Theme 3

Factors that limit access to and adoption of innovations by poor farmers

Farmers' Perceptions and its Influence on Uptake of Integrated Soil Nutrient Management Techniques: Evidence from western Kenya

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Abstract

Soil fertility depletion and the attendant declining agricultural productivity in western Kenya have led to many attempts to develop and popularize integrated nutrient management (INM) technologies that could restore soil fertility. INM bridges the gap between high external input agriculture and extreme forms of traditional low external input agriculture. The main components of INM in western Kenya are chemical fertilizers, animal manure, improved fallows and green manures. It is not well understood why farmers who rely on agriculture for their livelihoods, either do not adopt or adopt the technologies slowly. However, it is acknowledged that soil depletion is insidious and slow process, hence farmers' perception of severity of the problem and associated yield losses are critical in deciding adoption of soil fertility enhancing technologies. The objective of this study was to evaluate farmers' perceptions of soil fertility depletion and assess its contribution to adoption INM practices. Data were collected from a random sample of 331 households in Vihiga and Siaya districts and analysed by descriptive statistics and logit model. Results show that most households (94.6%) perceived declining soil fertility to be responsible for the low crop yields and difference in perception between the two districts was insignificant (P=0.141). From logistic analysis, farmers' perception of soil fertility depletion had no significant influence on adoption of any INM component. Socio-economic and technology characteristics militated against adoption of INM components. Policy reforms should focus on education of farmers while enabling farmers to access necessary inputs.

Keywords: *Adoption, households, integrated nutrients, perceptions, soil fertility*

Interaction between Population Densities, Cultivable Area, Resource Use and Land Productivity in Savannas of West and Central Africa

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Abstract

The linkage between population densities, resource-use, cultivable area, and crop yields is poorly understood. These factors were examined to identify crop production constraints and their impact on land productivity in two agro-ecological zones (Sudano-sahelian zone (SSZ) characterized by high population density and the northern Guinea savanna (NGS) characterized by low population density). For most land parcels in the population interaction zones traditional staples (e.g. millet) generate less returns and are rapidly being replaced by high-valued crops (e.g. maize) and nonfarm profitable activities. Yields of major cereals were low. Common soil fertility constraints identified were acidification, low organic matter, N and P status, imbalance of exchangeable bases, salinity and erosion. Generally, soil quality (using soil quality index SQI) varied among major landscape units ($p<0.05$) and was generally low (SQI<2). Relatively high quality soils in the SSZ zone were found in more densely populated areas. Agricultural intensification is evident in the SSZ, but at a level not sufficient enough to improve soil quality to ecologically acceptable levels. In the NGS, soils were of low quality (SQI=1.18) to good (SQI=2.78). Soil quality on two resource-use domains (low-to-medium and medium-to-high) was not significantly different. However, the percentage of fields in the medium-to-high resource-use domain (28%) with good quality soils (SQI>2) was two times that in the other domain (14%). The low percentage of good quality soils irrespective of resource-use indicates limited adoption of soil fertility improvement technologies. A broad perspective is needed to provide a measure of interaction between agricultural land and nearby population concentrations to properly target agricultural technologies.

Keywords: *Crop yield, Land productivity, Resource use, Savannas of west and central Africa, Soil quality*

Typologies of Smallholder Farms in Bukoba District, Northwest Tanzania

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Abstract

Dissemination of new technologies among farming communities in developing countries mainly follow blanket recommendations which usually ignore existing diversity among households. Using a multivariate technique by Plymouth Routines in Multivariate Ecological Research package (PRIMER), we established typologies of smallholder farms facing similar opportunities and constraints in the high and low rainfall zones of Bukoba District, North West Tanzania. In both zones, three farm typologies categorized as high, medium and low resource in both zones were differentiated by the degree of production orientation and soil fertility management. The degree of similarity within farm typology groups was 48%, 45% and 39% in the high rainfall and by 47%, 71%, and 44% in the low rainfall. The best explaining variables were level of education of head of the household, the number of cattle, and their management, amount of available labor to work on the farm and its productivity. This study identified the need for researchers and policy makers to consider existing diversity among the farming community when formulating alternative technologies and policies for sustainable development.

Keywords: *Multivariate analysis; socioeconomic variables; sustainable development*

The Dilemma of Using Fertilizer to Power the Green Revolution in Sub-Saharan Africa

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Abstract

Agriculture in over 84% of world farmlands is rainfed but yields just over half of the crops produced. In East Africa, 60% of the landmass is arid and semi-arid land (ASAL), where rainfall is inadequate for arable agriculture. Farmers must use recommended cultural practices including appropriate cultivars, fertility, seed, planting time, weeding and pesticide application. The produce must also attract competitive market prices. The ASAL environment is harsh. Rainfall is low, unreliable and bimodal and the seasons have unequal production potential. In Kenya, the Short rains contribute 55% of the annual rainfall while the Long rains contribute 35%. Frequent droughts cause crop failure raising the dilemma whether farmers can apply fertilizer to crops in either season. Fertilizer and hybrid seeds are expensive and farmers no longer keep sufficient livestock for manure due to small land units and lack of herdsmen occasioned by free primary education. Poor farmers plant inferior cultivars without fertilizer or manure and fail to apply pesticides or manage weeds. Illiteracy and low mechanization limit ability to maintain required plant population and planting is late due to inability to prepare land early. Crops are therefore unable to utilize all available moisture. Investing in production, including use of fertilizer is risky and can be done during the Short rains. The government must be courageous in formulating enabling policies. Policy should regulate use of land based on size and potential. Planting grass for livestock, not maize for humans, gives better results in ASALs. Overcoming these dilemmas empowers the ASALs to power the green revolution.

Keywords: *ASALs, bimodal, mechanization, production, risk*

Benefits of Integrated Soil Fertility and Water Management in semi-arid region

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Abstract

The synergistic effect of soil and water conservation (SWC) measures (stone rows or grass strips) and nutrient inputs (organic or mineral nutrient sources) was studied at Saria station, Burkina Faso. The reduction in runoff was 59% in plots with barriers alone, but reached 67% in plots with barriers + mineral N and 84% in plots with barriers + organic N, as compared with the control plots. Plots with no SWC measure lost huge amounts of soil (3t ha-1) and nutrients. Annual losses from eroded sediments and runoff reached 84 kg OC ha-1, 16.5 kg N ha-1, 2 kg P ha-1, and 1.5 kg K ha-1 in the control plots. The application of compost led to the reduction of total soil loss by 52% in plots without barriers and 79% in plots with stone rows as compared to the losses in control plots. SWC measures without N input did not significantly increase sorghum yield. Application of compost or manure in combination with SWC measures increased sorghum grain yield by about 142% compared to a 65% increase due to mineral fertilizers. Yields increase did not cover annual costs of single SWC measures while application of single compost or urea was cost effective. The combination of SWC measures with application of compost resulted in financial gains of 145,000 to 180,000 FCFA ha-1yr-1 under adequate rainfall condition. Without nutrient inputs, SWC measures hardly affected sorghum yields, and without SWC, fertilizer inputs also had little effect. However, combining SWC and nutrient management caused an increase in sorghum yield.

Keywords: *Economic benefit, grass strip, nutrient input, sorghum, stone row*

Determinants Of Organic Fertiliser Use By Farmers In North Central Nigeria

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Abstract

A survey of 450 farmers was conducted in nine localities within North Central Nigeria to determine the factors that affect organic fertiliser use by farmers. A multi-stage sampling technique was used to administer 50 questionnaires in each locality and descriptive statistical tools were used to analyse the results. Farmer characteristics showed an average age range of 37-50 years, literacy rate of 12-58%, and a family size of 3-9. The results showed that all the respondents use some form of organic amendment for soil fertility management, although the bulk of the organic resource is acquired from external sources. The proportion of farmers that raise livestock ranged from 33% to 76% with an average per capita generation and consumption of farmyard manure of 1.05 t yr^{-1} and 0.38 t yr^{-1}, respectively. Cattle dung was the most commonly used organic material with usage by 41% of the farmers; this was followed by crop residue at 28%. There were distinct locality and farmer variations in the use of organic fertiliser. The major factors that determine farmers' use of organic matter resource include access to mineral fertiliser, availability of the organic resource, family size and the educational background of the farmer. In one locality with a large number of migrant farmers, use of organic amendment was significantly lower on rented lands than on lands owned by the farmers. An over-view is made of the various purchasing and novel 'counter-trade' relationships that exist between farmers in some localities and itinerant 'Fulani' herdsmen, and how these could be scaled up to improve access to organic manure by farmers in rural countryside.

