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Food and Nutrition Security in Africa

Book of Abstracts

Susanna Rokka (ed.)



**FoodAfrica Midterm Seminar in
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Preface

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According to many studies investments in agricultural research play a key role in raising agricultural productivity and enhancing food security. In particular, the need for research inputs is relevant in Africa which in global terms has the lowest agricultural productivity and the highest level of malnutrition among the human population. Africa provides only 10% of global agricultural output, although it has the world's largest reservoir of unused arable land (about 60%). On the other hand, agricultural and livestock production is one of the most important economic sectors in Africa, as about 75% of the African population relies on it for their livelihoods. 90% of the agricultural output is produced by smallholder farmers on farms averaging 2.5 hectares in size.

African agriculture is challenged by many factors. According to FAO estimates up to 50% of harvested food is lost due to lack of proper agricultural technologies in small-scale farming, adequate inputs for cultivation, proper storage facilities for agricultural produce and reliable access to markets. Another reason for a slow agricultural development has been a low impact of knowledge transfer from researchers to farmers owing to adoption of unsuitable dissemination methods. Furthermore, climate change is aggravating the situation and calling for novel approaches in agricultural and livestock production.

It has been generally accepted that human capacity building, involving all stakeholders along the food supply chains is a successful strategy for increasing agricultural output and improving food and nutrition security. These facts were highlighted in the recent 4th EU-Africa Summit which in its road map 2014-2017 stressed the importance of investments in science, technology and innovation (STI) in Africa with a particular focus on development of a long-term, jointly funded and managed research and innovation partnership in the areas of food and nutrition security and sustainable agriculture.

The FoodAfrica Programme was launched in 2011 as a practical outcome of the Finnish Government development co-operation policy on rural development and food security. Also, the Programme is well in line with the above EU-Africa policy as it aims to provide new knowledge and tools for researchers, decision makers and local African farmers. To this end, basic and applied research is carried out on specific topics in six East and West African countries by a consortium of Finnish, African and international (CGIAR) research institutions. The results obtained will be disseminated back to all stakeholders in the supply chains. Human capacity building is also included through academic degree studies on agriculture, livestock and nutrition and training of farmers on better agricultural practices.

This issue of MTT Science presents the abstracts of key note papers and the first results of FoodAfrica delivered at the mid-term seminar held in Helsinki in June 2014. The results are primarily based on the work of the doctoral students attached to FoodAfrica.

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Strengthening Business Approaches to Tertiary Agricultural Education in Africa

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Abstract

Higher education institutions are under pressure to reform as a result of increased global challenges. In the case of sub-Saharan Africa, the issues are worsening poverty levels and the inability of agricultural graduating students to set up enterprises. This paper examines the need for restructuring tertiary agricultural education institutions in Africa to align with market demands and to link more closely to the private sector.

The paper builds on the case of two main programmes namely the UniBRAIN-Linking Universities with Business and research in Agricultural Innovations, and the SASACID – Strengthening Africa’s Strategic Agricultural Capacity for Impact on Development, that the African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE) has been involved in from 2010 to 2014, to show that aligning tertiary Agricultural Education systems with market needs requires systems restructuring. This restructuring includes accepting official participation of private sector in the management of institutions, in curriculum development and implementation, and in infrastructure upgrading and retooling of lecturers.

The main outputs from the UniBRAIN and SASACID programmes need to be

publicized and scaled out. They include the six (6) Agribusiness incubation consortia put in place in 5 countries (Kenya, Ghana, Mali, Zambia and Uganda), helping to develop students into entrepreneurs; the innovative Agribusiness curricula developed for all tertiary degree levels from Certificate to PhD, the Agribusiness Internship guide incorporating an optimal theoretical and practical approach and the contextualized Agribusiness learning materials published which bring the learning experience to the realities on the ground. Even though many of the ANAFE member institutions are enthusiastic in working with ANAFE in strengthening their business approaches to agricultural education and research, future challenges to foresee in reforming tertiary education systems to be more relevant to business development include the need to diversify sources of funding, increase capacity for new management functions and assure actual leaders and government that the required reforms are not threatening the fundamental ways tertiary agricultural education institutions make their contribution to the accumulation of knowledge and ideas.

Key words:

Tertiary Agricultural Education, Reforms, Agribusiness, ANAFE, UNIBRAIN, SASACID

Agricultural Research for Food and Nutrition Security

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Introduction

The challenges to achieving food security globally and regionally in the next decades are well known. They relate to population growth, diminishing availability of and competition for natural resources, climate change, access to land and tenure, disparities among gender and other social groups, plateauing of yields, food price fluctuations, food waste and pervasive problems related to nutritional status.

This paper looks at the challenges of food security from the perspective of research. It focuses on agricultural research and how it can contribute to food security and nutritional security. The paper discusses agricultural research in the context of international agricultural research for development in the CGIAR and draws from the work done in the past two years by the CGIAR's Independent Science and Partnership Council, a science advisory body, for improving the CGIAR's strategic direction and likely effectiveness.

The paper has the following components: the CGIAR research context; impact pathways to food security; impact pathways to improved nutrition; enhancing research effectiveness and expectations; and conclusions.

The CGIAR research context

The CGIAR of 15 International Agricultural Research Centers is a publicly funded research organization that has recently adopted four overarching high-level aspirational goals for impact: reduction of poverty, increasing food security, improving nutrition and health, and more sustainable management of natural resources.

For over 40 years of its existence, the CGIAR has focused primarily on improving food security. Its strategy has been to provide global public goods, that is: research results that are applicable across national borders and freely available to all. Major focus has been on enhancing crop yields and the productivity of commodities in general (livestock and fish included). The Green Revolution demonstrated the effectiveness of such strategy for wheat and rice. In Asia, particularly in India where under favourable policies adoption of improved varieties was accompanied by use of fertilizers and irrigation, Green Revolution helped to avoid serious famines. It led to sharp increase in cereal yields; growth in production exceeded demand caused by population growth and staple food prices fell as high yielding varieties were adopted. This price trend lasted till about 2008.

Since Green Revolution, the focus has shifted to relatively poorer regions and countries, to sub-Saharan Africa, to sustainable productivity increases (not just yield); still with the aim of improving food security while adding other goals, such as poverty alleviation. The concept of food security has changed from focus on energy security to including micronutrient nutrition and quality of food. Although the outlook that addressing hunger requires above all increased and stable production of the quantity of primary food crops for access and affordability, it is acknowledged that poverty, food security and nutrition are interlinked. Furthermore, it is acknowledged that in the face of environmental degradation and climate change, and as the Sustainable Development Goals are to supersede the Millennium Development Goals, sus-

tainable use of natural resources must underline all agricultural production.

