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UGANDA FARMERS COMMON VOICE PLATFORM (UFCVP)

THE COST OF AGRICULTURAL EXTENSION TO PERFORMANCE OF KEY PRODUCTIVE SECTORS OF UGANDAS ECONOMY BESIDES AGRICULTURE

Do Investments in Agricultural extension deliver positive benefits to Health, Trade and Industry, Water and Environment



AUGUST, 2017



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LIST OF THE ABBREVIATIONS

AE	Agricultural Extension
AEAS	Agricultural Extension and Advisory Services
CBOs	Community Based Organisations
DAES	Directorate of Agricultural Extension Services
IFPRI	International Food Policy Research Institute
FAO	Food and Agriculture Organization
HMIS	Health Management Information Systems
IRRI	International Rice Research Institute
LSMS	Living Standards Measurement Study
MAAIF	Ministry of Agriculture, Animal industry and Fisheries
MFPED	Ministry of Finance, Planning and Economic Development
NAADS	National Agricultural Advisory Services
NEMA	National Environmental Management Authority
NGOs	Non-Governmental Organisations
SDGs	Sustainable Development Goals
UBOS	Uganda Bureau of Statistics
UN ECA	United Nations Economic Commission for Africa
WFP	World Food Programme
WHO	World Health Organization
OWC	Operation Wealth Creation
SSES	Single Spine Extension System
CIP	International Potato Center

EXECUTIVE SUMMARY

The study set out to provide an overview of the state of Agricultural Extension in Uganda; with the major aim of identifying gaps and areas of advocacy in the laws and policies that govern extension service delivery in Uganda, document the linkages between agricultural extension and performance of selected sectors which include Health, Trade and Industry and Water and Environment sectors. The study document the analytical trend between performance areas in those selected sectors and the performance of agricultural extension, as well as establish the value of each shilling or dollar invested in agricultural extension and provides recommendations on collaborations and joint investments between those sectors on the impact of inadequate prioritization of extension service delivery.

Results from the study reveal that the state of agricultural extension services in Uganda is wanting and needs to be improved since farmers have limited knowledge of agricultural technologies. Most farmers in Uganda do not know the crop technologies in their farms. Adoption of improved technologies is very low and technology misuse is very rampant. In livestock, the quality of veterinary services is particularly very poor and use of animal production services compared to crops is very low. There is certainly need to invest in agricultural extension both in crop and livestock sectors.

Our analysis also shows that Uganda's agricultural extension sector has undergone a series of reforms from public to private and now back to the public sector. This has created instability and uncertainty in the sector. NAADS specifically managed to reduce government involvement in the provision of agricultural extension services. First, it affected the governance systems as it reduced agricultural extension from skills and knowledge provision to supply of inputs as agricultural extension officers considered their role as that of distributing inputs. This was particularly made worse because of commodification of planning and budgetary process. As result of these weaknesses, the program was reversed and rejected by the key stake holder MAAIF, paving way for a new public extension system popularly known as Single Spine Extension System (SSES).

Under the new arrangement, NAADS has continued to exist but discarded its initial role of providing extension services; and rather distributes inputs under the Operation Wealth Creation programme, which is manned by army officers. Results from interaction with farmers, recruited extension officers and local leaders reveal that the Operation Wealth Creation reform is welcome. Farmers are happy that extension officers are a call away and available. Politicians express similar sentiments and they have political gains to score because of improved access to extension services. In terms of inputs, it seems that quantities that reach the communities have increased compared to before. However, there are problems to be fixed. The input distribution is poorly done. Inputs are procured and delivered when farmers are not prepared to receive inputs. They are provided on first come first serve basis and people who receive them are mainly those close to sub-county. Some times what is delivered is not what farmers

want. The other problem is the logistical challenges for extension officers. They do not have transport and communication allowance, extension materials such as manuals for crops, supplies for demonstrations and access to laboratories

Advocacy is needed in persuading government to allocate more resources to extension for logistical support and field activities. We argue that International NGOs and local bodies working in agricultural extension need to collaborate with single spine extension system and local governments in running their programs. NGOs can for example use these extension officers to run their field activities in areas of operations. This will supplement government allocations and enable extension officers perform their duties. There is also need to facilitate interaction between extension officers and the breeders to ensure that extension officers are knowledgeable of the existing technologies and required agronomic practices for better performance.

Another area where advocacy is required is in lobbying Operation Wealth Creation to decentralize procurement of inputs and empowering communities to demand for better quality inputs. Farmers should have a say in enterprise selection and should, be organized and prepared to receive inputs or else government wastes a lot of resources in purchasing inputs without any impact on farmers' livelihood. We contend that such challenges if not fixed will render the program a failure.

The review of the agricultural policy documents reveal that agricultural extension is anchored on relevant policies. However, the challenge is that financial allocation remains relatively low. According to Agriculture Sector Strategic Plan 2015/16 -2019/20, the total amount of funds required to achieve these interventions are UGX 887.99 billion, but in the recent budgetary allocation, only 39.6 billion was allocated to operationalization of single spine extension system. This value is only 4.4% of the required amount. If we add the donor support which is estimated to be 14 billion, the percentage is about 6%. This is very small and – implies that the extension system will only be operating at 6% level. Advocacy is required to lobby parliament to allocate more funds to Agricultural extension in order to deliver the desired benefits. This is possible with correct strategy and concerted effort from all stakeholders.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and development partners need to sensitize and demonstrate to farmers the benefits of extension services. The farmers need to see the difference between the old system and the new system. This will ensure that farmers can petition their representatives to lobby for increased funding towards agricultural extension.

A review of the Veterinary Surgeons Act revealed that the Act is out dated and ineffective in the provision of veterinary services. According to the Act, if an unqualified person treats an animal

or misuses antibiotics, he is fined a fee of UGX 3000 which is less than the consultation fees for providing veterinary services in areas such as Mukono. It is our opinion that this is a reason why services are of low quality and a reason why there is increased acaricides and antibiotic resistance in animals as well as antibiotic resistance in humans. There is misuse of animal drugs in veterinary medicine, increased antibiotic resistance in both animals and humans who consume food of livestock origin. It is the reason why there are increased complications in patients; prolonged hospital stays, increased number of deaths from manageable illness, and increased need for intravenous therapy rather than use of oral therapy. Advocacy, therefore is required to support the development and passing of the veterinary and para-veterinary practitioners' legislation to minimize these negative impacts.

A review of literature linking agricultural extension to other sectors reveals 15% of all child mortality cases in Uganda are associated with under nutrition and 54% of the adult population in Uganda suffered from stunting as children. The associated annual costs of child under nutrition are estimated at 1.8 trillion UGX, which is equivalent to 5.6% of GDP (Hoddinott, 2016). Analyzing of the data reveals that agricultural extension is positively linked to improved nutrition status among households. We submit that nutrition sensitive agriculture is not integrated into the extension system. Although nutrition-sensitive agricultural knowledge is not currently an activity of agricultural extension, there is great potential for integrating it through newly established single spine agriculture extension system. Therefore, donors and NGOs need to work together with the extension system to deliver agricultural extension messages to make sure that farmers are practicing nutrition sensitive agriculture like diversified agriculture that includes crop, livestock and vegetables, adoption of nutrition rich technologies such as iron and zinc rich beans, orange fleshed sweet potatoes and "Bio fortified varieties".

There is a need for NGOs to work with secondary and primary schools - in teaching and practicing nutrition sensitive agriculture. Already, the Ministry of Education and Sports with International Potato center (CIP) have developed manuals for teaching children about orange fleshed potatoes and nutrition. So far, a few schools have been covered and CIP is looking for partners to promote the approach. Caritas which is a development wing of Catholic Church has access to many Catholic schools and can easily spear head this initiative.

Review of literature on pesticides shows that pesticide and fertilizer use in Uganda is very low, however, with recent outbreaks of pests such as the army worm, the use of pesticides is likely to increase. More so, our results show that as the number of farmers receiving agricultural production extension services increase also farmers using pesticides increases. It is therefore, important for extension officers to educate farmers not just on the use of pesticides but to apply them appropriately.

An analysis of literature on Zoonosis, reveals that Uganda is becoming a hot spot for zoonotic and food borne diseases. It has had more than eight outbreaks of highly infectious zoonotic diseases such as Yellow fever, Ebola, Marburg and Anthrax. These outbreaks are linked to deterioration of animal health care system. There is need to improve on the legislations governing animal health service delivery and invest in veterinary education especially for paraprofessionals. The key paraprofessionals are mainly those in pastoral and livestock areas as well as those working with wild life. This would reduce the zoonotic outbreaks, ensure prudent use of antibiotics thus, minimize incidence of food borne diseases.

Farmers are increasingly using pesticides, synthetic fertilizers and burning of crop residues. In fact, farmers remove crop residue from the plot during the harvest and this is affecting soil health, crop productivity and the environment. Agricultural extension is needed to promote sustainable intensification practices such as Integrated Pest Management Practices and Integrated Soil Fertility Management Practices such as grain legume intercropping or crop rotation as well as use of biological fertilizers for legumes like inoculants. Proper use of organic fertilizers, use of high yielding and pest resistant varieties, banana and coffee intercropping can reduce environmental impacts. In addition, Single Spine Extension System should promote agroforestry mostly for nutrition, animal feed and soil fertility.

In the context of trade, only allocations to local government have significant effect on exports. The impact propensity of a shilling investment in local government agricultural extension is 30 shillings in beans export, 6,000 shillings in maize export, and 13,000 shillings in total exports. The results suggest that much of the extension benefits on exports are mostly beans and maize. The long run impact propensity or multiplier for export values found to be approximately UGX 42,500.

Our results and estimations indicate that the unit cost of providing agricultural extension services that result in increased productivity, better nutrition as well as higher incomes to farmers is UGX 66,290 per visit. This amount shows the unit recurrent cost right from the top end to the point when the farmer receives extension service for each visit. This amount when multiplied by the total number of households to be visited country wide (about 10 million households) results in unit cost of UGX 662 trillion which is an enormous amount that the government may not be able to provide. Therefore, there is need for Civil Society Organizations and other partners to collectively support government in resource and knowledge provision.

On the other hand, the cost of not investing that shilling (UGX 66,290) to key performance areas in the selected sectors of health, trade and industry, water and environment is extremely high. For example, in health, absence of agricultural extension may result in issues of food insecurity among the population. According to UBOS (2015), about 55% of the food consumed at household level in Uganda is from own production or given in kind. This implies

that about 3.9 million households are at a higher risk of starvation without adequate food production. The cost of feeding these households per month was estimated at about UGX 112,424. Therefore, the estimated cost of feeding these households per year if extension services are not provided is about UGX 5,261.4 billion.

The provision of extension services plays an important role in maintaining the livelihood of about 44% of households who derive their income directly from agriculture (UBOS 2012/13). Therefore, about 3.1 million household's income are likely to be affected if no extension services are provided to the population leading to about 15 million people being out of employment. The estimated household monthly income is about UGX 227,000. Therefore, the estimated loss in income at household level is about UGX 8,389.9 billion per year. This implies that failure to invest in extension services might not only lead to loss of jobs, but also income of about UGX 8.4 trillion per year.

