ASARECA
Transforming Agriculture for Improved Livelihoods

"Transforming agriculture for economic growth in eastern and central Africa"

THE 2ND ASARECA GENERAL ASSEMBLY & SCIENTIFIC CONFERENCE

BOOK OF ABSTRACTS

Canadian International Development Agency
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SESSION 1: TRADE AND BUILDING CAPACITY FOR AGRICULTURE

Oral Presentations

Food Price Trend Analysis: Lessons for Strengthening Food Security Policy in Tanzania

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This study is part of the ASARECA regional Food Price Trend Analysis and Policy Options for Enhancing Food Security project being implemented in Tanzania, Kenya, Uganda, Ethiopia, and Rwanda. It contains preliminary highlights of the ongoing activities and the expected outcome. The paper analyzes local food price movement to generate scientific evidence for policy decision making process based on the link between prices and food security; because prices guide decisions for and economic activities of agents along the food value chain. The paper applies the fundamental principle of price transmission, i.e *the Law of one price* (Baltzer, 2013) represented as $|Pw - Pd| \leq t$ where Pw and Pd are are the prices of a commodity on the world market and the domestic market respectively and t represents the transaction costs associated with importing or exporting the commodity. In addition, the paper studies price transmission between different spatial local markets within the country. However, it is important to note that regardless of the markets under consideration the gap between the international and the domestic prices of a commodity or between spatial markets in the country are not greater than the transaction costs.

The common food price transmission analysis is sub divided into two main types – horizontal and vertical analysis. Much of literature to-date has focused on modeling vertical price transmission from the farm to the retail sector, while horizontal price transmission looks on markets shocks that are transmitted to related markets at different location. This paper applies the latter in examining the price transmission of three commodities, i.e. maize, rice, and beans in six selected markets by looking at the effect of prices in one market prices to another. This is measured in terms of the transmission elasticity, percentage change in the price in one market given a 1 percentage change in the price in another market. We start with the simple case in which the assumption is that markets are perfectly competitive; whereby the product is homogeneous, meaning there is no variation in quality; traders are numerous and small so that none of them has market power; traders have perfect information; trading occurs instantly; there are no trade taxes or other policy barriers to trade, and there are no transportation or transaction costs.

The studied markets on few selected markets such as Dar es Salaam, Mbeya, Morogoro, Rukwa, Arusha, Iringa and Shinyanga. This study will apply the vector error-correction model (ECM) to examine the relationship between world food prices and domestic food prices in Tanzania that will generate evidence based policy responses to the food price increases, volatilities and food security.

Antioxidant, antimicrobial and synergistic activities of tea polyphenols

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Polyphenols are secondary metabolites produced by tea plant, which play multiple essential roles in plant physiology and have potential health properties on human health, mainly as antioxidants, anti-allergic, anti-inflammatory, anticancer, antihypertensive and antimicrobial agents. Microbial resistance has become an increasing global problem and there is a need to find out novel potent antimicrobial agents with alternative modes of action as accessories to antibiotic therapy. This study investigated the antimicrobial, synergistic and antioxidant properties of tea polyphenols. The synergistic effect of tea polyphenols in combination with conventional antimicrobial agents against clinical multidrug-resistant microorganisms has been investigated and valuable data generated on the potential synergistic properties of tea polyphenols.

Water extractable fluoride in tea from East Africa: A case study of Kenyan tea

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Fluoride in food is currently a subject of immense interest globally as it is directly related to health and disease. Tea leaves are rich in fluoride, part of which is released into the tea liquor during the tea making process. Therefore, the main objective of this study was to determine the levels of fluoride in tea liquors prepared from different grades of black Cut, Tear and Curl (CTC) tea sourced from various tea growing regions in Kenya as well as other tea producing countries in East Africa (Rwanda, Uganda andTanzania).

The fluoride levels in tea liquors (1 g of black tea + 100 ml of boiling distilled water agitated on a mechanical shaker for10 minutes) were quantified to be in the range between 0.11 and 1.35 µg/ml using a simple, reliable and cheap potentiometric method by a Fluoride Ion Selective Electrode (FISE). These results confirm that tea consumption is indeed an important dietary source of fluoride. Also, these data demonstrate regional variations in the fluoride contents as tea liquors of the black CTC tea samples from different regions varied widely in terms of their fluoride contents.

Analysis of Comparative Advantage of EAC Countries in Coffee Export: What can Burundi learn from them?

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Coffee is a major contributor in the economy of EAC members. However, in the recent periods, the crop exports have declined due to internal and external forces of both supply and demand sides. This paper aims at shedding light on the degree of EAC's comparative advantage in this cash crop in the third market, with a special focus on Burundi whose green coffee export is a backbone of its total exports (75%). The study is based on proposition of trade theory that the patterns of international trade are determined by comparative advantage. An improved normalized comparative advantage index, NRCA, developed by Yu *et al.* (2009) is used on data of coffee exports, SITC3 4-digit, for the period 1980-2010. In order to carry out a dynamic comparative analysis, we use a time trend regression model to detect whether a country has gained or lost its comparative advantage during the period under study. Empirical results reveal that both EAC countries had a certain comparative advantage, Uganda and Kenya coming on top. However, they exhibit a loss of competitiveness in the world market during the period under study but at different level. The study suggests that if the countries of EAC, specifically Burundi, want to strengthen their position in the coffee global market, they have to tackle coffee price volatility and show a will to revamp the coffee industry whose production has been on a declining trend.

Kenyan Purple Tea Anthocyanins Ability Cross the Blood Brain Barrier Reinforcing Brain Antioxidant Capacity in Mice

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Studies on antioxidants as neuroprotective agents have been hampered by the impermeability of the blood brain barrier (BBB) to many compounds. However, previous studies have shown that a group of tea flavonoids, the catechins are brain permeable and neuroprotective. Despite this remarkable observation, there exists no data on the bioavailability and pharmacological benefits of tea anthocyanins (ACNs) in the brain tissue. This study investigated the ability of Kenyan purple tea ACNs to cross the BBB and boost the brain antioxidant capacity. Mice were orally administered with purified and characterized Kenyan purple tea ACNs or a combination of Kenyan purple tea ACN's and coenzyme-Q_{10} at a dose of 200mg/kg body weight in an experiment that lasted for 15 days. Twenty four hours post the last dosage of antioxidants; CO_2 was used to euthanize the mice after which the brain was excised used for various biochemical analyses. Brain extracts were analyzed by HPLC for ACNs metabolites and spectrophotometry for cellular glutathione (GSH). Kenyan purple tea anthocyanins significantly (p<0.05) raised brain GSH levels implying boost in brain antioxidant capacity. However, co-administration of both antioxidants caused a reduction of these beneficial effects implying a negative interaction. Notably, ACN metabolites were detected in brain tissue of ACN fed mice. Our results constitute the first demonstration that Kenyan purple tea ACNs can cross the BBB reinforcing the brain's antioxidant capacity. Hence the need to study them as suitable candidates for dietary supplements that could support antioxidant capacity in the brain and have potential to provide neuroprotection in neurodegenerative conditions.

The Status of Adulteration, Microbial Quality and Safety of Raw Milk in Mwanza City

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A study on the status of adulteration, microbial quality and safety of raw milk produced by farmers and milk obtained from vendors was carried out in Ilemela and Nyamagana districts of Mwanza. Thirty two (32) milk samples from farmers and twenty six (26) milk samples from vendors were collected and subjected to Lactometer test, California mastitis test (CMT), Brucellosis-Milk Ring test (MRT) and Microbial load analysis.

Through on-site observations at the farms data on animal, environmental and management factors that are likely to affect milk quality and safety were also collected for each cow. Samples which were positive to CMT were then screened for microbial load contamination of which Coliform, Staphylococcus and Proteus bacteria species were observed at varying counts. SPSS and SAS computer packages were used in data analysis. Across the study area respective percentage of samples that were adulterated, CMT positive and MRT positive were 28.1 %, 65.6% and 3.1%, respectively. Coliform bacteria recorded the highest percentage occurrence (37.5%) in isolates followed by Staphylococcus (18.8%) and Proteus recorded the lowest percentage occurrence (15.6%). Therefore the milk had risks of infection to consumers with Brucellosis, Food-borne illness and the frequency of adulteration with water. The results suggested for considerable contamination of milk from human and dung. However, mastitis level in milk was observed to be more strongly correlated to breed (r<0.001) than house and management variables. The quality and safety of milk produced and traded in Mwanza city therefore cannot be assured, therefore more efforts are needed in improving quality and safety of milk.

Development of a low-cost extruder for enhancing sorghum grain value-addition

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Extrusion cooking is a continuous process by which moistened, expansile, starchy, and/or proteinaceous materials are plasticized and cooked by a combination of moisture, pressure, temperature, and mechanical shear. This technology is commercially used to make a wide variety of snack-type and ready-to-eat foods from cereals grains. This

paper discusses the results of a study whose objective was to develop a low-cost extrusion technology from a oil-seed mill and to determine the quality and organoleptic properties for both extruded and un-extruded flours, porridges and soups.

The flours were evaluated for colour, fineness and flowability. The porridge samples were evaluated for taste, aroma, colour, mouth feel, consistency and overall acceptability. Extruded composite flours performed relatively well as far as colour, fineness and flowability were concerned. The paper concludes that value-added, nutritious sorghum-based foods with good consumer acceptability can be produced successfully by extrusion cooking from locally available cereals using a modified oil-seed mill as a low-cost extruder and that there is a huge potential for commercialization of value-added, sorghum-based foods exists for improved food and nutritional security.

Socio-economic factors affecting consumer behaviour and preference for farmed and wild fish around Lake Victoria basin, Tanzania

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The decline in fish stock in Lake Victoria has resulted into increased promotion of fish farming within the basin, with the aim of supplementing fish production. However, little is known about marketing information particularly on consumers' preference on farmed fish. This study, therefore presents the consumer behaviour and preference on farmed and wild fish within the basin. The study used data collected during market potential and consumer preference on farmed fish survey conducted in 2012. Statistically, the quantitative data were analysed by using categorical regression model. Results revealed that consumer behaviour and preference on fish around the Lake Victoria in Tanzanian part of the basin is significantly affected by socio-economic factors which include age, sex, education, marital status and place of the residence. In addition, while in most world markets, female consumers are reported to be more conscious in food choice and quality, around Lake Victoria basin male consumers were more sensitive than female consumers in reasons for choosing fish as food for their families and fish quality issues. These findings form the basis from which the market for farmed fish can be promoted in order to address protein deficiency problems around the basin.

Poster Presentations

Youth Engagement in Agriculture in Uganda: Challenges and Prospects

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The Ugandan population is to a large extent comprised of a high and increasing cohort of young people, close to 78 percent of the population is below the age of thirty. Evidence reveals that youth engagement in agriculture is declining amidst rising youth unemployment yet the services and industrial sectors despite growing at considerably faster rates have not created enough jobs for the burgeoning youthful labour force. This may have implications on food security, unemployment, and underemployment and may undermine the government efforts to drive economic growth through agriculture. Using data from the Uganda National Panel Survey data of 2005/6 and 2009/10, we examine youth employment dynamics across the different sectors and further provide insights into the determinants of youth participation in agriculture. Using the Uganda Census of Agriculture 2008/09, we further document the challenges and constraints inherent to the youth in agricultural production in relative to adults.

The findings reveal that youthful farmers are concentrated more at the production stage of the agricultural value chain. Their presence at the collection, storage, transportation, marketing and processing nodes of the agricultural value chains remains limited. Furthermore, a relatively lower percentage of youth use improved inputs. With this poor rate of adoption of appropriate inputs, productivity is likely to remain low and constrain the youth to subsistence farming. Furthermore, the youth are disenfranchised in the ownership and management of critical assets in agricultural production, especially land. Land tenure issues continue to impede many youths from engaging in agriculture, with the majority of youth using land without exclusive ownership rights. In addition, the results point to the fact that the youth are less likely to access credit, extension services and social capital (farmer group membership), all key factors in agricultural transformation. The in-depth analysis results seem to suggest that the youth with at least secondary education, males (both married and unmarried) and those youth residing in households with a large share of adults are less likely to engage in agriculture. For the youth to be gainfully employed in the agriculture sector and its entire value chain, the study proposes that they should be targeted depending on their aspirations and resource accessibility. *For the on farm youth: Promote youth groups/farmer associations for* the youth to be able to access, agricultural extension and advisory services, financial services and agricultural inputs and for ease of marketing their produce. *For the off farm youth: Build/support youth entrepreneurs for agribusiness,*Input markets storage and processing, and produce marketing can offer new employment opportunities for the youth who are currently exiting farming.

Non-tariff barriers in the tea trade and consumer safety: Selected heavy metals in CTC black tea

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Heavy metals, in addition to being associated with the etiology of a number of diseases have been listed as non-tariff trade barrier to the tea trade. Therefore, accurate quantitation of levels of certain elements in tea is of great importance because of the associated health and economic implications. In this study, levels of Iron (Fe), Zinc (Zn), Copper (Cu), lead (Pb) and Cadmium (Cd) in tea grown and marketed in Kenya were quantified by Flame Atomic Absorption Spectroscopy (FAAS). In unprocessed tea, the levels were found to range between 54.6 and 123.3 µg/g for Fe, 15.4 and 37.5 µg/g for Zn, 10.3 and 14.8 µg/g for Cu, 0.12 and 0.28 µg/g for Pb and 10.0 and 27.1 µg/kg for Cd whereas in black tea, the levels ranged between 81 and 369 µg/g for Fe, 17.1 and 44.9 µg/g for Zn, 9.0 and 17.8 µg/g for Cu, 0.12 and 0.41 µg/g for Pb and 9.1

and 40.0 µg/kg for Cd. The general accumulation pattern of these elements was established to be Fe > Zn > Cu > Pb > Cd in both unprocessed and black tea. All tea samples had metal contents within the Maximum Permissible Concentrations (MPC) set for tea, hence safe for consumption.

Linkages between rising food prices & Food Security in the Bugisu sub-region of Eastern Uganda

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High and fluctuating food prices have been widely studied by bodies like IFAD, FAO, ASARECA, and Government of Uganda. Stakeholders view high food prices differently, some saying farmers gain and others saying it's bad for food security. This study was conducted to establish linkages between high food prices and food security in three districts, Sironko, Mbale, and Manafwa in Bugisu sub-region in Eastern Uganda in April 2013. Data was collected from 9 Focus Group Discussions (FGDs), 15 Key Informant Interviews and secondary information from published statistical data sources. Data showed that whereas in the past, farmers' choices of crops grown (maize and beans) was driven by factors like low coffee prices and BXW, currently, high prices and ready market for maize and beans are key drivers for wholesale abandonment of traditional crops (bananas and coffee) grown in the sub-region. The study also found that ready market has not led to balanced trade. Regression analyses showed that the same trend is followed yearly whereby resource poor farmers sell produce cheaply after harvesting (beans <US$ 0.32) yet the price rises three months later (beans >US$ 0.88) implying that rich middlemen are still major beneficiaries. High food prices are a Food Security threat because of the attraction to sell almost all the produce to fund immediate cash needs. The abandonment of traditional perennial food crops like matooke implies that farmers now experience lean periods when they have to buy expensive foods like rice, maize meal and beans. Interventions like cheap agricultural loans using stored produce as collateral can help. FGDs revealed that interventions like a revamped Bugisu Co-operative Union can improve incomes as observed with coffee farmers. By-laws promoting food security crops are needed. Easy access to relevant information like http://www.eafpdp.org/ needed. Need Public-Private Partnerships to setup warehouses to even out trade imbalances.

The Role of Rural Markets in Servicing the Bean Seed Sub-sector in Uganda

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Agricultural markets are a key vehicle for improving the farm-level supply of seeds and the crop genetic diversity that they embody (Leslie *et al.* 2010). Participation in agricultural markets increases the returns to agricultural production and offers a pathway out of poverty (Ibid). Common bean in Uganda is grown by over one million households in a growing season (UBOS, 2010) on average areas of 0.1-0.5Ha (Soniia*et al.*, 2000) and spread everywhere in the country. Beans provide the second most important source of protein after maize and the third most important source of calories after maize and cassava (Pachico, 1993). Even with its importance, the crop does not have a fully developed formal seed sector to service it. The interest of private sectors progressively growing especially for seed relief, though traditionally they have been avoiding marketing self-pollinated crop seeds like beans due to competition from farm-saved seeds. Private companies also rarely market seeds in remote areas because farmers can't afford improved and certified seeds (David and Kasozi, 1999). This scenario has resulted in the bean grain market supporting the seed market.

A study was carried out in eight districts of Uganda to establish farmers' participation and marketing of beans, their sources of bean seed, and the constraints they faced in accessing bean seed and in marketing beans. Data was collected from respondents using a standard pretested questionnaire and analyzed using SPSS. From the study, 61.3% of the farmers acquired their startup bean seed from local markets and subsequently used home saved seed (53%). In terms of market participation, 86.7% of the farmers marketed their beans and on average sold 42.7% of their harvests. Farmers mostly supplied beans at farm gate level but significant proportions also supplied to rural and Urban Markets; mostly to retailers, wholesalers and mobile buyers.

Determinants of local pearl millet demand in Tanzania: A Case of Singida and Kishapu Districts

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Pearl millet is among of the crops which are performing well in central and Lake Zone of Tanzania and the majority of the residence in the areas depends on pearl millet for improving their income and food security. Despite of its relative benefits mentioned, the crop demand is low which is mainly contributed by the inferiority of the crop. This study opts to find out what could be done to increase demand for pearl millet by looking at the factors that influence demand.This study was carried out in Singida rural and Kishapu districts in Tanzania. Purposive sampling was used to select villages and simple random sampling was used to select consumers, traders and processors.

Data from 426 respondents were collected from which farmers were 224, 85 consumers, 76 traders and 41 processors. Primary and secondary data were collected; both descriptive and quantitative analytical tools were used to analyze the data. The demand model was used to determine the factors influencing demand from different actors. The findings show that, consumption for pearl millet by consumers is influenced by education level of the household head, income, pearl millet price and household location.

Whereas, demand for food processors is influenced by price and quality of pearl milletand for the feed processors the demand is influenced by price, quality of pearl milletand consumer demand. For improving pearl millet consumption, education strategy for the importance of pearl millet as food and feed is needed. Moreover, policies to improve consumption of pearl millet should be developed including the government to recognize pearl millet as a viable crop alternative.