FAO defines food security to encompass caloric and nutritional sufficiency and safety of food for all people. In estimating and monitoring food security four dimensions are used: availability, access, utilization and stability. These dimensions package a large number of conditions for them to be fulfilled. Agricultural research can address only some of the conditions – others being dependent on, for example, infrastructure, sanitation, transport, trade and education. Furthermore, there are trade-offs between different goals, given that poverty and hunger are multifaceted problems exacerbated by degradation of natural resources and climate change.

The reason why the CGIAR has opted to distinguish between food security and human nutrition and health is that the impact pathways to these goals are quite different and the assumptions underlying the impact pathways are not well known, particularly regarding the drivers of good nutrition. While the food security impact pathway targets availability, access and affordability, the nutrition pathway targets micronutrient sufficiency, particularly of women and children.

Impact pathways from research to development are typically protracted and non-linear. For better planning of research and accountability, each CGIAR research program is requested to define impact pathways from research to development impact specifying a set of intermediate development outcomes. These are realistic intermediate objectives among well-defined target beneficiaries and agro-ecologies that the research programs, in partnership with national players can contribute to.

Impact pathways to food security

The CGIAR research has impacted food security in large-scale mainly through food price effects. At regional and national levels, the impact pathways to food security are, however, quite nuanced. For instance, there are many different farming systems, rain-

fed and irrigated conditions, a whole range of food sources and options for diversification of food systems, and issues of seasonality, policy and national self-sufficiency. All these issues have implications to research prioritization, strategy and targeting.

Agricultural research can address many of the factors that influence food availability. These include variety development for tolerance of biotic and abiotic stresses and yield potential; water and soil management; water and nutrient use efficiency, agronomic practices and genetic erosion. It can influence land use, policy and markets through research-based options. It can also address equity and social change. Other factors and constraints are outside of agricultural research; such as distribution, trade, processing, food waste and health on which nutritional status depends.

Depending on their research focus, the CGIAR programs have multiple strategies and impact pathways to achieve food security. A few examples of research strategy and impact pathways for impact on food security are presented.

A main priority for the CGIAR is sustainable intensification of cereal production in the principal breadbaskets of the world. The research programs focusing on major cereals build around genetic enhancement and sustainable crop management practices. Reduction of post-harvest losses and socioeconomic research for enhancing technology adoption are also often included. The intermediate outcomes planned towards food security are increased crop productivity and farm profitability. On basis of empirical evidence it is assumed that the adoption of improved varieties enhances the probability of food security, per capita food consumption, and probability of attaining the food breakeven and food surplus status.

CGIAR research also targets entire system on which agricultural production depends with the aim of reducing risk and vulnerability and enhancing resilience to shocks at farm level, and strengthening the agricultural innovation systems. Research addresses natural resource use, improving and stabilizing productivity, markets and

value chains, enhancing enabling policies and services. The main pathway to better food security is through increased resilience and sustainable intensification of the production system, and increased income at household level.

CGIAR also works on livestock, fish and forest-based foods and income opportunities through these enterprises. Research targets more sustainable use of soil, water and genetic resources. The impact pathways on resource use have the long term objective of enhancing ecosystem services in agricultural landscapes for sustaining agricultural productivity and food security into the future.

It is known that agriculture is a key driver for economic growth at national level, particularly in agriculture-based countries (sub-Saharan Africa in particular), and that increased production and productivity of main commodities increases food security through lower prices and price stability, and improvement in income and employment. However, it is also known that the issues underpinning poverty and hunger are fundamentally complex and the impact pathways are specific to the development context.

These contexts range from subsistence farmers trapped in low-productivity farming in countries with slow economic growth, with limited resources and no off-farm opportunities at one end to dynamically developing regions at the other end where small market-oriented farms can supply growing urban areas with high value products. Research strategies for food security objectives need to respond to the context of urban vs. rural and, within the latter, subsistence vs. market-oriented farming. Research strategies also need to integrate technology and policy and address equity among different groups, including gender.

Impact pathways to improved nutrition

The CGIAR's nutrition security objective targets micronutrient malnutrition. Health objective, encompassing food safety and agriculture-related health risks, is also incorporated into this major impact goal. In the

CGIAR's research agenda, the justification for addressing human nutrition and health issues separately from food security is that malnutrition is much broader issue than just energy sufficiency, researchable issues are different and impact pathways are complex and largely dependent on other factors than agriculture. It is also acknowledged that gender and intra-household disparities contribute to poor nutrition. Malnutrition is particularly serious in areas where poverty and food insecurity are prevalent, including sub-Saharan Africa and South Asia. The CGIAR's mandate across a wide range of crops and livestock and production systems offers opportunities for addressing micronutrient malnutrition and health issues.

Although agriculture is considered critical for addressing malnutrition, there is limited evidence of how agriculture influences nutrition and how food availability and prices influence dietary diversity. More information and evidence is needed on how access to nutritious foods is translated to improved nutrition status at household and individual levels. Three dimensions related to women's role have been identified in the impact pathway from agriculture to better nutrition: women's status and control of resources; women's time and knowledge; and women's nutrition.

According to FAO, agricultural interventions can also lead to negative nutritional outcomes. Therefore, better analysis and understanding of the impact pathways is necessary to address critical bottlenecks. This requires more than just agricultural interventions. For instance, essential conditions for good nutritional status include education, health care and improved sanitation. In all of these national policies play a central role.

The CGIAR has several strategies for enhancing nutrition. One strategy is aligned with increasing production and productivity of the CGIAR's traditional mandate crops such as wheat and legumes, and livestock and fish.

A specific strategy, also related to CGIAR's past research on specific crops, is biofortification where research has been going on

for more than ten years. Focus has been on iron, zinc and vitamin A. The micronutrient content of major food crops is increased through breeding. Nutritional research has been conducted on retention, bioavailability and efficacy. The impact pathway from the research product (new variety) to consumption is long. For instance with orange fleshed sweetpotato it involves production of cuttings for propagating the crop, incentivising farmers to adopt new, biofortified varieties that need to be better performing than existing varieties, distribution and marketing, and advocacy for enhancing the consumption of the food in adequate amounts by the targeted groups, women and children. There is not yet much experience on scaling up from pilot projects and the effectiveness of this strategy. Challenges at producer level include inability to identify the biofortified varieties if the trait is not visible, and at the consumer level resistance to consume the crop if the trait is visible – for instance colour that is not preferred. Ultimately, the outcomes depend on other conditions for good nutrition being in place.