Keywords: *Guinea savanna, organic matter resource, organic matter use, soil fertility management*

Opportunities for sustainable crop production: Contributions from organic resource quality and quantity

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Abstract

Opportunities for sustainable crop production are essential to overcome the decline in crop yields commonly observed in smallholder agriculture in the tropics. Therefore, in a three-year field studies initiated in 2003 major season in the semi-deciduous forest zone of Ghana, maize yield indices as influenced by 5 organic resource quality and a control un-amended treatment were evaluated. Results underscore the beneficial effect of organic resource application for sustainable maize grain yield. There was a huge immediate benefit in maize grain yield of 85-150% depending on the quality of the organic resource applied, which was almost lost in the subsequent minor season and reappearing in subsequent seasons but discriminated on the basis of the quality of the material. The quantitative effect of organic resource application on maize grain yield was evident in 2004 major season where 4 t C ha^{-1} produced significantly ($P< 0.02$) higher maize grain yield than 1.2 t C ha^{-1} and remained superior in subsequent seasons. *Leucaena leucocephala*, a class II material showed superior maize grain yield across the years but in the absence of inorganic N application. On the other hand, cattle manure progressively showed superior benefits to maize grain yield from 2004 minor season when combined with inorganic N (120 kg N ha^{-1}) application. While underscoring the significant contribution of combined application of organic resources and inorganic N to improved maize grain yield, such combinations should be guided by the quality of the organic resource as well as the quantity of application for maximum benefits.

Key words: *Crop productivity, organic resource quality, organic resource quantity, N management*

Innovativeness of Common Interest Groups in North Rift Kenya: A Case of Trans Nzoia District

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Abstract

One measure of group evaluation is the classical structure, conduct and performance (SCP) analysis approach. Ignoring the inter-relationships among actors in the agricultural value chain leads to poor intervention strategy designs. Common interest groups (CIGs) are farmer associations established with the purpose of promoting special interest of communities. The groups were formed to alleviate poverty, enhance food security and improve health status through income generation. Kenya Agricultural productivity project (KAPP) recognized the need to use (CIGs) as key actors in agricultural sector value chain for intervention. However, there was limited information on the structure and performance of the CIGs. This study aimed at examining the structure, conduct and performance of the CIGs. A baseline survey was conducted in Trans Nzoia district in 2006. Fifty seven randomly selected CIGs were interviewed using a semi structured questionnaire. SCP and logit models were used in data analyses. . The results show that most of the groups were: Women (23%), research (9%), health (9%), Youth (5%) and mixed (54%). There was evidence that most of the groups had devolution of power to various sub-committees. The life span of the groups was 5±4.8 years with membership of 26±15.1. However, most (89%) of the groups were not registered. From logit regressions results, the major factors significantly influencing group external technical and financial support were; lifespan, group-type (women) and group special projects undertaken. This implies, for group sustainability, these factors may be considered. The CIGs form favourable targets for KAPP interventions for enhanced impact and improved community welfare.

Keywords: *Conduct, group, performance, structure*

Understanding cassava yield differences at farm level: lessons for research

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Abstract

Cassava is an important food crop in Africa. A range of improved varieties and IPM practices have been developed to maintain and increase its yields in response to emerging pest and disease problems. Much less attention has been given to ISFM and agronomic practices. Important yield differences in cassava are found between farmers. Using a farm typology approach and six case study sites in east Africa, yield differences between sites and farm types were quantified and factors contributing to the differences evaluated. Overall, yield differences are twice as large between sites (6 t/ha) as between farm types (3 t/ha), whereas within sites, cassava yield differences between farm types vary from 1.5 to 7.5 t/ha. While differences in agro-ecological conditions explain part of the variation found at site level, differences in management were important in explaining cassava yields between farm types. Richer households obtained significantly ($p<0.001$) higher cassava yield (+3.2 t/ha) than poorer households. Hired labour input ($p<0.01$-0.05), monocropping ($p<0.05$-0.15) and timing of first weeding ($p<0.01$-0.1) significantly explained yield differences between sites and farm typologies. Use of improved varieties was rarely linked to higher yield levels. Manure and/or inorganic fertilizer use is rarely targeted to cassava. To improve cassava production in Africa, more emphasis should be given to the development and dissemination of appropriate management practices, higher yielding varieties. R4D efforts in cassava should take into account and benefit from differences in cassava production that exist between farm types, while at the same time not loose sight of agro-ecological differences.

Keywords: *Cassava; Explaining yield differences; Sub-Saharan Africa; Management; Farm typologies*

Stakeholder Characterisation of the Biophysical and Socio-Economic Potential of the Desert Margins in Kenya.

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Abstract

The arid and semi-arid environment in eastern Kenya is composed of a range of socio-economic and bio-physical conditions that have not been characterised. The human population in such areas is on the increase making the area unsustainable for human, wildlife and natural resource utilization. A participatory characterisation was carried out to provide guidance towards sustainable utilisation of this environment. It was observed that the area has low fertility with flows for major nutrients being zero or negative. Soils are also highly susceptible to severe wind and water erosion. The vegetation consisting of *Acacia spp* and other wooded bushland is under constant decline due to deforestation for firewood and building materials as demand for agricultural land increases. The households have less than 50% of the total area as farmland with over 70% of them living below the poverty line. Pastoralism and arable farming is often in direct conflict with wildlife with the number of livestock to pastureland usually out of proportion. Crop failures of rain-fed agricultural production are common and occur in 3 out of every five years. Since the area suffers from serious moisture deficits, irrigation is practiced at various places but sometimes these offer inadequate methods leading to salinisation and sodification and ultimate abandonment. Kenya Agricultural Research Institute has undertaken, through three designated transects some GIS mapping and soil fertility studies. Appropriate soil and water management technologies are carried out in the area to enhance agricultural productivity.

Keywords: *Arid and semi-arid lands, biophysical and socioeconomic characterisation, Kenya.*

Bringing Soybean Production Closer to Farmer's Reality: Alternative Options for Inputs and Labour

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Abstract

The use of farm inputs in Migori District (south-western Kenya) is very low, leading to low yields and hence food shortage and unacceptably low income. As cash is lacking to access inorganic fertilisers, TSBF uses alternative soil fertility improvement technologies in this region, such as Promiscuous Dual Purpose Soybean and local inputs. In collaboration with the farmers we identified the problems perceived with soybean production and designed and conducted on-farm experiments to curb them. The experiments therefore focussed on labour reduction and input cost reduction, using the following treatments: for labour: point-placing with 2 weedings (reference), drilling at correct distance to avoid thinning with 1 and 2 weedings, broadcasting with one weeding; and for inputs: ashes, ½ ashes and ½ manure, DAP, ½ DAP and ½ manure, manure, ½ Tithonia and ½ DAP, all at a rate of 20 kg P ha-1, and no input as a control. There was a significant increase in yield when applying input, but no significant yield difference between the different inputs. As DAP is difficult to acquire by most farmers, there was high interest among farmers in the use of ashes, manure, Tithonia and combinations of local inputs. The different labour options did not lead to significantly different yields. Labour use efficiency favoured the low labour treatments; broadcasting and 1 weeding. Partial budgets, dominance analysis and field day discussions with farmers will be used to conclude which labour and input treatments suit which types of farmers, depending on their available resources.

Keywords: *Collaborative research, local inputs, labour reduction, soil fertility improvement, soybean*

Nutrition and utilization for health and income generation: an incentive for the promotion of legumes in Kenya

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Abstract

Soybeans contains 40% protein and 20% oil and .Soybean is both food and nutria health which can support human wellbeing. This project addresses the utilization of soybeans through sustainable and participatory capacity building in soybean processing, nutrition and mentoring in its production and marketing to act as an incentive to boost production of soybeans at the grass-root levels. Adequate and appropriate nutrition which can be achieved through the consumption of a balanced healthy diet (consisting of locally available foods and fortified food and/or micronutrient supplementation when needed) is vital for the health and wellbeing of all individuals regardless of HIV status. Nutritional support helps to maintain the immune system and to sustain healthy levels of physical activity. Our methodology included visiting farmer associations, living positive groups and giving short talks on the goodness of soybeans and allowing question and answer sessions to ensure that our clients had a voice. Also training of trainers (ToT) for five days (ToT–5 days) and training of farmers (ToF) for two days (ToF–2 days) in processing and utilization of soybeans, hygiene, sanitation, basic business management, and nutrition education were involved. Soybean is incorporated into several locally eaten foods with taste tests carried out and analyzed to determine the degree of quality improvement. We incorporate or replaced soybeans in locally eaten dishes such as mandazi, ugali, porridges, chapatti and "omushenye" or potato dish to increase their protein content without changing the tastes.