Water for production is one of the main resources that the government of Uganda under the Ministry of Water and Environment (MWE) has invested in to ensure increased production throughout the year. For example, in fiscal year 2005/6, about UGX 2.6 billion was invested in construction of water facilities for production. This has drastically increased to about UGX 23 billion in 2014/15 fiscal year. On average about UGX 15.8 billion is invested in water for production for the period 2005/6-2014/15 fiscal years. This translates into a total investment of about UGX 158 billion for the fiscal period 2005/6-2014/15. Therefore, failure to invest in extension services in Uganda will lead to poor utilization of water for production and hence, making the country lose about UGX 158 billion invested in Ministry of Water and Environment.

Our results on cost of not providing Agricultural Extension in relation to trade and industry indicate that failure to provide extension services will deprive the market of food that could be purchased which subsequently affects trade in food stuff. The expenditure on food at household level in Uganda is estimated at about UGX 112,424. Furthermore, 45% households depend on purchased food which translates into about 3.2 million households that might not have access to food from the market. The lack of production as a result of lack of Extension Services translates to about UGX 4,317.1 billion out of the economy. This implies that the country is at a risk of spending about UGX 9.6 trillion on food importation if the investment in Extension services is not provided and improved. Overall, the total cost of not providing Agricultural Extension is extremely high and the country stands to lose greatly due to the multiplier effect and spillover effect of Agricultural Extension in other productive sectors.

1.1 INTRODUCTION

This study explores the linkages between agricultural extension (crop and livestock) and other sectors such as health, trade and industry, water and environment in order to justify investments in agricultural extension.

According to the National Development Plan II, Uganda's development objective is to achieve a middle income status by 2040. A fundamental challenge that government of Uganda faces is how to generate faster and more widely shared economic growth in order to attain upper middle income status by 2040. The target of government is to raise per-capita income from \$506 to \$9500 between 2010 to 2040 and to reduce the poverty level from 24.5% to 5% (MAAIF, 2016). To achieve this objective, there is need to increase agricultural productivity among small holder farmers who occupy the majority of the arable land and produce most of the crop and livestock products. More so, the majority of households directly or indirectly derive their livelihood from the sector. In addition, increasing agricultural productivity will contribute to increased trade volumes and is the source of raw materials for agro- processing industries. However, Uganda's agricultural sector is characterized by low agricultural production and productivity. It is estimated that agricultural sector growth declined from 7.9% in 2000 to 1.5% in 2016/17 (World Bank, 2016).

The decline in agricultural sector growth is linked to low on-farm productivity and weather variations, which is largely linked to limited access to agricultural extension services. Anderson (2007) defines the term agricultural extension and advisory services as "the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills and technologies to improve their livelihoods." Extension services can be organized and delivered in a variety of forms, but their ultimate aim is to increase farmers' productivity and income. Extension can contribute to the reduction of the productivity differential by increasing the speed of technology transfer and by increasing farmers' knowledge and assisting them in improving farm management practices (Feder et al., 2004b).

Between 2006 -2012, access to extension services expanded from 8% to 12% representing a very small increase. As a result, very few farmers are using improved inputs thus limiting crop income growth as export volumes decline, land and resource degradation, the birth of agro-processing industries is stifled, high food prices, and increase in rural-urban migration especially by frustrated youth. This has exacerbated rural poverty and income inequality. Indeed, the World Bank poverty assessment report reveals that, for every three Ugandans who were lifted out of poverty, two are likely to fall back to poverty (World Bank, 2016). Considering the critical role that the agricultural sector plays in Uganda's economy, it is contended that agricultural policies should focus on improving access and provision of extension services to produce marketable surpluses and sustainable food security. Extension

services are expected to increase adoption or use of improved and quality inputs thus leading to increased agricultural productivity and household incomes (Marsh et al., 2004). According to the recent World Bank report, villages where extension services were provided, crop income was 20 percent higher than in villages where extension services were not provided (World Bank, 2016).

The government of Uganda has undertaken policy and institutional reforms directed at integrating NAADS into the main public extension system called the Single Spine Extension System. These efforts have resulted in the establishment of the Directorate of Agricultural Extension Services (DAES) under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) to support the implementation of the Single Spine System. The Directorate of Agricultural Extension Services during the study period had recruited extension workers in order to raise the number from less than 1,200 to over 7,000 extension workers. The objective was to reduce the ratio of extension staff to farmer from 1:5000 to the recommended 1:500. This was expected to lead to efficient agricultural production, thus contributing to the realization of vision 2040 and the Sustainable Development Goals (SDGs) one and two. However, this will require directing the limited financial resources so far available to other safety net programs to improve extension service delivery.

The scarcity of resources and limited funding for safety net programs tends to present a problem for extension reform. The government over the years has been seen to put less priority on extension service delivery, for example, between 2015/16 – 2019/20, the average financing gap for extension is over 394 billion Uganda shillings. The value of agricultural extension to agricultural sector and beyond the agricultural sector has received limited attention. In Uganda, the behavior is such that people believe having a new technology will increase agricultural productivity without agricultural extension and yet new technologies cannot perform without complimentary extension services (Swanson et al., 1998). In addition to improving agricultural productivity and marketable surpluses, agricultural extension results in improved food security and nutrition, enhances market participation, trade and exports, spurs agro-processing industries, and ensures sustainable protection of the environment due to increase in access to information and knowledge on sustainable agricultural intensification (Ndoro et al., 2014).

The lack of appreciation of the role of agricultural extension especially by policy makers that are involved in resource allocation leads to limited allocation of resources to agricultural extension. Part of the problem is that agricultural extension by nature is a public good to the extent that private sector has less interest to invest in it, thus necessitating government intervention. Government intervention on the other hand is not forthcoming because public agricultural extension does not produce positive political gains. Moreover, studies that try to value agricultural extension services in generating positive externalities from other sectors

other than agriculture are quite limited, thus under valuing the value of agricultural extension. Worse still, much of agricultural extension service delivery has focused more on crop extension with limited attention on livestock extension.

1.2 Objectives of the Study

The major objective of the study was to provide evidence on the benefits of Agricultural Extension to performance of key productive sectors of the economy besides agriculture. These sectors include health, trade and industry, and water and environment.

Specific objectives

- 1) To provide an overview of the state of agricultural extension in Uganda.
- 2) Identify gaps and areas of advocacy in the laws and policies that govern extension service delivery in Uganda.
- 3) To document the linkages between Agricultural Extension and performance of the health, trade and industry and water and environment sectors.
- 4) To document the analytical trends between performances areas in those selected sectors and the performance of agricultural extension.
- 5) To establish the value of each shilling or dollar invested in agricultural extension or the cost of not investing that shilling, to key performance areas in the selected sectors of health, trade and industry and water and environment.
- 6) Make recommendations on collaborations and joint investments between those sectors on the impact of inadequate prioritization of extension service delivery.

2.0 METHODOLOGY

2.1 Study Design and Data Types

The study used mixed methods including literature review, qualitative and quantitative methods.

The study used only secondary data obtained from different sources. The qualitative data was collected from published reports, policy documents, working paper series and refereed journal articles. The quantitative data on agricultural extension expenditure was collected from budgetary allocations from Ministry of Finance, Planning and Economic Development (MoFPED), data on volumes of agricultural exports and imports were obtained from UBOS. In addition, the study also used data from National Service Delivery Survey (NSDS) and Uganda National Panel Survey (UNPS) collected by UBOS.

2.2 Data Analysis

We reviewed literature mostly from reports from different organizations including UBOS reports, International Food Policy Research Institute and African Development Bank among other reports. We also reviewed a number of journal referred articles on the evaluation and learning outcomes of agricultural extension. We used data from UBOS and different other sources to provide evidence on some of the observations made on the state of agriculture services in Uganda.

To identify gaps and opportunities for advocacy, we reviewed key policy documents and laws that govern extension service delivery. These include Poverty Eradication Action Plan, Plan for Modernization of Agriculture, national Agricultural Policy, National Development Policy II, Agricultural Strategic Sector Plan, National Agricultural Extension Policy (NAEP) and Agricultural Extension guidelines. We also present perspectives of the farmers, recruited extension officers and district leaders from one of the districts in Western Uganda on recent agricultural extension reform. The laws that we looked into that are related to agricultural extension are the Veterinary Surgeons Act which makes provisions for the registration of practitioners of veterinary surgery and for other matters connected with and incidental to the practice of veterinary surgery.

To document linkages between Agricultural Extension and performance of the health, trade and industry and water and environment sectors, we reviewed literature from different sources. Data from Uganda Panel Survey and the National Service Delivery Survey as well as other sources was used to show trends and relations with key indicators from other sectors.

To establish the value of each shilling or dollar invested in Agricultural Extension or the cost of not investing that shilling, to key performance areas in the selected sectors. We used Parametric or Statistical Based Costing (PBC) which employs parametric methods. Curran et al. (2004) the presented work also sets out some of the recognised definitions of cost that relate to the engineering domain. The paper does not attempt to address the higher-level financial sector but rather focuses on the costing issues directly relevant to the engineering process, primarily those of design and manufacture. This is of more contemporary interest as there is now a shift towards the analysis of the influence of cost, as defined in more engineering related terms; in an attempt to link into integrated product and process development (IPPD defines cost estimation as a process of predicting the cost of a planned activity or output by interpreting historical data or information resulting into formulation of a cost model. Furthermore, Curran et al, (2004) and Scanlan et al. (2002), noted that the process of formulation of the cost model might suffer from the effects of inflation and other market conditions. Therefore, a parametric Cost Estimating Relationship (CER) establishes a relationship between cost and output performance; often defined using a regression model based on historical data. Since both the cost and the output performance varies with time, the relationship between the cost and output performance is defined using the chain rule. For specificity, we consider the expenditure on Agricultural extension service provision against the number of households who received the extension services.

Expenditure Modelling

$$E = f(\alpha, t) + \varepsilon_t$$

(1) Where E is the expenditure incurred to reach a defined number of households, α is the parameters to be estimated from the historical expenditure data while t is the financial year indicating when the expenditure was undertaken while ε_t is the expected precision in measuring the expenditures.

Output Modelling

$$HH = g(\beta, t) + \varepsilon_t$$

(2) where HH is number of households who received extension services, β is, the parameters to be estimated from the historical data while t is the financial year indicating when and how many households received extension services while ε_t is the expected precision in measuring the number of households visited in that financial year.