One strategy is diversifying diets by producing at farms nutritious crops, for example vegetables in kitchen gardens. This strategy assumes that labour is available for the time required to manage the crops, and that farming families consume produce from the farm or that income earned from high value crops is spent on buying nutritious food. These assumptions may not hold true in all circumstances. More needs to be known about decision-making in households regarding labor allocation, consumption and expenditure.

CGIAR research addresses also certain health issues that have a relatively simple impact pathway and straightforward effect; for example reduction of pesticides, and reduction of aflatoxins in the food value chains.

A single strategy is unlikely to be effective. In developing countries diet transition is occurring and overweight is increasingly a problem. It is a problem even in poor countries, for instance in sub-Saharan Africa. It may occur among the poor,

because nutritious foods tend to be more difficult to obtain and are more expensive. Furthermore, it is not unusual that in the same households, there is both stunting and obesity.

Improving research effectiveness and expectations

The diversity of contexts in which food and nutrition security are pursued by research requires different strategies. Often impact pathways are presented at a general level and as linear. In reality impacts are not linear. Thus the plans need to take into account the degree of heterogeneity among farming systems, beneficiary groups and agro-ecologies and the multiple feedback loops.

Research effectiveness can be improved by planning the impact pathways and periodically adjusting them in light of new evidence of causal linkages. Assumptions are often made about behavioural changes among farmers, community actors, extensionists, policy-makers, market actors etc. Research can influence such changes through approaches that engage local groups, but largely the changes depend on activities and incentives outside the research domain. In order to make the uptake of research results more likely, research organizations invariably need to engage also in capacity development, policy dialogue and advocacy.

Research groups need to identify and collaborate with appropriate partners at regional and national level. Adaptive and applied research that is often necessary for locally applicable results is best done by national partners. Collaboration is also needed with a range of organisations including research institutions but also NGOs and the private sector. Many CGIAR programs consider that agricultural change and development is most sustainably pursued in agricultural innovation systems where research is but one component. Partnership and collaboration with local groups provides the feedback loops that are necessary for adjusting research strategies and impact pathways.

Research is only a small contributor to impact. It has been estimated that about 10 times more investment, that in the CGIAR research, is needed outside the CGIAR for the planned impacts to accrue. Such complementary investments include more national funding to science and technology in agriculture. Better coordination at international, regional and national level is also needed for making research more effective. It also requires institutional and policy changes. An example of the difficulty to coordinate research and policy for better nutrition is that in developing countries the different ministries that deal with agriculture or health or sanitation or education do necessarily collaborate.

In the overall effort to improve aid-effectiveness there is a trend to set targets also for research effectiveness in the international context that the CGIAR is part of. Too often in the current discourse it is implied that research is accountable for “value for money” in terms of achieving quantifiable targets in food security and nutrition. Research is, however, by nature risky and its results take a long-term to generate outcomes and impacts on the ground. Research organizations have little control over outcomes beyond their outputs and research findings. Furthermore, serendipity is characteristic in research; outcomes from research occur unexpectedly.

It is important to set the expectations from agricultural research at an appropriate level where it is feasible to attribute change to agricultural interventions. Indicators, such as hunger index or stunting, used for monitoring of progress in the MDGs, are not appropriate. Agricultural research can be reasonably expected to influence change at farm and household levels in, for instance, productivity from diverse food sources, seasonal food availability, and resource-use efficiency; and at national or sub-national level consumption patterns, food safety in the value chain or policy change. Even these changes depend on many other actors and conditions than just agricultural research. Therefore research plans with elaborated theories of change and impact pathways are intended to improve the relevance

of research and adaptive research management and should not be seen as blue prints for success.

Conclusions

Agricultural research has great potential for increasing food security and nutrition security in developing countries and among poor populations. Agricultural research can contribute overall economic growth, to food availability, affordability and quality and to sustaining the natural resource base that agricultural production depends on in the longer term.

However, research is just one contributor along the impact pathways, which typically are protracted and non-linear. The ways by which agricultural research contributes are often very context specific. Therefore research planning and choice of strategies requires analysis of the target beneficiaries, environments and specific constraints, and integration of technology and policy research, capacity development and advocacy. Constant feedback from new evidence of what works and what doesn't is needed.

The impact pathways from research to changes in food security and nutritional status of people depend on multiple partners contributing; some of them involved in the research process and others translating research results into practical applications and outcomes, and scaling up promising technologies and processes. Better coordination and investment, particularly at the national level is needed.

The expectations for what agricultural research can deliver should be realistic acknowledging that agricultural research has no control over the many other conditions that are needed for better food security and nutrition. The drivers for good nutrition in particular are largely outside of the agricultural research domain.

Keywords:

Agricultural research, impact pathways, food security, human nutrition, research effectiveness

“Excessive Volatility and Its Effects. What to do?”

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Abstract

Since 2007 food prices in international markets have experienced three spikes, and prices of grains have been 50% higher on average than in the previous 25 years. Recent years have also seen an increased correlation between food and fossil fuel prices in international markets, implying that these two markets are co-moving. High and volatile food prices have been blamed for raising domestic consumer prices and thus reducing food consumption for net food buyers in developing countries and excessive volatility has also affect producers given the uncertainty on what price they will get for their planting decisions. The poorest net buyers were the most affected by these shocks as they spend a large share of their income of food. Similarly, net food importing countries were also negatively affected.

Among the key factors playing a role in creating the 2007-2011 price spikes and excessive volatility are increasing biofuel production, the medium- and long-term effects of climate change, and higher levels of trading in commodity futures markets. Insulating policies such as export restrictions in important food-producing countries also contributed to price increases and market jitters in 2010 and 2011. As a result in 2007-08 the above-mentioned shocks drove up excessive volatility to more than 100 days, affecting the livelihoods of both producers as well as consumers.

Although today's agricultural markets have three characteristics that make the price responses to these challenges more extreme. First, export markets for the main staple commodities—rice, maize, wheat, and soybeans—are either highly concentrated in a few countries or very “thin” (that is, only a small share of production is traded). Given

these high levels of concentration, the world's capacity to cope with shocks is limited. Any incidence of poor weather or other production shock in these countries will immediately affect global prices and price volatility. Similarly, any policy changes—such as trade bans, customs taxes, or other restrictions on exports—in any of the top exporters will significantly affect the levels and volatility of food prices. Research suggests that such policies explained almost 40 percent of the increase in the world market price for rice during the 2007–08 food price crisis.

Second, the world's stocks of maize and wheat were at historically low levels. This situation leaves the world vulnerable to food price spikes and threatens the proper functioning of markets. Third, appropriate and timely information on food production, stock levels, and price forecasting is sorely lacking. When information deficits lead to overreactions by policymakers, the result can be soaring prices.

