowledge on Mango Processing Technologies by Smallholder Farmers in Tanzania

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Abstract

Mango fruits are produced and consumed in Tanzania. They are eaten either fresh or in processed form. Processing is commonly by formal industry. The Government of Tanzania strategy on reducing post-harvest losses to promote economic development, reduce poverty and increase food security is to support farmers to transition from subsistence to commercial. To support mango farmers, processing and preservation technologies are being transferred through training to achieve the industrialization in the country. However, the training provided is not wide-spread and is undertaken by multiple agencies with variations in the training content and approach. This study was conducted to assess the access and use of knowledge on mango processing technologies in Kibaha district. The farmers were randomly selected in a systematic way from 21 trained farmer groups to obtain a sample size of 100 farmers for data collection

using a pre-tested interview schedule. Data was analyzed using descriptive analysis and Multinomial Logit Model. The study established technologies that are appropriate for mango processing; they include pulping, drying, production of vinegar, fermentation and pickling. Seventy-five-percent of the respondents have used processing technologies at least once for jam and juice manufacture. Twenty-five-percent indicated not having used the technologies that they had been trained on. It was established that processing for home consumption and for sale was significantly influenced by the number of trainings attended, number of technologies trained on, hands-on experience and own fruits production. The study concludes that the farmers have ample knowledge on mango processing particularly from training but the practice is low.

Keywords: Processing, technologies, training, mango, industrialization

4.11 Are Targeted Farm subsidies pro-poor?: An assessment of GESS input support program in Kano, Northwest, Nigeria .

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Abstract

Agricultural subsidies that encourage production and productivity have been widely criticized and perceived to be far from reaching the targeted beneficiaries. The aim of this study is to examine the pro-poorness of the newly introduced farm subsidy scheme in Nigeria.We use a cross-sectional survey design to collect data from 40 farming communities in Kano state North west ,Nigeria. Benefit incidence analyses (BIA) and ordinary least square (OLS) model was used to estimate the distribution of subsidy benefits base on some socio-economic characteristics and to check the effect of fertilizer used on household production and the impact of subsidy prices on fertilizer consumption in the study area. The benefit incidence analysis results suggests that the distribution of subsidy benefits tend to be pro-poor and targeting was effective on the basis of accessibility, quantity of fertilizer used ,gross revenue from maize, farm size and gender The result from OLS analysis show that fertilizer is the main driver of production among small farmers but land size, labour and years of the farmer are more significant drivers of production than fertilizer for the larger farmers. A reduction in fertilizer subsidy is, therefore, likely to have adverse impact on farm production and income of small and marginal farmers as they do not benefit from higher output prices but do benefit from lower input prices. This paper therefore justifies the use of farm input subsidies in improving production and income of smallholder farmers. The Study concludes that Improving

the design and implementation of the subsidy programs can better target and benefit resource-poor farmers and also enhance the achievement of program objectives.

Key words: Pro-poor, Targeted subsidies, Benefit incidence analysis, Kano, GESS

4.12 Assembling 'Mkulima Agricultural Knowledge Hub' For Up-Scaling the Adoption of Agricultural Innovations among Farmers in Tanzania

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Abstract

Agricultural sector plays a very important role in the economy as it employs more than 75% of the total population, contributes about 25% to the GDP, brings about 66% of the foreign exchange, and provides raw materials for local industries. For optimal agricultural production and post-harvest handling, farmers need timely access to relevant knowledge. Unfortunately, agricultural knowledge is mainly accessed through print media, agricultural extension and advisory system. However, the accessibility of print media in most rural areas in Tanzania is very low. Likewise, there is a limited number of agricultural extension staff and inadequate resources to facilitate the provision of agricultural extension services. ICTs facilitate access to agricultural information services along the value chain. Empirical evidences from India, South Africa and Ghana show that ICTs enhance access to agricultural knowledge and cut down costs associated with accessing knowledge. Tanzania can do better by leveraging on high level of ownership of mobile phones among farmers to increase access to agricultural knowledge. This study uses a web analytics methodology in investigating the informative potential of the Knowledge Hub. Findings indicate that the Mkulima Knowledge Hub provides access to full text of information resources repackaged in simple and most understandable form. It facilitates access to the required information through a simple search implying that information resources are well indexed by subject. Findings further indicate that the level of usage of the hub has been increasing from time to time, there are some months were the level of usage is higher than

others. It is concluded that the Mkulima Knowledge Hub is of great potential in enhancing access to repackaged SUA's research outputs to farmers. It is suggested to scale up and promote the Hub that more farmers may have access to agricultural knowledge.