3.0 STATE OF AGRICULTURAL EXTENSION SERVICES IN UGANDA

3.1 Overview

Agriculture is a critical sector for sustainable development and poverty reduction in developing countries including Uganda where agriculture employs about 72% of its labour force (GOU, 2015). According to Timmer and Akkus (2008), no country can sustain a rapid transition out of poverty without raising agricultural productivity. In Uganda, reduction of poverty from 53.2% in 2006 to 19.7% in 2013 has been linked to the growth of the agricultural sector (World Bank, 2016). Recent results from the National household survey conducted by Uganda Bureau of Statistics (UBOS, 2017) reveals that poverty is on a rise again and it is likely to continue to rise as agricultural production is increasingly being impacted by population pressure, weather changes, and increasing incidence of pest and diseases. Uganda's current annual population growth rate is 3.3 per cent (UBOS, 2017) while agricultural growth rate is 1.5 per cent as of 2016/17. This means that Uganda's population growth is far outstripping food production which is an indicator of the need for urgent measures to be undertaken to increase food production, which is largely in the hands of smallholder farmers (Shenggen et al., 2013).

The question is therefore, what can be done to increase agricultural productivity in Uganda? The Africa Competitiveness Report (2015) published by the African Development Bank suggests availing improved technologies such as high yielding varieties that are unique to our soils and condition. Factors that lead to increasing agricultural productivity include use of disease resistant varieties, increasing fertilizer use, improving market access, and making better use of the technology (Bah et al., 2015). A recent multi country study in selected African countries revealed that the use of modern inputs is no longer universally low in Africa especially for inorganic fertilizers (Christiaensen, 2017).

In Uganda, it was found that use of improved technologies such as inorganic fertilizers and agrochemicals was very low compared to other selected countries (Christiaensen, 2017). Ilukor et al. (2017), while comparing methods for maize variety identification in Uganda it was demonstrated that improved and hybrid variety cultivation is more widespread among Ugandan farmers than assumed although most of them do not have basic knowledge of how to use the technology. Farmers have a tendency to recycle maize hybrids, do not use rogue sprouting seeds, pruning, spraying and rates of fertilizer application are not known to farmers. They also found that 53% of the farmers do not know the crop varieties they are cultivating.

In their study on livestock, Ilukor and Birner (2014), using a role play experiment, demonstrated that the quality of veterinary services in Uganda are very low because of poor relations between veterinarians and paraprofessional most of whom lack required skills and training. Paraprofessionals have problems in drug prescription. Therefore, to increase agricultural

productivity in Uganda, there is need to expand and increase access to agricultural extension services as well as crop and livestock technologies.

3.2 The Delivery of Extension Services in Uganda

The delivery of extension services has undergone numerous restructuring aimed at improving efficiency and making it more responsive to smallholder farmers' needs. From the time of independence, Uganda adopted the Train and Visit System (T&V) of extension but was abandoned in the late 1980s and early 1990s because of fiscal challenges (Ilukor et al., 2015). This resulted in the decentralization, privatization of some services and the downscaling of the civil service (Umali et al., 1994). Most of the agricultural extension staff members were retrenched and the policy of automatic recruitment of the extension officers abolished. The purpose of these reforms was to reduce the costs of the public administration and to cut public expenditure. As contended by Ilukor et al. (2015), the expectation of cost reduction has not been met because as the public administration costs as a proportion of public expenditure declined, the costs of budget financing resulting from a significant increase in interest rates caused by increased public general budgetary support and increased inflow of foreign aid increased (Lister, 2006). Moreover, decentralization costs increased because of creation of new districts.

Attempts to improve agricultural extension service delivery with the decentralized, private sector framework led to experimentation of different methods of the extension such as cost recovery and demand driven models. In 2000, Uganda introduced a new model called National Agricultural Advisory Services (NAADS), which was one of the pillars of the Plan for Modernization of Agriculture (PMA) – a strategic framework for poverty eradication. NAADS was created to co-ordinate service provision to subsistence farmers. Such services included: advice on productivity enhancing technologies and soil conservation; knowledge and skills development; marketing; storage and agro-processing (GOU, 2000). The model was initially promising because it helped to strengthen farmers' capacity to demand and manage the delivery of agricultural advisory services that are likely to meet their local production and market conditions (Nkonya, 2011).

Our analysis of National Service Delivery Survey data from 2004 to 2015 revealed that the program was able to reduce government involvement in the provision of the extension services. As shown in Figure 1, the provision of crop production extension services from government declined while that from private sector and NGO/CBOs steadily increased.

In the case of livestock, the involvement of both government NGOs/CBOs in the provision of animal husbandry extension services in Uganda declined. Clearly, livestock sector is under served with extension services compared to crop production, and yet livestock is key to increasing crop productivity by providing means of opening land, manure, and market for crop outputs (Thornton and Herrero, 2015). However, the involvement of the private sector in providing extension services for animals to the farmers as shown in Figure 2 increased. As mentioned early, although the role of the private sector in providing animal extension services increased, the quality of services is very poor primarily because of weak legislation, absence of qualified trained paraprofessionals, poor relations between paraprofessionals and government veterinarians (Ilukor, 2017) the study applied transaction economics theory to generate recommendations on how to improve the delivery of these services and minimise livestock production risks, including those that pose a risk to human health, e.g. zoonoses. The most notable recommendations are as follows:

Figure 1: Sources of crop husbandry extension services

Sources of extension services (%)

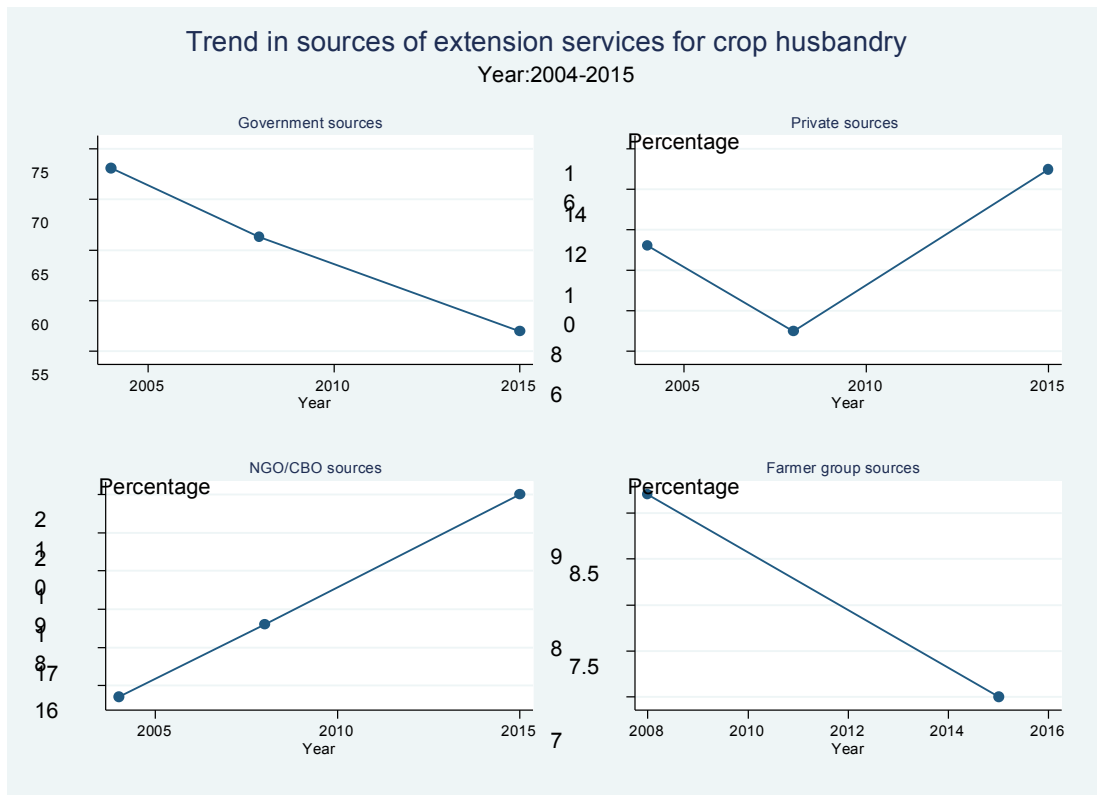
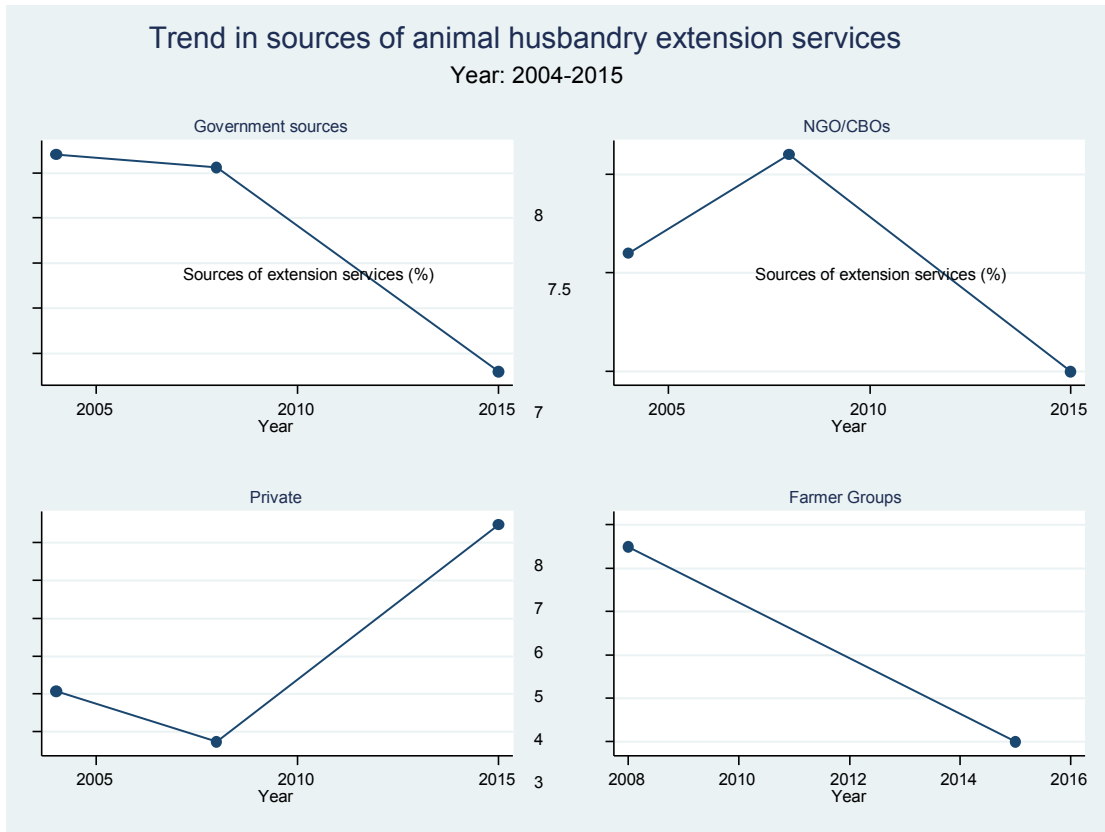