Point of sale recognition of porcine Taeniasoliumcysticercosis in Gisagara district, Southern Province, Rwanda

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This study was conducted among small holder pig farmers in Kansi and Nyanza sectors, Gisagara district, Southern Province of Rwanda between April and June 2013. The main aim was to assess farmers' knowledge on porcine taeniasis and the techniques local farmers and traders use to identify *T. soliumcysticerci* in pigs before buying for rearing or sale for slaughter. Contrary to the belief that the rural farmers may not know how to diagnose *T. solium* cystsin live pigs, 51/75 farmers (68%) interviewed in both sectors described in detail how taeniasis locally known as *ruche* is detected by tongue examination. On examination of pigs in additional exercise of bleeding for validation of the novel lateral flow assay diagnostic kit and Ag-ELISA, 13/73pigs (18%) had visible tongue cysts; all the 13 infected pigs were identified by local farmers and confirmed by our team. Although the technique of detection of *ruche*-infected pigs is well known to farmers, the disease is still prevalent in locally raised pigs in the two sectors. These preliminary results from an ongoing study indicate a need for better understanding of the epidemiology and risk factors for both porcine cysticercosis and possible neurocysticercosis in humans living in Gisagara district.

Common Bean Value Chain Analysis and Development for Improved Livelihoods in the Central Highlands of Kenya

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Majority of the rural population in Sub-Saharan Africa (SSA) and Kenya in particular derive their livelihoods from agriculture. Common beans are the most important legume crop in Kenya and present a potential rural poverty exit strategy. However, several constraints curtail this potential. Key among the constraints facing this sub-sector are disorganized markets characterized by limited opportunities due to inexistent or poorly developed market infrastructure, geographical remoteness and lack of effective farmer-based marketing groups.. The objective of this study was to carry out value chain analysis of dry beans sub sector in order to determine an upgrading strategy. The study focused on mapping the key value chain actors, market opportunities, constraints, opportunities, relationships and linkages and the findings used to develop an intervention strategy. Data was collected using semi structured interview schedules and checklists from stakeholders who included farmers, wholesalers, retailers, assemblers, agro input dealers and producers. Results showed that the cost of input and transportation were some of the factors limiting beans production. The most commonly used inputs for beans production were seeds and fertilizers. Farmers did minimal processing before marketing. These included threshing, drying, sorting, grading, dusting, and packing. Most farmers did not sell beans due to low production. A few farmers sold to national market, while some sold individually to the wholesalers in bulk and at a high price. A major recommendation emanating from this study is that there is need to build more capacity for all the actors in the beans value chain so as to stimulate the flow of the commodity along the value chain.

SESSION 2: CLIMATE SMART AGRICULTURE INNOVATION

Oral Presentations

Farmers' perception, psychological determinants of climate change adaptation and adaptation strategies in East Africa.

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Climate change is one of the major challenges facing smallholder crop and livestock farmers in Uganda. A study was therefore conducted in Masaka and Ngora districts of Uganda to identify climate change adaptation strategies used by farmers and psycho-social determinants for adapting to climate change strategies. Focus group discussions and a semi-structured questionnaire administered to 80 farmers who included implementers and non-implementers of adaptation strategies were used to collect data. The Logistic regression model in Stata software was used to identify the psycho-social determinants of climate change adaptation strategies. The study results showed that 86.7% (n=40) of the respondents in Masaka observed a change in climate in terms of decreased rainfall and increased temperature over the last 25 years. On the other hand, majority of respondents (66.7%, n=40) in Ngora district reported a change in climate in terms of an increase in the amount of the rainfall received while 33.3% reported a decrease in the amount of rainfall. About 75% (n=80) of the respondents in both study areas reported a late start of the first rainfall season (expected to be March-June) while 62% reported a late start in the second rainfall season (expected to be September- December). The major adaptation strategies in both districts are soil fertility management (42.5%), water harvesting and drip irrigation (64.5%), soil and water conservation (20%) and use of drought tolerant fodder crops such as Elephant grass (100%). The major psycho-social determinants for adapting to climate change strategies in both districts are: information channels (66%), societal beliefs (56%), level of climate change information possessed by the farmer (26.9%) and existence of agricultural extension services (50%). It is recommended that government policies and projects aiming at implementing adaptation strategies among farmers should consider psycho-social factors prior to their execution of the projects.

Advancing response farming for improved strategic and tactical agronomic management of seasonal rainfall variability

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Farmers in the semi-arid areas recognize climatic risks. Dry land farmers are interested to know in advance, when the rains will become fairly continuous and become sufficient to ensure enough moisture in the soil at the time of planting (the onset of rains). Farmers are also interested to know whether or not this level will be maintained or even increased as the season advances. Unfortunately, field application of climate forecasts by smallholder farmers in Arica remains a challenge owing to lack of adequate information on their reliability and usefulness, spatial inexplicitness, uncertainty of the value and impact of forecast information in multi-variable decision system, and difficulty of interpretation. Response farming management approach enables forecast of season potential. RF utilizes the date of onset as a predictor of season length. Thus, the assessment of the next season's potential is founded on and known at the date of onset of the season. Thus, the development of predictive model for the date of onset is absolutely necessary. Such ability to predict the potential of the pending season can lead to use of yield-improving technologies. A study was conducted on two high-risk agricultural systems in the semi-arid Central Rift Valley (CRV) of Ethiopia with aim to advance strategic planning and improve tactical aspects of response farming (RF). Through effective rainfall analyses and simulation modelling techniques, April 1 to mid-July were found to be risk-wise acceptable dates of onset for which predictive capacity are required. Evaluation of these dates conducted tracking a 150, 120 and 90 day maize varieties along a spectrum of long-term daily weather sequences with reference to seasonal water supplies and season duration revealed a flexible combination system of producing 150-day in early, a medium 120-day in median and 90-day maize in late seasons to be good-looking as compared to a win or lose fixed strategy of growing 90 day maize every year. Pre-onset rainfall parameters that effectively signal the dates of onset and season length at a lead time of three months were determined. Key findings of practical value to dry land farmer are that each day the first effective rain date is delayed, onset date and season duration is foreshortened by over half day. The date of onset was proven to be the best predictor of season duration, whereas in-season rain was found to be the best predictor of total season water supplies (TSW). Moreover, the date of onset was found to be good indicator for expected TSW. Each day the date of onset is delayed beyond April 1, TSW decreases by 1.8 mm to 2.8 mm. Rainfall experiments revealed cumulative early season rainfall (20 to 60 days) to be the best predictors of early, mid and late season rainfall. On farm evaluation of the predictors revealed an increase inmaize grain yield by more than 70%. It is recommended that all agronomic decisions should be organized based on the first effective rain date and the date of onset.

Effectiveness of Technological Options for Minimizing Production Risks under Variable Climatic Conditions in Eastern Uganda

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Climate variability is among the major risk factors affecting agricultural production and food security of smallholder farm households in Sub Saharan Africa (SSA). An increasing body of observations has emphasized the importance of managing climate risk to the optimization of crop and land management technologies. However, previous studies have tended to focus on the effects of predicted increases in average values of climate variables on average crop yields. Inference based on the mean alone can be misleading if the variance around the mean, and hence the probability distribution of the risk is not known. This study addresses this gap by providing evidence of the effects of technologies on both the mean and variance of crop production. Data for this study was obtained from 353 households nine Focus Groups and 23 Key Informant drawn from three sample districts of Mbale, Pallisa and Sironko. Data was analysed using both descriptive and econometric analyses, with the descriptive statistics involving multi-variate analysis and paired *t*-tests for hypothesis testing. The Just and Pope Stochastic framework was used to assess the risk effects of various farmer preferred adaptation technologies, while controlling for climate, household and plot level characteristics that would otherwise condition crop yield. Empirical evidence shows that farmer-preferred technologies have varying effects on the mean and variance of crop yield depending on the location, explained by rainfall variability and biophysical characteristics. Changing sowing dates and crop varieties, compost manure use, cover crops, crop rotation, intercropping and soil bunds generally showed risk reducing effects, while changing crop density and mulching showed significant risk increasing effects. Considering that risk effects of technologies are location specific, policy makers and planners should develop more localized adaptation policy frameworks instead of common state level policies. This should be guided by location-specific assessment of technology effects.

The adaptive and copping strategies of pastoralists to droughts in Uganda

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The resilience of pastoral production systems to the adverse effects of droughts is a function of the nature and suitability of the various adaptive and coping strategies undertaken by households in dryland ecosystems. The current study sought to understand how herders plan and respond to increased occurrence and severity of droughts in the rangelands of Buliisa and Nakasongola in Uganda. Specifically, the study sought to understand the level of utilization of weather forecast information, level of water, livestock and forage resources monitoring, mechanisms of herd management and feed conservation as well as policy factors limiting farmers' response to droughts. Pre-tested semi-structured questionnaires were administered to 104 respondents randomly selected following systematic random sampling procedures. Farmers' responses were used to compute percentages, generate graphs and charts using XLSTAT (2013). The study revealed that 77 and 89% of the respondents in Buliisa and Nakasongola Districts respectively utilized weather forecast information in planning animal management activities. However, 52 and 63% of the respondents that utilized weather forecast

information in Buliisa and Nakasongola respectively noted that the information is usually unreliable translating into huge economic losses. The study also indicated that despite the increased occurrence and severity of droughts, majority of households in Buliisa (59.7%) and Nakasongola (72.4%) did not practice any specific adaptive and coping measures. However, the few households that executed drought coping interventions noted that migration of animals towards permanent water sources and grazing reserves (18%), selling of animals (16%) and herd spliting (5.%) were the common drought coping strategies undertaken by households. Feed conservation was only reported in Nakasongola District with only 21% of the households conserving feeds inform of standing (60%) and baled (40%) hay. Inadequate knowledge on feed conservation and destruction of hay by subterranean termites were noted as the key limitations to feed consrvation. The study is indicative that the adaptive capacities and resilience of pastoral production systems in the two districts to the adverse effects of climate change is still low with only few hoseholds undertaking specific adptive and coping strategies.

Land use and cover changes in pastoral systems of Uganda: implications on livestock management under drought induced pasture and water scarcity

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The rangelands of Uganda were historically managed under traditional systems where grazers had open access to resources and with mobility a main coping strategy to drought. However, changes in land ownership, increases in human population and increased demand for food and fuel have led to changes in land use and cover types that consequently affect livestock management practices. This study was established to assess the extent of land use and cover change in Buliisa and Nakasongola Districts over a period of 27 years (1986 – 2013) and their impacts on livestock management under drought induced pasture and water scarcity. Landsat TM (1986) and ETM+ (2000 and 2013) images were obtained and processed using a hybrid of supervised and unsupervised classification algorithm using ENV1 software version 4.7. Area covered by open water and grassland declined by 3.5 and 48.3% while woodland, wetland, small scale farming and tropical forest increased by 0.2, 62.2, 320.7 and 64.1% respectively in Buliisa between 1986 and 2013. In Nakasongola, grassland, bushland and forest decreased by 96.1, 25.6 and 17.2% while open water, bare ground, wetland, and small scale farming increased by 5.3, 210.9, 2.7 and 26.8% respectively between 1986 and 2013.

The individualization of land in Nakasongola led to settlement of cultivators and fencing of land leading to blockage of livestock migration routes. The reduced mobility of livestock during drought periods, increased stock densities in specific locations and consequently caused land degradation with big expanses of bare land in Nakasongola as compared to Buliisa where communal land ownership and limited cultivation prevail and enable mobility. The current land use and cover changes in pastoral communities have delineated mobility as a coping strategy to drought, have contributed to degradation of rangelands, reduced the resilience of pastoral systems to drought and increased their vulnerability to climate change. Farm based water and forage conservation practices should therefore be implemented if livestock production is to be sustained in pastoral communities.

Experiences in up-scaling of integrated soil fertility management(ISFM) in East Africa

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Declining soil fertility is a major constraint to agricultural productivity in Sub Saharan Africa (SSA). Uptake of improved technologies is still limited due to inadequate capacity, socio-economic factors, among others. This paper presents experiences gained from up-scaling proven ISFM and value addition technologies, which could be relevant to the entire SSA.
Using a combination of participatory approaches like joint planning and learning/trainings, farmer field schools, mother-baby demonstrations, innovation platforms (IPs) and group strengthening, the project reachedover 4,000 participantswithin6-months,anddemonstrated 48 ISFM and 22 value addition technologies for groundnuts, banana, maize, beans, green gram and honey. Farmers' training in marketing information access and group marketing resulted intoestablishment of market information boards and marketing committees to bargain for better marketing options. A conceptual framework was developed illustrating the role of IPs in improving access to marketing information and profitable markets for higher income and consequently, re-investment in ISFM.

Impacts of Temporal and Spatial Climate variability and Trends in the Agricultural Systems of the Semi-arid Central Rift Valley of Ethiopia

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In semi-arid Central Rift Valley of Ethiopia in general and East Shewa zone in particular, agriculture interfaces with extreme temporal and spatial variability of climate factors. Rainfall variability poses significant challenge to crop production and productivity. In this paper, we present a study of spatiotemporal variability of rainfall in the .Central Rift Valley of Ethiopia. The result shows high intra seasonal variability of

rainfall behaviors such as onset and cessation dates of rainy seasons, length of rainy period, and rainfall amounts in all study sites. Similarly, high spatial rainfall variability has been observed in these areas especially in the recent years. Such spatiotemporal rainfall variability enhances the reduction of water availability for crop production in all study sites. The impact of rainfall variability on crop production can become even stronger than ever and will be severer particularly for long maturing crop varieties due to interruption of photosynthetic processes at various growth stages. Therefore, in order to reduce the impacts of spatiotemporal variability of rainfall, application of rainfall prediction based on flexible farming practices like response farming is crucial. Such forecast-led agronomics can aid key risk management decisions to be organised in a multi-staged decision array: first strategically using pre-season predictors, and second tactically according to what forecasted date of onset informs us. Field validation and calibration of the predictors' performance and further research to sharpen the predictions and possibly advance time of prediction through study of periodicity of rainfall are required. Furthermore, development of a framework for communication of localized agronomic forecast is a crucial to reach vulnerable communities with improved adaptation knowledge so that they can make sound strategic and tactical agronomic decisions. This way vulnerable rural populace may be able to capitalize on yield opportunities in good rainfall seasons and cut failure in bad seasons, and adapt to current climate variability and future climate change.

Chlorophyll as a proxy indicator of nitrogen management for potato production in the highlands of east Africa

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Potato is a major crop in the Kenya with it production being in the highlands. The production area is increasing as a result of people stopping growing of other crops and opting for potatoes. The production per area is however lower than what is expected due to several challenges, one among them being the poor fertilizer management. A survey conducted to find the fertilizer use and crop nitrogen status indicated that 78% of farmers use fertilizer and 90% of those using the fertilizer applied below the recommended rate of 90 kg of nitrogen (N) per ha. However the leaf samples from the farmers field indicated only 42% of farms were below the 4.5% N level in the leaves which means lower yields at harvest.

The differences could be explained by the use of foliar fertilizers and also adequate nitrogen level as indicated by the soil analysis from the same farms. A split-plot experiment has been conducted at the University of Nairobi Kabete Campus farm using Asante and Tigoni potato varieties with three NPK (17:17:17) fertilizer levels (45, 90, 135 N kg/ha) and a control with no fertilizer application.

The aim of the experiment is to relate the potato shoot nitrogen concentration to the chlorophyll meter (SPAD) reading. Correlation between total nitrogen and the SPAD index was 0.61 while a probability of <0.001 for the means of the above ground dry matter at 0.05 significance level. A linear relationship between shoot nitrogen content and the SPAD index was established for the two seasons with r2 of 0.45 and 0.51 respectively. The correlation between total nitrogen and SPAD reading means that extension can use the instrument to advice farmers on fertilizer management.

Managing Rainfall Variability in Arid Rain-fed Agriculture Using Adaptive Varieties and In-suit Water Harvesting

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Rainfall variability is one of challenges that affect farmers under traditional and vulnerable rain-fed agricultural systems in Sudan. One of the major effects on average Sorghum yield is the length of the growth season. The objective of this investigation was to establish the water harvesting technique for adaptation to rainfall variability in rain-fed sorghum production and relate it to yield in Gedarif area. A field experiment was conducted for two successive seasons (2009 and 2010). A factorial design was used to test the hypothesis that the crop yield was affected by three methods of sowing representing in-situ water harvesting techniques: wide level disc; in rows 80 cm apart using row planter; and at bottom of ridges 80 cm. Three sorghum varieties were used, Arfa Gadamak8, Wad Ahmed and Bashaer. Nitrogen fertilizer of zero and 0.5N in the form of Urea was applied. In season 2009, there was a significant difference between mean of yield of Arfa_Gadamak8 and Wad-Ahmed varieties when not taking the impact of the deficit into account the difference between varieties attributed to the fact that Wad Ahmed variety requires longer season to mature. Also, there wasn't significant difference between two rates of fertilizer. Analysis of variance for method of sowing showed that there was significant difference among the three methods of sowing. Water harvesting technique has increased the yield this may attributed to the sowing in the bottom of ridge (in situ water harvesting) increased soil moisture content. There was correlation between rainfall and grain per head, head weight and length of head. Thus any climate change adaptation strategy for rain fed agriculture under low rainfall areas should consider the combination of short maturing variety (e,g, Arfa-Gadamak8 variety) and in-situ water harvesting techniques.

Scaling up of the ISFM technologies on improved bio-fortified bean production in Rwanda

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Scaling up the ISFM for Improved livelihoods remains a crucial key to improve livelihood in Rwanda. This study aimed to promote the use of input technologies for improved production of bio-fortified bush (RWR2245) and climbing (MARC44) beans and assess the level of acceptability of new technologies by farmers. On-farm demonstration trials were installed in two agroecological zones of Rwanda namely central plateau and Bugesera. In each zone two sub-sites were selected. Sites selection criteria used are the proximity of the market as well as micro-climate differences. In Bugesera agro-ecological zone we selected Gashora and Mareba sectors and in Central Plateau Runda and Kayenzi were used for demonstration. The treatments under evaluation where NPK, rhizobium or the combination of rhizobium and inorganic fertilizer. The results revealed that Climbing and Bush beans grain yield and dry matter were higher in the

treatments combined NPK and Rhizobium and averaged 1.5 ton ha^{-1} compared to 0.8 for the farmer's practices, the use of rhizobium alone yielded 1.2 tons ha^{-1}. In addition, rhizobium application has significantly increased grain yield ($p<0.05$). Ninety percent of farmers appreciated the use of rhizobium as it is low cost and effective technology. Farmers were excited with improved bush bean variety as they grew faster and had many pods per plant. However, climbing beans could not perform very well due to shortage of rain toward the end of season. Gashora sites compared to others had higher grain yield averaging 1.8t ha^{-1} for both climbing and bush beans. Although the rainfall pattern was not favorable, the use of improved seeds and fertilizer application was positively perceived by farmers and they are ready to continue to use the ISFM technology. However, there is a need more effort to demonstrate that climbing beans can yield more than Bush bean in good rainfall season.