Despite since 2013 we don't phase periods of excessive volatility the three core characteristics that are structurally behind the vulnerability of global markets remain mostly unchanged. Moreover, commodity markets continue to experience an increased number of extreme weather events. Stocks have remained at particularly low levels, increasing the probability of international price spikes. Markets also remain highly concentrated, with just a few countries dominating world exports. What are some of the global strategies that can be implemented to reduce volatility and build resilience against such shocks? Firstly, there is a need for institutional improvements such as efficient futures and exchange mar-

kets for commodities in order to enable farmers and other agents to hedge and mitigate against risks. Secondly, an efficient stock management strategy is necessary in order to ensure adequate stocks at regional levels as this would enhance risk sharing and diversification. Thirdly, there is a need for a strategy dealing with the most vulnerable individuals through social protection mechanisms. An important

long-term strategy is the implementation of policies that would enhance openness to trade across countries. WTO can play a major role in implementing this long-term strategy.

Keywords:

Food Prices, Volatility, Excessive volatility, price spikes.

Development of an X-Ray Method for Mineralogical Analysis of Africa Soils Using a Benchtop Diffractometer

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Abstract

Soil mineralogy is a principal determinant of many soil functional properties that are expensive and time consuming to measure, and can in turn determine soil agricultural, engineering and environmental qualities. Africa soil mineralogy has however not been adequately and appropriately researched upon. This is because of poorly and fragmentally coordinated scientific investigations coupled with the limitations in the traditional analytical techniques. Recent developments in instrument designs and capabilities, and launch of bench-top X-ray Diffractometers (XRD) have widened the possible application areas for high-throughput X-ray diffraction (XRD) as a powerful complementary tool for soil screening. This study was conducted to develop a high precision and rapid throughput protocol for X-ray diffraction analysis and demonstrate its ability to make reliable and accurate measurement of Africa soil mineralogy, using a Bruker D2 PHASER benchtop diffractometer. A multiphase soil

sample was investigated for independent evaluation of the analysis accuracy, presenting the sample preparation and mounting techniques used. A further 160 diverse set of top soils samples selected from the sentinel sites of the African Soils Information Services (AfSIS) project was used to develop a generalizable approach, and to test the applicability of the protocol developed. With only half-hour scanning time, the method developed produced high quality diffractograms that could reliably be matched to possible known patterns from the powder diffraction files, taking XRD from what has been largely time consuming and specialized measurement, to a rapid and simple method that can be used for routine analysis of soil mineralogy by soil testing laboratories.

Keywords:

Sample Preparation, Preferred Orientation, Random Powder, X-ray, Diffraction.

Micronutrients in Selected Food Crops in Muguga, Kenya

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Abstract

Micronutrients are essential for growth of plants and although they are required in small quantities, inadequate supply of one or more of these results in reduced yields and quality of crop products. Micronutrients are transferred through the food chain to human beings and are important for health, growth and development. Deficiency of these poses a threat to the social-economic development of a nation due to the associated effects which include increased mortality rate, impaired physical and cognitive development and reduced labor productivity. In the 2011 national food and nutrition security policy, it was reported that due to inadequacy of food quality and diversity in the regular diet among Kenyans, over 10 million people suffer from chronic food insecurity and poor nutrition. There is therefore need to carry out research on the levels of micronutrients in food crops and this would be helpful in the establishment of plant quality monitoring systems as well as micronutrient bank and management systems in Kenya so as to monitor plant health and thus come up with possible interventions. The study was aimed at finding out crop response to micronutrients available in the soils on which they were grown and comparing the micronutrient levels among different food crop species. Leaves/whole plant of beans (*Phaseolus vulgaris*), potatoes (*Solanum tuberosum*) and maize (*Zea mays*) were sampled from Muguga, Ken-

ya, following an offset grid sampling pattern in which plots of 100*100 m were marked out and samples randomly collected within a radius of 3 meters from the grid intersection and composited. All the samples were analyzed for micronutrients (Mn, Fe, Ni, Cu and Zn) by Total reflection X-ray Fluorescence (TXRF). The mean concentration for Mn in beans, potatoes and maize were 215.594, 168.876 and 177.756 respectively. For Fe, the means were 750.262, 553.318 and 917.031 respectively. The means for Ni were 2.354, 1.342 and 0.788 respectively while Cu had means of 9.374, 11.914 and 10.082 respectively. Zn showed means of 65.852, 40.045 and 67.393 respectively (all concentration levels are in units of mg/kg). The results did not show deficiency among the micronutrients in all the food crops analyzed. However, following the coefficients of variation (CVs) the concentrations of Mn and Fe varied significantly between the crops while Ni, Cu and Zn showed no significant variation. Each plant takes up the available nutrients differently and this research showed that beans had the best response to available nutrients with a correlation of 0.9424. More research is to be conducted in other parts of the country for sufficient and conclusive micronutrient mapping.

Keywords:

Micronutrients, Food crops, TXRF, Kenya

Senegal Dairy Genetics

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Abstract

The FoodAfrica work-package Senegal Dairy Genetics aims to improve the productivity and profitability of small to medium scale dairy enterprises in Senegal, leading to improved food and nutrition security, enhanced livelihoods, and a more sustained environment. In addition, the project aims to build the capacity of various stakeholders in dairy, including young researchers, dairy-farmers, service providers, extension agents, educators, and policy-makers. The work-package is a collaboration between four research institutions based in Senegal, Finland and Kenya (the Interstate School of Veterinary Science and Medicine of Dakar, The University of Helsinki, AgriFood Research Finland, and the International Livestock Research Institute), and has involved students from a number of West and Central African countries, as well as Finland.

The particular focus of Senegal Dairy Genetics is to examine the trade-offs, in terms of both benefits and costs, of keeping different breeds or cross-breeds of dairy animals. These include indigenous breeds, such as Zebu Gobra and Zebu Maure, which have been raised by Senegalese livestock keepers over the centuries and are well adapted to the harsh environmental conditions, and crosses of these with newly introduced breeds, such as the Guzerat, Montbelliard and Holstein-Freisian, which produce more milk but require additional inputs in terms of health-care, feed and labour to survive and produce. To examine these trade-offs, Senegal Dairy Genetics has partnered with 239 dairy farming

households located in two sites in Senegal. These households range from the very traditional (such as those from the Fulani ethnic group) to the more innovative, and together keep more than 3500 dairy animals of numerous breed and cross-breed types. Productivity and economic information on these dairy animals is being collected over an 18 month monitoring period, resulting in an extremely valuable and unique database on dairy in Senegal. In addition, the breed-type of the animals will be determined using advanced DNA based approaches, ensuring this information is accurately known in the absence of recorded pedigree. On completion of the data collection period, the data will be analysed with feedback on the benefits and costs of keeping different breeds or cross-breeds of dairy animals disseminated to a broad range of stakeholders, resulting in enhanced capacity and better decision-making on this key issue. Further, Senegal Dairy Genetics is working towards ensuring farmers can better access the dairy breed-types of their choice, by building the capacity of local stakeholders to strengthen the dairy germplasm supply system.