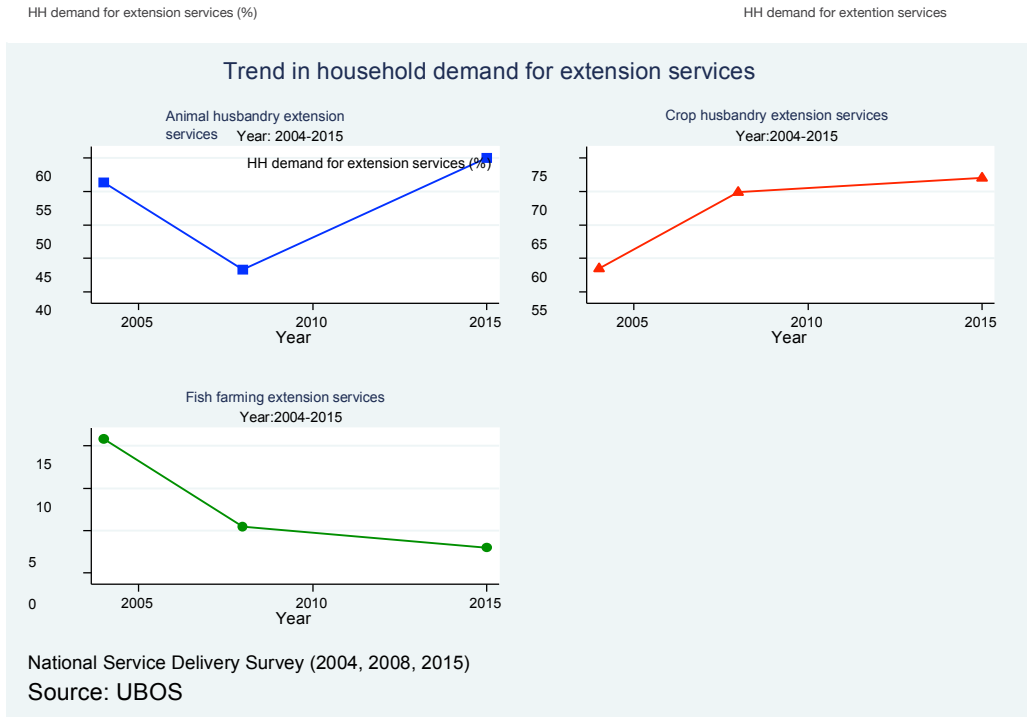
Figure 2: Sources of animal husbandry extension services

Sources of extension services (%)



Although NAADS was initially successful, it favored crop sector more than the livestock sector (Benson and Mugarura, 2013; Ilukor et al., 2015). Our results from the analysis of National Service Delivery Surveys data from 2004 to 2015 reveal that in 2004, during the early stage of the program, household demand for extension services for animal husbandry was about 56%, it reduced to 43.3% in 2008 before again increasing to 60% in 2015. In the case of fisheries, demand for extension services for fish farming was about 16% in 2004, it drastically decreased to about 6% in 2008 and to about 3% in 2015 as shown in Figure 3. Household demand for crop husbandry extension services on the other hand was about 59% in 2004, increased to 69.9% in 2008 and further increased to 72% in 2015 as shown in Figure 3. One would submit that the decline in demand for livestock services is indicative of declining interest by livestock farmers, but this would be far from the truth. Farmers from livestock keeping areas noted that NAADS did not finance provision of livestock/ veterinary services even when livestock is their main source of livelihood.

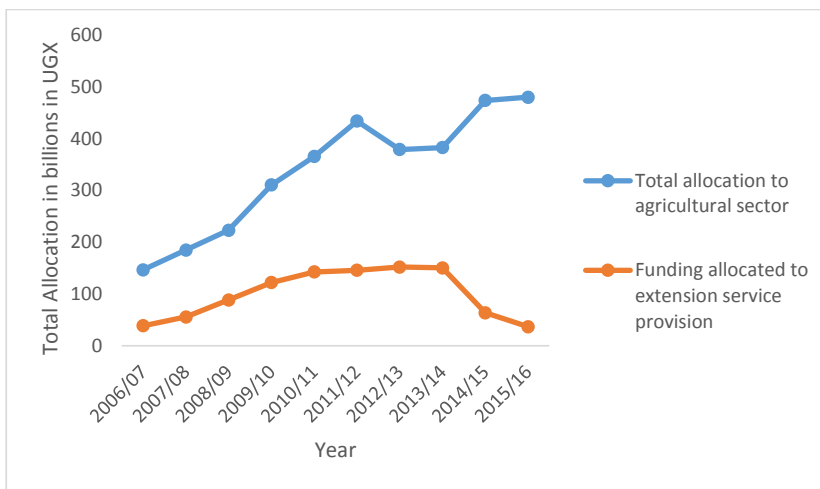
Figure 3: Household Trend in the demand for extension services in Uganda



Despite the success of the program in strengthening farmers' capacity to potentially demand and manage the delivery of agricultural advisory services, the NAADS program was disbanded paving way for the single spine extension system. As Bahigwa et al (2005), contends that the program had good intentions, right targets but the mechanism of implementations was wrong. The program was politically captured and the Ministry of Agriculture, Animal industry and Fisheries (MAAIF) did not own the program (Joughin and Kjær, 2010; Nana and Nkonya, 2015). Kjaer and Joughin (2012) ownership was not as encompassing as it first appeared. In essence, the agricultural reform programme represented market-oriented values that were not echoed in large parts of the Ugandan polity. The eventual reversal of policy, back to government-provided extension, and to a large programme of heavily subsidised input supply, testifies to that. In addition, key stakeholders, notably local politicians and officials in the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF stated that reversal of policy back to government-provided extension, and to a large program of heavily subsidized input supply is testimony to lack of ownership. This lack of ownership was linked to exclusion of key stakeholders, notably the local politicians especially at local government level and the officials from MAAIF from implementation and design process.

As Ilukor et al. (2015) found out, the design of this project did not reflect the implementation structure of the ministry, thus could not be effectively implemented resulting in passive resistance. The planning and the budgeting process, was based on commodities and results service sections like extension could not be budgeted or planned well as technical experts from MAAIF were being excluded from the planning process because they were seen as hostile to the program and not willing to change. As a result, the extension sector budget declined as shown in Figure 4 below

Figure 4: Funding to Agriculture and Agricultural Extension over Time



3.3 Is the Single Spine Extension System structure fit for the purpose?

Under the new arrangement, NAADS has continued to exist not in providing extension services but rather in distributing inputs through Operation Wealth Creation which is manned by soldiers. The involvement of the soldiers was informed from the success of the deployment of the UPDF officers in Luwero and some parts of eastern Uganda. This program was seen to have delivered because more inputs were delivered than previously under NAADS (Ntambirweki-karugonjo and Jones, 2015). The role of extension officers under the Single Spine extension system is to provide technical support to soldiers. The question is, is this a better structure for the agricultural extension system?

According to Birner (2007), for a chosen policy instrument or structure to be fit for the purpose, it must be politically feasible, administratively feasible, and fiscally feasible. Political feasibility implies that the political environment should favor the implementation of the policy instrument. It should induce political will and should not be politically contested (Birner, 2007), and even when political contest exists between the ruling government and opposition, the opportunity cost to the government in power should be less than the gain in terms of

the votes. In general, the local politicians should be included and must own the program or structure. The experience from a district in western Uganda reveals that the Single Spine extension system is acceptable, owned by the local politicians and the community. This is partly because MAAIF under the Directorate of Extension has focused on sensitizing, involving local leaders on the operations and the importance of the program to them, the political leaders and the local communities. So far the directorate has managed to conduct regional workshops countrywide to engage the CAOs, DPMOs, and Town Councils (TCs).

Interviews with farmers, recruited extension offices and district officials in one of the districts in western Uganda reveal that farmers are happy with new the program. One of the farmers remarked that *“these days, the extension officers have been passing by and advising us on what to plant during this tough dry season. During the rainy season they come to my garden, observe it and give me the advice.”* Another one stated that *“For me I have got their number when I have a problem like when my cows falls sick I just call him and he will come solve my problem.”* Another old lady of 40-year-old noted that, *“she got the number of extension officers the first time the extension officer appeared in his farm”*. We also asked the farmers and extension officers in a FGD about NAADS and the extension officers seem to have favored NAADS but the farmers preferred single spine extension system. One old man noted that *“I have seen many programs apart from NAADS. These people who worked with NAADS cannot tell you what was wrong with NAADS, but NAADS’ problem was that, much of the money was going to salaries and administrative expenditures the inputs that NAADS brought were very little. Under the current system quantity of inputs delivered to the farmers is very high. Similar sentiments were expressed by the local council five, three chairmen and the councils.*

On the other hand, farmers noted NAADs was better because most of the activities involve their direct participation. For example, enterprise selection was done through meetings and ranking by farmers. One of the farmers stated that *“In the old NAADS used to have meetings where farmers would be identified and selected for specific enterprises. The farmers would be prepared for the inputs to receive. These days, the soldiers are quick and the inputs are served on the basis of first come first serve. They come with speed and give whoever is available. As a result, the people who need them most do not get them. One of the participants noted that it is mostly the boda- boda men who get the inputs, but because they are available while farmers who need the inputs are still in their farms. The boda-boda men end up selling the seeds to farmers who need them and if they do not sell, the seedlings get wasted and dry out. Indeed, a joint survey by teams of Operation Wealth Creation and Uganda Coffee Development Authority (UCDA) officials in 2016 discovered that only 40% of the coffee seedlings distributed to farmers survived to maturity (Mutegekiu, n.d.).*

In context of administrative feasibility, Single Spine Extension system needs to have a well-functioning and effective public administration to make it effective. The structure as it is less

complex and does not create scope for corruption as the role of extension officers is to provide technical guidance and deal with procurement of the technologies. About 70% of the districts have fully recruited and filled the established single spine extension system structure. The challenge however, is that most of the extension officers would want to be involved in technology dissemination. Some view agricultural extension as technology dissemination and join the service because they expected things to be running like NAADS where staff are paid highly, provided with transport and communication allowance. One of the extension staff noted that *“I was employed under NAADs and in this very sub county. I had a motorcycle but at first we walked. When I compare NAADs and single spine extension system, NAADs was better because we had a monthly allowance, which was small but could sustain us. We used to get 75,000 Uganda shillings per month as top up on the salary. If you spend money in the field, at the end of the month, you were assured that the 75,000 will cover it. These days you have to spend your salary to able to move.* The Chief Administrative Officer (CAO) expressed similar concerns stating that these problems and expectations need to be managed; else the extension staff will be frustrated and will fail the system.

Another problem that extension officers face is that NAADS was better than single spine extension system because in NAADS, the procurement of inputs for example, an animal was the responsibility of the farmers under the farmer forum. The farmer would identify the animal he or she would wish to buy in the surrounding location and come to the procurement committee at the sub county level to discuss with the NAADs coordinator who goes to check out the animal. If the animal is fit for the farmer then it is procured. However now, animals are brought from places like Kiruhura which has different weather conditions compared to where they are taken, as a result, the animals die. Another officer gave a scenario where he received a heifer, which at first he was told it had calved, but when they reached the sub county they found that it had not. As a result, farmers keep complaining and blaming the extension officer.