Farmers' perception of land degradation and sustainable land management measures in Western Usambara Highlands of Tanzania

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A study was conducted in the West Usambara highlands, Lushoto district, northeastern Tanzania to assess the perception of farmers on land degradation and sustainable land management (SLM) measures. The study involved two villages and 176 farmers. Participatory approaches were used to generate the data. Resource inspections and soil testing were employed to verify farmers' perceptions and T-tests were used to analyze farmers' perceptions. Results indicate that, farmers are aware of land degradation problem and its causes in their surroundings. Their perceptions of land degradation and SLM compliment the current scientific thinking. There are significant differences in soil and crop conditions across the two villages however, in each village, only 5 percent of farmers were estimated as good SLM managers. The SLM measures were found to be of comparable composition ($p<0.05$). These results imply that service providers (extension services) in the District can device similar interventions for both communities to combat land degradation. The study concludes that for effective engagement against land degradation, biophysical issues related to irrigation water, land quality, location and distance of farms, effectiveness of measures advocated for improving quality of environment and food security should be considered together with providing farmers with soil conservation knowledge.

Observed and Future Climate Variability and Extremes over East Showa Zone, Ethiopia

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This study has been conducted with the aim to analyze variability and extremes of daily values of precipitation, maximum and minimum temperature. The future projected data set is downscaled for three future periods and for the two scenarios (A2 and B1) using delta method approach from CMIP3 GCMs and applied to historical station data set. Analysis of the 27 core set of extreme weather indices, which are defined by ETCCDI, is carried out on four selected sites and all the results were reported in detail. In addition comparisons in variability has made between models and values of these indices observed in the base climate period (1981-2010) and values of projected periods. In the case of base period precipitation, total precipitation over Modjo station showed significant increase (12.1mm/year). However on the reverse, a significant decrease (3mm/year) in R95pTOT was observed at Wonji station. On the other hand the downscaled data showed no significant change in either of the indices observed in the period at Modjo. Yet consecutive dry days would rather increase significantly at Melkassa and Wonji (0.5day/year each) in all GCMs and in both scenarios. In terms of temperature, during the base period, summer days showed significant increase of 2.6 days per year at Ziway and a relatively lower increase of about a day per year at Melkassa and Modjo. The result was accompanied by significant increase in warm day-times and significant decrease in cold day-times. Yet, future projections showed no significant trend in terms of summer days, warm day-times and cold day-times. Similarly, cold nights would show significant increase at Adama (0.5 day/year) and Melkassa (1.1 day/year) in all GCMs and both scenarios. In this paper we found less difference in the results variability of extreme events between models and during different future periods.

Climate Change Vulnerability Mapping over Selected Districts in Central Rift Valley of Ethiopia

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There is growing demand among stakeholders across public and private institutions for spatially-explicit information regarding vulnerability to climate change at the local scale. The present study was conducted over 16 districts in Central Rift Valley of Ethiopia with the aim of determining the relative vulnerability of the 16 districts to climate change and thereby identifying vulnerable hotspots. Biophysical and socioeconomic indicator based integrated vulnerability assessment technique was used to map climate change vulnerabilities. Indicators were collected, generated and analyzed under three components of vulnerability: exposure, sensitivity and adaptive capacity and finally aggregated into a single vulnerability index. The values of all indicators were normalized by considering their functional relationship with vulnerability and expert judgment was used to assign weights to all indicators. Aggregate vulnerability index (VI) was finally determined from the weighted sum of all indicators and mapped over the 16 districts. We found out from aggregate vulnerability index that Selti, Dodotana Sire and Tiyodistricts are relatively highly vulnerable to climate change while Arsinegele, Adami-Tulu-Jido-Kombolcha and DugdaBora are least vulnerable. The rest of districts are under relatively medium level of vulnerability to the changing climate. This study shows that vulnerability mapping is technique is crucial in determining the varying degrees of vulnerability of different localities and generated information that can be help researchers, policy makers, private and public institutions in formulating site specific adaptation strategies and prioritizing adaptation investments

to the most vulnerable hot spots. This kind of studies should be extended to national levels to capture the vulnerabilities all districts in the country.

GIS Assessment of Climate Change Effects on Teff Production in Ethiopia: Implications for Food Security

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We investigate two methodologies on the use of Geographic Information Systems (GIS) in assessing climate change impacts on the productivity of teff. The first method examines the spatial implications of climate change on the areas suitable for teff production and the second estimates the effects of altered environments on teff's productivity. We show a non-linear relationship between suitability indices, the output of spatial analysis and teff yield data collected from diverse ecological zones, this serves as the basis for country-wide crop yield analysis for both current and future climate scenarios. With the current climatic conditions only 988,638.50 Km of Ethiopia is suitable for teff but the suitability varies country wide. In future (~2050) only 751,661.85 Km will be suitable for teff production, translating to a loss of an average 236,976.65 Km (24%) of the climatic suitable area. Suitability index (SI) and the actual crop yield data showed a strong positive correlation of 74%. The analysis showed a severe predicted drop in teff yield of 0.46 tonnes per hectare and above by the year 2050. The model confirmed future teff distribution changes and yields reductions due to climatic changes. The results show that the variability in rainfall intensity and duration makes the performance of agricultural systems in relation to long term climate trends very difficult to anticipate. This means that climatic conditions in Ethiopia directly affect the distribution and yield of teff.

Drought mitigating technologies: lessons learnt from sorghum and cowpea production in semi-arid areas of Embu County, Eastern Kenya

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Soil fertility degradation remains the major biophysical cause of declining per capita crop production on smallholder farms in Eastern Kenya highlands. A study was conducted to compare farmers' perception and biophysical data on selected water harvesting and integrated soil fertility management technologies on sorghum (*Sorghum bicolor* (L.) Moench) and cowpea (*Vigna unguiculata* L.) production in Embu County. Three hundred and seventy one smallholder farmers were invited to evaluate thirty six plots laid out in Partially Balanced Incomplete Block Design (PBIBD) replicated three times. The treatment which was ranked best overall rated as 'good' by the farmers was farmers practice with a mean score of (2.78) and yielding (3.5t/ha) under sorghum alone plus external soil amendment of 40 Kg P /ha + 20 Kg N /ha. This was closely followed by tied ridges and contour furrows overall rated as 'good' by the farmers under sorghum alone plus external soil amendment of 40 Kg P /ha + 20 Kg N /ha + manure 2.5 t/ha and 40 Kg P /ha + 40 Kg N /ha + manure 5 t/ha both with a mean score of (2.7) and yielding (3.0 t/ha) and (2.9 t/ha) respectively. Generally, all experiment controls were overall scored as 'poor' yielding as low as 0.3 t/ha to 0.6 t/ha. Therefore, integration minimal addition of organic and inorganic inputs on highly valued traditional crops with adequate rainfall under normal farmers practice in semi arid lands could be considered as an alternative option contribution to food security in Eastern Kenya.

Poster Presentations

Cage aquaculture in African lakes: management of environmental and social interactions

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Despite strong markets and adequate biophysical resources, aquaculture in sub-Saharan Africa still contributes little to fish supplies. However, although starting from a low production baseline, rapid growth is apparent in several ASARECA member states, including Kenya, Tanzania and Uganda. One sub-sector which is attracting both increasing attention from investors and concern from environmental authorities is cage aquaculture. A technology that originated in Asia and that dominates production of marine fish, cage aquaculture is becoming increasingly prevalent in African inland lakes and reservoirs. The technology allows the farming of fish in areas where land is scarce or too expensive, affording opportunities to a range of different types of investors. In order that cage aquaculture is able to generate employment, increase fish supplies and create economic development in the ASARECA region, a better understanding is needed of the range of social, economic and environmental interactions that result from different types of development. Participatory planning processes, supported where necessary by regulation and by adaptive management systems, are also needed in order to both sustain the supplies of ecosystem services and maintain environmental conditions within acceptable limits.

Current variability, observed trend and associated risk of intra-seasonal rainfall features in Adama district of Ethiopia

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Current variability and observed trend of intra-seasonal rainfall features were analyzed using weather data (1971 – 2012) taken from 5 weather stations located in Adama district of Ethiopia. We used Pierre Camberlin and Mbaye Diop, 2003 approach, principal component analysis (PCA) based on daily rainfall, to define the onset and cessation dates of a rainy season. We found that onset dates show a steady positive trend with a coefficient of determination (R^2) of 0.02. Moreover, when compared with the whole analysis period of 42 years, the districts experiences early and late onset of a rainy season over 20% the years. However, the cessation dates are less variable than the onset and also shows insignificant negative trend throughout the study period. As a result, there is a minor shrink in the length of growing season (LGS). Though there has been no significant trend in number of dry spells within the JJAS season, there is high year to year variability ranging from 5 to 17 events per season. Considering our findings and results, it's understood that there is a need to find a suitable agricultural technologies to tackle the losses and risks associated with the intra-seasonal rainfall variability and shift observed in the area.

SESSION 3: INCREASING AGRICULTURAL PRODUCTIVITY

Oral Presentations

Biochemical quality indices of sorghum genotypes from East Africa for malting and brewing

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Changing climatic conditions has led to decreased cultivation of barley hence reducing supply to the brewing industry. Sorghum has been proven to be a good alternative because it produces malts that biochemically match up to some barley genotypes. Adoption for brewing will increase sorghums agricultural productivity through market provision. Biochemical characteristics were assayed on 131 accessions to determine which is favourable for brewing. They were assayed for their total starch, amylose, amylopectin, proteins, tannins content, germination energy and capacity. Starch contents of the sorghum genotypes ranged from 22.8% to 81.2% which were comparable to barley accessions. Sorghum genotypes had an amylose content ranging from 11.5% to 30.2% while the amylopectin content ranged from 6.6% to 59.8% with a mean of 34.7% the same range as barley. Generally, amylose contents of sorghum genotypes were lower than their amylopectin contents with a ratio of 1: 2. The protein content range for the sorghum accessions was 3% to 18%, while that of barley was from 7.7 to 9.8%. The appropriate range of proteins for brewing is 6 to 10%. Sorghum tannin contents ranged from 2.55 mg/100 ml to as high as 100 mg/100 ml with a mean of 31.6 mg/100 ml. This was the main limiting factor in the sorghum accessions. Germination energy and capacity for sorghum ranged from 82.9% to 99.8%, and 74.0% to 99.5% respectively. The barley genotypes had high germination energy and capacity greater than 98% as some of the sorghum accessions. To produce good malt, the above variables are needed in certain quantities in the grain before malting. Results from this study demonstrate that SDSA 1 X ICSR 43 and SP 993520-1 had the qualities required for malting and can be good substitute for barley in the beer industry, and this was confirmed by East African Breweries Limited.

Genetic Diversity of Sorghum from African Countries Using SSR Markers

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Sorghum [Sorghum bicolor (L.) Moench] plays a very important role both as a source of food and income in Africa. Due to the crop's economic importance the development of high yielding cultivars is now recognized as an important initiative. Sorghum breeding however has been constrained by lack of vital information on genetic diversity of cultivated accessions which would otherwise guide in the choice of heterotic parents and is important for effective breeding, maintenance and conservation. We therefore characterized 136 sorghum accessions collected from Africa for evaluation using thirty SSR markers. The number of alleles per microsatellite locus ranged between 2 to 22, with a total of 259 different alleles, while Polymorphism Information Content (PIC) for all the accessions was 0.55. Expected heterozygosity of population ranged between 2.91 for Sudan and 1.58 for Central Africa. Genetic identity of the populations ranged from 0.36 Central Africa and Northern Africa to 0.93 between Eastern Africa and Rwanda. AMOVA revealed that 75% of the variation was partitioned into within individual populations with only 25% partitioned among populations. We established that sorghum accessions clustered based on geographical regions and that genetic identity was high between Rwanda and East Africa populations either due to continuous exchange of genes or no intense selection processes. Our study recommends that Sudan and Kenya populations be conserved because of high diversity and high level of unique alleles respectively and that Rwanda, IS 11909 and IS 11162 accessions are very disparate hence potential in breeding heterotic varieties. Also strategies for conservation should focus on a few populations covering wide geographic amplitude. A future study to tag these markers with important agronomic traits is warranted.

Towards improving the contribution of aquaculture to food security and incomes in the East African region: highlights of ASARECA Aquaculture Project outputs

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As fish supply declines and the fish-supply demand gap widens due to increasing demand among the East African countries, aquaculture has been expected to grow and meet the demand gap. This has not been realized because of the persistently low aquaculture productivity and profitability among the majority of small to medium scale producers in the region. This has not encouraged sufficient investments into the sub-sector. However, recent initiatives supported by the Association for strengthening Agricultural Research in Eastern and Central Africa (ASARECA) as a regional project carried out within the three East African countries of Kenya, Tanzania and Uganda has made a significant contribution to the development of commercial aquaculture in the entire region. A series of research outputs obtained from this project provide answers for increased aquaculture

productivity and profitability which, if widely adopted, will encouragement investments that will result in the development of the sub-sector. The selection of appropriate broodstocks and larval feeds has significantly improved fish hatchery productivity and profitability. Research work on cages and tanks provide the optimum stocking densities of these systems that give higher yields and will guide faster adoption of these production systems that are higher yielding than the traditional ponds. The selection of appropriate fish feeds and development of proper feeding guides have significantly increased pond yields, feed utilization efficiency and profitability. The diversification of the products of aquaculture production has significantly enhanced market acceptance and improved marketability of some fish species that hitherto had limited markets.

Effect of pruning frequency on quantity and quality of Gliricidia herbage for feeding dairy cattle

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Herbage quantity and quality response of *Gliricidia sepium* to pruning intervals (1.0 to 6.0 months) was evaluated. Chemical composition of coppice re-growth was estimated and herbage was incubated in three rumen fistulated Friesian steers for 3, 6, 12, 24, 48, 72, 96 and 120 h. Herbage dry matter yield tended to follow linear response (P=0.0689) with decreasing coppice re-growth maturity and ranged between 36.2 tones/ ha/year to 49.1 tones/ha/year. Protein content (291 g/ kg DM to 220 g/kg DM) also decreased following a quadratic trend. However, fibre content increased following a curvilinear trend as herbage matured but levels of lignification increased linearly with delayed harvesting. Additionally, fraction 'b' of dry matter degradability (548 to 716 g/kg DM) decreased linearly with herbage maturity. Herbage potential degradability (a+b) (926 to 785 g/kg CP) was indicative of high protein solubility and the rumen degradable protein (RDP) decreased with increasing maturity. Consequently, microbial protein synthesis and net energy of lactation decreased linearly while rumen undegradable protein (RUP) and digestible undegradable protein (DUP) increased linearly with increasing herbage maturity. These results are interpreted to mean that *G. sepium* herbage quantity and quality is influenced by pruning management.

Diversity and Evolution of Banana Xanthomonas wilt causing bacterial strains in the Great Lakes Region

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Banana xanthomonas wilt (BXW) is a devastating vascular disease caused by *Xanthomonascampestrispv. musacearum* (Xcm). This disease has devastated economies based on banana and plantain crops (Musa species) in East Africa. It was first reported in Ethiopia in 1961 and Uganda in 2001 with subsequent observations in the other great lakes countries Rwanda, DRC, Kenya, Burundi and Tanzania. Various efforts through cultural regimes have been devised to manage the disease, but are however not very effective nor sustainable. Previous studies show that Xanthomonads use a Type Three Secretion System (T3SS) to infect their hosts. Differences in the effectors released for infection have led to the specificity of tissues and hosts among Xanthomonads. Through a Genome wide sequencing analysis of Xcm 4381 and Xvv 702, various putative virulence factors and other proteins were reported to be present in the two genomes. The evolution of virulence factors is dependent on the need to escape host recognition. Comparative analysis between strains of Xcm and Xvv from various hosts across different geographical regions and time can provide more information on the virulence factors that may be responsible for the distinct pathogenicity and evolution of Xcm. Here we use genome-wide sequencing to discover a set of single-nucleotide polymorphisms (SNPs) among East African isolates of Xcm. Our analysis reveals the presence of at least two major sub-lineages of the pathogen; Xcm isolates from Uganda, Kenya, Tanzania and Burundi are genetically distinct from isolates collected in Ethiopia, DR Congo and Rwanda, suggesting that the current outbreaks of BXW on Musa species in the region may have more than one introduction. An isolate from Madagasca on a *Musa* sp. did not show any relationship to the isolates in the great lakes region.

Developing community based low tissue culture innovations for improved food security and livelihoods in the ECA

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Banana, Cassava, and sweet potato are key staple food security, income and potential industrial crops in sub Saharan Africa. However, their production and productivity is constrained by lack of adequate clean planting materials free of pests and diseases and poor seed delivery systems that does not allow timely availability and replacement of quality planting materials. In 2008, the association for strengthening agricultural research in east and central Africa (ASARECA) initiated projects aimed at building capacity and generation of technologies for low cost tissue applications of cassava, sweetpotatoes, bananas and potatoes to supply farmers with pest and disease free planting materials. These projects

have developed tissue culture capacity that has generated a number of technologies for smallholder farming systems. Both private and public tissue culture laboratories have been enhanced and 41 scientists and technicians trained in tissue culture, conservation biotechnology, virus indexing, and seed systems for vegetative crops. The trained scientists have used these skills to generate key technologies including low cost protocols for production of tissue culture plantlets. These technologies include use of locally available materials and supplies as ingredients for tissue culture, a DNA based tool for detection of viral diseases of sweet potatoes, an antibody based diagnostics for cassava brown streak virus, and a virus indexing scheme for cassava and sweet potatoes. 360 cultivated and landrace cassava accessions and 449 accessions of sweetpotatoes have been collected and conserved using conservation biotechnology technologies. Protocol for production of tissue culture banana, cassava and sweet potatoes and tissue culture certification scheme have been developed. A follow project has been developed to facilitate uptake of the generated technologies and innovations for smallholder farming system using the framework for African agricultural productivity (FAAP) principles of the Comprehensive Africa Agricultural Development Programme (CAADP).

Application of biotechnology research for agricultural transformation in East and Central Africa (ECA)

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The association for strengthening agricultural research in eastern and central Africa (ASARECA) through its Agrobiodiversity and biotechnology programme is enhancing utilization of biotechnology research and development innovations in eastern and central Africa (ECA). In this article we present successes on the application of biotechnology to enhance the productivity of maize, cassava, sweet potato, sorghum and bananas in ECA. Low cost tissue culture protocols have been developed for banana, sweet potato and cassava.

Virus indexing tools have been developed for screening banana, cassava and sweet potato planting materials against common diseases and pests. Production and dissemination of clean banana tissue culture plant materials has been strengthened. Research activities involving development of a genetic linkage map to map the genes that confer resistance to cassava brown streak disease (CBSD) is underway.