Keywords: Agricultural information; Agricultural innovations; Mkulima knowledge hub; Farmers

4.13 Attitudes and perceived Impact of Insecticide Treated– Bed Nets on Malaria Control in Rural Tanzania

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Abstract

Insecticide-treated nets (ITNs) are the most powerful malaria control tool if used correctly. Yet up to date, utilization is still low. The aim of this study was to investigate the intra-household factors that affect the utilization of ITNs in rural households in Morogoro CBD District. In addition, this study analysed the reasons for ITNs non-use in households with children under five years. Questionnaire, interviews and observation were the key tools for data collection for this study. The intra-household factors affecting the utilization of ITNs reported in this study include, chemical substances impregnated in the nets (36%), household financial inadequacy (24%), warmth and discomfort of the nets (24%) and skin irritability (17%), among others. The general community knowledge about mosquito nets was found to be high (91%); however, the knowledge of ITNs was low (30%). In addition, it was found that the ITNs were inadequately

accessible in the study community. Based on the results of this study, adequate accessibility of ITNs and community education related to the use, and the significance of the nets is important.

Key words: Insecticide treated bed-nets; attitude; malaria; Morogoro CBD

4.14 Livelihood Strategies among Unmarried Adolescent Mothers of rural and urban Katavi, Tanzania

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Abstract

Unmarried adolescent mothers (UAMs) in Sub Saharan Africa including Tanzania, face a lot of challenges livelihoods being one of them. The study sought to examine the various types of livelihood strategies engaged by unmarried adolescent mothers (UAMs) in Katavi region, Tanzania whereby Mpanda Municipality and Tanganyika District were purposely selected to represent urban and rural Katavi respectively. The study further sought to determine association between livelihood strategies and the two localities and to identify the dominant livelihood strategies among the localities. A cross-sectional research design was adopted for the study whereby data were collected using non-probability convenience sampling approach with a sample of 240 UAMs. Descriptive statistics were used to present the livelihood strategies in form of frequency and percentage while Chi-Square Test was used to determine the relationship between adopted livelihood strategies and the localities. Quantitative data were supplemented with rich qualitative data analysed through content analysis. The approach used to classify UAMs' livelihood strategies is based on the main income activities as stated by the UAMs based on a predetermined list of six categories of livelihood strategies established from a pilot study. Study findings show a significant relationship ($p < 0.000$) between livelihood strategies and locality with trading emerging as the dominant livelihood strategy in both localities. The study recommends that governmental and nongovernmental institutions need to provide life-skills and entrepreneurial skills to UAMs. There is also a need for capacity building in form of financial management so as to enable UAMs to manage properly their existing businesses. It is further recommended that those UAMs aspiring to upgrade their education could do so through the Qualifying Tests programme.

Key words: unmarried adolescent mothers, livelihood strategies, teenage pregnancy and Katavi

4.15 Engaging communities and government as key stakeholders during evaluation of zoonotic viral sharing among bats, primates, and people in southern Tanzania

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Governments and communities are directly impacted by zoonotic disease outbreaks and are key One Health stakeholders. We used a One Health approach to build capacity and conducted surveillance for viral sharing among geographically overlapping bats, primates, and human populations in Southern Tanzania. The project aimed to build capacity and work with communities, human and animal health officials to increase zoonotic disease awareness and support the research team during human and animal sampling. We trained and partnered with district-level government human and animal health officials, rural health clinic staffs, village leaders, and communities to implement the project. These stakeholders were critical to sampling site characterization and human, wildlife, and environmental surveillance. Apart from research team trainings, 151 individuals, including veterinarians, human health professionals (clinicians and nurses), animal and human health students, and wildlife officers were trained. We also developed partnerships with diverse, rural communities, central and local-governments, and university groups. The established One Health team sampled human patients, bats, primates, and fruits discarded by foraging bats. Zoonotic viruses (filoviruses, coronaviruses, paramyxoviruses, flaviviruses, and influenza viruses) were analyzed. We built strong partnerships among communities, governments, and interdisciplinary researchers, which were essential for implementing human, animal, and environmental surveillance. The capacity established will enhance future One Health research and development in Tanzania.