Keywords: *Immune boosting, processing, HIV, soybeans, training and quality improvement*

Biological nitrogen fixation by rhizobia and mineral fertilizer savings: implications for green revolution in Africa

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Abstract

African smallholder farmers are generally poor and many are unable to afford fertilizers. Legumes are being introduced into farming systems for their N-fixing attributes and to reduce the pressure to purchase fertilizers. Support for projects aimed at increasing legumes and their roles in farming systems would be higher if economic value of the N-fixed can be demonstrated through valuation. Such information can lead to formulation of policies to increase legumes in the farming systems and to conserve soil microorganisms. Applying the knowledge gained from several past researches, complemented with assumptions on FAO-sourced data on soybean (*Glycine Max*) from 19 countries in Africa, this study attempted to test the hypothesis that "*Bradyrhizobial* population nodulating promiscuous soybean is so diverse and efficient and will give economic benefits (yields, N_2 fixation similar to specific *bradyrhizobium* nodulating American type of soybean through inoculation)". The computation of economic value of nitrogen fixation was mostly based on methods of cost replacement and cost savings associated with the fixed nitrogen compared with the nitrogen fertilizer required to attain the level of nitrogen fixed. Result shows that the economic value of the nitrogen-fixing attribute of soybean in sub-Saharan Africa, especially the promiscuous varieties, ranges from 197 - 203 million US$ with a mean of US$ 199 million across 2002, 2003 and 2004. The study concludes with recommendations on how to increase the chances of smallholder farmers benefiting from the nitrogen-fixing attribute of LNB (Legume Nodulating Bacteria), especially since many cannot afford adequate quantities of fertilizers for increased productivity.

Keywords: *Africa; economic valuation; favorable policies; legumes; N_2-fixation.*

Crop Rotation Leguminous Crops as Soil Fertility Strategy in Pearl Millet Production Systems

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Abstract

Crop rotation is one of the strategies in crop and soil fertility management practices that is being implemented in Namibia to improve soil fertility and crop yield per area of land cultivated. The benefit of improved cultivars could only be realised if combined with other soil management practices that can improve soil structure thereby retaining fertility as well as moisture. In order to achieve the goals, experiments are being conducted at four different research stations in the northern Namibia communal areas. The experiments are carried out in each region of the four northern communal regions were pearl millet is predominantly grown. This project is an ongoing and has started during the 2004/2005 cropping season and is expected to end during 2009/2010 growing season. The experiments are being conducted on poor sandy soil selected specially for this purpose. Soil samples were taken for fertility analysis before each planting season. During the first growing season 2004/2005, all the plots were planted with the main crop (pearl millet) and on the alternating year 2005/2006 different crops including legumes (cowpea and lab lab), fallow and sorghum were planted in different plots. It is expected that the experiment will be concluded by 2010 for a meaningful impact to be noted. Results presented in this paper are preliminary and therefore it is expected for meaningful results to be drawn from the experiment later.

Keywords: *Soil fertility, Pearl millet, Leguminous, Crop rotation, crop yield*

Taking Soil Fertility Management Technologies to the Farmers' Backyard: The Case of Farmer Field Schools in Western Kenya

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Abstract

Farmer Field Schools (FFS) were introduced in western Kenya in 1999 to empower farmers with knowledge for informed decision-making.Taking cognizance of diverse farming systems, the FFS applied Integrated Production and Pest Management (IPPM) approach. IPPM involved training farmers on productivity enhancing technologies especially soil fertility and pest management, and how to access agricultural services--extension and credit. However, the influence of the FFS on adoption of the technologies is not clearly understood. The objectives of this study were to assess adoption of soil fertility enhancing and pest control practices by FFS and non-FFS households; analyse farmers' access to credit and extension services; and evaluate households' social capital. Data were collected from a random sample of 400 households, comprising FFS and non-FFS members, and analysed by descriptive statistics and logit model. The main soil fertility-enhancing technologies adopted were chemical fertilizers (64%), farm yard manure (56%), and compost (13%). The mean application rate of chemical fertilizer was lower than recommended, but slightly higher among FFS households than non-FFS households (p=0.149). The main pest control method was use of local concoctions (50%). Whilst 69% of the households received extension advice, a paltry 3% accessed credit. Regarding social capital, 91% of the households had members in one or more social organizations/groups; of which the most important group for one-third of the households was "merry- go- round". We conclude that taking technologies to grass roots and improving farmer' knowledge requires concomitant improvement in access to complementary agricultural services for improved adoption and impacts.

Keywords: *Adoption, empowerment, farmer field schools, households, soil fertility*

To Conserve or not to Conserve: Exploring Smallholder Farmers' Knowledge Towards Soil Erosion and the Status of Conservation Farming across the Central Kenya Highlands

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Abstract

Human induced soil erosion across the arable lands in the Central Kenya highlands is a major threat to sustainable agricultural productivity. This is against the backdrop of disappointing uptake of recommended conservation farming measures by smallholder farmers' in-spite of the intense efforts towards promotion of the appropriate conservation measures. This study therefore explored the knowledge of the farmers to the occurrence and effects of soil erosion and, the status of conservation farming at household-farm level by characterizing case study farms that represented distinguished generic farm types for two agro-ecologically dissimilar study sites. Trained enumerators carried out a formal farm survey by use of specific focused questionnaire for 48 households across the sites. The farmers were aware of the occurrence of erosion in their farms though the severity and risk varied across sites and farm types. The farmers understood the dynamics of the erosion process and were able to identify most of the factors responsible for occurrence of erosion as well as assessing the effectiveness of recommended conservation farming measures prior to implementation. The farmers also recognized various conservation farming measures for the control of erosion but the actual implementation varied depending on the site and farm type. The sources of conservation farming information for the farmers were site dependent and were mainly from either agricultural extension agents or other farmers. The smallholder farmers faced diverse constraints in the adoption of conservation farming measures that revolved around farm and household circumstances such as shortage of labour and capital.

Keywords: *Central Kenya, conservation farming, smallholder farmers, soil erosion*

Prioritizing research efforts to increase on-farm income generation: the case of cassava-based farmers to in peri-urban southern Cameroon

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Abstract

The growing group of poor subsaharan Africans and a trend of declining agricultural research budgets demand priority setting on technological improvements targeted to direct impact on poverty alleviation. However, the extent to which agricultural technologies benefit the poor remains questionble when not targeted to well defined client groups with specific socio-economic situation and associated restrictions and opportunities. In this light, it may be appropriate to de-emphasise on crop yield and re-emphasise on labour requirements as a parameter of succes of a technology. As a case study, this paper defines the problems and opportunities of commercialization of cassava production in the forest margins of peri-urban Cameroon. Cassava *(Manihot esculenta)* is the chief subsistence staple and mainly produced extensively in traditional mixed food crop fields in a short fallow rotation with virtually no use of external inputs. The urban demand for cassava products is growing yet yields are generally low and current production increments are mainly based on increased cassava growing area. Preliminary data from surveys in peri-urban Yaoundé indicate that technologies for sustainable intensification of cassava production should be targeted both at pre- and post harvest levels. Options for specific targeting of labour saving technologies will be discussed with emphasis on weed suppressing planted fallows, fallow vegetation management and herbicide use as well as post-harvest processing mechanisation. Farmers' participation from the start is key in this developing / introducing / adapting of technnologies and ensures appropriateness and subsequently better adoption potential and hence, higher impact.

Keywords: *Cassava, impact, poverty aleviation, labour saving, technology targeting*

Cost-effectiveness of fertilizer use in the production of main crops in Cameroon

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Abstract

A survey of crop producers was carried out in the 10 provinces of Cameroon to assess the level of fertilizers use and their consumption status in the production of fertilizer-depending crops like maize, cotton, irrigated rice, Robusta coffee, onion, Solanum potato and tomato. To achieve that goal the study evaluated the cost-effectiveness of the fertilizer use for those crops and further identified strategy axes to be undertaken for an efficient use and increased levels of fertilizers. Results indicated that for onion, tomato and potato, it was highly profitable to use three types of complete fertilizers (NPKMgO 12-14-19-5, NPKMgO 11-11-12-5 or NPK 20-10-10) combined with urea (46% N). The crop yields margin ranged between 6000 -10000 kg ha-1 with a gross benefit per ha comprised between USA$1578 and $3681. For cereals (rice and maize), it was moderately profitable to use the "special maize and rice fertilizer" (NPKSMgO 14-24-14-5-35) in addition to urea, meanwhile crop yields margin ranged between 1000 - 4000 kg ha-1 with a gross benefit per ha fluctuating between $585 and $759. It was not profitable to use either "special cotton or coffee fertilizer" or NPK 20-10-10 plus urea on tree crops (cotton and coffee) as this led to have crop yields <1000 kg ha-1 for a gross benefit ranging between $302 and $384. Crop yield increases through the use of improved cultural practices and increase in crop proceeds through the improvement of products quality and development of exports to sub-regional/regional markets were identified as the two main strategy axes capable of boosting the consumption level and improving the cost-effectiveness of fertilizers in the country.