Keywords:

Dairy cattle, Senegal, breed, genetics, food and nutrition security, capacity

Milk Composition of Dairy Cattle Breeds in Senegal

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Abstract

Milk is rich in protein, energy and essential micro-nutrients and its availability contributes to food and nutrition security. To improve milk production, mostly in terms of quantity but also in terms of quality, in Senegal, cross-breeding traditional breeds (such as the Zebu Gobra) with newly introduced breeds (Guzerat, Holstein Friesian, and Montbeliard, amongst others) has become common in some regions.

This study takes place in the general framework of the project, "Senegal Dairy Genetics". The overall objective of the project is to determine the most suitable dairy cattle breeds for low-input, small to medium scale, dairy producers' households in Senegal. The present study contributes to this overall objective by determining and comparing the milk composition of the various dairy cattle breeds found within the project sites.

Milk samples were collected from 241 lactating dairy cows belonging to 97 households in two regions of Senegal (Thies and Diourbel), during the period September to December 2013 which is the wet season when feed availability is high. Animals were classed into 4 groups based on their breed-type: group 1 comprising animals that are pure-bred ancient Zebu (such as the Zebu Gobra and Zebu Maure), group 2 comprising animals that are 75% ancient Zebu and 25% recently introduced Zebu (such as Guzerat), group 3 comprising animals that are 50% ancient Zebu and 50% recently introduced taurine (such as Holstein Friesian and Montbeliard), and group

4 comprising animals that pure-bred recently introduced taurines. The number of milk samples per group was 132, 38, 56 and 15 for groups 1, 2, 3 and 4, respectively. The milk component analyses were carried out in the field, using a portable milk analysing device (Lactichek Analyzer®). Results were obtained for the percentages of fat, solids-not-fat (SNF), protein and lactose; density and freezing point were also obtained. Each sample was analysed three times for machine repeatability and the average of these measures was used. The different groups were compared using Student's t-test in SPSS® 20 software.

Across all groups, average percentages (\pm SD) of 5.05 \pm 1.56; 9.86 \pm 0.60; 3.65 \pm 0.21; 5.47 \pm 0.31 were obtained for fat, SNF, protein and lactose, respectively. The milk content of cows in group 3 versus 4 clearly differed by all their components ($p < 0.05$). Conversely, the milk of cows in group 1 and 2 was very similar in all their components. These latter differed from cows in group 3 only by their fat content; a higher level of fat content was found for animals of group 3 (5.75 \pm 1.89). Cows of group 3 also had the lowest levels of both SNF (9.53 \pm 0.57) and protein (3.52 \pm 0.21).

The four dairy cattle breed groups derived from this study differ with regards to their milk composition.

Keywords:

Dairy cattle, Crossbred, Milk composition, Senegal

Predicting Lactation Records from Test Day Samples in Indigenous and Crossbred Dairy Cattle in Senegal

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Abstract

Demand for milk in Sub-Saharan Africa is rising constantly and small scale dairy producers will continue to be an important part of African agriculture. Farmers in low-input dairy production systems in Senegal currently lack the needed information on the relative production performance of different breed-types to be able to select the best animals for their needs and to feed the cows according to their milk production. The aim of this study is to use different models to estimate lactation curves and predict annual milk yield from test day records for different dairy breeds and crossbreeds.

The Senegal Dairy Genetics project is working in two regions in Senegal (Thies and Diourbal), where there is a mix of both indigenous and non-indigenous dairy animals. In total 239 dairy households and about 3500 dairy animals have been recruited into the project. The data is collected by a team of six field staff (enumerators). The enumerators are each allocated approximately 40 households and they visit these on a rotational basis (about once every 4 to 5 weeks), using questionnaires to collect socio-economic and productivity data. In addition, milk is recorded through direct milk measurements of both morning and evening milk production on the test day. All activities on farm are carried out in the local language of Wolof.

On first four rounds of longitudinal monitoring (September 2013 - February 2014) test day result of milk volume was record-

ed at least once for 984 animals. Of these, 489 animals had the needed information on date of last calving, number of parturitions, age and the breed of the animal, and were included in the analysis.

Animals were grouped according to breeds, based on farmer-given breed-types. The largest group (50%) consisted of Zebu Gobra and Zebu Maure breeds. The other main groups consisted of crosses between zebu and taurine breeds, crosses between taurine breeds or purebred taurines. The most commonly used taurine breeds were Holstein-Friesian and Montbeliard.

Daily milk yield was estimated from morning and evening milkings using a regression model, which took into account stage of lactation and number of parities. The estimated daily milk yield for 365 days of lactation was 2.7 l for first parity and 2.6 l for later parities. For the breed group of Zebu Gobra and Zebu Maure, the estimated average daily milk yield was 2.3 l for first parity and 2.1 l for later parities. The breed group of crosses between Zebu Gobra (25%) and Holstein-Friesian (75%) or Montbeliard (75%) had estimated average daily milk yield of 3.8 l for first parity and the highest estimated average daily milk yield of 4.7 l for later parities.

Keywords:

cattle, dairy breeds, milk yield, lactation curve, Senegal

Climate Change Impacts on Agriculture & Agricultural Economies: The example of Senegal

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Abstract

The impact of climate change on agricultural economies is a topic of active research, given the concern about the limited adaptive capacity of less-developed countries like Senegal that is likely to face severe consequences of ongoing and future global environmental change. The country's agricultural sector employs more than 60% of the active population but contributes for less than 10% on the country's GDP. This shows a bad performance related to low productivity due to low level of fertilizer use, old agricultural equipment, poor seeds and climate conditions (Jalloh, 2013). Recent studies on climate change in West Africa and Senegal specifically (Jalloh et al, 2013; Sène et al, 2012; Roudier, 2012, etc.) have pointed to the vulnerability of the agricultural sector in Senegal. Most studies found that the 21st century will be warmer than the past century (McSweeney et al., 2010; Jalloh et al, 2013). Although there remains uncertainty in future rainfall patterns climate perturbations will probably have an impact on Senegalese agricultural production and farmers' livelihood.