Another farmer noted an example where goats were brought from north eastern Uganda to western Uganda, but were suffering from goat plague resulting in an outbreak of goat plague in the area. Consequently, they suggest that the procurement should be localized or decentralized rather than being centralized. They also argue that farmer groups need to be established for accountability to the program and ensuring that inputs are supplied and enterprises are those that farmers want.

In NAADS, there was emphasis on farmers' needs assessment. For example, conducting a needs assessment in which farmers interests are known like the crops or animals they need, after they are registered, the farmers would receive what they ordered for. One respondent revealed, *“In the current system things just come from the centre. A truck of coffee seedlings will appear from nowhere, and then they tell people to come and pick on a first come first serve basis. Farmers just pick any planting material available even if it wasn't their choice. As*

a result, most of the coffee seedlings have been left under trees to dry.”

The other problem we noted is that extension officers did not have knowledge of existing agricultural technologies because of lack of access to research scientists or breeders. Additionally, when research institutions are conducting experiments on testing the varieties, extension officers are not involved. Every time the technology is released, extension officers should be given the information and manuals, so they can advise farmers on technology adoption.

The fiscal feasibility challenge especially affects policy instruments that require a constant flow of financial resources and are difficult to maintain over time, especially after donor funding ends. The good news is that current extension system is financed under the tax payers’ money and there is no external funding. However, the extension wing or the technical wing does not receive adequate funding while the technology distribution receives enough funding. If the funds are not being allocated to extension, the input will end up being wasted and this can create political challenges. The program would suffer. Of course one would argue that Operation Wealth Creation is different from single spine extension system but communities and extension officers see this as one program. If they are dissatisfied, then they are likely to influence politicians against the program.

4.0 ARE THERE GAPS AND OPPORTUNITIES FOR ADVOCACY IN AGRICULTURAL EXTENSION IN UGANDA?

4.1 Introduction

Uganda's agriculture sector has passed through successive policy regimes since the late 1890s. A number of policies, programs and interventions such as Structural Adjustment Programs, Economic Recovery Program, Poverty Eradication Action Plan and Plan for Modernization of Agriculture, among others have been implemented. Most of these policies have continually evolved and have focused on increasing agricultural productivity in order to transform agriculture from subsistence farming into commercial farming. To achieve this goal, significant investments in agriculture are required. In this regard, Uganda signed the Maputo and Malabo declaration 2014 committing itself to increase public spending on agriculture to 10 percent of the national budget to end hunger and halve poverty by 2015. However, the signing of the Maputo declaration did not make a difference in Uganda as government failed to increase government spending to 10% (Kreuger and Kreuger, 2015). Lukwago (2010), states that the current low levels of budgetary allocations to Uganda's agriculture cannot support the attainment of the middle income status by 2020. As highlighted above, the problem is really farmer limited access to agricultural extension services that have led to underutilization or misuse of the agricultural technologies. In addition, financial allocation has been directed more to technology distribution and less to agricultural extension a situation that is credited to policy inconsistencies and weakness in the legal framework (Ilukor et al., 2015).

4.2 Is Agricultural Extension Anchored in Uganda's Agricultural Policies?

The main policy that governs the agricultural sector is the National Agricultural Policy (NAP), which was developed and passed in 2013 with the objective of increasing agricultural productivity and marketed surpluses. Before this policy was passed, Uganda had not had a clear agricultural policy. This policy has six objectives that include increasing incomes of farming households; ensuring food security; promotion of specialization in strategic, profitable and viable enterprises and value addition through agro-zoning; ensuring sustainable use and management of agricultural resources; promoting domestic, regional and international trade in agricultural products; as well as developing human resources for agricultural development. While this policy has been hailed as well intentioned, its approaches, especially emphasis on private sector-led and market economy, the farmers can hardly afford the resources needed for the agricultural sector to take off.

To achieve the objectives of the National Agricultural Policy (NAP), the Agriculture Sector Development Strategy and Investment Plan was developed to guide investments in

Agriculture. In the current Agriculture Sector Strategic Plan 2015/16 -2019/20, the key specific priority and strategic commodities are: bananas, beans, maize, rice, cassava, tea, coffee, fruits and vegetables, dairy, fish, livestock (meat), and four strategic commodities, namely, cocoa, cotton, oil seeds, and oil palm. The other specific areas of investments are: research, extension, pest, vector and disease control, provision of inputs, promoting sustainable land use and soil management, post-harvest handling, improving markets access and value addition (MAAIF, 2016).

Agricultural extension is one of the key priority sectors of the strategic plan. The focus of agricultural extension policy is described as to:

“Strengthen extension services in the country by filling vacant staff positions in MAAIF and District Local Governments - district and sub county levels; farmer group formation into co-operatives, associations and federations, with support from the Uganda National Farmers Federation (UNFFE), carrying out farmer training needs assessment in the areas of agricultural production, business, agro-processing, post-harvest handling, value chain upgrading and nutrition, conducting residential and non-residential farmer training to address identified needs, profiling farmers according to farm sizes and enterprises, development of a curriculum for a professional certificate course in extension skills for extension service providers, initiatives to increase youth participation in agriculture, development and implementation of the extension policy and other statutory instruments, developing PPP projects such as investments in silos, warehousing, storage and bulking centers, operationalization of the commercialization challenge fund, establishment of demonstration and incubation centers, and implementing the sector communication strategy (Agriculture Sector Strategic Plan 2015/16 -2019/20).”

To operationalize the extension system, the National Agricultural Extension Policy was developed and passed in 2016 to provide long-term strategic direction for agricultural extension services in Uganda. The focus as articulated in National Agricultural Extension Policy document is to “transform extension from a system of parallel institutionally fragmented public and non-state actors to Single Spine Extension System (SSES) which is well-coordinated, harmonized, regulated and inclusive of multiple providers addressing diverse needs of the farmers.” The policy objectives are to: create effective organizational and institutional framework for pluralistic agricultural extension services, put in place human resources management and capacity development system, ensure effective agricultural extension planning and financing, develop agribusiness development services and market linkages, establish agricultural knowledge management and information system, provide regulation and quality assurance system for extension services, support the formation of

farmer organizations and their empowerment, integrate gender and other vulnerable groups into extension service delivery, and integrate issues of climate change and environmental issues into extension service delivery.

The Policy is now in operation, the Directorate of Agricultural Extension Services under the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) is mandated to ensure that objectives of the policy are achieved. The directorate has embarked on filling the positions in both the ministry headquarters and at the local government level. The current report is that more than 60% of 4990 approved positions at sub counties, municipalities, divisions and the district have been filled. Although the recruitment seems to be successful, the challenge now for the local governments is making sure that extension officers perform their roles. Our recent interaction with the Chief Administrative Officer, District Production Officer, and the Local Council 5 was quite revealing. They indicated that at the moment their district has fully recruited its extension officers, however, they lack transport and operational funds. Sometimes they are required to go to the radio stations since the greatest population of farmers can be captured through radio programs but there are no funds to facilitate them to appear on radio programs. The extension staff we interviewed reported that the main challenges to their work are; lack of facilitation to move from farmer to farmer, they do not have materials for demonstrations, and lab facilities for animal disease diagnosis is not available. Although, the extension to staff ratio is estimated to be 1: 2200, the extension officer believes that the ratio is 1:20000 and varies by sub-county.

Therefore, to successfully implement the Single Spine Extension system, it's important to move beyond recruitment and filling the extension structure. The extension officers will need to be enabled to conduct their duties and responsibilities. They need transportation and the equipment depending on the field of the extension staff. This is a big challenge that will require support from non-state actors like donor, NGOs among others. Clearly, the existing budgetary allocations by government cannot enable the operation of an effective extension system. According to Agriculture Sector Strategic Plan 2015/16 -2019/20, the total amount of funds required to achieve these interventions are UGX887.99 billion but in the recent budgetary allocation, only 39.6 billion was allocated to operationalization of single spine extension system. This value is only 4.4% of the required amount. If we add the donor support which is estimated to be 14 billion, the percentage is about 6%. This is very small and that means the extension system will only be operating at 6% level. Donors, development partners and government alike need to dig deeper.

In addition, for the extension policy to work, facilitating legislations need to be passed and enforced. One such policy that links directly to the extension is the Veterinary Surgeons Act. The Act makes provisions for the registration of practitioners of veterinary surgery and for other matters connected with and incidental to the practice of veterinary surgery. The current

existing Act formulated in 1958 is out dated. According to the Act, only a person who holds a degree or diploma in veterinary science awarded by any university recognised by the board and pays 60 shillings is entitled or licensed to provide veterinary extension services. Section 13 of the Act states that any person found to be providing services without license and qualification commits an offence and is liable on conviction to pay a fine not exceeding 3000 shillings.

Seriously, Veterinary Surgeons Act is out dated and ineffective in deterring malpractice. For example, the consultation fees for providing veterinary services in Areas such as Mukono is about 5-10 thousand Uganda shillings which is more than 3000 shillings. A person who commits an offence can happily pay the fine but does not feel any pinch. It is therefore, not surprising that the quality of veterinary services in Uganda as highlighted earlier, is very poor and the market has been taken over by quarks. These paraprofessionals are known to misdiagnose diseases and offer wrong drug prescriptions, overdose animals and later charge a higher fee thus increasing the costs of keeping or even causing death of the animal (Ilukor et al., 2015; Mockshell et al., 2014). Misuse of animal drugs in veterinary medicine has led to increased acaricides resistance in animals as well as antibiotic resistance in both animals and humans who consume food of livestock origin (Byarugaba, 2004). As discussed herein, the cost of antimicrobial resistance in humans is rising rapidly in form of increased numbers of deaths, increased complications, additional expense, prolonged hospital stays by the infected patients, additional toxicity coupled with the need to receive intravenous therapy as an inpatient rather than being able to use oral therapy as a patient based in the community (Collignon, 2012).

Antimicrobial Resistance (AR) is increasingly becoming a problem in both animal and human health in Uganda (Byarugaba, 2004). Byarugaba et al. (2011) investigated the levels and patterns of antibiotic resistance in resistance-indicator bacteria; *Escherichia coli* and *Enterococci* of food animal origin especially in chickens, pigs, cattle, goats and sheep which was tested against selected panels of antibiotics. They observed high resistance for both *Enterococci* species and *E. coli*. *Enterococci* isolates revealed high resistance against erythromycin, gentamycin and tetracycline. *E. coli* isolates showed highest resistance against erythromycin, tetracycline, and ampicillin. Recent communication by the state minister for livestock on acaricides resistance is that 60 heads of cattle were dying daily in Kiruhura district between 2012 and 2013 which is a loss of Uganda Shilling 48- 60 million daily and 18 billion annually. This was just in one district. This legislation should be passed to regulate veterinary service delivery. In addition, investment in veterinary education is vital, to ensure that enough qualified veterinary staff are available to offer veterinary services to farmers. As it is now, there is no institution training veterinary paraprofessionals. Most institutions in Uganda are training animal production and management scientists not animal health scientists.