Drought tolerant transgenic maize has been developed for sixteen farmer preferred tropical maize lines for Kenya, Sudan, Tanzania and Ethiopia. Marker assisted selection has been used to generate 51 sorghum lines resistant to striga. Fine mapping of striga resistance QTL in sorghum is almost complete. These products - drought tolerant maize, sorghum resistant to striga as well as the technology for producing and distributing disease free planting materials of cassava, sweet potato and banana to farmers - are central for agro-ecological intensification of farming systems in the central African highlands.

Properties of extrudates from four sorghum varieties

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Four varieties of sorghum namely, Seso1, Epuripur, Seso3 and Eyera were extruded with and without defatted soy flour. Physical-chemical properties of the extrudates including, lateral expansion, bulky density, hardness, water absorption index, water solubility index, as well as proximate composition were determined.

The extrudates exhibited 240-300% lateral expansion; 0.067-0.095 g/cm^3 bulk density. The water absorption index of extrudates was 6.4-7.9 g/g as compared to 1.9-2.3 g/g of the control while the water solubility index was 6.5-13% as compared to 3.4-5.0%% of the control. Extrusion of all the varieties reduced the peak and final viscosity of the extrudates.

There were no varietal differences with respect to lateral expansion, bulk density and hardness. However, the water absorption index for the varieties increased in the order, Eyera, Seso 3, Seso 1 and Epuripur; while the water solubility index for the varieties increased in the order, Seso 1, Seso 3, Eyera and Epuripur. Defatted soybean flour did not have an effect on the extrudate properties.
The results suggest that all the four sorghum varieties in this study can potentially be used in the production of extruded puffed snacks, breakfast cereals and other food products.

Detoxification of Aflatoxins in diets of broiler birds using Ugandan bentonite

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One hundred fifty day-old commercial broiler chicks were reared in six groups with each group containing 25 chicks. The chicks were maintained on two diets including diet BSA: broiler starter feed containing 25-35 ppb of aflatoxin and diet BSB: broiler starter feed containing 25-35 ppb of aflatoxin+0.5% Ugandan bentonite (UB). After three weeks, broiler starter diets were replaced with two diets of broiler finisher mash namely BFA (broiler finisher feed containing 25-35 ppb of aflatoxin) and BFB (broiler finisher feed containing 25-35 ppb of aflatoxin+0.5% UB). In both starter and finisher phase, highest weight gains (t-test; $P<0.0001$, df=2) were observed in groups fed of diets containing UB. During the starter phase, the weight gained by chicks fed on BSB was 29% higher than the mean weight gained by chicks fed on BSA. Also, feed intake for chicks fed BSB was 15% higher than the mean feed intake for chicks fed on BSA. A similar trend was observed during the finisher phase with the mean weight gain and feed intake for birds fed BFB being 22 and 14% respectively higher than values for birds fed BFA. The mortality in groups fed the diet containing UB was 141% lower than the percentage mortality for groups maintained on diets without UB. The findings of the study are suggestive that the clay can be incorporated in animal feeds to detoxify the aflatoxins and eventually reduce mortality of broiler chickens as well as improving their dressing percentage and eventually profitability of chicken production systems.

Seed potato production in Burundi: strategies for improvement.

Astère Bararyenya, P.Claver NAHAYO, Micheline INAMAHORO, Ernest VYIZIGIRO

Potato is one of the major staple food crops in Burundi and its importance is continuing to raise thanks to increased urbanization and various consumption uses. 31.7% of Burundi farmers are producing potatoes. In spite of the increasing demand for potato, its productivity is declining owing to lack of sufficient quality seed. Planting material contributes highly to the potato production inputs. Previous publications indicate that over 90% of seed potato in Burundi is home saved and hence of poor quality. In Burundi, efforts were made by various projects or programs to improve the situation. Preliminary studies were conducted with an objective of developing recommendations to formulating policies to sustain improved seed potato system in the country. Survey results indicate that the success of each farming enterprise, either smallholder or commercial, depends on the quality of both variety and seed, in addition to all other inputs. The effective and efficient management of the production cycle is vital to ensuring a high quality product. As far as potato crop is concerned, the type and quality of seed or planting material is critical. Therefore, areas of improvement were identified by the assessment as strategies to move the potato seed system forward in Burundi. These strategies include, creating suitable environment of integrated seed systems, ensuring that interests of Private sector are taken into consideration in enabling environment, ensure that farmers have enough capacity to implement innovations and coordination of development partners with regard to financial and technical support.

The contribution of dairy-vegetable integration to household food and nutrition security in smallholder farming communities of Uganda

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Uganda is one of the countries with increasing number and proportion of undernourished people most especially in the rural areas. A project on harnessing crop-livestock integration to enhance food security and livelihoods resilience to effects of climate variability and change in ECA was implemented in Burundi, Kenya, Tanzania and Uganda and its impacts on food and nutrition security were monitored in Masaka District, Uganda. 30 Project beneficiary (PBH) and 30 non project beneficiary households (NPBH) were interviewed on food production trends and consumption habits and anthropometric measurements (weight and height) of household members recorded for different age groups in Mukungwe sub-county. Dairy-vegetable integration increased milk and vegetable production by 86.7 and 377.6% respectively and increased household income by 19 folds. Number of meals per day (macronutrient consumption) and dietary diversity were above the critical levels of ≥3 and ≥6 respectively in PBH (3.85 and 8.4) but below the critical levels in NPBH (2.76 and 5.68). Consumption of cereals, roots/tubers, matooke, milk, fish, eggs, vegetables and oils/fats was higher in PBH than NPBH. Annual milk consumption in PBH (81 litres/person) was more than the national per capita consumption (50 litres) but lower in NPBH (13 litres). Children under 12 years were underweight in all households but those in PBH had higher body mass index (BMI) of 16.7 than the NPBH of 15.7. Normal BMI (18.5 – 24.9) was only found in PBH with people above 12 years. In NPBH, adults were either underweight with BMI of 17.6 or overweight with BMI of 27.2 hence presenting a double burden of malnutrition. Integrated dairy-vegetable production systems increased food production and income as well as improving food and nutritional security in smallholder farming households.

Climate smart agriculture technologies for improved food security and poverty alleviation in smallholder dairy-vegetable production systems in Eastern and Central Africa

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Climate change and its attendant extreme weather conditions, pests and diseases, poor soils, low and unreliable rainfall and high population have devastated food, feed and water resources in smallholder crop-livestock systems in Eastern and Central Africa. A project was therefore implemented in Uganda, Kenya, Tanzania and Burundi during 2009-2013 to promote climate smart agriculture (CSA)technologies and innovations (drought tolerant forages, water harvesting and, soil fertility management and drip irrigation for year-round vegetable production) in smallholder dairy-vegetable systems.Drought tolerant forages that were evaluated and promoted included *Brachiaria*hybridcv.Mulato (Brachiaria) and *Pennisetumpurpureum* intercropped with forage legumes. Livestock manures from the farms were utilised to replenish soil fertility for vegetable and fodder production. Rain water was harvested for domestic and livestock uses and to drip irrigate vegetable (cabbage) grown on plots amended with either goat, cattle or poultry manure. The project involved 480 smallholder dairy-vegetable farms, most of which had women as key players. The trials were laid out in a randomised complete block design, with 3 replications. This paper presents data for one site, namely Masaka in Uganda. From the study, introducing 0.5 ha of a mixture of Brachiaria and *Clitoriaternatea*on farms previously dependent on 0.5 ha of *P. purpureum* and *Centrosemapubecens* mixture, provided year round feed supply to dairy cattle. Intercropping maize with *Lablab purpureus*(lablab) improved stoverdry matter (DM) and grain yield (4,998±154.6kg/ha/yr; 2,912 kg/ha/yr, respectively) by 23 and 6, respectively compared to maize monocrop. Drought tolerant forages and water harvesting technologies increased fodder availability (76%), water offered to animals (46.3%), milk yield (78.7%) and cash incomes (52.4%). Application of goat, cattle and poultry manure with drip irrigation increased cabbage yield by 9%, 49% and 95%, respectively.Supplementing dairy cattle fed Napier grass and Brachiaria forages with 0.5 kg/cow/day of homemade Nutrient feed blocks improved milk yield by over 10% during the dry season. In conclusion, integrated management of CSAtechnologies in dairy-vegetable production systems improved food security and income. Relevant policies should be bolstered to enhance adoption of climate change coping technologies, as a strategy for improving livelihoods.

Performance of Early calves' weaning diet as milk replacer for smallholder dairy production systems in Kenya

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In an attempt to maximize milk sales to cope with current rising cost of living, calves in small-holder dairy production systems suffers neglection, and later dies of malnutrition. Early weaning not only releases more milk for household consumption, and/or for sale, but also reduces the cost of rearing calves during their nursing period. This study was designed to determine the performance and economics of replacing milk with formulated test-Early Calves' Weaning diets (EWDs) on dairy calves On-station. A 5 4 x 4 factorial design was used, with 5 treatments and 4 animals per treatment, with 4 types of fortification. The experimental diets were: Milk feeding (105d (Control) and milk (28 days) + EWD, not fortified or fortified with either Effective microorganisms (EM), Diamond-V or Diatomite (DT), up to 105d. The calves received colostrums in the first 7d. Basal diets (quality Napier grass and *Leucaena leucocephala* leaf-meal) and water was offered *ad-libitum. F*eeds offered and refused were recorded daily, while body weights were measured weekly during the data collection period.
The evaluated parameters were: Average weight gains, Dry matter intake, Feed:Gain ratio, Economic efficiency and incidence of diseases/diarrhea. Weekly growth response slopes varied ($P<0.05$ by diet. Calves on non-fortified EWDs had the highest average weight gains ($P<0.05$) than the control.

However, no disease incidences were reported in the EM-fortified EWDs, a factor which increased marginal rate of returns in this treatment. Fortification of test-EWDs with either Diamond-V or EM ($P<0.05$) influenced average weight gains. However, higher incidences of diarrhea were observed in Diamond-V treatments, associated with higher intakes of the test diets. Signs of hair loss and discolorations were observed in DT-fortified EWDs, possibly associated with copper deficiency. Hence, the test-EWD fortified with EM is recommended for small-scale dairy farmers to wean calves at 28-35d with good economic and performance results.

Evaluation of Optimum Doses of Five Selected Botanical Extracts in Managing Mexican Bean Weevils

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Bean bruchids *Acanthoscelides obtectus* (Say) and *Zabrotes subfasciatus* (Boheman) are the main storage pests of beans in Tanzania. Mexican bean weevil *Z. subfasciatus* prevail more in warm areas in law altitudes of Tanzania. In Tanzania, farmers have been using different botanicals to reduce postharvest losses that could be caused by bruchids. But the amount of botanical pesticides required to protect beans from bruchid damage is not known. Laboratory studies were carried out to investigate the optimum of five botanical extracts namely *Chenopodium ambrosioides, Neorautanenia mitis, Dolichos kilimandscharicus, Gnidia kraussiana* and *Zanha africana* in managing *Z. subfasciatus*.

The experiment was set in a Completely Randomised Design to determine the optimum doses of five selected pesticidal plant formulations that can be recommended for protecting beans against bruchids. The effectiveness of the extracts was compared with Actellic Super Dust, a synthetic chemical commonly used for control of bean bruchids. The results shown that, two plant species namely *N. mitis* and *C. ambrosioides* performed similar to synthetic Actellic Super Dust in all doses used followed by *Z. africana* at the highest tested concentration.

The study shows that lower doses of *C. ambrosioides* and *N. mitis* have higher efficacy comparable to Actellic Super Dust followed by *Z. Africana* at higher used dose. Hence, the amount of insecticidal plant product can be used efficiently as the recommended doses. However, further study is recommended to assess the insecticidal plants role in seed deterioration during storage, shelf life, active ingredient and toxicity to mammals.

Effect of cutting frequency and cutting height on dry matter yield and nutritive value of *Brachiaria mulato* for fodder production in Uganda

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Inadequate knowledge on appropriate forage agronomic practices is a major constraint undermining productivity of newly introduced forages in Uganda. As, such a study was executed in three agro-ecological zones of Uganda to establish the productivity of *Brachiaria mulato* (a newly introduced forage in the country) under various cutting frequency and height regimes. A split plot experimental design was adopted with cutting frequency (CF) at three levels (4, 8, 12 weeks) constituting the main plot treatments and cutting height (CH) at two levels (10 and 20 cm) constituting the sub-plot treatments. The dry matter yield (DMY) and nutritive quality were significantly ($P<0.05$) affected by CF. The DMY was negatively correlated with the cutting frequency, with highest DMY values obtained at a cutting frequency of 12 weeks. However, Crude protein (CP) was noted to be positively correlated with Also, DM, acid detergent fibre (ADF), neutral detergent fibre (NDF) increased with decrease in cutting frequency. In contrast, cutting height had no significant effects ($P > 0.05$) on dry matter yield and chemical components of *Brachiaria mulato.* The result of this study indicated that to obtain the best balance between dry matter yields and forage quality of *Brachiaria mulato* the optimum cutting frequency seems to be about 8weeks, approximately two months from standardized cutting.

Sustainable management of banana Xanthomonas Wilt in East and Central Africa: an innovation systems approach

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Banana is an important food and cash crop in East and Central African (ECA). The average per capita annual consumption of banana in some of the ECA countries is the highest in the world (250-300kg). The devastating epidemic of banana Xanthomonas wilt (BXW) caused by *Xanthomonas campestris* pv. *musacearum* is currently threatening banana production and therefore the livelihoods of millions of banana farmers in the region. Besides being a threat to food security in the region, the disease has economic implications which emanate from yield loss, cost of control measures as well as reduced harvest during the period between peak of epidemic and fully recovery of the banana production Insect transmission is believed to be behind the epidemic, together with the use of contaminated garden tools and infected planting materials. All banana cultivars grown in the region are susceptible to BXW and no source of resistance has been identified. The recommended control measures for the disease include destruction and disposal of infected plants, disinfecting tools used in the plantation, using clean planting materials, early removal of male buds and quarantine measures. Innovation systems that have been used to mobilize and empower stakeholders for the management of BXW in the region include: Institutional structures (task forces), benchmark site approach, farmer field schools, learning and experimenting for farmers (LEAFF) and going public. These innovation systems have been used in different agroe-cologies of ECA with varying levels of success in controlling BXW. This paper discusses the different innovations systems which are currently being used in the region to manage the disease; and how integration of different elements of innovation systems may be the most effective option for the management of BXW in ECA. Strategies for scaling out the most promising innovation systems for effective and sustainable management of BXW in ECA are recommended.

Enhancing Production through Optimization of DPPH and Radical Scavenging Activity of Grape Seed Extracts

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Polyphenols are important due to their positive contribution to cellular processes within the body. In terms of pharmacological activity, they protect against the oxidation of High Density Lipids (HDL). Thus they help the body to retain the HDL while removing the problematic Low Density Lipids (LDL). Polyphenols have also been found to have anti-ulcer, anti-carcinogenic and anti-mutagenic activities. Use of polyphenol extracts would result in increased agricultural production of grape fruits and thus diversifying their common use for wine making. In this study, polyphenols were extracted from milled (<0.5 mm) and whole grape seed using compressed hot water (high temperature and high pressure) and solvents (Acetone, Methanol and Ethanol). Hot water extraction was carried out in a Titanium cylinder at 80, 105, 120, 135, 150, 165, 180 and 200˚C for a period of one and two hours. Solvent extraction was carried out at 25˚C for a period of two hours. The experimental extracts were filtered using a 0.2 μm micro-filter before being analyzed. The total polyphenol content and DPPH radical scavenging activity of the extracts were determined using spectrometer and the active compounds identified using HPLC. Experimental results showed that total polyphenol content increased with extraction temperature but decreased at 200˚C. The difference in polyphenol extracts from the milled and whole seed decreased with increase in temperature but was more evident at 135˚C. The 2 hour extracts showed relatively higher values compared to those for 1 hour with the lowest difference occurring at 165˚C and the highest at 180˚C. Solvent extracts from whole seeds were very low compared with the milled seeds with acetone showing the highest value of 105 mg/g of dry matter for polyphenol content and 110 mg/g of dry matter for DPPH radical scavenging activity. Methanol had the lowest value of 78 mg/g of dry matter for polyphenol extracts

and 80 mg/g of dry matter for the DPPH radical scavenging activity. The methanol extracts compared well with those for hydrothermal extraction. The main extracts compounds were identified as gallic acid, catechin and epicatechin. It was concluded that above 135°C and below 200°C, hydrothermal extraction could effectively be used to optimally extract polyphenols from whole and milled grape seeds. Solvent extraction was however only suitable for milled seeds.

Performance of local made fish feeds versus imported commercial feeds for tilapia rearing and its economic implications

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Recent studies conducted in Mwanza and Tarime on tilapia feeds and feeding point out no significant different between feed types in both growth rate, food conversion ratio, and in net production of tilapia culture in nylon hapas of $8m^2$ and for the earthen ponds. 25% Crude protein of local made feeds of TAFIRI- I using animal protein source and TAFIRI- II feeds made from plant protein source were both compared with 25% crude protein commercial feeds of Ugachick in both hapas and ponds. 5% body weight was used to feed the fish in both systems as daily ration. Fish was fed three times a day. Specific growth rate ranging from 2.96% to 3.11% were observed while food conversion ratios of 1.44 to 1.61 observed. Net production for a hypothetical rearing period of 120 days was estimated using a power function by fitting to the relation of the specific growth rate and as well as stocking weight.

Cost-benefit analysis of local made fish feeds compared to the imported Ugachick from Uganda was also analyzed. The results revealed that TAFIRI-I is performing well compared to TAFIRI-II as well as Ugachick. Since there is no significant difference in performance of the feeds, and ingredients can easily obtained from the local markets for mass production of TAFIRI-1, Therefore the use of TAFIRI-I is recommended for profitable tilapia fish farming as well as the development and sustainability of the aquaculture in Tanzania.

Evaluation of the Effect of Three Staking Techniques on Yield of Climbing Bean in Highlands of Burundi

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Common bean (*Phaseolus vulgaris* L.) is an important grain legume in the Great Lake Region as staple crop and major source of proteins, energy and micro-nutrients (Fe, Zn) for smallholder farmers. Climbing bean has been recognized in the region to be more productive, efficient land use and tolerant to environmental stresses compared to other types of beans. The lack of appropriate staking options and low profitability of the common mono-cropping system using wood as stakes remains the main limiting factors.
Three staking techniques of climbing beans were tested during the 2010B and 2011A cropping seasons in ten sites of Ngozi, Mwaro, and Karusi provinces of Burundi. The experiments were set up to compare the performance of three different staking techniques and identify the staking technique that optimizes climbing bean production. The tested staking techniques were (i) staking with woods, (ii) staking with strings and (iii) staking with growing maize intercropped with beans. Data collected on bean grain yield showed that staking with wood technique is the most yielding technique among the three. The analysis has shown a significant difference between the three staking techniques ($p<0.001$).