In this presentation we discuss the potential impacts of climate change within a key agricultural region of Senegal – the peanut basin. Specifically, we measure farmers' response to climate shocks, i.e. inputs allocation, and the impact of climate change on a population of farms. This has been done by combining two complementary models : i) the PMP farm production modeling approach of Howitt (1995) to evaluate farmers' response to different climate

shocks ; ii) the “Trade-Off Analysis model for multi-dimensional impact assessment” (TOA-MD) of Antle and Valdivia (2011).

The tradeoffs model assesses ex-ante the impact of climate change on economic variables in a heterogeneous population of farms by considering two systems representing farmers in two different situations: an observed situation (current) and an unobserved situation (in 2050) with changing climate, social and economic conditions. The key drawback of the TOA model lies in the fact that it does not explicitly embed behavioral response to climate shocks, so we are not able to represent the endogenous adjustment process in production practices (either on the intensive or extensive margins) that we would expect to occur as a result of climate change. As a possible remedy to this, we looked at complementary methodology that will allow us to represent farm-level adaptation behavior in a more explicit way and take that into account in the specification of the unobserved system of TOA-MD. The PMP farm production modeling approach of Howitt (1995) offers a promising way to do this, and we have illustrated the adaptive behavior for a representative household in the Peanut Basin. Our simplified model shows much more adaptive response than would be possible with the TOA model only, and offers a promising way to proceed with the further analysis of the peanut basin, as well as other key regions of Sénégal. The disaggregation of production types demonstrated by Howitt and Msangi (2014) offers a possible ap-

proach that can be adapted to the case of Sénégal.

We discuss the implications of the results, and also address some weaknesses in the methodology and the potential ways to address them.

Our key results show that the extreme climate shock to Sénégal described in Jalloh et al (2013) has a mixed effect on households in the peanut basin, with larger households having expanded coping capacity over smaller ones.

Keywords:

agriculture, climate change adaptation, global environmental change, economic policy

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Which Factors Could Determine Stunting in Rural Areas in Benin?

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Abstract

Background: Benin is a West African country where malnutrition is a public health problem. The trend of stunting among 6-to-59- months old children is rising after 3 successive Demographic Health Survey since 2001, showing prevalence over 35%. This prevalence is higher in rural areas than urban despite the importance of biodiversity in these regions. Local biodiversity is a source of nutrients for populations and its valorization is generally considered as a strategy to fight against malnutrition. In fact, Benin villages profit a large biodiversity provided by: agricultural production, animals breeding and an important diversity of non-grown product such as wild fruits, vegetables, roots, tubers, mushrooms, animals.

Objective: The main objective of this study is to identify the determinants of stunting in Bopa and Houéyogbé villages, two rural communes in Southern Benin.

Methodology: The study was conducted on 1242 mothers and 6-23 months old children selected in 17 villages of Bopa and Houéyogbé. A consent form was signed before starting data collection. To assess the nutritional status, anthropomet-

ric data (weight and height) were collected among children and mothers as recommended by the WHO. Data on the socioeconomic determinants of nutritional status were collected with the principal caregivers of children, mothers in most of cases, using a semi-structural questionnaire. We focused on education level of mothers, size of household, number of children under 5 years in the household and food insecurity assessed by HFI-AS questions. Goods and income generating activities were also documented and permit to appreciate household income. Z-score Height-for-Age, Weight-for-Age and Weight-for-Height were used in order to evaluate malnutrition among children. The nutritional software WHO Anthro was used. The Body Mass Index of mothers was determined in Excel. For socioeconomic data, the food insecurity status of each household was determined as described in the HFIAS guide and the economic data were combined as an index to appreciate the wealth of households. SPSS 17.0 is being used to determine the correlation between the determinants (nutritional status of mothers, food insecurity and socioeconomic factors) and the severity of chronic malnutrition.

Complementary Foods Patterns Among Infants and Young Children in Houeyogbe and Bopa Districts in Southern Benin, West Africa

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Abstract

Background: feeding practices among Bopa and Houeyogbe districts in Mono Department, Southern Benin conform to the World Health Organization (WHO) guiding principles is uncertain. The inadequate complementary feeding practices within infant young children is one of the main factors associated with the high level (43%) of stunted children noticed in Benin despite the diversity of local food resources.

Objective: To characterize complementary foods given to infants and young children of 6- to-23 months old and by pointing out the role of local biodiversity and cooking practices.

Methodology: The study was conducted for 2 months during one of the major seasons (dry season) and comprised 3 visits at 2 weeks intervals (± 15 d). A sample of 1263 children was randomly selected in 17 villages within two districts of the study area. Dietary intake of infants was estimated using two non-consecutive 24-hour recalls. Size of portion consumed at home was estimated using local household utensil standardized for the study. Recipes of meals and foods consumed by children were collected immediately following the administration of the recall to the mother or the caregiver in order to reconstitute them. The recipes reconstitution was carried out among a sub-sample of 219 mothers selected according to their indigenous knowledge of food processing and cooking after three repetitions. Detailed weighed recipes data

were also collected for all the composite dishes consumed by the children, and used to calculate the weight of the actual ingredients consumed. Average recipe data were compiled for use. For purchased meals an average value was calculated and an equivalence weight-volume-price was used to estimate the quantity of food consumed in household during the survey.

Preliminary results: Among 90 recipes itemized, 64 recipes have been reconstituted Cereal-based foods in the form of porridge and as traditional family staples consumed with soup and stews were predominant. Porridge of maize fermented or not like “Koko” (fon language) or “Godo” (Sahouè language) prepared at home are often the very common foods recorded. Another types of complementary food (CF) are composed of mixed local resources such as starchy staples from cereals and tubers (maize, rice, cassava, potatoes,...) accompanied with traditional sauces based on palm nut/red palm oil or green leafy vegetables (*Corchorus* spp c, *Amarantus* spp, *Solanum* spp, *Launanea taraxacifolia*, *Talinum triangulare*, *Telfairia occidentalis*, *Cleome gynandra*, *Struchium sparganophora*, *Moringa oleifera*,...) or legumes (beans, soybean,...) and scarce animals proteins such as eggs, fish . These are the common family foods, showing that CF are not specific foods given to infant and young children in Benin. There is a notable absence of fresh fruit in the records. This may reflect actual dietary intake which will be confirm or not by the ongoing analysis.

Costs of Aflatoxins in Kenyan Dairy Value Chain

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Abstract

Kenya's dairy industry plays an important economic role in the life of farmers, milk processors, milk traders, feed manufacturers and traders. This industry contributes 14% of the agricultural GDP and 3.5% of the total GDP. In Kenya, the dairy sector, and especially milk production is exposed to different risk contamination factors which will not only affect the product quality but also its innocuity.