5.0 THE RELATIONSHIP BETWEEN AGRICULTURAL EXTENSION AND OTHER SECTORS

5.1 Overview

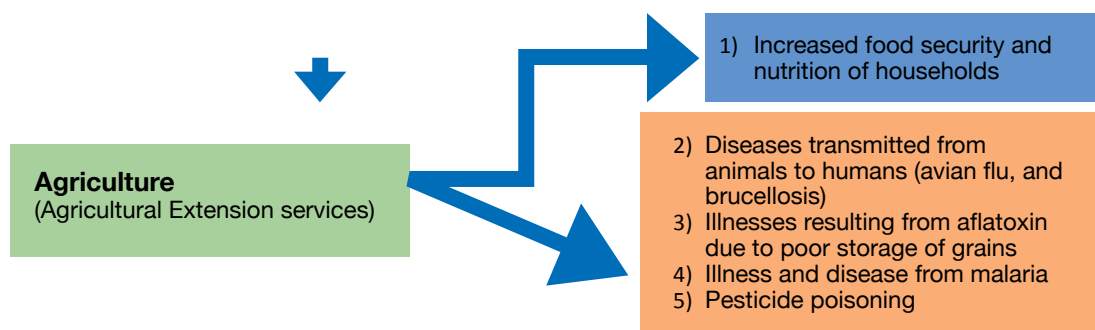
Agricultural Extension plays a crucial role in promoting agricultural productivity, increasing food security, improving rural livelihoods, and promoting agriculture as an engine of pro-poor economic growth. According to Evenson (2010), Agricultural Extension can be visualized as achieving its ultimate economic impact by providing information and training services to induce the following: farmer awareness, knowledge, and adoption of agricultural technologies to increase agricultural productivity. Increased awareness, knowledge and adoption of agricultural technologies will generate both positive and negative externalities to other sectors. For example, increased agricultural productivity will lead to increased volumes of agricultural output marketed and volumes traded.

Increased use of agricultural technologies especially pesticides, fertilizers and machinery can generate negative externalities such as diseases, environmental degradation and deforestation. Increased access to agricultural extension services is expected to reduce these negative externalities. In livestock, misuse of the antimicrobial agents has been cited because of the failures of agricultural extension. Improvement in agricultural extension especially for veterinary services is expected to reduce the misuse of antimicrobial agents and antimicrobial resistance in humans. In this section, we review studies on linkages of agricultural extensions to other sectors. In particular, we examine studies on costs and benefits for agriculture to other sectors. Later, we focus on the studies that link Agricultural Extension to health, trade and environment.

5.2 Linkages between Agricultural Extension and Health

Agriculture and health have a two-way link in which agriculture can support health by providing food, nutrition and generating income that can be spent on health care yet agriculture can also pose major threats to health through health hazards linked to poor agricultural practices and systems. On the other hand, health problems can have disastrous effects on agriculture through lost labor, assets and lost income. Figure 5 illustrates the direct linkages between agriculture and health.

Figure 5: Direct Linkages between Agriculture and Health

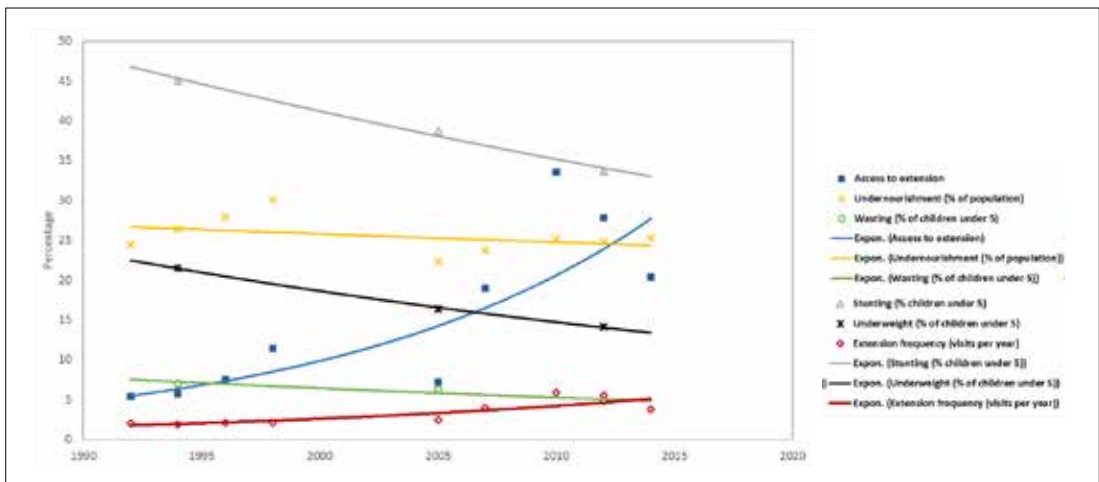


5.2.1 Agricultural extension and food and nutrition Security

Agricultural Extension can be used as a tool to achieve the objective of improving health through farmers adopting new methods and techniques of production, efficiently using their resources that result in food security situation, better nutrition as well as higher incomes that lead to better health outcomes and better health care for the family. According to Shenggen et al. (2013), large supply of global agricultural output comes from smallholder farmers in developing countries. Agricultural extension can enable a country to be able to meet future food demands of a growing and increasingly rich and urbanized population as well as their dietary needs and food preferences for an active and healthy life. Moreover, meeting dietary needs is a key to reducing the consequences and costs of malnutrition such as; increased susceptibility to infection, impaired child development, and increased mortality rate (Léonor et al., 2011). Hoddinott (2013) reported that the persistent effects of under nutrition in early life have significant economic consequences in adulthood.

The main indicator and consequence of under nutrition in populations is neurological damage and the key indicators among children below five years are wasting, stunting and being under weight. Using Uganda Bureau of Statistics (UBOS) and Living Standards Measurement Study (LSMS), data from Uganda Bureau of Statistics shows that as the proportion of households receiving agricultural extension increases; the proportion of children under five who are stunted, wasted and underweight reduces as shown in Figure 6. The results suggest that access to agricultural extension reduces stunting and wasting. Higher percentage of households accessing extension services is associated with a reduction in malnutrition related health variables. A closer look at the correlations between these health variables and access to extension indicates no significant correlations. However, scanning through the data sources we find data on extent of provision of nutrition advice by extension workers is not captured, therefore, the need to capture information on nutrition by extension workers.

Figure 6: Relationship between access to agricultural extension and selected health variables over the years



We also estimated a regression model on Calorie intake as measure of nutrition with other variables including extension. As shown in Table 1, regression results reveal that household size, household expenditure, and asset ownership or being rich positively influences calorie intake. The only agricultural extension variable that significantly influences calorie intake is receiving advice on livestock marketing. When we estimate elasticity's, the only significant elasticities ones were those receiving livestock marketing advice and being male headed households. The results suggest that receiving livestock information is likely to increase calorie intake by 1.1%. The results reinforce the fact that livestock is a source of nutritious rich food and income that can be used to diversify food consumption (Randolph et al., 2007). Moreover, livestock is source of manure and is used in animal traction which supports crop production.

Table 1: Determinants of Household Calorie Daily Consumption

	Fixed effects not controlled	Control for Urban Rural Fixed effects	Controlled for Regional fixed effects
Household size	2110.9*** (30.70)	2106.6*** (30.62)	2099.9*** (30.45)
Adjusted monthly household expenditure	0.00829*** (6.24)	0.00841*** (6.32)	0.008*** (6.04)
Welfare based on usual members	0.0653*** (28.82)	0.0651*** (28.73)	0.0652*** (28.75)
Poverty line in constant prices	-2.520*** (-8.47)	-2.013*** (-4.29)	-3.018*** (-8.07)
Poverty status	-3457.6*** (-9.36)	-3454.9*** (-9.36)	-3243.0*** (-8.57)
Advice on livestock Marketing	2343.6** (2.72)	2355.8** (2.73)	2267.7**
Sex of household head	860.4* (2.70)	885.2* (2.77)	897.5* (2.81)
Age of the household head	28.59** (3.09)	28.63** (3.10)	28.40** (3.07)
Education of the Household head	-1043.2*** (-5.12)	-1035.9*** (-5.08)	-1013.0*** (-4.93)
Eastern region			-1063.9* (-2.25)
Northern region			-1671.3*** (-3.72)
Western region			-1191.7* (-2.32)
N	2439	2439	2439
R ²	0.646	0.647	0.648

Figures in parentheses are *t* statistics. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

On costs, the estimated impact of malnutrition on the global economy can be as high as US\$3.5 trillion per year or US\$500 per individual (FAO, 2013). The costs are a result of opportunity costs of economic growth foregone and lost investments in human capital resulting from

infections, impaired child development and mortality. About 45% of which can be attributed to poor nutrition, as well as premature adult mortality linked to diet-related non-communicable diseases (Black, R. *et al.*, 2013). The risk of death rises steeply as malnutrition becomes more severe (Webb, 2015). In Uganda, it is estimated that 15% of all child mortality cases in Uganda are associated with under nutrition and 54% of the adult population in Uganda suffered from stunting as children. The associated annual costs of child under nutrition are estimated at 1.8 trillion UGX, which is equivalent to 5.6% of GDP (Hoddinott, 2016). Interventions that combat under nutrition in early life such as food supplementation and those that increase agricultural productivity such as agricultural extension in general convey lifelong benefits (Hoddinott, 2016). According to Babu *et al.* (2016), one of the solutions to malnutrition at the farm household level is increased access to agricultural extension.

5.2.2 Agricultural Extension and Disease Incidence and Related Effects

Agricultural extension has a potential to reduce incidence of diseases and related costs that arise from zoonotic diseases, misuse of antimicrobial agents, aflatoxin contamination due to poor storage and diseases from pesticide and chemical use in agriculture.

Pesticides related diseases

Pesticides can increase agricultural productivity, but when handled improperly, they are toxic to humans and other species. Unintentional exposure to pesticides can cause death to especially children while improper use can result in poor harvests and pesticide poisoning. Kamel & Hoppin (2004) examined association of pesticide exposure with neurologic dysfunction and disease. They found that poisoning by acute high-level exposure to certain pesticides has well-known neurotoxic effects. Pesticide poisoning may go undiagnosed, especially among farm-workers with poor access to medical care (London *et al.*, 2002). Many studies have found an association of Parkinson disease risk with living in rural areas, drinking well water, and farming as an occupation (Brown *et al.*, 2006; Priyadarshi *et al.*, 2001). Economic costs and losses can accrue from overuse or misuse of pesticides and herbicides that result in poor performance of the health sector as well as the overall economy.