Keywords: *Cameroon, consumption, crops, fertilizers yield margin, profit*

Bio-Socio-Economic Factors Influencing Tree Production in South Eastern Drylands of Kenya

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Abstract

Empirical evidence on key biophysical, social and economic factors and their interplay for enhanced tree production in drylands of Kenya is scarce and scattered. The thesis for the study was that tree production in drylands was mostly practiced by resource poor farmers who based their decisions on a multiplicity of bio-socio-economic factors. Data was collected through a survey covering 100 households using structured questionnaires. Sampling units were selected through multi-stage stratified random sampling procedures, and regression and descriptive statistics applied in analysis. It was observed that tree production was taken as a land use system by mostly youthful, poor and modestly educated farmers. Apart from tree varieties, and environmental and climatic conditions, tree survival was dependent on labour, type of farm enterprise, and availability of germplasm, market and farmer while tree technology adoption was dependent on farmer's age, capital assets, product price, and availability of water and farmer. Household male heads were heavily involved in all tree operations. Marketing of tree products was dependent on price, labour, capital assets, and technical know-how. It was concluded that tree production in the South Eastern Drylands of Kenya was practiced more with resource poor farmers who based their decisions on a multiplicity of factors. Measures aimed at increasing farmer accessibility to water and markets were crucial in enhancing tree production. Exploratory research on ways of enhancing growth rates and economic value of indigenous trees was urgent.

Keywords: *Adoption, land use system, markets, resource poor farmers*

Economic Analysis of Improved Potato Technologies in Rwanda

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Abstract

The Rwanda Agricultural Research Institute, in collaboration with CIP and PRAPACE, generated and disseminated over the three last decades, improved potato based technologies. Conducted in two major potato producing agroecological zones in Rwanda (hautes terres de laves and hautes terres du Buberuka), this study aimed at identifying the best-bet technological packages from five alternatives. Based on the minimum acceptable marginal rate of return criterion, results from a two-season on-farm trial revealed that three technological package, T2 (Improved seeds + Fertilizer "NPK"+ Fungicide «dithane »), T3 (Improved seeds + Fertilizer «DAP » + Fungicide«dithane ») and T4 (Improved seeds + Fertilizer "NPK" Fungicide«ridomil+ dithane») are profitable in both zones. The same decision criterion shows also that T5 (Improved seeds + Fertilizer «DAP» + Fungicide"ridomi+dithane) is profitable only in the terres de laves zone whereas T1 ("improved seed + farmer practices") would be attractive to farmers only in Buberuka zone. The sensitivity analysis shows that all the treatments have almost the same trend and are very sensitive to the decrease in potato prices. Treatment T5 (Improved seeds + Fertilizer "DAP" + Fungicide "ridomil + dithane") constitutes however the less sensitive to the change in fertilizer prices whereas T2 (Improved seeds + Fertilizer "NPK"+ Fungicide «dithane») is the less sensitive to changes in pesticide prices in the "terres de laves" zone. The sensitivity analysis in Buberuka zone reveals that treatment T4, although superior to other treatments, becomes more sensitive to change in potato price beyond a 25% increase.

Keywords: *Marginal analysis, marginal rate of return, partial budget sensitivity analysis, technological packages*

Socio economic characterization of communities with different potato market linkages in the highlands of southwestern Uganda

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Abstract

Many countries in Africa have started implementing economic reforms that could lead to rapid growth and improved socio economic conditions of its growing populations. Uganda has been undergoing major economic reforms through stabilization, economic recovery and structural adjustment programs. Adoption of market liberalization policies has favored growth of private sector in the country demanding increased production at farm level, which in turn favors marketability of farm produce in competitive manner. When farmers are able to sale farm produce, it is expected that they are able to improve upon household incomes, acquire more assets as well as improving their livelihood. It is believed that after satisfying personal demands and prevailing favorable conditions farmers could increase farm outs through investing back into natural resource management. The study was conducted in *Kamuganguzi* sub County considering six parishes with similar biophysical characteristics. Three parishes (*Buranga, Kicumbi and Katenga)* had farmer field schools and were properly linked to city fast food restaurant while other three parishes (*Kasheregyenyi, Kyasano and Mayengo*) had no farmer field schools and lacked proper market linkages for potato. However, the impact of farmer field school and proper market linkages on the communities and categories of farmers benefiting from the process were still not clearly unknown.

Keywords*: Economic reforms, farmer field school, livelihood, market linkages production*

Economic Returns of the 'Mbili' Intercropping Compared to Conventional Systems in Western Kenya

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Abstract

In Kenya smallholder farmers practice maize – bean intercropping. Low nutrient levels in soils result in low yields for both crops. Farmers plant both maize and beans in the same hill or between maize rows result in low yields. In the MBILI system (Managing Beneficial Interactions for Legume Intercrops), the spatial rearrangement gives high legume and cereal yield. An on farm experiment was carried out in four districts (Bungoma, Siaya, Trans Nzoia and Uasin Gishu) of western Kenya in a randomized complete block design giving three intercropping systems (MBILI, Hill and Conventional), maize and two legumes (bean, soybean or groundnut) and two fertilizer levels (0 and 150 kg of DAP/ha) with three blocks. The aim was to compare grain yields and economic returns of the MBILI and conventional intercropping systems. Treatment effects were determined by ANOVA analyses using the General Linear Model of the SAS system. The Bungoma site had the highest groundnut yields for both long rains 2005 and 2006; bean yields under MBILI intercropping (1.4 t/ha). Kitale gave the highest soybean yields of 583 kg/ha from MBILI with fertilizer. The MBILI intercropping gave the highest maize yields (5 t/ha) in all the sites except Sega, while the controls gave low yields (1 t/ha) in all the sites compared to the fertilized intercrops. Economic analyses showed that MBILI gave the highest returns on capital. The distinct finding is that MBILI gave increased maize and legume yields compared to conventional intercropping systems.

Keywords: *MBILI, Intercropping, legume, cereal, Yield*

Modelling Applications for Soil and Water Management for maize production in the Drylands of Eastern Kenya

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Abstract

The traditional field experimentation approach (whether on-station or on-farm) is becoming increasingly inadequate in addressing problems related to complex agricultural systems. The conventional methods of experimentation, where multi-location trials are conducted over several years, are both time-consuming and expensive. One practical and cost-effective alternative is to use simulation models. Models enable effective investigation of a wide range of production scenarios over varying climatic and soil conditions. Over the past two decades, the crop growth modelling approach using dynamic process models has been adopted in Kenya to address problems related to effective and efficient management of natural resources. This paper provides a review of CERES-maize model adaptation and application for maize production and the APSIM model for evaluation of soil conservation practices in the drylands of eastern Kenya. CMKEN, the Kenyan version of CERES-maize, was used to simulate maize yields comparable to those experimentally derived (R^2 0.88), when tested under rainfed and irrigated conditions with varying cultivars, sowing dates, plant population and nitrogen fertiliser rates. After validation, the APSIM model accurately predicted maize yield (R^2 0.94) and was also tested for estimation of total soil, N and C losses, through runoff at KARI – Katumani, under similar conditions.

Keywords: *Carbon, maize, modeling, nitrogen*

Impact of different market types on investment in soil management technologies: A case study of Ugandan cotton

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Abstract

Cotton has been grown in Uganda since 1903. Despite this, fiscal and economic reforms geared to market-driven production have led to a decline in the production area. Greater private sector participation in national agricultural functions and elimination of public subsidies for input and product marketing has negatively affected the management of soils and NRM investment in many cash crops in Uganda. This study assesses the differences in the soil management technologies of the export and local markets for cotton which smallholder farmers are linked to. It was hypothesized that increased farmer-to-market linkages result in reduced investment in natural resource management (NRM) and increased exploitation of the natural resource base. A survey of 200 smallholder farmers was carried out in Lira, Northern Uganda. Results showed that certified organic export markets encourage the use of indigenous knowledge in managing soil fertility and increased investment in NRM to maintain their organic certification. Local market linkage through private local ginneries promotes conventional cotton production. The study found that the costs of soil management inputs is predominantly promoted and absorbed by other actors in the market chain of this linkage. Without this source of inputs, farmers are less motivated to use soil fertility enhancing inputs due to their expense. The recommended use of these inputs by farmers was less profitable due to the low prices set by the Cotton Development Organization (CDO) compared to the export market counterparts. The export market offered a premium price above the CDO price.