Economic costs of aflatoxin contamination could be split into two categories: direct market costs and human health costs. Using agro-ecological zones, five counties in Kenya- Kwale, Isiolo, Tharaka Nithi, Kisii, and Bungoma were selected randomly for this study. For direct costs, questionnaires were directed to feed retailers, milk producers, milk traders and feed producers. Food and feed samples (99 dairy feed, 286 milk, 386 staples (maize, millet, sorghum ground nuts and cassava) were collected for laboratory aflatoxin analysis (ongoing) to estimate the aflatoxin daily consumption rates in man and dairy cattle.

In the case of health costs, primary and secondary data is being collected to assess the

estimated cost of aflatoxin in Kenya. Following Rico-Sole (2012) and introducing an additional weighting factor related to the proportion of aflatoxin provided by milk consumption, the health expenditure costs related to aflatoxin through milk will be estimated.

It is possible to assess health costs using secondary data provided by the national health statistics in Kenya (health expenditure, diseases, number of the population, number of exposed population, etc.) and fixing values for the remaining variables on the basis on literature review. However, the uncertainties about the actual health impacts of aflatoxin exposure in a population make it difficult to fully evaluate the burden. The approach in this study follows the risks of exposures at different steps in the dairy value chain and includes consumer surveys. This will provide increased knowledge about the risks and a basis for improved assessments of the costs.

Keywords:

Aflatoxin, costs, health, dairy sector, Kenya

Aflatoxin M1 Survey on Raw Milk Collected from Rural Households in Four Agro-Ecological Zones in Kenya

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Abstract

Kenya has the largest dairy herd and highest per capita milk consumption in east Africa. Kenya has also experienced multiple aflatoxicosis outbreaks in recent years, and several surveys have reported high levels of contamination in maize. When lactating cows consume feed which is contaminated with aflatoxins, they excrete a metabolite (aflatoxin M1) in their milk. This metabolite is injurious to human health, but there is no current information on the risk to human health posed by aflatoxins in milk in Kenya. To fill this gap, a risk assessment is being conducted in four agro-ecological zones in Kenya (semi-arid, temperate, sub-humid and humid). In 2014,

we conducted a survey of households in these four zones. We surveyed 286 households in 37 villages and in each household administered a questionnaire and collected feed and milk samples. In all, 280 milk samples were analyzed using competitive ELISA. The limit of detection was 2 parts per trillion (ppt). Overall, 59 per cent of all samples had aflatoxin below the limits of detection, 32 per cent of samples had aflatoxin between 2 ppt and 50 ppt while 9 per cent exceeded the WHO/FAO limit of 50 ppt.

Keywords:

Aflatoxin M1, dairy, milk, risk assessment, Kenya

Creating Novel Approaches to Mitigate Aflatoxin Risk in Food and Feed with Lactic Acid Bacteria - mold growth inhibition

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Abstract

Aflatoxins, produced by *Aspergillus* fungi, are ubiquitous toxins and they can present a severe health risk to humans and animals if contaminated food and feed is consumed. Fungi live in the soil and on the surface of the crop and *Aspergillus* species are dominant in favorable conditions of maize cultivation areas. A novel biological method could reduce the health risks of aflatoxins through inhibiting mold growth and thus aflatoxin production. Lactic acid bacteria (LAB) are commonly used in fermented food production; they are also known to inhibit mold growth. Mold growth inhibition by certain LAB strains may be caused by competition for living conditions between bacterial cells and fungi and/or production of antifungal compounds such as organic acids. 200 LAB

strains of bacteria have been isolated from 21 different indigenous fermented dairy and cereal products prepared locally in different parts of Kenya. These strains are being tested for their growth inhibition abilities against aflatoxin producing *Aspergillus* fungi in laboratory conditions. Later, these same effective strains will be tested in various food and feed matrices against *Aspergillus* growth and then the ones with most potential will be identified. Novel biological methods can have a role in preventing toxic effects of aflatoxins in food and feed. Exploitation of LAB is a good option for existing methods as LAB are generally recognized as safe.

Keywords:

Aflatoxins, lactic acid bacteria, *Aspergillus*, growth inhibition

Household Features that Support Women Empowerment – The role of women in household decision-making in Uganda

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Abstract

Up to 85% of all food consumed locally in Africa is produced by women farmers. The role and contribution of women concerning local food security, nutrition and family well-being is therefore of vital importance. In addition to non-market household work women are also involved in both cash crop production and non-farm income generating activity. However, studies suggest that because of their lack of access to resources, women are often less productive than men. This affects the well-being of the whole household and therefore should be a focus of research and development efforts. In order to support women farmers we need to identify which are the most problematic barriers preventing women's access to resources. Our hypothesis is that one of the essential barriers is lack of empowerment, specifically the ability to make decisions about production and the allocation of household resources.

In this paper, we discuss women decision-making and household patterns and features that relate to it. The goal is to examine the determinants of women empowerment and gender equality in household decision-making. More specifically, what are the household characteristics associated with unequal decision-making power within the household? Our analysis will identify focus areas in which the strengthening of women empowerment could have an important effect on human development goals, such as household wellbeing and economic security of women.

The data are from a detailed household survey collected among small-scale farmer households in Uganda as part of the FoodAfrica Programme. The survey was administered to over 1400 farmers in eight districts of rural Uganda in late 2012 and early 2013. The data include information on agricultural production, input use, crop marketing, and income, but also on the roles of household members in making decisions about production and marketing. The household-level questionnaire was administered to one household member, either male or female. In addition, an individual-level questionnaire focusing specifically on the decision-making was administered to both female and male members of the household, in most cases the household head and spouse.

The individual component is an important part of our analytical framework, inspired by the Women Empowerment in Agriculture Index (WEAI). The index was developed in 2012 by International Food Policy Research Institute (IFPRI) and Oxford Poverty and Human Development Initiative (OPHI). It identifies five domains of empowerment related to agriculture. The overall empowerment score of an individual is calculated from the achievements in the individual domains, a methodology based on multi-dimensional poverty theory. In addition the WEAI calculates a gender parity index (GPI) showing the difference between the man and the woman on the household level. In our

work we have used an adapted version of the WEAI.

We test new ways of measuring empowerment and inequality and the implications these have on household well-being. The WEAI offers an interesting perspective and opportunity for this. Being able to compare responses of men and women in the same household provides insight into power relations and structures within the household that may not have been captured by previous surveys, which typically use the household as the unit of analysis. Previously comparison has more often been made between male and female headed households, leaving the large group of women farmers within male-headed households unanalyzed. This is where our study can contribute to previous knowledge, both in terms of testing a new approach for collecting data and through identifying the key household features and patterns that correlate with high women empowerment in the Ugandan context.