The mean grain yield was the highest with the use of wood or strings as staking materials while the lowest was due to inter-cropped climbing bean maize. However, the marginal analysis showed that inter-cropping climbing bean with maize was the most efficient. The staking technique with strings or growing maize were founded as new alternative options for increasing climbing bean productivity on small scale farmers. Considering comparative advantages of the three systems, the use of strings is more appropriate for bean crop intensification. The use of strings as staking materials can replace the use of woods and maintain high climbing bean production.

The performance of artemia shell-free embryos, Moina micrura Kurz and phytoplankton on the larval rearing of African catfish, Clarias gariepinus Burchell

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The artemia shell free embryos, *Moina micrura*, and green water were used as starter feed in the larvae rearing of African catfish (*Clarias gariepinus*) and their performance assessed. The experiment lasted for 15 days in a set of nine tanks of 900 L capacity (3 tanks in each feed treatment) randomly allocated. During the first 5 days (1st phase), the larvae were fed on purely live feed three times a day. During the last 10 days (weaning phase), the larvae were acclimatized on a formulated diet.

In the end of each phase, the larvae from each set of tanks were counted and 30 larvae were randomly chosen and measured their weight and length for growth rates, SGR, survival rates, and condition factor. During the 1st phase, the larvae fed with artemia indicated the highest growth rate, survival %, and SGR (138.11%/day, 97.71%, and 0.41, respectively) followed by the larvae fed with *M. micrura* (Growth rate, survival %, and SGR of 24.02%/day,81.65%, and 0.16, respectively).

During the 2nd phase, the larvae fed with green water indicated the highest growth rate (67.62%/day) and SGR (0.2), however, with lowest survival % (of 28.66 %). The larvae fed with *M. micrura* performed as the second best in this phase (Growth rate, survival %, and SGR of 41.88%/day,71.32%, and 0.17, respectively).

The differences in performance between the artemia embryos and *M. micrura* is probably caused by the differences in feeding rations rather than the quality of feed, This study recommends the use of *M. micrura* as starter feed on the larvae of *C. gariepinus*. However, green water can as well be used but on the condition that the larvae are made to feed continuously, and not on feeding rations as we did.

Contribution de la lutte chimique et génétique contre le mildiou de la pomme de terre à Madagascar

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La culture de la pomme de terre s'est développée à Madagascar grâce à sa contribution à la sécurité alimentaire et en en tant que source de revenu. La production nationale avoisine les 285 000t/an dont la majeure partie est produite sur les Hautes Terres. Cependant depuis cinq ans, l'explosion du mildiou (*Phytophtora infestans*) a atteint un niveau épidémique et a affecté significativement la productivité (jusqu'à 80%) et par conséquent la production en fonction de la sensibilité des variétés cultivées (Meva, Spunta, Menamaso, Garana…). Les facteurs de risque de la maladie sont constitués entre autres par la présence de la culture presque toute l'année et la coïncidence de la période cyclonique avec la saison de culture de saison pluviale. En effet, des méthodes de lutte axées sur l'application de produits anti-mildiou ou fongicide et l'utilisation des variétés résistantes issues récemment du CIP (Centre International de pomme de terre) ont été effectuées en se basant sur des fortes pressions naturelles de la maladie. Par ailleurs, par l'établissement d'une série de différentiels de mildiou composés de variétés/clones avec différents niveaux de résistance a été initié. Les tests entrepris ont permis de déterminer l'efficacité de produits à action protectante et à action systémique. Il s'agit soit de 1,5kg/ha de dithane M45 plus 1,5 kg/ha de ridomil à base de métalaxyl plus manèbe. Ce qui a permis de dégager un rapport valeur-coût supérieur à 3. Concernant les variétés/clones, CIP393177.54, CIP395015.6, CIP 385111.13 et CIP396236.20 résistent au mildiou et s'adaptent aux conditions de culture avec un rendement moyen plus de 20t/ha. Les variétés résistantes conviennent bien aux paysans avec un peu de moyens financiers pour se procurer de produits ; cependant leur niveau de résistance doit être suivi régulièrement. Ces résultats contribuent beaucoup à la gestion du mildiou et en améliorant la production.

Effet du Maïs protéiné (Quality Protein Maize-(QPM-) sur l'élevage des poulets de chair dans la province du Bas-Congo et son impact sur la production du maïs protéiné en République Démocratique du Congo

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Le facteur limitant le développement de l'aviculture est le coût élevé des provendes. Une solution locale et bon marché s'impose. Le maïs constitue l'ingrédient majeur dans la formulation de la ration de poulets de chair. Sa déficience en lysine et tryptophane limite sa valeur nutritionnelle. Cette étude avait pour but d'évaluer l'impact de la valeur nutritionnelle du QPM sur les performances zootechniques des poulets de chair en vue de remplacer l'aliment commercial onéreux. Elle a porté sur 99 poussins de chair non sexés de souche Cobb 500. Ils ont été soumis à trois rations correspondant à l'aliment commercial(R0), l'aliment à base de QPM (R1) et l'aliment à base de maïs normal (R2). Chaque lot avait comporté 3 répétitions de 11 sujets chacun. Les poids vifs obtenus à 7 semaines d'âge ont été de 0,896kg, 0,791kg et 0,450 kg respectivement pour les sujets soumis aux R0, R1 et R2. Les consommations alimentaires individuelles ont été de 923 g, 907 g et 812 g, avec des indices de consommation de 1,03; 1,15 et 1,80 respectivement pour les aliments R0, R1 et R2. Pour ces paramètres zootechniques, les tests statistiques ont montré une différence significative entre les différents traitements au seuil de 5% ($p<0,05$). Il a été conclu que l'aliment à base de QPM peut remplacer totalement l'aliment commercial dans la ration des poulets de chair tout en générant des bénéfices d'environ 2 %. Ceci contribuera à l'augmentation de la production du QPM en République Démocratique du Congo.

The performance of two locally formulated feeds compared against the commercial feed on the rearing of African catfish (Clarias gariepinus Burchell).

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Aquaculture is yet to become a sector that contributes importantly in improving food security in Tanzania and generally in the world despite of having high potential. Of the major obstacles towards its takeoff, is the availability of quality seed and feed to poor fish farming communities. As an initial effort to contribute in solving the feed problem in the country, two feed types (TAF Feed 1 and TAF Feed 2: 35% Crude protein) made from locally available ingredients were formulated. Fish meal and soya beans were used as source of protein for TAF Feed 1 and TAF Feed 2 respectively. Nine concrete tanks, of 2mx4m were stocked with 360 catfish fry each for testing the performance of the two formulated feeds compared against an imported commercial Ugarchick of 35% crude protein too. Fish were fed at 15% of body weight and the experiment lasted for six months. Water in the experimental tanks was wholly flushed out and fish sorted on weekly basis. In each month, 25 to 30 fish were randomly taken and measured their weights and lengths. Concurrently with this, Temperature, DO, and pH were measured on weekly basis using a portable DO–pH meter. In terms of Food Conversion Ratio (FCR), Growth rate (GR), Specific Growth Rate (SGR), and conditional factor (CF) of the fish, TAF feed 1 indicated as the best feed for African catfish followed by the Ugarchick. However, the indicated differences in growth performance of the feeds were not significant, but the unit cost of production of the feed is low, therefore development and use of TAF Feed 1 as a grow out feed for catfish is recommended.

Genetic transformation with IPT gene enhances drought tolerance and improves grain productivity in tropical maize (*Zea mays* l.) under water limited environment

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Drought diminishes maize productivity mainly by causing

premature leaf senescence. It is now possible to delay drought induced leaf senescence in order to enhance tolerance to drought and stabilize crop yield through genetic transformation. The *ipt* gene codes for isopentenyltransferase (IPT) enzyme, which catalyzes the rate-limiting step in the biosynthesis of cytokinin (CK) and enhances tolerance to drought by increasing the foliar level of CK that delays drought-induced leaf senescence in transgenic crops. The objective of this study was to investigate if *ipt* gene driven by the drought inducible SARK promoter can be useful in enhancing tolerance to drought stress by delaying drought induced leaf senescence in locally adapted tropical maize genotype. The *ipt* gene was sub-cloned into the pNOV2819 binary vector to take advantage of the *pmi* gene as plant selectable marker and mannose as selective agent to develop a product which is safe to environment and consumers. The pNOV2819 binary vector carrying the *ipt* gene was introduced into the Agrobacterium strain EHA101, which was subsequently used to transform immature zygotic embryos obtained from the tropical maize inbred line CML216. Nine independent transgenic lines were generated and analyzed using PCR, southern blot and RT-PCR. Southern blot analysis indicated stable integration of the transgene into the genome of CML216 with 2-3 copy numbers in five independent events. In drought assay carried out in the glasshouse transgenic plants expressing the *ipt* gene maintained higher leaf relative water content (RWC) and total chlorophyll concentration during the drought period and produced significantly higher grain yield compared to the wild type (WT) plants. The *ipt* gene was observed to improve drought tolerance in tropical maize by delaying drought induced leaf senescence. It was concluded that the transgenic line developed can be further tested for tolerance to drought under contained field trials. Furthermore, it can be used in breeding programs to improve drought tolerance in other commercial tropical maize genotypes through conventional breeding.

Optimizing aquaculture productivity through enhanced seed, feed and appropriate technology adoption in Kenya

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Development of commercial aquaculture industry in Kenya is hampered by inadequate use of appropriate technologies, and the shortage of good qualityfish seed and feeds. A study was undertaken to explore the adoption of simple technologies that will lead to increased supply of seed and feed farmers and enhanced productivity. Through structured questionnaire and personal interviews, data were collected from fish farmers, traders and hatcheries and analyzed using descriptive and inferential statistics. The results showed that socio-economic factors such as age, household size, literacy levels and land ownership had a positive and non-significant relationship with fish production ($P > 0.05$). Farmer's occupation had a significant relationship ($P<0.05$) to the number and size of ponds owned by a household. Major constraints to commercialization included high mortalities during stocking and larval development, high costs of supplemental feeds, inadequate supply of hatchery inputs and equipment, lack of technical advice, poor transport networks, water quality maintenance and electricity. Kenya's aquaculture production of ~22 000 MT can be increased by ensuring a stable supply of inputs and transferring suitable technology to fish farmers. The study recommends that hatcheries develop their own manufactured feeds and tilapia breeds using simple procedures within their technical and financial resources. This option will also help sustain the diversity of locally adapted domestic stocks of tilapia. Due to the rapidly changing technological landscape, hatchery seed operators require regular training and capacity building programs that will improve their skills.

Empowering women smallholder dairy farmers with forage processing technology

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The desire to improve household food security and empower women in rural households has seen the implementation of various agricultural projects, particularly livestock initiatives targeting women smallholder farmers. These livestock development projects seek to empower women by providing zero grazing dairy animals to improve their incomes and nutrition, and the nutritional status of other household members. In zero grazing, animals are permanently confined in a cattle shed and fed on fodder cut and carried to them daily. This livestock production system is characterized by high feed requirements and high labour demands. Forage materials for zero grazing animals require chopping for ease of consumption by the animal and increased palatability. Hand chopping, which is the common practice among majority of farmers, has low output capacity, the method is tedious, time consuming and quite dangerous to the operator. In an effort to address some of the labour constraints in zero grazing, NARO developed a manual forage chopper that is able to cut forage into small pieces more conveniently and quickly. With a technographic approach, this research evaluated the effectiveness of the technology as a labour saving device for smallholder dairy farmers in Masaka and Ngora districts. It was evident from this research that the forage chopper indeed eased the forage chopping role, reducing a dependence on hired labour. However, the context in which the forage chopper saves time and labour needs to be clearly specified.

Growth performance, carcass composition and profitability of Nile tilapia (*Oreochromis niloticus* L.) fed commercial and on-farm formulated fish feed in earthen ponds

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The cost of commercial feeds world over is high and contributes to the highest expense of all operational cost in fish farming. Similarly in sub-Saharan Africa fish feed is expensive and in most cases prohibitive for semi-intensive culture of Nile tilapia (*Oreochromis niloticus*). An experiment was conducted to compare growth and economic returns of *O. niloticus* reared on feeds from commercial companies with cottage formulated fish feeds in Kenya. Two commercial diets (diet 1- (D1) and diet 2 (D2) and one cottage feed (diet 3 (D3) from an on-farm cottage feed industry owned by a cluster of fish farmers were tested over a period of six months. The diets had each indicated a crude protein content of 26%. However, proximate analyses for the crude protein level were 32.7, 16.0 and 28.0% for diets 1, 2, and 3. There were significant differences ($P < 0.05$) in mean weights, specific growth rates and feed conversion ratios between diet1, diet 2 and diet3. Fish that fed on the diet 1 grew significantly larger than those fed on diet 2 and diet 3 ($P < 0.05$) with mean weight of 122.47g. Fish fed on diet 1 gave the highest ($P < 0.05$) gross income of US$193.30 while those on D2 had the least gross income. Cost benefit analysis results showed that the on-farm formulated feed D3, produced significantly higher ($P < 0.05$) net returns of US$ 95.54 compared to diet 1 and diet 2 from the commercial company which had net returns of US$ 83.66 and US$ 54.21 respectively. The on-farm formulated diets had the lowest breakeven price of US$ 3.55 and the best economic returns for semi-intensive system rearing of *O. niloticus.* This indicates that cottage feed is a viable alternative that can substantially lower tilapia production costs at semi-intensive level.

Feed resources and utilization strategies in selected pastoral and agropastoral communities in Kenya

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Yearlong feed availability in adequate quantities and at affordable prices is a major requirement in livestock production. However, feed scarcity has continued to constrain livestock production especially during the droughts in Eastern and Central Africa (ECA). The Arid and Semi- Arid Lands (ASALs) are home to a wide variety of natural pastures produce large quantities of high quality feed materials. In addition, farmers in the ASALs also produce large quantities of crop residues. If properly managed, the natural pastures and crop residues can provide feed materials for yearlong livestock feeding. A team of scientists from four countries in ECA used reconnaissance and systematic surveys to identify feed plant species in the natural pastures of some selected pastoral and agro-pastoral communities. The team also gathered data on strategies used to avail feed to their livestock. The qualitative data collected was analyzed using the descriptive tool in SPSS version 12. Some of the valued feed plant species in the natural pastures included *Cynodon plectostachyus, Echnochloa haploclada, Aristida adscensionis, Grewia tenax, Lwsonia inermis Acacia tortilis and Prosopis juliflora*.
Crop residues include maize stover, beans haulms and bananas stems and leaves. Feed conservation is not common (<25%) in most of the communities studies. There reasons for not conserving feeds included lack of skills (69%) and lack of storage facilities (21%). We conclude that there is need identify and conserve feed species in the natural pastures and to build the capacity of pastoralists to improve feed conservation and utilization strategies for enhanced feed availability and livestock productivity in the ASALs.

Optimization of Seed and Broodstock Transport Densities for Improved Survival of Cultured Nile Tilapia (*Oreochromis niloticus*, L. 1758)

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Nile tilapia fingerlings weighing 0.2 g, 0.5 g and 5 g and brooders weighing 65 g were harvested and conditioned for 24hours before packaging for simulated transport. Fingerlings and brooders were packed in oxygen pressurized 5 L polythene bags filled with 2 L of water and 5 g of NaCl to reduce ammonia toxicity effect. Packaging was done at 35, 60, 90, 120 and 150 fish/bag and 8, 16 and 24 fish/bag for fingerlings and brooders respectively. Mortality, pH, temperature, total ammonia, free ammonia, and DO were determined at 0, 12 and 24 hours and 0, 8 and 16 hours for fingerlings and brooders respectively. Mortality of brooders was monitored in hapas over 7 days post transportation. There was a significant combined effect ($p<0.05$) of transport duration and weight differences on DO and ammonia levels in fingerling bags. There were also significant differences ($p<0.05$) in mortalities in bags containing fish transported at different load densities. Fingerlings of 0.2 g packed at 120/bag had the highest survival (100%) over the 24hours transportation time while those of 5 g packed at 120 and 150/bag performed poorly with survival of 82.5 and 74.5 % respectively. Similarly, transport time and reducing DO levels ($p< 0.05$) significantly affected the survival of brooders packed at 8 fish/bag having the highest survival (96%), while brooders packed at 24 fish/bag had the least survival (67%). Size, number and duration of transport of *O. niloticus* fingerlings and brooders need to be considered during transportation and ensure transportation duration is within 12 hours to avoid low DO and increased ammonia levels.

Evaluation of Napier grass (*Pennisetum purpureum*) clones for performance and tolerance to Napier stunt disease in Central Uganda

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Napier grass (*Pennisetum purpureum*) constitutes 40 to 80% of the forages fed to cattle in smallholder dairy farming systems in Eastern and Central Africa region. Napier stunt disease (NSD) significantly reduces herbage yield and therefore threatens the sustainability of smallholder dairying. A study was therefore conducted at the National Crops Resources Research Institute in Uganda to assess the herbage biomass yield and tolerance to NSD of 22 Napier grass clones acquired from Kenya Agricultural Research Institute. Each clone was replicated three times in a Completely Randomized Design and each of the plots was surrounded by infected Napier grass. For every two months, the plots were harvested for determination of leaf biomass, stem biomass, total biomass

yield and disease severity and tolerance and a total of five harvests were made. Results showed that the clones differed significantly ($p < 0.005$) for dry matter yield (DMY), disease severity ($P<0.005$) with no significant ($p <0.005$) difference between the clones for leaf:stem. Clone 97 had the highest accumulated DMY (46.863±7.708t/ha) whereas 79SN (79 Sugar+ Napier) had the lowest (12.505±7.708t/ha). There was a registered decrease (32.75%) in DMY, this shows that NSD negatively affected the production potential of Napier grass. Majority (68.18%) of the clones became susceptible with increasing number of harvests. Kakamega2, 16702, 112 and Kakamega 1 which were tolerant to NSD up to the fifth harvest and among the clones with highest DMY are recommended for multiplication and dissemination to farmers but there is need to follow their performance for a period longer than one year used in the current study.