4.16 Health Literacy and Its Associates in the context One Health Approach in Tanzania

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Abstract

Transformation of agriculture and natural resources for sustainable development towards attainment of industrial economy in Tanzania, inter alia, relies on the quality of population. Health has always remained a very essential determinant of quality of a population. Evidently, attaining optimal health calls for collaboration between humans, animals and environmental health professionals plus understanding consequences of humans, animals and environment interactions on health. Attaining good health faces numerous challenges, health literacy (HL) inclusive. Despite, HL being an important predictor of health outcomes, health care costs and utilization, yet most countries, Tanzania inclusive, lack HL measurements in their health datasets. A crosssectional study was conducted in Morogoro urban and Mvomero districts in Morogoro, Tanzania to assess HL and its correlates in the interface of humans, animals and the environment. The sample comprised of 1440 respondents who were obtained through a multistage sampling procedure. Data was collected through a structured questionnaire administered using a Computer Assisted Personal Interviewing (CAPI) electronic platform. Health literacy was measured using a context specific One Health Literacy Assessment Tool (OHLT) which captured health related aspects reflecting the interactions of humans, animals and the environment. The study used IBM-SPSS (v20) and Gretl software to analyse quantitative data. The results revealed that 36.3% of the respondents had Inadequate Health Literacy, followed with Marginal Health Literacy at 30.8% and Adequate Health Literacy standing at 32.9%. Pearson coefficient correlation revealed health literacy correlating to group of attitudes ($r=0.135$, $p=0.01$), levels of engagement in health-related discussion ($r=0.609$, $p<0.05$), health behaviour categories ($r=-0.648$, $p=0.05$) and category of information seeking ($r=0.753$, $p=0.05$). Efforts should be made by the government and nongovernmental organizations to promote health literacy in the context of One Health Approach through mass awareness given its importance towards realization of optimal health for humans, animals and the environment.

Keywords: Health literacy, Correlates, One Health Approach, One Health Literacy

Assessment, Tanzania

4.17 Prospects of Village Knowledge Centre in Linking Farmers, Extension Agents and Researchers: First Insight from Ilenge, Rungwe - Mbeya

Camellius Sanga et al

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Abstract

Information and Communications technologies (ICTs) have played a major role in improving the provision of traditional or conventional agricultural extension service to farmers and livestock keepers in Tanzania. Some of the notable achievement is the use of radio, TV, web-based farmers advisory information systems, mobile based farmers advisory information systems, mobile payment systems, mobile apps, weather information systems, just to mention

a few. These systems have also brought another challenge to villages which have not connected to Internet. Earlier attempts to solve this problem by Government led to initiating telecentres and ward resource centres. These approaches have helped extension agents to reach rural areas with a view to bringing agricultural development to these areas. Most Telecentre and ward resource centres are not functional because of sustainability issues. This is the gap that INNOVAFRICA-SUA project wants to address through implementation of village knowledge centre (VKC). This paper examines the implementation of VKC at Ilenge, Rungwe district. We first describe the development in agricultural extension service in Tanzania, and show some projects in ICT for agricultural extension service. Also, we discuss why telecentres have failed in Tanzania. Furthermore, we justify the implementation of INNOVAFRICA-SUA that extends ICTs to village. We examine in detail what has been done at Ilenge Village knowledge Centre. We describe our field visits and observations, and conclude with an analysis of the role and benefits of VKC, unresolved questions and issues, and possible directions for future work in this area.

Keywords: Ilenge, Rungwe, Village Knowledge Centre, ICTs, Agricultural extension service

4.18 Large Scale Agricultural Investments and Neighboring Communities' Perceptions on Development Outcomes.

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ABSTRACT

This paper is based on preliminary survey of selected large-scale agricultural investments (LSAI) and neighboring communities in Iringa Rural, Njombe and Karatu Districts. The objective of this paper is to present preliminary findings of development perspectives with respect to employment and land tenure of communities neighboring large-scale agricultural investments. The methodology comprised a selection of 3 study locations of large-scale agricultural investments (LSAI) with presence of (clusters of) Danish and other foreign agricultural investors. A minimum of two villages was selected in the immediate vicinity to the selected investments for qualitative interviews. Wellbeing ranking approach was used to determine perceived land tenure security among selected interviewed respondents. LSAI has a long history in Tanzania as such each of the studied LSAI had a different history. The historical backgrounds to a large extend influence the perceptions of the neighboring communities in terms of livelihood transformations in general, land tenure and employment opportunities specifically. With increased population, demand for land for economic activities is increasing. As such majority of community members perceive this shortage is resulting from acquisition