Key words: *Soil management technologies, farmer to market linkages, smallholders, cotton, export market, local market*

Overcoming market constraint to pro-poor agricultural Growth in the Eastern of DR. Congo, South Kivu

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Abstract

The opportunities and constraints facing the marketing of the agricultural production have been poorly documented in the DR Congo. To address this lack of information, a survey of the marketing opportunities and processing constraints facing agricultural markets was conducted in 11 rural markets in South-Kivu. The objectives of the study were to assess the marketing opportunities, which may increase farmers' income, create technology demand, and provide incentives for sustainable production, by investing in soil fertility improvement. The results have shown that (1) There are enormous marketing possibilities within and around the country: Main national towns receive an average of 29083t (48.4%) of the beans produced by small-holder farmers in the Kivu region and about 31 737t, (22.5%) is traded seasonally between DR CONGO, Rwanda, Burundi and Uganda, (2) smallholders have few alternative sources of income and lack capacity to access and use these market opportunities;. Most of the constraints are linked to limited market access and development, inhibiting economic and technological development, low economic activity, poor markets for agricultural input, output and finance, high transaction costs and risks and high unit costs, weak institutional and infrastructure environment, high cost and weak information access and property right. The study suggests that overcoming agricultural marketing constraints requires a strong information programme to sensitize farmers to take advantage of regional and national opportunities (potential market), a collaborative mechanism between public and private sectors, for improving access to agricultural services, including market information, instituting contractual enforcement measures and strategies for optimizing the utilisation of processing capacity.

Keywords: *Agricultural market, market constraints, opportunities*

Improving African agricultural market and rural livelihood through *warrantage*: Case of Jigawa State, Nigeria

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Abstract

Poor agricultural commodity prices are the key causes of poverty in many sub-Saharan African countries. Efforts to improve rural livelihoods must improve agricultural produce marketing. This study was carried out to ascertain how the warrantage (a micro-credit scheme) system can be used to improve agricultural marketing and livelihoods in *Madana* community, *Jigawa* State, Nigeria. The design was an action research approach, based on supervised enterprise project framework. Data was collected using questionnaires, interviews, and group and personal discussions. Analysis was carried out using qualitative and quantitative methods. Prior to intervention, farmers in the area sold their produce at low prices immediately after harvest to meet urgent cash needs, resulting to low returns on investment and limited use of improved farm inputs. A pilot phase led to the observation that farmers could overcome the above problem if offered the opportunity to hold onto the produce for few months after harvest to take advantage of high prices during lean season. This study was to scale-up the findings from the pilot phase. Through the *warrantage* system, farmers have been able to timely access subsidised farm inputs, increase production, store their produce and sell during the lean period when prices are high. The outcome include: farmers are increasingly able to meet their cash and other needs. The impact of the project has generated widespread interest among other farmers even outside the *Madana* community. They are adopting the *warrantage* system as a model for sustainable self-help and a robust means of improving their livelihoods.

Keywords: *Warrantage*, *Improved rural livelihoods, improved farm commodity prices, Nigeria*

Constraints in Chickpea Transportation in the Lake Zone of Tanzania

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Abstract

Chickpea (*Cicer arietinum*) is an important food legume providing food and income for farm families, used as medicine and provides the country with foreign earnings. Despite its importance, its marketing system still performs below par. The main objective of the study aimed at identifying the constraints facing traders in the chickpea marketing and determining the optimal quantities and costs of chickpea distribution from four supply sources to three markets. Eighty traders were interviewed using a structured questionnaire. The analysis was done using Statistical Package for Social Science and SOLVER- Microsoft Excel computer software. The findings indicate that the total cost of procuring chickpea was US$ 47,745 that was much higher than the optimal total cost calculated at US$ 37,710. Transport took up a large proportion of the marketing costs accounting for 45.3% of the total marketing costs. Transportation costs are high as a result of poorly maintained feeder roads, seasonal supplies of chickpeas, lack of information about prices and haphazard choice of transportation routes. To reach the optimal solution, the distribution schedule was re-allocated; thus increased the number of routes from nine to eleven and changed the quantities transported in different routes. This change would result in a reduction of costs by 21%. Moreover improvement of road network; storage facilities; farmers' market education and information; formation of traders' association; would reduce marketing costs and hence increase marketing efficiency.

Keywords: *Chickpea, constraints, marketing costs, optimal solution, transport*ation

Mobilizing Producer Marketing Groups for Sustainable Production and Natural Resource Management: Prospects and Challenges for Achieving Impacts at Scale with "Green Revolution" in Africa

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Abstract

Achieving Green Revolution in Africa critically depends on organizing small-scale producers into marketing groups and strengthening their capacity to undertake collective action in natural resources management (NRM). This paper draws from a cross-sectional study of 100 producer marketing groups (PMGs) in Uganda. The paper presents a typology of PMGs based on their market readiness and innovation capacity, and investigates the factors that determine their capacity to compete in markets and to disseminate NRM innovations. The paper examines the PMG members' incentives to invest in ISFM, and the trade-offs and synergies between market access and soil fertility status for different categories of PMGs. The results, suggest that the chances of achieving impacts at scale with ISFM innovations can be improved by (i) improving functioning of input and output markets; (ii) strengthening innovation capacity and skills for experimentation in PMGs; (iii) strengthening social capital and connectivity to service providers and local government; (iv) promoting market institutional innovations for collective marketing (credit, market information system, financial management and business skills), and (v) identifying value chains and incentives that are strong enough to compensate for the risk in adoption; in combination with strategies to improve PMGs' skills that will contribute to their accumulation of financial, natural and human capital. The paper suggests that we need a better understanding of social resilience and sustainability of PMGs. Social resilience is the capacity of groups or communities to cope and adapt to changes in markets (products, prices, demand) and in the broader socio-ecological system.

Keywords: *Innovation, input-output markets; Natural Resource Management, producer marketing groups, scaling up, social capital, value chains.*

Enterprise prioritization and implications for Soil Fertility Management – The case of Kiambu district

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Abstract

High potential areas form the major food producing zones in Kenya. However, the small-scale farmers in such areas are not necessary food secure or income sufficient. In these high potential areas several factors, including declining soil fertility, hamper increase in farm household incomes by contributing to low and declining yields. Priority of enterprises selected and the objective of selecting the specific enterprise was hypothesized to influence Soil fertility management (SFM) options the farmers use. The objective of this study was to understand enterprise selection amongst 3 SFM classes (good (1), average (2) and poor (3)) in Kiambu district and its effect on their SFM techniques. The study was conducted amongst 99 farmers in Githunguri division of Kiambu district in AEZ classified as Upper midlands zone. Dairy was ranked highest by 88%, 78% and 60% of farmers in the 3 SFM classes respectively. This was followed by maize and potatoes (65% and 44% of all farmers respectively) as they provide stable food and income source, though lower compared to high value crops like tomato. Tomatoes received on average 85kg/ha N fertilizer followed by potatoes (27kg/ha N) and maize (25kg/ha N). This was supplemented by manure application at 14t/ha on napier, 12 t/ha on tomato, 8 t/ha on potato and 7 t/ha on maize/beans. All rates were lower than recommended. In developing and disseminating SFM techniques, researchers should consider the farmers priority enterprises, reasons for the selection as well asaddress the conflict between risk and fertilizer use in high value crop production.

Keywords: *Enterprise selection, Farmer classification, Soil Fertility Management,*

Participatory variety selection of pulses under farmer management in Kadoma District, Zimbabwe

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Abstract

A study was initiated in Kadoma District (29^{o} 53'E and 18^{o} 19'S), to select the best varieties from 3 cowpea varieties, 7 bean varieties and 7 soyabean varieties that performs well under local conditions (climatic and resource availability). It was also intended to assist farmers to develop their own criteria for evaluating different crop varieties. These three crops had been selected to address issues of food security (cowpea and beans) and income (soyabean and beans). Three factors where tested in 2005 i.e. source of nutrients, time of planting and pesticide application. The first experiment was established in late November 2005 and the second in late November 2006 based on results of the previous season. In 2006, the experiments tested botanical crude extracts on selected varieties i.e. 2 varieties of cowpea, 4 varieties of soyabean and 4 varieties of bean. Farmers' selection criteria included; disease tolerance, yield, grain characteristics (size, shape and colour), cooking time and taste. Pesticide application was important for cowpea and bean yield underlying the fact that pest control is still crucial for optimum yields. CBC1 (cowpea), UBR92/25 (bean) and Solitaire (soyabean) were considered to be the best pulse varieties that could be grown in Kadoma District with conventional pesticide applications.

Keywords: *Farmer evaluation, food security, grain legumes, participatory research*

Community Soil Fertility Management in the Region of Gourma Burkina Faso -West Africa

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Abstract

Meeting the millennium development goals in Africa, can only be achieved by intensification and increasing crop yield per unit area. Despite the research efforts made in the field of soil fertility management and the proposition of technology packages, crop yields are still under population needs in Africa. How African soil can nourish conveniently its population? To answers this question, field investigations using rapid and participatory method of research was carried out in 15 villages of the region of Gourma. These investigations were aimed to determined farmers knowledge on soil resources: soil classification, and soil degradation using local indicators, local soil fertility management, and smallholder farmers' capacity to adopt new technologies in soil fertility management. The results of the investigations show that the main parameter for soil classification was texture. Fellow, organic manure and crop rotation were the main soil fertility management; soil degradation was judged according to the agricultural output, and the apparition of certain species of weeds. Concerning the villages where modern technologies of soil fertility management were introduced, the lack of tolls and information were mainly the limitation factors of the adoption of these technologies at smallholder farmers' level. Our investigation have shown that stone belt construction in the field was essential for the limitation of soil erosion process and behind that advantage, it was the starting point of what farmers consider as investigation which can keep them from the practice of shifting agriculture.