Enhancement of drought tolerance in tropical maize through silencing of *PARP1* gene

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Maize is extremely susceptible to drought especially at the flowering stage. In most of the production areas under maize, mild drought can significantly reduce yields while severe drought can sometimes completely destroy an entire plantation. Development of maize varieties with improved tolerance to drought is therefore necessary for yield stabilization under stress. Remarkable levels of dehydration tolerance have been obtained using new and promising genetic engineering strategies designed to manipulate a variety of process. One such approach is the silencing of the PARP gene which leads to preservation of cellular energy under extreme or persistent water stress conditions. In this study, the maize *PARP1* gene silencing constructs (amiRNA-PARP1) was cloned in the same T-DNA region as the *PMI* selectable marker gene (SMG) or placed in a separate T-DNA region for cotransformation of plants. The cotransformation vectors were first validated in tobacco before application in transformation of different maize genotypes. Maize transformation was achieved by co-cultivation of immature embryos with *Agrobacterium* harboring an amiRNA-PARP1 construct. Transgenic plants were assessed for downregulation of the *PARP1* gene using qRT-PCR. The effect of *PARP1* gene downregulation on drought tolerance was assessed. Out of 13 genotypes evaluated, two (TL03B6754A-20 and TL03B6757-68) were found to be highly regenerable and were chosen for recovery of transgenic plants using either the PMI/mannose or bar/PPT system. These genotypes were found to be highly transformable, averaging transformation frequencies (TF) of 48% and 34.16% with the PMI/mannose system respectively. The control genotype CML216 average TF was 32.19%. The proportion of resistant callus tissues recovered on PPT for the inbred lines CML216, TL03B 6757-68 and TL03B 6754A-20 was 26.16%, 14.81%, and 21.69% for pmarkfree3.1 and 27.22%, 32.10% and 36.32% for pmarkfree3.2, respectively. In total 34 independent amiRNA-PARP1 transgenic plants were generated. Out of these, 18 were confirmed transformed by PCR. The transgene was expressed in 15 out of 18 plants analyzed by RT-PCR. A qRT-PCR analysis conducted on six lines revealed that the expression of the *PARP1* gene was reduced in plants exposed to methyl viologen-induced oxidative stress. However, the level of *PARP1* gene expression was higher in wildtype plants. Plants with reduced expression of the *PARP1* gene were tolerant to oxidative and drought stress at the vegetative and physiological levels.

Enhanced drought tolerance in transgenic tropical maize (*Zea mays* L.) through over-expression of *Xerophyta viscosa peroxiredoxin*2 gene-*XvPrx*2

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Maize supports lives of more than half of the population in Africa yet its production is extremely affected by drought. Yield losses of up to 70% are frequently attributed to drought stress. Narrow genetic base of drought tolerant traits in available germplasm is another existing limitation in breeding for drought tolerance. In this study selected maize germplasms adapted to Eastern and Central African region were transformed with *Xerophyta viscosa peroxiredoxin 2*, (*XvPrx2*) gene. *XvPrx2* gene has previously been isolated and characterised from resurrection plant *Xerophyta viscosa* Baker. The *XvPrx2* gene encodes a type II peroxiredoxin that scavenges for excess reactive oxygen species produced during dehydration stress. The plant expression vector contained *phosphomannose isomerase* gene to allow the use of mannose as selective agent. One inbred line (CML144) and one open pollinated variety (Staha) were transformed using *Agrobacterium*-mediated transformation. Ten and 6 transgenic lines were recovered from CML144 and Staha maize, respectively. To confirm the success in genetic transformation, PCR, Southern Blotting and Reverse transcription PCR were used. Transgenic maize plants were further subjected to drought stress assays that compared the performance of both transgenic and non-transgenic plants under dehydration. Transformation frequencies for CML144 and Staha averaged at 12.9 and 23.9%, respectively. Transgene integration in transgenic T_1 plants was revealed with low copy numbers. RT-PCR in T_1 plants confirmed the expression of gene transcripts in transgenic maize plants under drought stress. Under drought stress, relative water content in transgenic CML144 and Staha plants were significantly higher than in non-transgenic maize. Analysis of chlorophylls under drought stress revealed relative stability in transgenic plants compared to wild types. The transgenic plants designated CMl144-XvPrx2 and Staha-XvPrx2 generated herein demonstrate

great potential to drought stress tolerance under controlled laboratory conditions. However, further assessment of these transgenic plants under confined field conditions need to be conducted prior to integration into the breeding programs. The transgenic drought tolerant maize developed from this work can be used to subsidize yield in drought prone areas of Eastern and Central Africa.

Poster Presentations

First products of DNA marker-assisted selection in sorghum released for cultivation by farmers in sub-Saharan Africa.

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The Sudan National Variety Release Committee approved the release of four *Striga* resistant sorghum varieties in June 2012. Marker-assisted backcrossing (MAB) was used to introgress *Striga* resistance QTLs from donor parent N13 into agronomically superior genetic backgrounds of three popular, but *Striga*-susceptible, sorghum varieties: "Tabat", "AG8" and "Wad Ahmed". MAB was initiated under a BMZ-supported project led by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in 2004. This 3-year project generated second backcross generation progenies for three farmer-preferred varieties, "Tabat", "AG8" and "Wad Ahmed", however, these progenies were not agronomically elite enough to be released. Therefore, the national program in Sudan, in partnership with the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA), completed recovery of recurrent parent eliteness with *Striga* resistance.

To do so and improve the efficiency of MAB, additional SSR and DArT markers closely linked with targeted *Striga* resistance QTLs were identified and used for genotyping. Three additional generations of marker-assisted selection (MAS) were completed before the product lines reached the required state of agronomic eliteness combined with high and stable levels of *Striga* resistance. Standard variety trials were carried out in *Striga* sick plots over three seasons (2009-2011) at Gezira, Damazine, Sinnar, and Gedaref in Sudan. Results revealed that backcross-derived lines T1BC3S4, AG6BC3S4, AG2BC3S4 and W2BC3S4, were *Striga* resistant and agronomically superior, giving 180 to 298% increases in grain yield over their recurrent parents. All four were released.

This is an excellent example of a national program adopting and implementing MAS to generate improved cultivars combining agricultural eliteness with high levels of resistance to an important biological constraint, in this case the parasitic weed *Striga hermonthica*, which is the bane of all cereal-growing farmers in sub-Saharan Africa that do not have access to reliable and cost-effective control measures.

Introgression of *Striga* resistance genes into an Eritrean farmer preferred sorghum variety, Hugurtay, through Marker Assisted Breeding

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Sorghum [S. bicolor (L.) Moench] is the most important cereal crop in Eritrea grown over 200,000 hectare annually. However, production is seriously hampered by the parasitic weed *Striga hermonthica*. *Striga* is highly variable, with the ability to adapt to many hosts and environments, thereby complicating breeding for resistance against it using conventional approaches. The aim of this study was to transfer *Striga* resistance Quantitative Trait Loci (QTL) from N13, a characterized resistant donor source to Hugurtay, a popular but *Striga* susceptible farmer preferred sorghum variety (FPSV) in Eritrea using marker assisted backcrossing and evaluate the best introgressed lines for *Striga* resistance in infested fields. Hugurtay was crossed with N13 and three backcross generations were made with Hugurtay as the recurrent parent. Foreground selection for the *Striga* resistance QTL was performed in all the three backcross generations using 11 simple sequence repeat (SSR) markers while background selection was conducted in BC_3F_1 generations with 29 SSR markers. Eighty four lines of BC_3F_1 generations found to have one to four *Striga* resistance QTL were selected and evaluated in artificially *Striga* infested field in the first season. Out of this population, thirty genotypes with 1-4 *Striga* resistance QTL and that also showed better performance in season one were further evaluated in two locations under artificial *Striga* infestation using an alpha lattice design of three replications. Results showed that majority of the introgressed lines were more resistant than the recurrent parent, Hugurtay. Genotypes L2P3-B, L1P5-A and L2P5P35 performed best with comparable yield and supported fewer *Striga* plants. The results reveal that Marker Assisted Selection (MAS) is a useful tool for enhancement, expediency and precision in crop improvement.

Improving farmers' food security and income through rice based cropping pattern in Madagascar

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Rice is staple food of Malagasy but the average yield is low: 2.5T/ha and the country is not self-sufficient in it. The situation becomes worst under changing and variable climatic conditions with the monocropping based system commonly used by farmers. However, using the available resources mainly water and soil, their food security and income can be improved by doubling irrigated rice yield through improved agronomic practices coupled with growing non graminean off-season high market value crops on paddy field after rice.In the other hand, most of farmers are not able to invest for rice cultivation which product is mainly for home consumption. On the contrary, they can afford to use more inputs for off season crops because they will sell the product right after

harvest. Through the project, it is shown that "irrigated rice-off-season cash crops" pattern can fit well in the prevailing cropping calendar in the central part of Madagascar. In fact, it is a best bet option which allow increasing productivity per year and per surface unit area while preserving or even improving soil fertility of the rice field which in its turn will ensure sustainability of high rice yield.For rice, improved varieties (X 265 and FOFIFA 160) with the recommended agronomic practices (fertilizer, young seedling, line planting, weeding, and good water management, etc) give more than 5000kg/ha which is 240% higher than the local ones in term of yield. Using the rice improved package will give back US$800.00 per ha as net income after deducting all additional costs and the period of food insecurity is reduced significantly by 60%.For off-season crops, potato (variety "meva") or onion (variety "red Creole") and haricot bean (variety RI 15) can be grown as off season high value crops for this part of the country and can give a good return up to US$615.00 per ha. Moreover, use of crop diversification will contribute to improved human nutrition.More than 80 farmers (which are 7 times of their number of the 1st year) are adopting this pattern by 2nd season 2012-13 in the project watershed. In brief, through integrated management options of "lowland rice-off-season cash crops (potato, bean and onion)" pattern, farmers can double rice yield and get more income, expect more food security while improving in a sustainable manner soil and water productivity even under variable and changing climatic conditions.

Use of Innovation Platforms in dissemination of technologies for control of banana Xanthomonas wilt in Rwanda

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Xanthomonas wilt (Xw) disease of banana was reported in Rwanda in 2005. Management strategies adopted failed to prevent the spread of the disease in the country. Dissemination of technologies and innovations for Xw control was initially done through traditional extension methods including sensitisation meetings, trainings and several awareness campaigns. In the current project we adopted participatory approaches to increase ownership of the problem by stakeholders and promote uptake of technologies. Village level innovation platforms (IP) were established in two districts, Gisagara District (Southern Province) and Kayonza District (Eastern Province). First, district level stakeholder meetings were held and global action plans were drawn up. Secondly, cell level meetings bringing together leaders and farmer promoters of different villages were also organized, at which village IP committee members were proposed and local action plans developed. Innovation platform officials (President -in most cases the Village Head, Vice President, Secretary and Treasurer) were elected at village IP meetings. Staff of Rwanda Agriculture Board (RAB) facilitated the process of developing village action plans by IP committee members for control of Xw. The activities in the action plans included visiting farmers to determine and document households with Xw, training meetings to create awareness among farmers, organizing community work sessions ('umuganda') for uprooting and burying infected plants, follow up of execution of Xw control activities, holding committee meetings and reporting. Members of IP committees were given in-depth training on Xw symptoms, spread and control; production and handling of clean banana planting material; and organization of IPs. Data sheets were also designed for documenting activities of committees and individual households for control of Xw. Currently, 30 IPs in Gisagara and 16 IPs in Kayonza are operational. The effectiveness of the IP approach for dissemination of Xw control technologies in Rwanda will be evaluated.

Evaluation of resistance of snap bean varieties to bean fly, *Ophiomyia* spp.

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Snap bean (*Phaseolus vulgaris* L.) , an important export crop for Kenya experiences high pest infestations leading farmers to use highly persistent pesticides which leads to produce rejection due to high residues. A study was carried out to evaluate varietal resistance of seven commercial snap bean varieties to bean fly. The study was done at Mwea, Central Kenya from Feb., 2010 to Jan., 2011 for three planting cycles. The seven varieties evaluated were Amy, Alexandra, Bravo, Serengeti, Paulista, Tana and Mara. Each variety was grown with and without Confidor (imidacloprid (N-[1-[(6-Chloro-3-pyridyl) methyl]-4,5 -dihydroimidazol-2-yl]nitramide)) in a split-plot design where Confidor formed the main plots and variety the sub-plots. Confidor was sprayed on soil surface after emergence and later sprayed on the foliage. Data was collected and analysed for analysis of variance and tested for significance using GenStat Discovery edition 3 software. The varieties were significantly different in the number of plants (P=0.001), marketable (P=0.001) and total yields (P=0.001). Alexandra and Serengeti had higher plant numbers and yields than Amy. Treatment of varieties with Confidor increased yield in all the varieties by between 50 and 490 %. Some degree of resistance was noticed in Alexandra and Serengeti against bean fly which was enhanced by treatment with Confidor. The two varieties could be recommended to snap bean farmers in areas like Mwea which experience high infestation of snap bean pests. The most susceptible varieties were Paulista, Tana and Bravo. For effective protection against bean fly relatively safe insecticides such as Confidor should be integrated with these varieties in the Mwea snap bean production system

Improving Zebu cattle dairy productivity through targeted selection and crossbreeding programmes in ECA countries. Preliminary evaluation of existing breeding practices

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This study provides some preliminary results of a broad project that aims to improve Zebu cattle for dairy production through targeted selection and systematic cross breeding

programs in East and Central African region. A household survey was conducted by way of personal interviews in 360 households in Kitui, West Pokot, Busia and Homa Bay counties of Kenya. Descriptive statistics and logistic regression were analysed using Statistical Analysis System (SAS) and N-Logit statistical softwares. The preference for indigenous to exotic cattle was 48%, 32%, 43%, 43% and 22% in Kitui, Homa Bay, West Pokot and Busia respectively. Indigenous bulls were selected more based on their appearance than on performance of relatives and phenotypic characteristics in all counties. In cow selection udder placement, teat size and body shape were ranked the important traits. In all counties, coat colour was mainly ranked as less important in selecting for dairy characteristics. Crossbreeding for increased milk was highest in West Pokot at 30.9%, 19.3%, 12.5 and 5.9% in Kitui, Busia and Homa Bay respectively which was achieved mainly through the use of bull service. The use of artificial insemination (A.I.) is still rather low (<4%) among farmers within these counties despite the high willingness (74%) to use the services. Respondents who have spent an extra year in education are 38 % more willing to use AI in Busia, 34% in Homabay, 36% in Kitui, 1% in West Pokot. Farmers who ranked meat highly as an objective of keeping indigenous cattle were less likely willing to use AI. The targeted genetic improvement programmes should address the farmers, objectives while considering the conservation and utilisation of the indigenous cattle genetic resources.

Evaluation of Effectiveness of Nine Selected Botanical Extracts in Managing Bean Weevils

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Bean weevils *Acanthoscelides obtectus* (Say) are the main storage pests of beans in widespread of Latin America and Africa. Farmers in Tanzania have been using different botanical insecticides which were not uniform from different locations for many years to reduce damage in their produce. The study was carried out to investigate farmers' preparation methods of botanical insecticides and their applications to grain storage. Laboratory studies were carried out to investigate the effectiveness of nine botanical extract in controlling common bean bruchid and compare botanicals from four region of Tanzania. The study included plant species from Iringa, Kilimanjaro, Mbeya and Morogoro Regions. The insecticidal materials were extracted from the following plant species, *Eucalyptus citriodora, Vernonia amygdalina, Telfairia pedata, Chenopodium ambrosioides, Neorautanenia mitis, Dolichos kilimandscharicus, Gnidia kraussiana, Zanha africana* and *Schinus molle.* The powders were tested under the laboratory conditions, where doses commonly used by farmers were tested to identify plant species with superior characteristics. The experiment was set in a Completely Randomised Design. The effectiveness of the extracts was compared with Actellic Super Dust a synthetic chemical commonly used for control of bean bruchids. The results show that, all plant species used in experiment were potential in controlling *A. obtectus.* Two plant species namely *N. mitis* and *Chenopodium* sp, performed similar to synthetic Actellic Super Dust. The study shows that *Chenopodium* sp and *N. mitis* have higher efficacy as that of Actellic Super Dust followed by, *Z. africana* and *Gnidia* sp which performed better in protecting common beans against bruchids. Hence, the plants can be used efficiently as the recommended botanical insecticides. However, further study is recommended to assess the botanicals role in seed deterioration during storage, shelf life, botanical combination and toxicity to mammals.

Increasing dairy farmers' income through use of home made rations in lactating cows

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Farmers participatory ration development and evaluation was conducted in Mwanza peri-urban with the main purpose of assessing the effect of rations on production efficiency of milk and optional strategies for cost reduction in the feed dairy sub-sector. Four rations in the ratio of 75% energy, 20% protein and 5% minerals were formulated. The rations were: R1- Maize bran, Cotton Seed cake and minerals; R2- Maize bran, Sunflower cake and minerals; R3 - Rice bran, Cotton seed cake and minerals and R4- Rice bran, Sunflower cake and minerals. Rations were subjected to 23 cows in a CRD with covariate. Average milk yield were 14, 12.5, 11.9 and 11 for R1, R2, R3 and R4. There were significance differences in milk gain ($P<0.05$) among rations (treatments) fed to lactating cows as supplements. R1 gave the highest milk gain of 2.5 litres per day per cow while R4 gave the lowest yield of 1.9 litres per day per cow. There were significance differences ($p<0.05$) between cows fed grass only and those fed grass and breweries residues prior to supplementation. Cows fed grasses and breweries residues prior to supplements gave less response to all rations. Cows in the fourth parity gave highest response in terms of milk gain and there was significance differences ($p<0.05$) among breeds. It was noted that only about 25% of cows yielded above15 litres per cow and per day. Economic analysis revealed the profit per lactation period per cow of Tshs 1,176,750; 2,315,250; 2,400,750; 2,514,150 and 2,451,150 for Non-supplemented, R1, R2,R3 and R4 respectively. It can be concluded that it's possible to improve the production efficiency of milk through capacity building and use of cheaper formulated rations using locally available feed ingredients. Also, profitability of the dairy farming depends not only on the market of milk but strategies to reduce feed costs especially supplements.

Minitubers: A new frontier to enhanced basic seed potato production at ADC, Kenya

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Seed potato is seen as a vital input in any potato production system, as it's the physiological basis for vigorous crop development, genetic basis for the adaptation to varied ecological and product preferences. At the Agricultural Development Corporation (ADC) Molo Complex, a formal seed potato production system exists, however over the years, it has been unable to produce sufficient seed to farmers due to shortage of basic seed from the national potato program, lengthy field multiplications hence low yields. The seed shortage has led to farmers obtaining planting material either from the local market, neighbours or own farm saved seed. This has promoted build-up of devastating bacterial

wilt and viral disease, low yields and poor quality of tubers. An improved certified basic seed potato production system capable of ensuring sustainability in seed multiplication using minitubers is now underway at ADC through collaboration with CIP. With the new var. *K. Mpya* and *K. Sherehekea* the technology has worked well in getting healthy, true to type basic potato seed, rapidly, in a timely manner, under reduced field generations hence lowering costs and raising the plant health quality of the field production generation. With reduced field generations and precise practice of recommended agronomic practices and inspection services by KEPHIS the seed potato produced has improved in trueness, quality and quantity. Potato being a promising food security crop in Kenyan households, production is expected to significantly increase, contributing to poverty alleviation through income generation, provision of employment opportunities through value addition enterprises in production, processing and marketing. Minituber production system is thus seen as a new frontier that will open a window for production of own breeder's seed at ADC, resulting in enhanced sustainability of the formal seed potato production system, to the local small scale farmer in Kenya and Africa as a whole.