of large pieces of land by large-scale agricultural investors. Different categories of employment opportunities exist in LSAI including permanent, short term and task based contracts. It is generally perceived that access to the different categories of employment opportunities is largely through social networks rather than formal advertisements'. At the same time, majority of people employed in LSAI claim that the wages are low compared to cost of living as such, own agriculture and petty business are undertaken to supplement the wages. The general perception of communities surrounding LSAI is that, land tenure security is threatened by the existence of the LSAI while at the same time the employment opportunities do not meet to the expectations of the communities in terms of income generation. Further analysis in this study will provide insights as to how best LSAI can contribute to livelihood transformation.

4.19 Innovation Value Chain Status of Government Co-operative Supporting Organizations in Tanzania

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Abstract

Managing innovation processes is a crucial facet to organizations. This is because the contemporary global competition has necessitated organizations aiming at becoming and remaining vibrant to invest in innovation as a key competitive tool for their survival and growth. For innovation outputs to be realized, organizations thus should be able to establish and maintain effective innovation chains or processes in terms of ideas generation, conversion and dissemination. This study assessed the innovation value chain status of government co-operative supporting organizations (GCSOs) in Tanzania. The study adopted the case study research design using multiple cases where five cases were picked. Primary data were collected using focus groups discussion, key informants' interviews, documentary review and non-participant observation. Data were analyzed using content analysis. The findings show that the innovation value chains of most of the studied GCSOs were weak. Moreover, the innovation value chains of most GCSOs were poorly linked towards innovations dissemination to PCSos. The innovation value chain analysis revealed a weak progression from lower node of ideas generation to dissemination. The study recommends that GCSOs should work to ensure strengthening of the innovation value chains through genuine allocation and prioritization of resources. Deliberate efforts such as setting innovation units to enhance innovation activities within GCSOs are also recommended.

Key words: Innovation Value Chain, Government Co-operative Supporting Organizations, Innovations Dissemination, Primary Co-operative Societies

4.20 Political-Administrative Relations: Its Importance and Challenges in implementation of Health and Education Development Projects in Morogoro District Council, Tanzania

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ABSTRACT

Social services provision is a central focus of any local government. Under decentralization by devolution (D by D), Local Government Authorities (LGAs) became responsible in delivering social services within their areas of jurisdiction. This paper sought to explore the importance and challenges of political-administrative relations on the implementation of public development projects, specifically in health and education at the local level. The study adopted a cross-sectional research design and total of 308 respondents were involved randomly selected. Qualitative data were collected through key informant interviews, focus group discussions and observation techniques. The study used content analysis to analyse and interpret the qualitative data and descriptive statistics such as frequencies and percentages to analyse quantitative data. The study revealed that good relationship between elected and appointed officials facilitates mobilization of project resources, increases public participation improves trust, minimizes conflicting interests and ensures transparency and accountability. It is concluded that political-administrative relations in implementation of development projects in the local governments are crucial and play a significant roles in the success of the projects. However, it was revealed some challenges which to some extent limit the attainment of good political-administrative relationships. Such challenges include the following: partisan politics and politicization of public services, low levels of education and role ambiguities, distrust and poor accountability and lack of financial incentive to elected officials at local levels. . Therefore, it is recommended that local governments should monitor interaction between the elected and the appointed officials in projects implementation, ensure adherence to political neutrality and good governance. The government is urged to pay certain monthly allowances to village/hamlet chairpersons as incentive to the elected officials at local level to motivate their active involvement in development projects.

4.21 The Relationship between Women Reproductive Factors and Household Socio-economic Status in a Rural Setting in Morogoro District, Tanzania