Keywords: *local soil classification, region of Gourma, small holders' farmers, soil fertility management, stone belt.*

Linking policy, research, agribusiness and processing enterprise to develop Mungbean *(Vigna radiata)* production as export crop from Senegal River Valley

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Abstract

Mungbean (*Vigna radiata*) is a short-duration and high nutritive value leguminous pulse crop. To allow Senegalese farmer to access to increasing Mungbean market, different stakeholders, policy maker and research, private and industry sector were brought together. First phase was, screening varieties and evaluating yield performance. In experiment 2004, 34 varieties were evaluated for their potential, whereas in 2005, ten best accessions were submitted to a second screening, including grain technological analysis for marketability. Considering mean yield level and stability criteria, Line 4, VC 6123 B-11, VC-6173 B-10, CDHA, VC 6123 A, Line 7, Line 6, VC 6379 (23-21), KPS 7 and Line 5 were retained following the first screening process. Global aboveground biomass average was 3677 kg ha^{-1}, ranging from 2707 kg ha^{-1} by Line 5 to 4736 kg ha^{-1} by VC 6379 (23-21). Harvest index varied between 0.47 by Line 6 to 0.59 in VC 6123 A, with global biomass average standing at 0.54. All varieties yielded higher than 1500 kg ha^{-1} with a peak at 2222 kg ha^{-1} by VC 6123 B-11. The performance of varieties was established as follows: VC 6123 B-11 > Line 4 >KPS 7 > VC 6379 (23-21) > Line 5 > Line 7 > CDHA > VC-6173 B-10 > VC 6123 A > Line 6. Using technological scoring criteria, Line 4, Line 6 and KPS 7 were chosen as best varieties for export purpose. Other varieties should be devoted to local use to enhance farmer's food security.

Keywords: *Mungbean, Senegal River Valley, Vigna radiata*

Linking research to market using farmers' field school approach

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Abstract

Many countries in Africa are undergoing economic reforms to reverse the wide spread and deepening poverty at the household level. Market liberalization is causing steep competition among the different stakeholders resulting in the need for spiral change in the production technologies. In the past, research was mostly geared towards food production and little was done to link it to market demands. Low adoption of agricultural technologies was mainly due to low participation of farmers in the technology development coupled by lack of market for produce. Linking research to market was done using farmer run farmer field school (FRFFS) approach in the highlands of southwestern Uganda. This was done after identifying potato as a possible enterprise for community's household income. Major constraints to potato production were bacterial wilt, late blight and low soil fertility. To perfect production, two FRFFS were set up in two sites and two experiments conducted on *Victoria* and *KachPot 1* varieties. Experiments involved integrated late blight management with four different spraying regimes of rodimil and agrozeb and planting on ridges and conventional planting with and without fertilizers. Complete block randomized design with two replicates was used. Performance of technologies was done basing on marketable yield. Results showed that, for each unit of money invested in using agrozeb every after 14 days, 2.9 extra units of money are generated, 2.6units with agrozeb, then rodimil when necessary. However, spraying with agrozeb, followed by rodimil then agrozeb, results shows a loss of 2.0 units of money for each unit invested.

Keywords: *Economic reforms, farmer run field school, market, research, technologies*

Market Access: Components, Interactions and Implications in Smallholder Agriculture in the Former Homeland Area of South Africa

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Abstract

While insufficient market access is recognized as a key institutional constraint to smallholder development in Africa, the generalities that characterize much of recent research on the subject mean that the mechanisms by which market access exerts influence are not well understood. Drawing on household-level data from the former "independent homeland" of South Africa, this paper employs the logistic model to isolate key components of market access, including access to market/price information, productive inputs, infrastructure, etc. Differences in the extent to which these factors constrain smallholder crop and livestock farmers buttress the expectation of greater policy impact from research that takes a wider view of market access. The paper fits the foregoing finding against the backdrop of South Africa's troubled past that continues to negatively impact on its agricultural economy. How this history has influenced intra- and inter-sectoral relationships and coordination is discussed. The paper further presents results that shed light on how policy and smallholder support measures can be better targeted to address the problems of limited market access in the communal/rural areas in order to increase the use of agricultural inputs such as mineral fertilizers, enhance agricultural productivity and equity as well as improve overall rural livelihoods. Results will be extrapolated to other rural areas of sub-Saharan Africa which, in many respects, are similar to the former "independent homelands" of South Africa.

Keywords: *Agricultural productivity, institutional and technical constraints, market access, rural livelihoods, smallholders.*

Farm input market system in Western Kenya: constraints, opportunities and policy implications

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Abstract

Widespread and increasing rural poverty in sub-Saharan Africa (SSA) has been of great concern to the development community. Compared to other developing regions of the world, low use of inputs by smallholder farmers is one of the factors responsible for the gap between potential and actual yields. Market constraints reduce profitability in use of inputs and increase production risks. This study interviewed 130 farm input dealers in Kenya to analyze trends, inputs stocked, distance to markets, services to farmers, and constraints and suggest how to improve input delivery to farmers. Results indicate that although the number of agro-dealers is still small relative to population, there has been a steady annual increase (2–22%, with a mean of 16% across inputs) in their number from 2003 to 2005. DAP fertilizer (stocked by 92% of respondents) was the most frequently occurring. Others are CAN fertilizer (84%), Urea (78%), and NPK (40%). Input information (75% of respondents), credit (13%), bulk breaking (8%), and spraying (4%) were the other services provided. Selling price of inputs increased with distance to markets. The most important constraints faced by agro-dealers were transportation (53%), limited market (30%) and market information (21%), storage (13%), and inadequate business skill (12%). Policies and institutional frameworks suggested by dealers to streamline farm input trade were associated and government as the main proposed institution. The study concludes with suggestions on how to enhance efficiency of agro-dealers in input delivery. This is timely since SSA governments are presently creating structures to enhance input use.

Keywords: *Farm input delivery; input dealers; Kenya; market constraints; poverty and yield gap*

Fertilizer Policy, Trade and Marketing in Zambia

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Abstract

The nature of fertilizer marketing and pricing policies in Zambia were heavily interventionist in the 1980s and liberalized in the 1990s with both government and private sector participation. The demand for fertilizer in Zambia is estimated at 300,000 Mt per annum fluctuating to as low as only 100,000 Mt in some years. However, Government continues to be convinced that the private sector has not developed well enough to adequately serve the needs of smallholder farmers, especially in the more remote parts of the country. For example, only 20% of the 650,000 smallholder farmers used fertilizer during the 1999/2000 farming season. Fertilizer marketing has been affected by several constraints such as high cost, availability and poor supporting infrastructure. Currently, as from the 2002/2003 season, the government has been implementing the Fertilizer Support Programme (FSP) where the targeted 120,000 farmers are expected to pay upfront 50% of the total fertilizer cost. Due in part to this programme, coupled with favorable weather conditions, maize production increased by 64.4% to 1,424,000 Mt in the 2005/06 season. For sustainability purposes, however, government needs to have a clear exit strategy from the FSP to enable the private sector handle the production and marketing of inputs effectively; government needs to improve the infrastructure and the macro-economic conditions to facilitate effective fertilizer marketing; government should invest more in extension services; government should enforce fertilizer quality regulations in order to ensure adherence to minimum quality standards and government needs to develop strategic partners and form consortia (local and regional) for procurement of fertilizer and raw materials to cut costs.

Keywords: C*ost and availability, fertilizer constraints, marketing*

Policy framework for utilization and conservation of below-ground biodiversity in Kenya

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Abstract

The reasons for the lack of inclusion of below-ground biodiversity in the Kenyan policy and legal framework were sought through a purposeful survey. Gaps were identified in the relevant sectoral policies and laws in regard to the domestication of the Convention on Biological Diversity (CBD). Below-ground biodiversity had no specific schedule in any of the sectoral laws. Most sectoral laws were particular about the larger biodiversity and soils but had no specific mention of below-ground biodiversity. Material Transfer Agreements and Material Acquisition Agreements that are regarded as tools for the domestication of the CBD to guide transfers, exchanges and acquisition of soil organisms lacked a regulating policy. The lack of regulating policy could be attributed to the delay in approval of draft regulations by the Ministry of Environment while the lack of specific inclusion of below-ground biodiversity in Kenya's legal and policy framework could be as a result of lack of awareness and appreciation among stakeholders.