Enhancing Access and Availability of Certified Wheat Seed to the Smallholder Farmers in Kenya

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Wheat is the second most important cereal crop after maize in terms of production and consumption and contributes to the country's food security. Kenya produced 441,750 MT of wheat in 2012 while the national requirement stood at 1million MT and the deficit of 56% was met through importation. Demand for wheat products is increasing by 4% annually. The low wheat production is to attributed to land subdivision, emerging pests e.g., UG 99 and Russian aphid, lack of access to certified seed by the smallholder farmers. They use own recycled seed or buy grain as seed from large scale farmers. Large scale farmers produce 80% of the wheat but these farms are being subdivided due population pressure. Inorder to meet the deficit smallholder farmers must play a key role in wheat production. To increase availability and access of certified wheat seed to these farmers, five farmer groups were identified in EAAPP wheat growing cluster areas through a stakeholder consultative forum in 2011.The groups were trained on seed production with the objective of graduating them into licensed seed merchants. In the long rains season 2012, they were provided with the 10 MT of breeders seed of two varieties 'Robin' and 'Eagle 10' that are tolerant to UG 99 to produce certified seed under the KARI Seed Unit (KSU). A total of 53.6 MT was produced as clean certified seed by KSU.

The groups earned Kshs 2.6 million after deduction of 30% the total production cost. In October 2012 and April 2013, 18.8 MT of the seed was planted in 150Ha for seed bulking by the groups. The balance was sold to farmers within and outside the cluster areas through KSU. Farmers who benefited from the improved seed are getting 4.5t/ha compared to 2.2 t/ha from the poor quality seed.

An analysis of the sustainability of community based decentralized seed systems in Uganda

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The paper analyzes the economic sustainability of community based seed enterprises in Uganda. Data was collected from 376 seed producers who belonged to different groups in 2011 from South West, Northern and Eastern Uganda. Data was analyzed using a multiple regression model. Sustainability was measured by the level of productivity per hectare of the seed enterprises. The results show that the level of sustainability of the enterprises is affected by the gender of the farmer where female farmers achieved a 30% lower level of productivity compared to male farmers. Results also show that farmers that joined production groups earliest (more than 20 years earlier)or latest (less than 3 seasons earlier) were less likely to achieve high productivity (3.6% lower) indicating there was an optimal level of farm experience that led to higher productivity. Farmers that were able to sell to both men and women were more likely to achieve higher productivity (25%) relative to those that sold only to women. Farmers that preferred the kind of beans they were growing were likely to achieve 10% higher outputs relative to those that did not have positive evaluations of the varieties. Farmers that had planted seeds for more seasons were able to get 50% higher outputs relative to those less. Additionally, farmers that did not participate in the promotion of the beans also had lower levels of outputs by up to 11%. Overall, groups that initiated their enterprises for commercial purposes as opposed to other social objectives (e.g. wide distribution of varieties to community members) were likely to achieve higher levels of outputs per hectare (430 kg versus 300kg, respectively). Establishing organized and reliable markets for seeds and encouraging and strengthening farmer group efforts would motivate the seed enterprises to increase productivity and hence sustainability.

Participatory sunflower variety selection under sole and intercrop system in Nyandarua County, Kenya

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Participatory variety selection is one of the best options to facilitate dissemination of new crop technologies. Participatory approaches to variety evaluation increase adoption of new technologies. The objective of the study was to provide farmers and scientists the opportunity to work together in selecting the most suitable sunflower (*Helianthus annuus* L.) varieties for their region, under sole and intercrop systems with runner beans (*Phaseolus coccineus* L.). The study was conducted at Kiriogo location of Nyandarua district in Kenya in the main season 2012. The trial was laid out in a randomised complete block design with three replicates. The treatments comprised four released sunflower varieties Kenya Fedha, Kenya Almasi, Kenya Mkaa and H8998 under sole and intercrop system with a local dwarf runner bean variety. Evaluation of the sunflower varieties was done 78

participants through a participatory process at flowering and physiological maturity stages. The farmers developed nine criteria for selection of the varieties through a participatory process. The criteria were the head size, stem thickness, plant height, head shape, expected yield, plant vigour, neck bending, leaf size and maturity period. Kenya Fedha emerged the best variety at flowering in both sole and intercrop systems by scoring a mean of 26.2 and 30.3 respectively. Variety H8998 was selected as the best at physiological maturity by scoring a mean of 29.7 and 30.9 in sole and intercrop systems respectively. Combined analysis resulted in H8998 emerging as the best variety under the intercropping system while Kenya Fedha was the best under sole cropping. The variety Kenya Fedha had the best farmer preferred traits. Participatory variety selection cannot only aid the farmers' in selecting the most suitable variety for their environment but can also aid breeders' in determining deficiencies in the available technologies.

Performance of elite potato clones for drought tolerance in Western Uganda

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Potato plays a major role in national income, food and nutritional security. Potato production is being affected by fluctuation in precipitations in both timing and amount, increased temperatures, which together reduce productivity. This study identified potato clones resilient to water and heat stress and determined the effect of temperatures on the performance of the selected clones. A set of twelve potato clones was evaluated both on station and on farm for three seasons in Kabale, Mbarara and Kasese districts; Kasese being the driest of the three districts. Farmer participatory approach was employed to determine acceptability of drought tolerant clones.

Highly significant differences were observed among clones selected by farmers in Mwizi. The average yield at Kalegyere was 16 t/ha and seven clones yielded above average with clone 395111.13 giving the highest mean yields for all the on station sites of 22 t/ha, 10 t/ha and 7 t/ha for Kalegyere, Mbarara and Mubuku, respectively. From on farm trials, clones revealed high significant differences and Mwogyera gave the highest yield of 31t/ha, Isule 6.6 t/ha and Mwizi 4.7 t/ha. Generally clone 381471.18 gave the highest yield in tonnes per hectare (20.98), followed by 393077.159 (19.59), 396038.107 (18.48), 395111.13 (16.35) and 396038.103 (15.05).

Clones showed significant differences in number of flowered plants, number of flowers, number of leaves, number of stems, leaflets length, leaflets width and leaf area between clones. Significant interactions were only observed for plant height, number of stems and number of leaves. Maximum plant height was recorded for 393382.44 (59.3 cm) and least for 381381.20 (40.3 cm). 395111.13 added more leaves (4), 393382.44 had more flowered plants (26), 396034.103 more flowers (21), 395029.250 more leaves (14), 396034.103 and 391691.96 more stems (4) while 395111.13 and 395029.250 had a bigger leaf area (11.8) compared to other clones.

Tissue culture for improvement of banana in Sudan

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Dwarf cavendish' is the most widely grown banana cultivar in the Sudan and it is sensetive to cool weather, low yielding and less suitable for export. Mutation induction and introduction of banana germplasm were used to improve banana production and quality. Two cultivars of banana with high yield potential were released. A technique for micropropagation of these banana cultivars using shoot tip culture was established to facilitate the desimination of these cultivars to farmers. The frequency of shoot morphogenesis on shoot tip cultures initiated from green house grown plants was better than that from field grown plants. Length of shoot tips (4 and 8 cm) had no effect on shoot elongation on the banana *cv*. Albeely. The best number of shoots per explant was induced on BAP at 4 mg/l. Addition of 0.5 mg/l IAA improved the *in vitro* propagation of banana shoot tip explants. Addenine sulfate did not increased the number of shoots regenerated per explant of banana. Coconut water at 10 mg/l improved the morphogenesis of shoots from shoot tip explants of the banana *cv*. Albeely. Limited number of farmers are using tissue culture produced plantlets. Most of the planting material is imported with high cost. Low cost innovation initiated under ASARECA project will improve the adoption of these cultivars and reduce the cost op plant material.

Cage culture trial of Nile tilapia *Oreochromis niloticus* (L) in the Lake Victoria, Tanzania

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Cage culture trial of Nile tilapia *Oreochromis niloticus* (L) was conducted at Tanzania Fisheries Research Institute (TAFIRI) Sota sub-station. The aim of the study was to determine the optimum stocking density for Nile tilapia cage culture. The study also assessed the economic viability of cage culture system and its impact on water. Nine cages of 2m x 2m x 2m were constructed for Nile tilapia cage culture trials. They were sited at the near shore of the station within the Lake Victoria, Tanzania on January 2013. All cages were set at about 75 m from the shore at 7 m depth. The cages were stocked with Nile tilapia of mean initial weight and total length of 18.0±2.1 g and 9.4±0.4 cm respectively at a stocking density of 70, 100 and 130 fish/m^3 in triplicates. Fish were fed on 25% crude protein Ugachick feed imported from Uganda at feeding ration 5% per body weight three times per day at 1000hrs, 1300hrs and 1600hrs. Fish was sampled for individual weight and length on monthly bases. Dissolved oxygen, pH, temperature and transparency were monitored on weekly basis at 0900hrs. Whereas water samples for un-ionized and ionized ammonia, nitrates, nitrites, total dissolved solids, phosphorous, free Co_2 were collected after every two months. Results to be generated from this study will suggest the

optimum stocking density for cage culture that will give the highest growth and yield performance. The results will also demonstrate whether cage culture of Nile tilapia in the Lake Victoria is economically viable or not.

Acceptability and Physicochemical Characteristics of Dried Leafy Vegetables in Ngora, Uganda

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Vegetables are a vital component to human diet because of the nutritional and health accrued benefits. According to nutritionists they should be consumed throughout life. In many parts of Uganda however, consumers cannot access vegetables during the dry seasons due to lack of appropriate preservation methods. Drying combined with packaging and appropriate storage could ensure shelf stability and regular supply to consumers. Unfortunately information pertaining to nutritional, physicochemical functional, and storage quality of dried vegetables is still lacking in the country. Solar drying and open raised drying rack technologies combined with blanching were evaluated for their effect on quality and extending shelf life of Amaranthus, cowpea and hibiscus leafy vegetables. The colour, water activity and organoleptic properties were determined. Moisture content 6.06% to 8.68% (dry weight basis) and dry matter contents 92.46% to 95.62% (d.w. basis) in dried raw amaranthus, cowpea and hibiscus were established. Dried vegetables positive L* values, 37.9±0.577 to 44.95± 0.087, signifying light colour in blanched amaranthus and raw cowpea leaves, negative (-ve) a* values (-7.275± 0.063 in cowpea leaves to -3.3 ± 0.735 in Hibiscus, signifying greenness, and positive (+ve) b* values (3.45±0.087 in cowpea leaves to 7.90±0.115 in hibiscus, signifying yellow colours after processing and one month storage were established. The green, yellow and light (positive L) colour were suggestive of no darkening or loss of colour ($p \leq 0.05$) in the first month of storage. Water activity levels 0.34 – 0.54 found after one month storage in high density polyethylene packs were indicative of good storage stability. Mean organoleptic scores >5.00 for appearance, taste, flavour, and texture signified moderately to slightly acceptable dried cowpea leafy vegetables. Overall dried leafy vegetables attained water activity <0.6 and moisture contents <10.0% suitable for storage stability. Moderately high scores for organoleptic attributes of the dried cowpea leafy vegetable showed the potential of acceptability on the market.

Effects of cattle manures on production of tomato (Lycopersicon esculentum Mill.) Grown in the sandy soils

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Tomato (Lycopersicon esculentum Mill) is an important vegetable crop produced in Tanzania. In the peri-urban areas, smallholder farmers do keep livestock at the same time grow crops. Due to this fact farmers may recycle both crop residues and manures from gardens and animal barn for vegetable production. Among the vegetable crops tomato is the most important due to the fact that it fetches better market than the rest of vegetables.

The production of vegetable crops has been declining over time in the cause of low soil fertility, pests and diseases. Soil fertility improvement especially in the sandy soil areas is highly needed to significantly boost and improve tomato production and ultimately food security and farmers livelihood.

This study was conducted to the farmer's fields in Luchelele which is one of the peri-urban areas of Mwanza city during the dry season of May - August 2012. The objectives were: (i) to determine nutrients content of cattle manure under farmer's management's level, (ii) to determine the effects of different application rates of cattle manure on tomato production in sandy soils and (iii) to recommend an optimal application rate of these cattle manure for tomato production in sandy soils. The experiment was laid down in a RCBD with four treatments levels: 10t ha^{-1}, 5t ha^{-1}, 2.5t ha^{-1} and 0t ha^{-1}(control). Farmers were used as replicates. Both soil and cattle manures were analyzed in the Laboratory to determine plant nutrients content before start of the experiment. Both the cattle manure and soil samples had low nutrient content especially nitrogen which was less than 0.2% for both cattle manure and soils. At the end of season/harvest soil samples were collected and analysed, it was found that application of cattle manures in sandy soils improved chemical properties.

After seventy days from planting date plant height and number of fruits were recorded at an interval of 7 to 15 days. Actually fruit weight and total number of fruits in cattle manure treated plots at harvest were significantly higher than control. However, 5t ha^{-1}, and 10t ha^{-1} were not significantly different in tomato yield and number of fruit.

To minimize costs of production in terms of labor costs and input supply farmers may apply 5t ha^{-1} of cattle manure because it gives the same results like that of 10t ha^{-1}. Proper management of cattle manures is required to avoid losses of nutrients. To synchronize nutrients release/mineralization and crop uptake farmers are advised to apply cattle manures three months prior planting.

Linkage map saturation and fine mapping of *Striga* resistant QTLs in Sorghum (S*orghum bicolor* (L.) Moench using (N13x E36-1) RIL population

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Striga is a devastating parasitic weed in sub-Saharan Africa and parts of Asia. Striga resistance is a complex trait controlled by five QTLs, Molecular markers linked to the resistant QTLs can accelerate development of Striga-resistant lines. Genetic maps provide an important genomic resource for understanding genome organization and evolution. Linkage mapping is used to identify and map genes and quantitative trait loci (QTL) with phenotypic traits. The aim of this study

was to saturate Striga resistance QTLs using SSRs & DArT markers and to fine map Striga resistance QTLs.

QTLs associated with Striga resistance were well saturated and the confident intervals were reduced, 22 SSR marker mapped to sorghum linkage map, we precisely mapped 271 markers tightly linked to the Striga resistance gene on SBI-01, SBI-02, SBI-05a, SBI-05b and SBI-06 at a distance of 3-5 cM, respectively. The fine-mapped QTL regions were validated under Sudan conditions by genotyping and phenotyping of RIL population for Striga resistance. The markers co-segregated with Striga resistance in all tested lines and the QTLs were in the same position as proposed by Haussmann 2004. The identified markers would be useful in marker-assisted selection for introgressing this trait into susceptible sorghum cultivars.

We successfully proposed a saturated linkage map with (271) markers and addition of 22 SSR tightly linked to Striga resistance QTLs and DArTs covering the 10 linkage groups offers real advantage for MAS application. We also test the validity of the QTLs identified by Haussmann in Sudan environment to insure that the QTLs are stable and can be introgress to elite backgrounds sorghum.

SESSION 4: KNOWLEDGE MANAGEMENT FOR GREATER IMPACTS

Oral Presentations

Ameliorating Melarsoprol Toxicity Using Kenyan Purple Tea Anthocyanins and Co-enzyme-Q_{10} in a Mouse Model

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Melarsoprol, an organic arsenical is the only drug used to treat late stage *T. b. rhodesiense* infection in spite of its toxic side effects. A mouse model was adapted to study the effects of melarsoprol which was apparently toxic at normal intravenous doses of 3.6mg/kg body weight. Results from this study show that melarsoprol prominently reduced aconitase-1 and glutathione levels in the brain of mice. Additionally, blood analyses showed that it decreased packed cell volume (PCV). However, orally administered Kenyan purple tea anthocyanins or coenzyme-Q_{10}, prevented to a significant degree melarsoprol-induced decrease in packed cell volume and restored aconitase-1 and glutathione levels. Notably, anthocyanin metabolites were detected in brain tissue of anthocyanin fed mice using high performance liquid chromatography. Co-administration of tea anthocyanins and coenzyme-Q_{10} caused a reduction of these beneficial effects implying a negative interaction between the two antioxidants. The present study demonstrates a role of reactive oxygen species sensitive aconitase-1 and glutathione in the induction of reactive encephalopathy by melarsoprol. Evidence provided in this study implicates melarsoprol with interference of brain antioxidant systems and proposes that therapeutic intervention with purple tea anthocyanins or coenzyme-Q_{10} may be useful in improving treatment outcome in late stage Human African Trypanosomiasis consequently reducing occurrence of post treatment reactive encephalopathy occurrence.

Nutritional status of children aged (0-59 months) and associated; factors in Mbeere South district, Kenya

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Information on nutritional status of children under five years is a indicator of nutritional situation in society. Identification of core factors influencing nutrition of this population supports plans to alleviate child malnutrition and its consequences. This study sought to determine the nutritional status of children under five years and associated factors in Mbeere South District. This cross-sectional descriptive study used a structured questionnaire and measurements of weight and height. A total of 144 households were randomly sampled. Nutrition status of one child from each of the sampled households was assessed using anthropometric measurements. The World Health Organization (WHO) reference standard was used to interpret the nutrition status. ENA for SMART was used to compute z-scores; and SPSS was used for descriptive, correlation and regression analyses. The results show that 39% of the children were stunted; 7.9% were wasted; and the underweight prevalence was 22.0%. The prevalence of stunting and wasting was significantly higher in boys than in girls (χ =6.765, df =2, p =.034) and (χ= 13.053, df =2, p = .036), respectively. The individual dietary diversity score showed that the most consumed food group was cereals. Eggs and meat were the least consumed foods. Low diversity scores were recorded for 41.9% of the children (< 4 food groups); 35.7% had medium scores (4-5 food groups) while 22.5% had high scores (6- 8 food groups). There was significant association between household size and nutritional status (P=0.047). The findings indicate that malnutrition and dietary diversity are major challenges in Mbeere South District. Future interventions should focus on improving food access and availability for enhanced diet diversification for the rising population.