Studies by Oesterlund *et al.* (2014) and Nalwanga & Ssempebwa (2011) knowledge and attitude, symptoms of intoxication, personal protective equipment (PPE) in Uganda show that farmers were not aware of pesticide hazards and they lacked appropriate knowledge on safe handling and use of pesticides, which could be attributed to inadequate Agriculture Extension services. Indeed, data from Uganda panel survey reveals that only 20% of the households in Uganda receive agricultural extension and only 13% use pesticides. The low utilization of pesticides means we have less negative impacts from pesticides use but use of pesticides is rising mostly in households to control mosquitos, cockroaches and even rats

(Nalwanga and Ssempebwa, 2011) 100 households in Kireka ward, Wakiso district in Uganda were involved in a cross-sectional survey to assess pests, knowledge, and use patterns of pesticides. A structured pretested questionnaire was administered via personal interviews, and observational checklists were used. Mosquitoes were the most prevalent pests (83%). In addition, increased outbreaks of pests such as cereal stem borers, cutworms, aphids, and the recent fly army worm in Uganda that led to the loss of close 450,000 MT is forcing farmers to increase use of pesticides. Using data from UBOS, we estimate the correlation between pesticides use and gender in the results show that farmers who receive advice on agricultural production and are headed by male households use pesticides. The challenge however, is that we cannot get data on whether farmers receive advice on proper use of pesticides.

Table 2: Correlates of Pesticide Use among farm households in Uganda

	Regional Fixed effect not controlled	Rural fixed effects controlled	Regional Fixed effects controlled
Household size	0.00284 (1.10)	0.00282 (1.10)	0.00278 (1.13)
Received production advice	0.189*** (3.94)	0.189*** (3.94)	0.188*** (4.10)
Received advice on agricultural prices	-0.0975** (-2.59)	-0.0976** (-2.59)	-0.0649 (-1.80)
Received advice on agric. processing	-0.0417 (-0.96)	-0.0419 (-0.96)	-0.0173 (-0.41)
Received crop marketing advice	0.0008 (0.02)	0.0009 (0.02)	-0.0230 (-0.58)
Received livestock marketing advice	-0.0167 (-0.39)	-0.0165 (-0.39)	-0.0251 (-0.61)
Received advice from NAADS	-0.0629 (-1.35)	-0.0628 (-1.35)	-0.0481 (-1.08)
Received advice from input supplier	0.124 (1.60)	0.125 (1.60)	0.161* (2.17)
Received advice farmer organization	-0.0203 (-0.27)	-0.0203 (-0.27)	-0.0677 (-0.93)
Male headed household	0.0305 (1.91)	0.0304 (1.90)	0.0506** (3.29)
Age of household head	-0.0004 (-0.96)	-0.0004 (-0.94)	-0.0007 (-1.51)
Education of household head	0.0316** (3.23)	0.0320** (3.23)	0.0218* (2.32)
Constant	0.0656* (2.17)	0.0658* (2.18)	0.267*** (8.38)
<i>N</i>	2407	2407	2407
<i>R</i> ²	0.030	0.030	0.115

Figures in parentheses are *t* statistics. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Zoonotic Diseases

Zoonotic and food borne are diseases that are spread between animals and people through direct contact or through water, food, and environment but can be avoided by adopting good

farming practices. Zoonotic diseases are transmitted by infectious agents from an infected animal to a human or another animal through direct contact or close proximity with infected animals. Food borne diseases on the other hand are caused by consuming food or drinking water contaminated by pathogenic micro-organisms such as bacteria, viruses, and parasites. Such bacteria include Salmonella, campylobacter E. coli and toxins from fungi like aflatoxins. The aflatoxin producing fungi, Aspergillus spp is one of the highly toxic secondary metabolites that usually infect cereal crops including wheat, maize, cotton, and legumes such as peanuts and tree nuts. Aflatoxins can lead to serious threats to human and animal health by causing various complications such as hepatotoxicity, teratogenicity, and immunotoxicity resulting in health hazards and even death (Kumar et al., 2017). Increases in zoonosis emergencies are directly linked to agricultural intensification and environmental changes (Jones et al., 2013) and it is estimated that 75% of the newly emerging diseases are zoonoses that result from various anthropogenic, genetic, ecologic, socioeconomic, and climatic factors (Gebreyes et al., 2014; WHO, 2006). Some of the important zoonotic and food borne diseases and their impacts are indicated in Table 3.

Table 3: Important Zoonoses and their impact on Human Health

Important Zoonoses in terms of human health impact					
Disease	Pathogens/ Agent	Transmission	Common Illness in Humans	Death human annual	Affected human annual
Gastro-intestinal	Bacteria (Salmonella, E. coli, Cryptosporidium)	Contact with infected farm and wild animals as well as pets. Eating contaminated food, and drinking water contaminated with excretions from infected animals, Imprudent use of antimicrobials in animals	Diarrhoea, Possible nausea, vomiting, and loss of appetite, Abdominal cramps, Weight loss	1,500,000	2,333,000,000
Leptospirosis	Leptospira bacteria	Contact with infected animals, and contaminated water	Fever, Chills, Intense Headache, meningitis, liver damage and renal failure	123,000	1,700,000

Disease	Pathogens/ Agent	Transmission	Common Illness in Humans	Death human annual	Affected human annual
Cysticercosis	Parasite (<i>Taenia solium</i> , a pork tape worm)	Eating pork or fruits and vegetables infected with <i>Taenia solium</i>	Decreased vision, seizures, heart failures spine nerve damages	50,000	50,000,000
Tuberculosis	<i>Mycobacterium tuberculosis</i> bacteria	Inhalation of aerosols or the ingestion of unpasteurized milk	Cough, Fever, Fatigue, Sweating, Weight loss chills, abdominal swelling and chills	100,000	554,500
Rabies	Neurotropic virus	Bites from infected animals including dogs, cats and bats	Fever, headache and fatigue, confusion, hallucinations and paralysis	70,000	70,000
Leishmaniasis	Parasites (Sandfly)	A parasitic disease spread by the bite of infected sand flies	Affects internal organs: spleen, liver, and bone marrow	47,000	2,000,000
Brucellosis	Bacteria (Brucella)	Contact with infected animals or meat. Drinking raw milk from infected cattle, goats, camels,	Back pain, chills, Abdominal pain, excessive sweating, Headache, Fever, Joint pain. Weight loss, Muscle pain	25,000	500,000
Echinococcosis	Parasites (Echinococcus)	Humans become infected when they swallow eggs in contaminated food from cattle, deer, pigs, sheep and contact with dogs	A closed pocket tissue forms in liver, brain, bones kidney, lungs skeletal muscles and spleen	18,000	30,0000

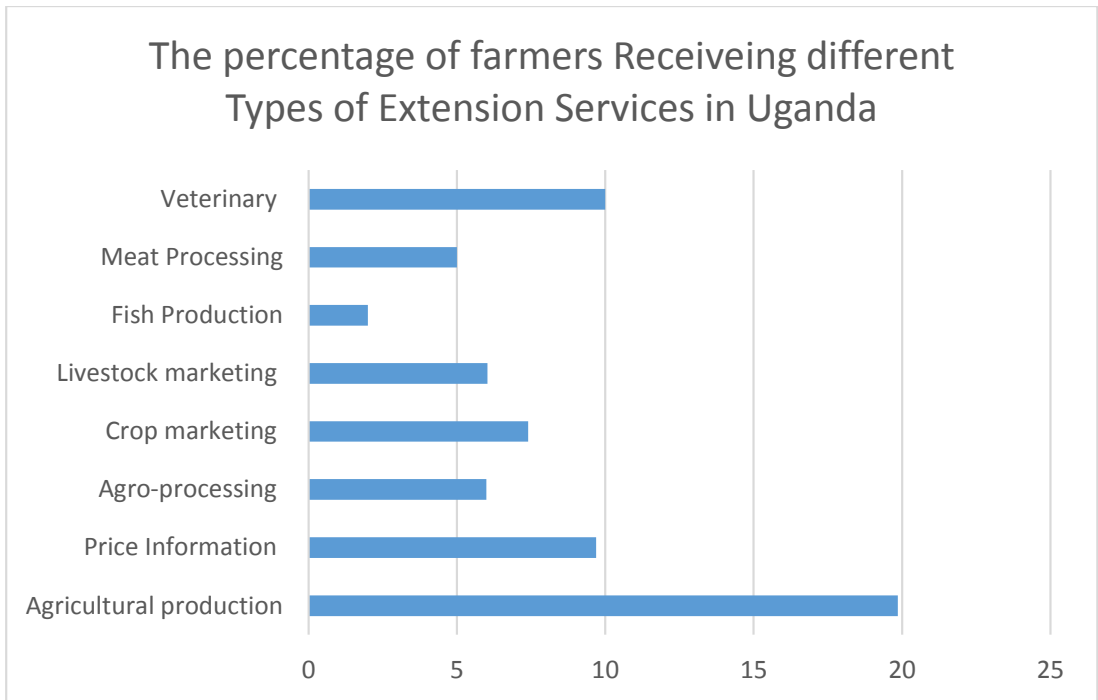
Disease	Pathogens/ Agent	Transmission	Common Illness in Humans	Death human annual	Affected human annual
Toxoplasmosis	<i>Toxoplasma gondii</i> parasite	Contact with cat feces that contain the parasite, Eat contaminated food (lamb and pork) or drink contaminated water	Body aches, Swollen lymph nodes, head ache, miscarriages, still borne child, blurred vision, liver problems	10,000	2,000,000
Q fever	Bacteria <i>Coxiella burnetii</i>	Drinking raw or unpasteurized milk, as well as inhaling dust or air contaminated with infected animal faeces, blood, or birth products	Dry cough, Fever, Headache Chest pain rash muscle pains	3000	3,500,000
Trypanosomosis	Parasite <i>Trypanosoma brucei</i> ,	Tsetse fly bite	Fever, swollen lymph glands, headaches and irritability confusion, slurred speech, seizures and difficulty in walking and talking	2,500	15,000
Anthrax	Bacillus anthracis	Contact with infected animals, wool, meat, or hides	Cutaneous (skin), lungs and gastrointestinal infections	1,250	11,000
Hepatitis E *	Hepatitis E virus	Ingestion of faecal matter especially through drinking contaminated water, food from infected animals, blood transfusion	Abdominal pain and tenderness, nausea and vomiting, Acute liver failure	300,000	14,000,000

Information and data in this table is based on study by Grace et al. (2012) and U.S.

In Uganda, there have been eight zoonotic disease outbreaks and they include in 2010/11, there was yellow fever outbreak affecting 273 cases and resulting in 54 deaths, Ebola in 2007 resulting in 149 cases and 37 deaths; Ebola in 2012 affecting 24 cases, and leading

to 16 deaths; Marburg in 2012 affecting 28 cases and leading to 15 deaths; Anthrax in 2009 had 13 cases, 5 deaths and in 2011 Anthrax had 5 cases and 2 deaths (Nabukenya et al., 2014). This greatly burdens the human health care system and it is attributed to the weakness in provision of livestock services especially the use of antibiotics and accaricides (Okello, 2016). The provision of quality veterinary extension services can reduce the outbreaks and the associated economic costs (Grace et al., 2012a, 2012b). The challenge however is that, deteriorations of animal care systems have limited this possibility (Perry et al., 2013). In case of Uganda, the animal health care system has very few practicing veterinarians and the market has been captured by unqualified staff affecting the quality of veterinary services (Ilukor et al., 2015; Ilukor and Birner, 2014). Extension services on good livestock management practices or biosecurity measures at farm and post-harvest handling are limited. As shown in Figure 7, very few farmers received extension services related to veterinary services, Agro-processing/postharvest handling, and meat handling or processing.