Keywords: *Below-ground Biodiversity; Convention on Biological Diversity; Material Acquisition Agreement; Material Transfer Agreement; Policy framework.*

Policy Issues Affecting Integrated Natural Resource Management and Utilization in Arid and Semi Arid Lands of Kenya

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Abstract

This paper analyses policy issues affecting utilization and management of natural resources in Kenya's arid and semi-arid lands (ASAL) that constitute 84% of the total landmass, supports 25% of human population, 54% of livestock and almost all wildlife. The ASAL has fragile natural resources, which require appropriate management strategies. Focused group discussions and single subject interviews were conducted involving various policy institutions and lobby groups to identify policy flaws in management and utilization of natural resources and recommend to policy makers for review. Privatization policy on land ownership was found to be unsustainable for resource development and utilization. It denies communities accessing communally utilizable resources and nomadic grazing systems. Conventional farming systems have failed to address soil and water conservation practices contributing to land degradation. The policy is unclear on appropriate areas for farming and livestock keeping. Wildlife conservation policies have impacted negatively on communities living in wildlife areas due to few direct benefits from wildlife. Yet the communities bear all the costs of living with wildlife. Existing marketing policies are unfavorable in guaranteeing markets for ASAL products. Water management and utilization policies favour large-scale farmers at the expense of pastoralists. Policies on energy conservation are unclear leading to excessive charcoal burning which degrades the environment. The government needs to review its national policies and invest more in development of human capital in rural areas to release pressure from the environment. There is also need to involve many stakeholders in policy formulation.

Keywords: *ASAL, Kenya, natural resource management, policies*

Drivers of Occupational Health and Environmental Safety Concerns during Pesticide Use among Small-scale Farmers at Sagana, Central Highlands, Kenya

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Abstract

Small-scale farmers in Sagana area of central Kenya constitute a population at risk due to intensive use of pesticides. The main drivers of the risks observed are farmers' own perceptions and attitudes towards pesticides. This paper examines these drivers with emphasis on farmers' susceptibility perception, severity of the hazards, and barriers to taking risk reduction measures, and cues to adopting safety behaviour when dealing with pesticide at the farm level. Data was collected by use of interviews conducted in 2006/2007 from a sample of 140 farmers. Perception scales were developed from interview items and were ranked along a modified 3-point likert-scale. Analysis of the items and scales showed that farmers had fairly high levels of perceived risk, perceived severity and perceived benefits of taking action to mitigate pesticide hazards. However, most of them remain susceptible to pesticide related dangers due to various factors notably; fate, perceived high cost of purchasing protective gear and lack of adequate training in the use and handling of pesticides. Further, although generally regarded as important, education had limited positive effect to safety knowledge and behaviour when handling pesticides. The challenge to policy and practice toward safe use of pesticides must address issues of farmers' economic survivability, perceptions and attitudes, along the whole chain from pesticide procurement, storage, farm application and disposal.

Keywords: *Environmental safety, occupational health, pesticides, small-scale farmers*

Gender Differentials in Adoption of Soil Nutrient Replenishment Technologies in Meru South District, Kenya

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Abstract

Understanding gender differentials in adoption of soil nutrient replenishment technologies is critical to their successful implementation. A survey was conducted to examine gender differentials in choices of technologies adopted in male and female headed households; socio-economic, institutional and demographic factors influencing adoption and gender differences in participation in project activities. Chi-square tests run at $p<0.05$ revealed a significant relationship between gender and the choice of manure and fertilizer. Results of the logistic regression model revealed that adoption in male headed households was influenced by; farm size, area under food crops, area under cash crops, household size, number of adults, number of cattle, frequency of hiring labor, participation in project activities, access to credit and group membership. Factors that influenced adoption in female headed households were: area under cash crops, number of adults, perception of soil infertility, participation in project activities, access to credit and group membership. T-tests run at $p<0.05$ revealed statistically significant gender differences in participation in field days, problem diagnosis meetings and village training workshops. There is a clear need for strategies and policy to address gender disparities in adoption of soil improvement technologies and to encourage women's participation in training activities.

Keywords: *Adoption, gender, participation, technologies*

Land Insecurity as a Limiting Factor of Soil Productivity

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Abstract

In Burkina Faso, agriculture is facing many constraints that limit seriously agricultural production and hinder to achieve food security. One of these constraints often evoked by farmers is land insecurity. This problem has been pointed out during a study of farming systems carried out in two rural localities around Bondoukuy village, in the province of Mouhoun. The methodology used to understand farming systems and the way to have access to agricultural lands, was investigations with land owners and migrants. The land holders are the Bwaba, the local ethnic group. The two rural localities are Mokouna and Bukuy, divided in three parts: top Bukuy, middle Bukuy and low Bukuy. The low Bukuy where soils are more fertile is exclusively reserved for Bwaba. The other rural localities are cultivated by migrants, manly composed of Mossé coming from central zone of Burkina Faso because of recurrent droughts of 1970, 1973 and 1984. Soils are less fertile because of long cultivation. The results showed that land is rent to migrants for an undetermined time. In fact, the land owner can at any moment dispossess the user for no reason. Some activities like trees plantation are considered as an appropriation act of the land. Migrants have no sustainable right to the land. This situation does not encourage them to make investments in order to improve soil productivity and is a big handicap for achievement of food security in the region.

Keywords: *Burkina Faso, Bondoukuy, landed insecurity, migrants, food security*

Tracking Changes in Livelihoods and Natural Resource Management Impacts of Agricultural Innovations in Africa: *Lessons from Applying Participatory Monitoring and Evaluation Systems*

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Abstract

Participatory, monitoring and evaluation (PM&E) can be a vital component of an effective demand-driven R&D system by providing a systematic process for tracking changes in the livelihoods of agricultural innovations. PM&E provides a systematic process for self-reflection and learning; documenting experiences and lessons; and assessing long-term environmental, NRM and poverty impacts. This continuous process of learning and adjustment of strategies is central to enhancing the impacts from agricultural innovations, and is crucial in deciding on what strategies should be scaled up and how this might be achieved. This paper presents the lessons of an action-research project aimed to strengthen capacity of biophysical scientists and their development partners, farmers' organizations and other stakeholders to implement PM&E systems to track progress of their projects, and assess NRM and poverty impacts of integrated natural resources management innovations. The paper shares various lessons: (1) Challenges with developing the capacity of scientists and other stakeholders in PM&E; (2) Types of scientific and local indicators that should be used to track the various aspects: NRM changes and livelihood impacts; (3) Comparative analysis of local indicators across Eastern, Southern and Western Africa and factors that affect the differences; (4) A comparative analysis of scientific versus local indicators for tracking changes in livelihoods, NRM and agricultural innovations; (5) Impacts of the PM&E process on enhancing the involvement of local stakeholders in the execution of their projects, leading to better results; (6) Impacts of the PM&E process on enhancing the performance and relevance of R&D projects.

Keywords: *Local and technical indicators, tracking change*

Participatory Verification of Effect of Local Organic Materials on Yield and Profitability of New Bean Varieties by Katosi Women Farmer Group in Mukono District

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Abstract

Research has found that linking farmers to market is a motivating factor for encouraging farmers to invest in soil fertility improvement techniques to maintain the sustainability of their production. Organic sources of fertilizers are common for farmers that cannot afford, or access, inorganic fertilisers. Integrating good varietal performances with organic soil fertility amendment improve soil quality and crop yield. Initially, five "new" bean varieties (NABE 4, NABE 5, NABE 11, NABE 12C and Mani ga mulimi) were tested for yield performance and profitability. Yields were only significantly different ($P \leq 0.05$) across sites. Therefore, farmers based selection on other characteristics rather than yield for varieties to adopt. NABE 4, NABE 5 and NABE 12C were the most preferred due to their good qualities (colours, size, promising marketability). In the subsequent trial, compost and liquid manure were evaluated on yields of two selected varieties. Similarly, yields were significantly different only across soil types. Participatory farmer evaluation using scoring determined that compost was preferred because most farmers were able to make it themselves. NABE 4 was most preferred because it was highly tolerant to drought and diseases, had short cooking time and tasty thick soup. Based on cost benefit analysis, control was more profitable than compost and liquid manure, farmers concluded that there was no need to add more nutrients to the soils. This reinforces the fear that farmers linked to markets will continue to exploit their natural resources and will not invest in sustainable crop production due to constraints investment ability and labour.

Keywords: *Bean production, organic farming, yield, farmer evaluation, profitability.*

Application of soil quality indicators in semi-arid rangelands in South Africa: perspectives for degradation monitoring

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Abstract

Concerns were raised over the past decades on the degradation condition of arid and semi-arid rangelands in South Africa, mainly in areas under communal land management. Changes of vegetation components were often used to characterize degradation, whereas soil quality and degradation processes remain less understood. The integration of soil information in rangeland monitoring cannot be overemphasized. The aims of this study were to characterize and establish baseline indicators of soil quality/health, and to investigate the potential effects of grazing and exclusion management on soil quality indicators, that could be used for reporting on rangeland degradation in semi-arid South Africa. The soil characterization provided some valuable baseline indicators of soil quality (and fertility) at the sites surveyed. Notwithstanding the alarming plea about communal rangeland degradation, similar soil quality indicators were observed between the sites under communal management and surrounding commercial and/or game areas, considered well managed based on the attributed of their aboveground vegetation. This challenges the sole use of vegetation parameters in monitoring and assessing rangeland health. Furthermore, site-specific approach is cautioned when assessing degradation between different rangeland management systems. The results warrant the need to re-examine the "tacit" degradation in communal managed areas rangelands. This warrants the need to re-examine the "tacit" degradation in communal managed areas. The effects of grazing were divergent depending on the soil properties monitored and site-specific characteristics. Last, the integration of both science-experts and community knowledge and understanding is essential to empower local stakeholders in order to support management decisions for sustainable rangeland use.