Client Focused Extension Approach for Disseminating Soil Fertility Management in Central Kenya

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Soil fertility replenishment in sub Saharan Africa (SSA) is critical to the process of poverty alleviation. Although researchers have developed many soil fertility improving technologies, adoption of the technologies is low due to inadequate awareness of the technologies and lack of

requisite resources. Extension agents are professionals in the extension system responsible for enhancing farmers' acceptance of innovative practices from research which leads to increased farmers' productivity and income. Hence, the study sought to investigate factors considered by agricultural extension agents in selection of communication channels to disseminate soil fertility information in the central highlands of Kenya. Structured questionnaires were used to elicit information from 105 extension agents. Both descriptive and inferential statistics were used for data analysis. In choosing the communication method to be used in dissemination of soil fertility management (SFM) practices, target group was scored as the most relevant factor followed by type of SFM, time available then number of staff sequentially. Education was perceived to highly influence the selection of workshop (φ= 3.4) while age was perceived to highly influence the selection of video showing (φ = 2.8) as an extension methods in dissemination of SFM. The implication of the study is that diverse communication channels should be utilized to get to farmers of different socio economic characteristics.

Transforming Agriculture through Contacted Extension Service Delivery Systems: The Case of Kenya's Agricultural Productivity and Agribusiness Project

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Transformation of small holder agriculture from subsistence farming to agribusiness focused systems is paramount towards attainment of Kenya's vision 2030 and the Millennium Development Goals. This requires appropriate and demand driven extension service delivery approaches that focus on addressing challenges within agricultural products value chains (APVC) continuum. Conventional extension service approaches have not effectively contributed towards this due to their limited capacity and expertise diversity. Such services focus more on production issues, missing out on marketing and value addition interventions. The Kenya Agricultural productivity and agribusiness project (KAPAP) is piloting an innovative service delivery model that adopts a community demand driven approach (CDD) to avail to farmers extension services from contracted service provider (SPs) consortiums. The selection of SPs is done in a competitive manner while the targeted farmers enlist themselves into common interest groups (CIGs) whose common interest is to improve their productivity and incomes. Payment for services rendered is pegged on achievement of set income indicator benchmarks negotiated and agreed upon between farmers and their SPs. A total of 109 SP consortiums were contracted in January 2012 to offer services to 118,865 farmers (Males- 57%, Females-43%) within the twenty project counties. The total farmer earnings achieved by within the first year was KSH 2,158 billion at a service delivery cost of 95.6 million Kenya shilling. In spite of some regional differences on farmer participation, and level of achievements, the return to investment of 39.4 is an indicator on the potential behind contracted service delivery systems towards transforming agriculture in Kenya.

Determinants of Access to and Use of Technologies by Groundnut Value Chain Participants in Eastern Uganda

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Access to information and new technologies empowers various participants in a given value chain. There are various participants in the groundnut value chain in Eastern Uganda, who have differential access to information and hence market power. This study was aimed at determining the factors that enable participants to access information on new technologies used at various stages in the groundnut value chain. It was conducted in the major groundnut producing districts of Tororo, Mbale and Bukedea where 155 Producers, 88 traders and 19 service providers were surveyed. Logit and Multinomial Logit (MNL) models were fitted to the data using STATA analytical package. Our preliminary results reveal that on average, producers in production groups were more likely to access and use new technologies compared to their counterparts without groups. In addition, group membership and education also pre-disposed producers and processors to access and use of new groundnut technologies. Service providers also were more likely to interact with producers and traders organized in producer-marketing groups than individual actors along the chain. Efforts should be strengthened to facilitate group formation to enhance knowledge sharing and technology adoption in the groundnut value chain.

Linking local seed system to bean seed value chain in the DR CONGO: Experience of Innovation Platform in the DRC

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The paper describes the experience gained form linking local and informal community farmer's bean producers to bean seed value chain. This was expected to increase the availability of quantity, quality, and affordable seed of a wide range of the best marketable varieties opportunities to smallholder and resource-poor farmers. A collective effort to grow and supply seed approach was used to set up a consulting and participatory framework of bean seed producing and marketing in South and North Kivu provinces. 74 participants including: Farmers, grain/seed merchants, private and public extension agents from 3 sites spread into three territories Kabare, Rutshuru and Masisi were embarked in the Innovation Platform process (IP). A rate of success was achieved using this strategy in making bean seeds available to bean producing farmers on a pilot scale. The experience showed that once well surveyed, technically and financially supported, and linked to sources of improved varieties; the informal seed sector can play a significant role in a crop value chain development. The IP may help to overcome or reduce the existing biases in access and availability of quantity and quality of seed of improved varieties in the seed value chain.

Public Private Partnership in Dissemination of Improved Bean Technologies in Uganda

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The innovation platform with partners like NARO-BEAN PROGRAMM, the National Agricultural Advisory Services/ extension agencies, Civil Society Organizations, Farmer associations, Market information firms, government, CIAT/ PARBA and Media with each playing specific roles and using different methods was adopted as a model for disseminating bean technologies. This paper evaluates the roles, benefits, lessons and challenges of public-private partnership model, implemented through platforms, in the dissemination of improved bean technologies. The data was collected through discussions with the key partners, seasonal production and reach data, interviews and focus group discussions basing on the evaluations close to surveys, case studies and success stories. The use of the model showed improved awareness, dissemination and utilization of bean technologies especially improved bean varieties. Partners expressed satisfaction with the approach but noted challenges in conceptualizing how it works, distribution of roles, fostering self-drive, funding gaps, poor communication and information sharing. We conclude that involvement of multiple stakeholders in dissemination of improved bean varieties and other technologies facilitates wide reach, stimulates adoption, creates demand for technologies and also may facilitate commercialization of some technologies. It thus should be implemented on the basis that all partners involved have equally critical roles and none is under looked in the process.

Enhanced Dissemination through Radio: A Success Story in Dairy in Kenya

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Milk production in Kenya is low with an average of 8 litres/ cow/day, due to poor dairy husbandry, low quality breeds, poor quality and shortage of feeds during dry season. Dissemination of available technologies and innovation to overcome the low production has been limited by low staff to farmer ratio 1:2000. As a result, radio programs have been recognised as effective pathways of enhancing dissemination of dairy technologies when followed by field demonstrations and field days. In order to develop the radio program, a baseline was conducted in 10 sub counties to identify training needs of farmers. The following areas were identified; dairy as a business, group dynamics, farm structures, breeding, feeds and feeding, animal husbandry, milk quality and value addition. From the needs a training module was developed. A Radio Station broadcasting in Kiswahili covering the whole country and the best time of program were identified. At the inception, stakeholders were sensitized and grouped into thematic areas of training. Individual farmers were required to registered by ksh100 (US$ 1.2) through *M-pesa*. Thirty interactive radio sessions were aired between 8pm - 9pm on Thursdays. A question was posed to farmers to answer through DTI dedicated lines at the end of each session. Each session was followed by practical skills development through demonstrations, field days and exchange tours to areas of excellences. Certificates and rewards were presented to the farmers who had participated in more than 75% of the sessions. The program surpassed its target of 16,360 farmers to reach 23, 000 listeners (31% females 69% males) in seven months. As a result, farmers have improved on zero grazing structures, youth groups are pulverizing crop residues as a business and demand for improved breeds and AI services has increased making the radio program an excellent tool for technologies and innovations dissemination.

Awareness and Sources of ISFM Technology Information for Improved Groundnut Production and Value Addition

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Groundnuts are a key crop in Uganda, both as a source of nutrition and income. However, lack of knowledge and information on key practices along the groundnut value chain is a key contributor to the poor performance of the sub-sector. This study aimed at establishing baseline knowledge on key aspects of groundnut production, processing and marketing with a view to identifying areas and gaps for capacity building interventions. A total of 155 farmers were randomly sampled and primary data collected in early 2013 from three districts in Eastern Uganda namely; Bukedea, Mbale and Tororo. Results indicate that farmers were aware of most recommended pre and post harvest technologies/ practices including knowledge on improved planting material, better agronomic practices, proper drying and cleaning, proper storage, grading, sorting and packaging. However, knowledge of these technologies did not correlate with usage as not all who knew about an improved technology applied it. This finding points to presence of constraining factors that hinder access and application of known technologies. Capacity building efforts to increase both access and utilization of value-enhancing groundnut technologies will eliminate the gap between awareness and use of these technologies for improved livelihoods.

Sustain bean utilization and innovations for improvement of small farmer livelihoods: case study of the North and South Kivu Provinces in Eastern DR. Congo

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Common bean (*Phaseolus vulgaris* L) is one of the staple foods that provides cheaper protein and essential minerals such as: iron, zinc, fiber and vitamins in the dietary food consumption of the poor people. In the Great Lakes Region that comprises: Burundi, Rwanda and eastern DR. Congo, the bean consumption per capita is high (about 50 kg/year or 137 g/day), but the bean production remains low because of non access to seeds of improved varieties and related technologies. Due to low production and non-availability of foods, hunger and malnutrition are bound up with ill-health and poverty. To combat this situation, the national research bean program of INERA has developed a quite number of

biofortified bean varieties and related technologies to be used in integrated crop systems of the farmers and respond to end-users requirements. The main objectives of this study were to avail seeds of improved bean varieties and validate integrated crop management (ICP) options as a package technology in participation with end-users. Thus four pillar strategies were developed:-1) Avail biofortified improved bean varieties and validate integrated crop management options; -2) Diversify dietary food through facilitating access to nutrient rich bean products and bean based food baskets; -3) Develop gender-responsive organizational mechanisms and arrangement to strengthen market linkages; -4) Enhance equitably the capacities of stakeholders across the bean value chain in the innovative platform forum. Thus, some outputs were developed; a)-production of the basic/certified rich bean varieties on pilot research stations of INERA and on-farm sites with four key partners: PABU, COOPAM, UMAMABU and AJECEDEKI, besides some ICPs utilizing bean in association with cassava and bean with corn were validated; b)-identification of traditional bean recipes; c)-identification of local, national and regional markets and d)-production of baseline data. This is a progress report of the ASARECA bean utilization project in the DR. Congo.

Evaluating effects of farmer group's membership on agricultural technology adoption and crop's productivity in Uganda

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The study attempts to provide a policy answer on whether targeting of farmer groups will lead to agricultural transformation in Uganda. Uganda Census of Agriculture (2008/09) database was used. Descriptive statistics and results of probit, translog production function and propensity score matching were used in describing major characteristics, factors influencing participation to farmers' groups and assessing impacts of group's membership on agricultural productivity.

Membership to farmers groups in Uganda is low with only 19 percent of households having at least a family member belonging to farmers' group. Access to National Agricultural Advisory Services (NAADS) is also very low at 11 percent of farmers, with membership to groups only improving access slightly from 6.4 to 7.6 percent of all the households.

Although membership to farmers groups resulted to increased productivity for banana, maize and cassava, negative impacts were observed for sweet potatoes. Groups' members achieved significantly higher productivity on banana and cassava by 4.2 and 1.9 tonnes/ha respectively. Sweet potatoes productivity declined significantly among members of groups with about a tonne per hectare.

The study recommends improved campaigns on enrolments to farmers groups, improved linkages between the farmer's groups, extension and research functions, and monitoring and evaluations of group's sourcing of agricultural technology.
The paper also notes that the membership and participation of farmers in groups is at its early stages entailing concerted efforts to ensure observable outcomes that will ensure maintenance of members and attraction of risk-averse farmers.

Empowering small scale farmers through participatory market development: A Case Study of Kiriogo Location, Nyandarua North District, Kenya.

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The study was carried out in Kiriogo Location in Nyandarua County, Kenya. This is one of the project sites of the Kenya Agricultural Research Institute (KARI), International Development Research Centre (IDRC) funded project "Making agri-food systems work for the rural poor in Eastern and Southern Africa." Empowering farmers through participatory market development was designed to help the farmers overcome the constraints of inadequate markets and poor market infrastructure, so that they could learn how to interact and bargain more confidently in both the local and external markets. It aimed at reducing farmers' vulnerability by ensuring that they integrate marketing in their production plans. Building marketing infrastructure from the grassroots lays a strong base for building resilience in rural communities and it enhances farmers' ability to overcome the challenge of inadequate markets and marketing infrastructure that commonly face the Kenyan farmer. The innovation process adopted the six step FPMD procedure that was formation of umbrella CBO for 5 farmer groups, participatory, gender-sensitive choice of priority value chains, formation of marketing committees, market opportunities identification, enterprise design and business planning and collective marketing. This has built confidence in the farmers and they can now express themselves effectively in the market and seek help in the pertinent offices. As a result of this training, the sunflower growing farmers used their newly acquired skills to negotiate for an oil press from their local Member of Parliament (MP). They also formed a Community Based Organization (CBO) that has negotiated for the building of a local market. The CBO members now have the skills and capacity to undertake a market survey without assistance. The FPMD innovation revealed the great potential that farmers hold to learn and implement that which they perceive is beneficial and which could bring profit to them. Farmers now appreciate market dynamics and buyers' preferences and the need to produce with the market in mind. A field day was held where farmers displayed skills and branded products. A hundred and sixty farmers attended the field day. Other stake holders including policy makers attended and appreciated the field day

Information and Communication Technologies (ICT) for Sudanese Agricultural Knowledge Management (SAKM)

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Information and communication technologies are key agents for global change that facilitating faster knowledge sharing and innovations. Agriculture is a vital development tool in achieving the Millennium Development Goals. Sudan has launched the National Agricultural Renaissance Program to improve agricultural production and food security in the country. The Agricultural Research Corporation (ARC), the Ministry of Agriculture and Irrigation has recognized that knowledge management is a critical factor to assure executive program for national agricultural development. Within the framework of ARC as the NARIs of the Sudan, a remarkable index is the research and development performed in Sudan through collaborative projects with national, regional, international and sub-regional activities and initiatives. Their aims are to improve agricultural knowledge sharing

which are exposed to economic and social challenges. Advances in information and communication technologies "ICTs" are key agents for global change. The emerging of new digital systems together with the ongoing processes of globalization is facilitating faster sharing of information and innovations. ICTs have also opened new avenues in SAKM. The ultimate objectives of SAKM activities are to come up with results that can advance research more in certain areas, and engender technologies that SAKM stakeholders can use to increase production, conserve the environment, etc. This paper discusses the agricultural knowledge management challenges, explains how ICT could play a role in addressing and highlighting them in Sudanese Research Institutions and specifically information centers whose main function is to conduct applied research in ICT in Agriculture. The paper also highlights recent projects, networks and initiatives that support agricultural knowledge management in the Sudan. Finally the most applicable knowledge management applications are approached.

Poster Presentations

Challenges and lessons learnt in implementing regional projects: A case for the Livestock and Fisheries Project LFPRJ 05 on cattle in Eastern and central Africa

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ASARECA regional project LFPJ 05 on Testing and validation of breed survey methodology, Socio-economic survey and Characterisation of selected indigenous cattle of Eastern and Central Africa was conducted during the period 2009 to 2011. The project was implemented in Ethiopia, Kenya, Tanzania and Uganda by the NAES institutes (Ethiopian Institute Agricultural Research (EIAR), University of Nairobi (UoN), International Livestock research Institute (ILRI), Sokoine University, Makerere University MAK) and National Agricultural Research Organisation (NARO), respectively). The level of achievements varied depending on the country and implementing institution. Key activities included generation and utilisation of cattle breeding technologies and innovations on characterisation and community breeding schemes, policy reviews and formulations, capacity building and dissemination of information through networking and partnerships. Close collaboration with farmers, the public and private partners were valuable components. Different cattle breeds were covered in the different countries and sites. Several challenges were encountered but these varied from country to country and from institution to institution. These ranged from long delays between proposal submissions to project start ups, while projects objectives remained the same, thus making some of the activities that were initially proposed irrelevant. In additions there were delays in disbursements and accessing of project funds leading to inadequate time for implementing project activities, poor budgeting process, thus preventing the field extension workers from effectively participating in the project activities. Due to too much bureaucracy, there was lack of harmony in so far as institutions' grant accounting and management. Due to long delays, inflation related cost increases and huge exchange rates changes occurred, thus causing expenditure nightmares. Procurement procedures were often too complex and unnecessarily long in many institutions causing delay in implementation of activities. High staff turn-over adversely affected smooth project progression. Despite efforts to harmonize survey methods, especially for socio-economic surveys and data collection, huge variations occurred due to large inter-country capacity differences. This created difficulties in joint analyses and led to delays in reporting of results. The very nature of the projects, required long distance travels, thus good cars were needed yet were not budgeted for. Some, of the projects which started earlier as Stream B CGS ASARECA project run for the year 2006-2007 in the same countries of Kenya, Uganda, Tanzania and Ethiopia, was terminated prematurely in 2007. Changes had to be made on log frame, budgets, content and implementers to produce the LFP PRJ 05 version of 2009-2011 that conformed to the FAO Global Plan of Action (GPA) for Animal Genetic Resources. It is prudent for Project leaders to exercise open attitude, sharing information and building strong teams that effectively ensure continued good leadership and smooth continuity of project activities that deliver desired outputs. Lack of sharing of information undermined robust data analysis and inter-country comparisons. There is therefore a need to build strong and active project teams, including development of project staff capacity to enhance project leadership. Differences in the accounting systems in various institutions need to be harmonized to ensure timely implementation of activities in terms of technical and financial accountability.

Farmer's pest management practices in Mwea East and Embu East districts

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This study was undertaken to determine pest management strategies used by small scale French bean farmers in Embu east and Mwea east districts. The survey included 70 farmers, where 32 and 38 were from Embu east and Mwea east respectively. Multistage sampling technique was used to collect information on constraints that hinder French beans production, insect pests, and pest management practices, how decisions to control pests are made, pesticides that are used for pest control, and marketing and certification status of the farmers. Results indicated that most of farmers in the study area considered French beans farming as an important source of income, and up to 50% of the farmers had been in French beans production for a period of three years and more. Over 90% of French bean farmers were affiliated to groups, and were growing beans under contract. Less than half of the farmers had access to agricultural extension services, the rest relied on fellow farmers and relatives for information on French beans production. Julia was the most preferred variety, other varieties grown by the farmers mainly for fresh market and processing were Serengeti, Samantha, Amy, Ogandi, Teresa, Star and Alexander. Sorting and grading were the major post harvest activities practiced at farm level, rejects from sorting and grading were mainly used as livestock feed while local consumption of French beans was minimal. Over 70% of the farmers interviewed had good knowledge of insect pests and diseases. However, knowledge of their pest management strategies was inadequate and was entirely dependent on synthetic pesticides. White fly was the major insect pest while rust was the major disease as identified by majority of farmers. Only 36% of the farmers kept all the records of production, spray and sales. The main marketing channels used by farmers were brokers and exporters. Less than 30% of the farmers were involved in implementation of EUREPGAP (GLOBALGAP), with 3.1% of the farmers certified. The findings showed that farmer's pest management practices were incompatible with good agricultural practices and export market standards, there is need for farmers to be trained and sensitized on the use of alternative pest control methods and export market standards.

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