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Abstract

Different theories have been proposed to explain the factors that lead to poor socio economic status (SES) among women. Women's poor SES is linked to multiple contributing factors, most of which are related to performing multiple roles that include family and childcare and reproductive responsibilities in general. However, the relationship between women reproductive factors and SES remains uncertain. This study aimed at exploring the associations that exist between selected reproductive factors and household SES among households consisting of women of reproductive age in a rural setting. A cross-sectional study, involving six villages selected randomly from three wards of Morogoro District, Tanzania, were involved in the study. A total of 542 participants consisting of women from male and female-headed householdswere involved in the study. Data analyses were performed using Statistical Package for Social Sciences. The first component of Polychoric Principle Component Analysis (PCA) and proportional odds ordinal logistic regression model were used to estimate relationship of study variables. The number of children a woman wished to have had negative association with SES ($p<0.05$) whereby wishing to have more than 5 children was associated with less likelihood to attain higher (Medium to High) SES. The mean age at first pregnancy was 18.5 years with 56.5% of participants becoming pregnant for the first time at ≤ 18 years. The age at first pregnancy had significant positive association with SES whereby being pregnant at the age of more than 18 years increases the chance of attaining better (Medium-High) SES ($p<0.05$). This implies that early pregnancy (18 years or less) and women's desire for relatively many children >5 constrain attainment of better SES. Findings from this study emphasize the need for reproductive health education particularly family planning and advocacy against early pregnancies to rural communities.

Key words: Women, household SES, reproductive factors

4.22 Performance of retention and revolving funds in Tanzania prisons services' farms; case of maize production

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ABSTRACT

The study was conducted at four prisons farms' namely Karanga in Kilimanjaro, Arusha in Arusha, Songwe and Ngwala in Songwe regions to assess the performance of retention and revolving fund at Tanzania prisons farms on maize production. Cross sectional and purposive sampling were employed whereby primary and secondary data were involved and secondary data was the main source. Secondary data were collected from TPS documents while 4 key informants were interviewed to collect primary data. SPSS and Excel were used for data analysis whereby descriptive statistics revealed that 100% of key informants were male with age ranging between 21-60 years, 3 of them were diploma holders while only 1 was a degree holder. All farms were used certified seed and fertilizer and prisoners were the main source of labour. The maximum and minimum mean of maize yield under revolving funds and retention farms in 2018 were 5.2 and 0.2 tons per hectares respectively. The results revealed gross margin per hectare of Tsh.4,094,400.00 at Arusha and Tsh.129,480.00 at Songwe farms both under revolving fund and Tsh 2,669,250.00 at Karanga and Tsh.(-342,375) at Ngwala farms under retention fund in 2018. In compare means the results revealed the statistical significant differences between revolving and retention fund farms in farm size, maize yield, revenue and variable costs at 1%, 10% and 5% and 1% levels of probability respectively

Keywords: Retention, revolving, Funds, Prisons, Maize

4.23 Smallholder farmers' beliefs on quality seeds of improved common bean varieties in Tanzania

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Abstract

The importance of quality seed of improved varieties in agricultural production is well recognized and widely documented. Studies on the contribution of quality seed of improved varieties to increased productivity are well documented. However, farmers in most developing

countries including Tanzania mainly use grain as seed from farmer managed seed systems. Smallholder farmers' demand for quality seed of improved varieties has remained low for years. Previous studies have broadly identified technological, economic, institutional and human specific factors as the major determinants of adoption. Using representative farmers from major common beans producing regions, this paper examined if there were any smallholder farmers' beliefs influencing their decision to use quality seed of improved common bean varieties. The study adopted the Theory of Planned Behaviour. The findings indicate that farmers' decision to use quality seed of improved common bean varieties is influenced by various behavioural, normative and control beliefs. These included quality seed unavailability, low market potential for produces from improved varieties, inadequate extension services, low family income and high costs of associated inputs. The findings indicate further that behavioural, normative and control beliefs significantly influenced smallholder farmers' attitude, subjective norm and perceived behavioural control respectively. Therefore, attempts to increase smallholder farmers' use of quality seed of improved common bean varieties have to pay attention on their beliefs towards quality seed.

Key words: common beans, quality seeds, improved varieties, theory of planned behaviour, behavioural, normative, control beliefs, attitude, subjective norm, perceived behavioural control

Theme 5: Education for skills development and entrepreneurship

5.1 Advances in Capacity Building for Training and Research in Health of Aquatic Resources in East and South African Region: A Case of Sokoine University of Agriculture, in Morogoro, Tanzania