We examine the level of input into decision-making as the main indicator of empowerment. We have used the WEAI questions to measure the level of input into decisions made on production and other income generating activity as well as on the use of income from these activities. We compare the response levels of men and women through creating a continuous variable for decision-making and looking at the overall difference as well as differences on the specific activities. Through re-

gression analysis we then look at how high scores of decision-making among women relate to a range of specific household characteristics which may be causal factors, such as the age and sex composition of the household, family size, and the level of education of the man and the woman in the household.

Preliminary results show that there is a clear difference between the levels of decision-making between men and women, especially when it comes to the use of income. The data will be disaggregated and analyzed further to identify categories of households with different types of decision-making patterns and the specific features of these households.

The results suggest that women's empowerment could be strengthened by addressing some of the problems of households where women in general have a smaller impact on decision-making. Considering the changing dynamics of African agriculture and rural development, where there seems to be a trend towards feminization of agriculture, focusing on and understanding the role of women is essential. The intra-household setup used in the present study contributes insight into this through the novel way of collecting gender-sensitive data. Conclusions and policy implications will be formulated based on further analysis.

Keywords:

Women Empowerment, agriculture, decision-making, Uganda

Improving Livelihoods of Smallholder Dairy Farmers Through Increased Fodder Accessibility: New strategies, linkages and options for stakeholders in Kipkaren sub-county, Kenya

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Abstract

Livestock production is projected to benefit smallholder farmers due to the doubling demand of its products in developing countries. However, farmers are constrained in maximizing milk production and experience pervasive fodder shortages despite fodder technologies developed to boost production. The low impact on livelihoods of smallholder farmers has been attributed to development approaches used in the past that focused on linear flow of knowledge from researchers to farmers. The study builds on concepts in the agriculture innovation system to examine stakeholder linkages, strategies, working practices and the institutions in organizing fodder innovation. The purpose of the study is to provide a framework for establishing a robust fodder innovation system to improve access to and use of fodder for improved livestock productivity and livelihoods of smallholder dairy farmers. A participatory research design will be adopted whereby key stakeholders will be co-researchers in an action research process in Kipkaren sub-county, Kenya. It will commence with a baseline survey, benchmarking the status of the fodder innovation system. About 10% of the dairy management groups will be randomly sampled followed by purposive sampling so that each location in Kipkaren sub-county is represented. Initially farmers will be engaged in a focus group discussion to agree on present and attainable milk production figures in the dry and rainy season. Based on the milk yields, the groups will be divided into three using quartiles and a fourth group com-

prising of individual farmers not affiliated to any group will be included in the sample for comparison purposes. There will be focus group discussions with members of groups applying the five models of capabilities to assess group capabilities to innovate and appreciative inquiry to assess actions responsible for present fodder situation and those required for a future desired state. Venn diagramming, ranking, scoring and key informant interviews will be used to determine stakeholder activities, categories and linkages in the system. The action research process will comprise of a series of stakeholder meetings where learning and sharing of ideas will take place on how to improve the fodder situation in the study area. Gap analysis using SPSS (Statistical Packages for Social Scientist) software will reinforce qualitative data gathered from the focus group discussions on the variation in fodder availability among the groups. Chi-square statistics will be used to analyze methods of managing innovation, attributes of each method and differences in mean. A diagrammatic representation of strength of linkages between the stakeholders and effectiveness of methods of organizing innovations will be shown using the spider web tool. It is expected that institutions that enable stakeholder interactions, learning and joint problem solving will generate knowledge useful in alleviating fodder scarcity.

Keywords:

stakeholder, fodder, agriculture innovation system, innovations

FoodAfrica Programme Brief

Title:	Improving Food Security in West and East Africa through Capacity Building in Research and Information Dissemination
Acronym:	FoodAfrica
Sector:	Agriculture
Focus:	Food security
Geographical coverage:	West and East Africa (Benin, Cameroon, Ghana, Kenya, Senegal, Uganda)
Duration:	Four and a half years (including inception phase): July 2011- December 2015
Beneficiaries:	The direct beneficiaries are the local research institutions and universities in the African partner countries, as well as local extension experts from Government Ministries and non-governmental organisations, NGOs like farmers organisations. Through these partners the research results are expected to be transferred to the final beneficiaries of the programme, the local small-scale farmers and food producers, many of whom are women.
Overall objective:	To create new knowledge and tools for the use of decision makers and local farmers for reducing absolute poverty and improving food security in Eastern and Western Sub-Saharan Africa.
Purpose:	Improved capacity of local research and education institutions in research, education and information dissemination for strengthening the agricultural sector, local livelihoods and food security in Western and Eastern Sub-Saharan Africa
Activities:	Seven work packages (WP) encompassing the following applied research topics (countries involved in brackets): <ol style="list-style-type: none">1) Micronutrients in soil fertility (about 20 African countries)2) Genetic improvement of livestock (Senegal)3) Economic effects of climate change in food production (Senegal)4) Traditional foods for improved nutrition (Benin)5) Safety of the feed-food chain (Kenya)6) ICTs to support market access of small scale farmers (Ghana, Uganda)7) Innovative extension approaches for African farmers (Cameroon, Kenya)

- Expected results:**
- 1) Strengthened capacity of local research and education institutions, and local soil laboratories for diagnosis and management of soil micronutrient deficiencies
 - 2) Strengthened capacities of local institutions to support sustainable dairy production
 - 3) Best agricultural practices and adaptation responses produced for and disseminated to the farmers, agricultural extension officers and national policy makers
 - 4) Strengthened information base on traditional foods for marginal and vulnerable households through nutrition-sensitive value chains
 - 5) Improved methods for reducing risk for mycotoxin contamination in staple crops
 - 6) Improved market access for small scale farmers through market information by modern information and communication technology (ICT)
 - 7) Innovative extension approaches made available for local extension organizations for transfer of research results to end-users

Partners:

Finnish partners:
MTT Agrifood Research Finland (Programme Coordinator)
University of Helsinki (UH)
Häme University of Applied Sciences (HAMK)

CGIAR Centres:
Bioversity International
World Agroforestry Centre (ICRAF)
International Food Policy Research Institute (IFPRI)
International Livestock Research Institute (ILRI)

Local partners: local universities, research institutions and NGOs in each WP country

Resources:

9,5 million Euros of Finnish ODA + 2,3 million Euros from the above partners
Total value about 11,8 million euros

Further information:

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