Keywords: *Baseline indicators; communal rangeland management; grazing and exclusion effects; rangeland degradation; soil quality.*

Income, food security, nutrients and labour: a comparison of key aspects of African smallholder farming systems using IMPACT.

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Abstract

The livelihoods of African smallholders are largely dependent on appropriate natural resource management on their farms. Income, food security, soil fertility and labour availability are key aspects that are closely linked and that determine, and are determined by, livelihood strategies of rural families Africa. As part of the AfricaNuances project, we collected information on the dynamics of smallholder farming systems in selected locations of eight African countries (Kenya, Tanzania, Uganda, Zambia, Zimbabwe, Mali, Ghana and Cameroon), differing broadly in agroecology, markets and demography. Case studies representing farmers of different wealth status were selected in each location. This enabled us to have a wide variety of systems types to explore key aspects determining the productivity and sustainability of these systems. The information was collected using the IMPACT tool (Integrated Modelling Platform for Animal-Crop sysTems) and consisted of detailed monthly household-level information on land management, crop and livestock production, household composition and farm labour, input/output flows and market links. A comparative analysis of income and expenditures and their sources, household food security in relation to labour availability nutrient flows was performed across the case-studies, identifying trade-offs between these different dimensions of the systems. The role of key components in the farming system determining the well-being of smallholders was analysed and synthesised to identify potential development pathways required to promote sustainable development in rural Africa.

Keywords: *AfricaNuances, Food security, IMPACT, smallholder farming systems*

Optimization of Soil Fertility Management Across different Socio-Economic Gradients: A Case of Smallholder Maize-based Agro-ecosystems in Central Kenya

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Abstract

In the last two decades, risks and uncertainties have impeded possible increases in per capital food production by smallholders in central Kenyan Highlands. These include erratic weather, degraded soils, dilapidated road infrastructure and limited access to credit. However, soil fertility depletion is the most fundamental cause of declining per capita food production. The situation has been exacerbated by increase in costs of inorganic fertilizers occasioned by structural adjustment programmes (SAPs) over the same period. Resource-poor smallholders have therefore resorted to low-external input soil fertility management technologies. The major objective of this study was to carry out socio-economic analysis of smallholders' soil fertility technologies with a view to enhance their profit maximization and food self-sufficiency under different resources constraints for different farm typologies in Maragwa District. Participatory Learning and Action Research were used to delineate farmers into different bio-physical and socio-economic strata while Gross margin analysis was used to develop recommendations for optimal farm resource us across different farm gradients. Total gross margin in Class I was KES 20,818, KES 5,377 in Class II while in Class III it was KES -4,372. All smallholders' actual farm plans were found to be inefficient in resource allocation leading to low food production, farm incomes and poverty. About 100 % of farmers were living below USD 1 per person per day. Application of Manure (5 tons/ha) combined with inorganic fertilizers (20- 60 kg N/ha) was found to be most optimal integrated soil fertility management options for sustainable maize-based production systems across different socio-economic gradients.

Keywords: *Maize-based production systems, Millennium development goals (MDGs), Profit maximization, Resource-poor smallholders*

Agronomic and farmer assessment of new bean and soybean germplasm in selected regions in Rwanda and the Democratic Republic of Congo

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Abstract

Introducing resilient germplasm often presents a rapid approach to improve crop production. Evaluation trials were installed with 36 farmers' associations, aiming to simultaneously assess the agronomic performance, including the efficacy of particular traits, and to obtain feedback on the adoption potential and marketability of the germplasm. Farmer associations in Rwanda and DRC (4 sites in Bas-Congo, 4 sites in Sud-Kivu, 4 sites in Umutara, 2 sites in Bugesera and 2 sites in Kibungo) tested 27 bush bean and 9 climbing bean varieties. Measurements included scoring of susceptibility to pests and diseases, biomass production, biological nitrogen fixation, grain yield and grain micronutrient contents. The performance of the germplasm varied largely, principally due to differences in climatic conditions. Low soil fertility was the foremost constraint for crop growth and large responses to manure application were observed. In almost all associations, new varieties were found with favourable traits compared to the local variety. Performance of individual varieties, however, differed largely between sites. Results of participatory evaluation showed significant differences between male and female farmers, between producers and traders, and between sites, in the criteria used for evaluation, and in the varieties selected. This demonstrates the importance of providing a basket of options from which farmers can select their preferred varieties when introducing resilient germplasm. Some generally well-performing bean varieties were AND-10 and VCB81012 in Sud-Kivu, CODMLB003 and VCB81012 in Rwanda, and Lola and MLV06-90B in Bas-Congo. Farmers are currently multiplying their preferred varieties and producing seed for other smallholder farmers in the region.

Keywords: *Common bean, participatory evaluation, resilient germplasm*

Responding to farmer resource endowments in targeting ISFM on smallholder farmers

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Abstract

A two-year study was conducted between 2005-07 in Chinyika smallholder faming area of Zimbabwe under the Soil Fertility Consortium for Southern Africa (SOFECSA)'s integrated soil fertility management (ISFM) initiatives. The objective was to evaluate how deliberate targeting of ISFM options to farmers along social gradients could enhance farmer participation and crop yields. Maize, green manure and grain legumes were planted to fields belonging three farmer resource groups (RGs), namely Resource-endowed (RG1); Intermediate (RG2); and Resource-constrained (RG3). Organic and mineral fertilizer resources were allocated according to these RGs, which were otherwise used as Learning Centres (LCs). Based on farmer criteria, the same treatments were sequentially rotated the following season. In season 1, five LCs, with at least one from each RG were established. The number increased to 18 the following season: 8 in RG1; 6 in RG2 and 4 in RG3. Average maize yields were 0.3 t ha-1 (RG3), 1.0 t ha-1 (RG2) and 4.2 t ha-1 (RG1) in season 1. Overall, highest maize yields were from manure + mineral fertilizer combinations. Legume yields followed the same trend with soyabean yielding ~50 kg ha-1 (RG3), 600 kg ha-1 (RG2) and 1.4 t ha-1 (RG1). Significant yield increases of up to 400% for RG3 and 250% for RG2 were achieved in maize plots in season 2. Green-manured plots gave exceptionally high maize yields of 7 – 10 t ha-1 for RG1. The LC approach apparently encouraged better participation of all farmer groups and could enhance the contribution ISFM within smallholder communities.

Keywords: *Learning Centre; maize yields; mineral fertilizer; resource endowment*

Optimizing the production under trees in parklands at Nobéré (Burkina Faso) using shade tolerant crops

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Abstract

Cereals production has been reported to be reduced under trees in parkland systems due to the shade indicating the need to replace them with shade tolerant crops. Thus, an experiment on the association of two fruit-trees, *Adansonia digitata* (Baobab) and *Parkia biglobosa* (Néré), with the millet (*Pennisetum glaucum*) and a shade tolerant crop called tabouchi (*Xanthosoma sagittifolium*), was conducted in Nobéré (Burkina Faso). The two crops were grown under 4 trees of each fruit-tree species. The influence zone of each tree was subdivided in 3 concentric zones: A= from tree trunk to half radius of the crown; B=from half radius to the edge of the crown and C=from the edge to 3 m away. A control plot was established for each tree in an area under no influence of any tree. The results revealed no significant difference in the height of millet plants under the two fruit species whereas the highest plants of the tabouchi were observed under néré tree. Trees shade increased the number of tillers but reduced the total leaves area of millet plants. In turn, the total leaves area of tabouchi plants was increased by shade. The photosynthetic energy conversion yield measurements revealed that the two crops were stressed during data recording period even though plants stress was lower in shaded zones. As a consequence of the above functioning parameters, the highest yields of millet were obtained in zone C (1754.17±177kg ha^{-1}) under baobab trees while tabouchi performed better in zones A (4531.82±835kg ha^{-1}) and B (3470.92 ±955kg ha^{-1}) under néré trees proving its shade tolerance. An economic evaluation of the option of replacing cereal by shade tolerant crop is going to be conducted.

Keywords: *Adansonia digitata, Parkia biglobosa, Pennisetum glaucum, shade tolerance, Xanthosoma sagittifolium*