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Abstract

In the developing world including countries in the Eastern and Southern Africa (ESA), there is a significant documented knowledge gap on health of aquatic resources and environmental stressors. This includes lack of understanding of aetiologies, diagnostics and management of diseases in aquatic animals and other resources through preventive and control measures. Lack

of knowledge hampers the socio-economic development of aquaculture and fisheries industries in the region, pre- cludes evidence-based policies and decision-making and also has societal implications. There is also a need to build competence for monitoring and protection of wild freshwater and marine re- source populations which are essential for food and nutritional security, employment opportunities and income generation in the region. In cognisant of these challenges, in 2013, six Universities, including one in Norway and five in East and South African Region embarked on innovative training and research programme with key activities centred at Sokoine University of agriculture in Tanza- nia. This paper presents the genesis, current initiatives and projections towards Capacity Building for Training and Research in Health of Aquatic Resources in the East and South African Region. It sheds light on key achievements towards workforce development at Post-doc, PhD, MSc, BVM/ BSc and Diploma levels; scientific and popular publications in this field; and development of the African Centre for health of Aquatic Resources at SUA. The state of viral, bacterial, fungal and parasitic infections and diseases of socio-economic importance have also been highlighted. It is concluded that, the capacity building for training and research at SUA and its satellite centres at Makere University, University of Zambia, University of Nairobi and the Institute of marine Sciences in Zanzibar are key regional footprints for optimising productivity and trade of fish and fish products through enhanced disease management practices.

Key words: Fish health and diseases, Aquatic Toxicology, Norway, Tanzania, Uganda, Kenya, and Zambia

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5.2 Democratic processes for sustaining environmental education in primary schools: implications for teacher education in Tanzania

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Abstract

Tanzanian educational policies emphasize the teaching of environmental topics across all levels of education as a sustainable strategy to address environmental challenges through educated citizens. However, environmental degradation is still a major challenge in Tanzanian communities threatening their sustainability. The paper is based on the authors' experience of

a project aiming at the improvement of Environmental Education (EE) in teacher training colleges and thus in primary schools within Tanzania. Through participatory action research (PAR) in collaboration with a teacher training college, nine primary schools, and local community members, we developed examples of, and arenas for, the active teaching of environmental topics. In this paper, we discuss the factors that influenced the implementation and challenged sustaining EE in the participating primary schools and the teacher training college. More specifically, we will debate to which degree the introduction and implementation of democratic processes in teacher training programs increases the different stakeholders' abilities to manage and negotiate environmental challenges and the resilience of the local communities. We conducted follow up study, collected data through Focus group discussion and analyzed the data by content analysis. The findings indicated that the transfer of teachers and education leaders was the main challenge in sustaining positive change in schools and at the teacher training college. We discuss the findings in terms of institutionalized top-down power structures that characterizes Tanzanian educational governance. We argue that the contextualization of teacher education curriculum through participatory action research and action learning strategies that are grounded on democratic principles is the gateway toward environmental sustainability in Tanzania. We thus recommend the inclusion of participatory action research and action learning in the teacher education curriculum.

Key words: Environmental education; Educational governance; Democratic processes
Participatory action research; Teacher education

5.3 Advancing soil health in Africa: A learning experience in implementing Regional MSc program in Soil Science and Water Management

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Abstract
With the limited and declining funding of public universities, fewer professional agriculturalists are being trained. The goal of the MSc in Soil and Water Management Program was to develop and strengthen human resources and institutional capacity to undertake impact-oriented research in soil and water management as an entry point towards more sustainable agricultural production in the Eastern, Central and Southern African countries. The training program targeted students from Malawi, Rwanda and Tanzania. These three countries were targeted because of their poorly developed human resource base dealing with issues on soil water management. Female students were given priority because even in the earlier AGRA supported PhD SWM program at Sokoine University of Agriculture there were no female students from these countries. Sixteen (16) female students and three (3) male students have received and continue to receive MSc training support under the project. Outputs are that four (4) students graduated in 2015, seven (7) in 2016, four (4) in 2017 and one (1) in 2018 giving a total of sixteen (16) graduands to date. Currently three (3) students are carrying out research

work having successfully completed their year one of coursework. The project supported four (4) more students above the initial maximum of 15. All Tanzanian graduands so far have secured permanent employment. Four got employed in Higher Learning Institutions in Tanzania and Rwanda. Thirteen paper manuscripts were prepared by students under guidance of supervisors. Up to now nine have been published in peer reviewed journals Major research findings include (i) the fact that in SRI rice production systems in many areas in Tanzania that have in the past 15+ years been using UREA as the only source of N stand to increase yield if they also apply Phosphorus and Sulphur. After abandoning Sulphate of Ammonia (SA) as N source in the mid-1990s there is now a deficiency of these nutrients in most rice fields. (ii) Plastic degrading microorganisms have been isolated from soils at SUA.

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