Figure 7: Percentage of farmers receiving different types of Extension services in Uganda



5.2.3 Agricultural Extension and Costs of Antimicrobial Resistance in Humans

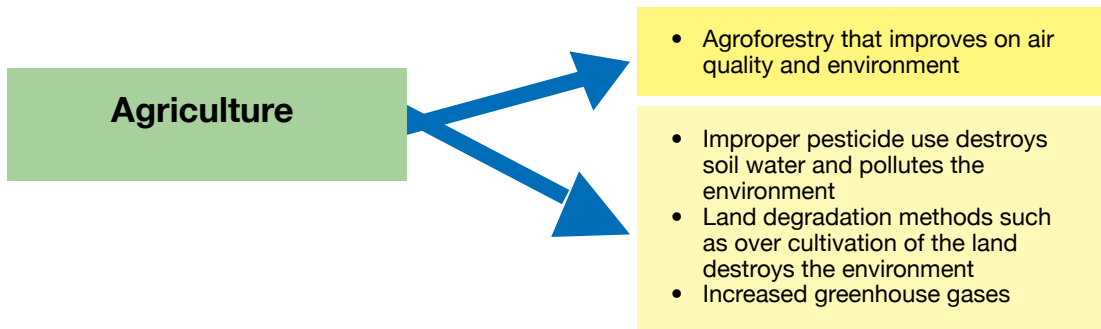
Agricultural extension plays a critical role in guiding farmers to proper use of antimicrobial agents. Several divergent views exist on antimicrobial resistance. However, the converging point is that any use of antimicrobial agents enhances the likelihood of resistance (Coast *et al.*, 1996). McGowan, (2001) in an assessment of economic impact of antimicrobial resistance revealed that, the value of antimicrobial effectiveness might differ from an economic viewpoint rather than the medical one. For example, from a public health perspective, the use of antimicrobial agents to promote growth in animals would be evaluated by comparing the relative benefit to food production against the potential for decreasing the effectiveness of prevention and treatment of infections in humans. Furthermore, from the public health (societal) view point, then, appropriate use of antimicrobial drugs for treatment and prevention of infection would lead to an appropriate or acceptable decrease in the value of antimicrobial effectiveness. Conversely, overuse or misuse of antimicrobial drugs would create an inappropriate decrease in antimicrobial agents.

Zanetti and Platt (2000), reports that when treating one person leads to decreased effectiveness in treating the next person receiving the drug, society is affected adversely. McGowan (2001), further shows the challenge in determining economic impact of antimicrobial drug resistance due to so many variables and perspectives involved. The challenge is in getting better methods for assessing practical implications and harmonizing divergent views for those from all perspectives, whether prescriber, patient, health-care business, pharmaceutical company, or the public. The economic impact of antimicrobial-drug resistance deserves more attention from government and professional societies. The increasing demand for livestock products amidst low productivity in livestock sector creates unethical temptation for inappropriate use of antimicrobial agents to increase supply of livestock products. Agriculture extension in this case, plays central role of harmonizing the food demand and supply issues with public health concerns.

5.3 Linkages between Agricultural Extension and Water and Environment

To feed the ever increasing population amidst reducing farm land, farmers are being encouraged to intensify on agriculture to produce more food from the same area of land (Evenson and Gollin, 2003; Godfray *et al.*, 2010). This means adoption of high-yielding varieties, more use of pesticides and fertilizers (Evenson and Gollin, 2003). The use of pesticides and fertilizers has helped considerably to reduce crop losses and to get better yield of the crops such as maize, vegetables, and cotton. However, pesticide use also imposes unfavorable effects in form of environmental degradation leading to economic losses in the long run. Mismanagement of pesticides and herbicides causes severe damage to water, environment and health related effects discussed above.

Figure 8: Direct Linkages between Agriculture and Water and Environment

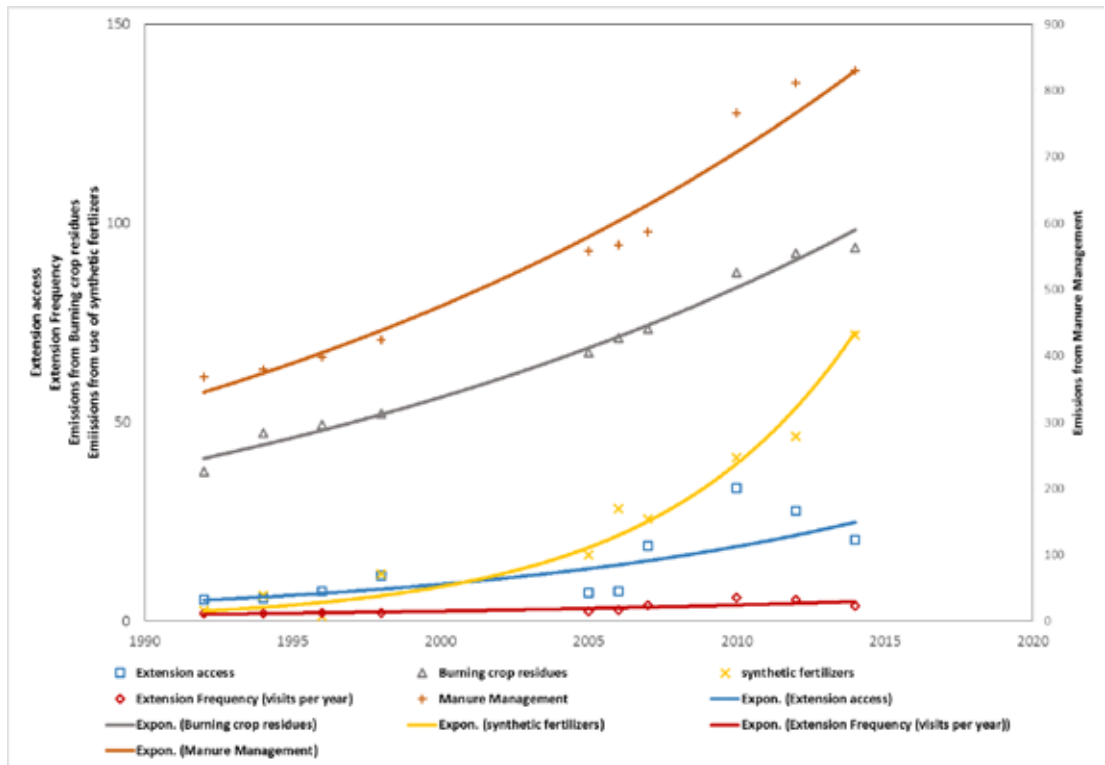


Volk, (2013) examined impact of nitrogen and phosphorus from agriculture on Delaware's water quality. His findings indicate that, nitrogen (N) and phosphorus (P) are essential elements in the aquatic environment. However, agriculture and urban practices add more N and P to surface water than they would receive under natural conditions. When one or both of these nutrients exceed critical concentrations, pollution of downstream water bodies occurs. High concentrations of nutrients in water bodies fuels the overgrowth of algae which impacts the local ecology by blocking sunlight from reaching beneficial submerged aquatic vegetation. Nutrient pollution often leads to large daily fluctuation in dissolved oxygen levels. Dissolved oxygen is used by fish and shellfish to breathe. Organisms that can escape the potentially lethal low dissolved levels leave, while those organisms that cannot leave typically die. Thus, nutrient pollution is often associated with fish and shellfish kills.

Agricultural extension can create awareness, inform farmers on proper usage of pesticides , herbicides as well as alternative practices and techniques such as organic farming that limits use of pesticides and herbicides. In addition, access to agricultural extension influences farmers to adopted environmentally friendly practices. In case of Uganda, the key challenge farmer's face is declining soil fertility or soil health and pests. By promoting pest and soil management practices such as Integrated Pest Management Practices and Integrated soil fertility management practices such as grain legume intercropping or rotation as well as use of biological fertilizers for legumes like inoculants, proper use of organic and inorganic fertilizers, and use of high yielding and pest resistant varieties, banana coffee intercropping, the soil health will improve, and need to use pesticides would be reduced thus reducing environmental impacts. In addition, agricultural extension promotes agroforestry, which helps in filtering air and conserving soil water and biodiversity.

Using data from UBOS and emissions in Uganda, we examined the relations between access to agricultural extension and emissions from different activities such as manure management, burning of crop residues and use of synthetic fertilizers as shown in Figure 9. The results suggest existence of positive relations between the agricultural extension and emissions. However, the degree of association is not significant.

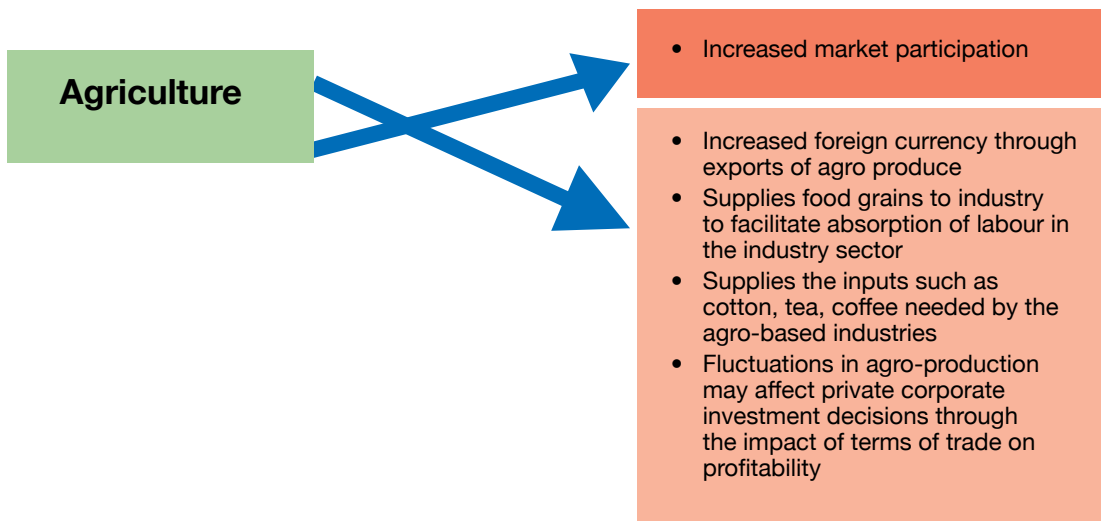
Figure 9: Emissions from agricultural activities as related with extension services access and frequency of access



5.4 Linkages between Agricultural Extension, Trade and Industry

The relationship between agriculture, trade and industry in Uganda is complex. Many goods that Uganda exports to foreign countries are agricultural products in which the country earns foreign exchange from these exports. Likewise, most of the raw materials needed for industries are produced from the agriculture sector. Agricultural Extension, which is an input to agriculture, is necessary for this strong linkage to arise and be maintained. Figure 10 illustrates the direct linkages between agriculture, trade and industry.

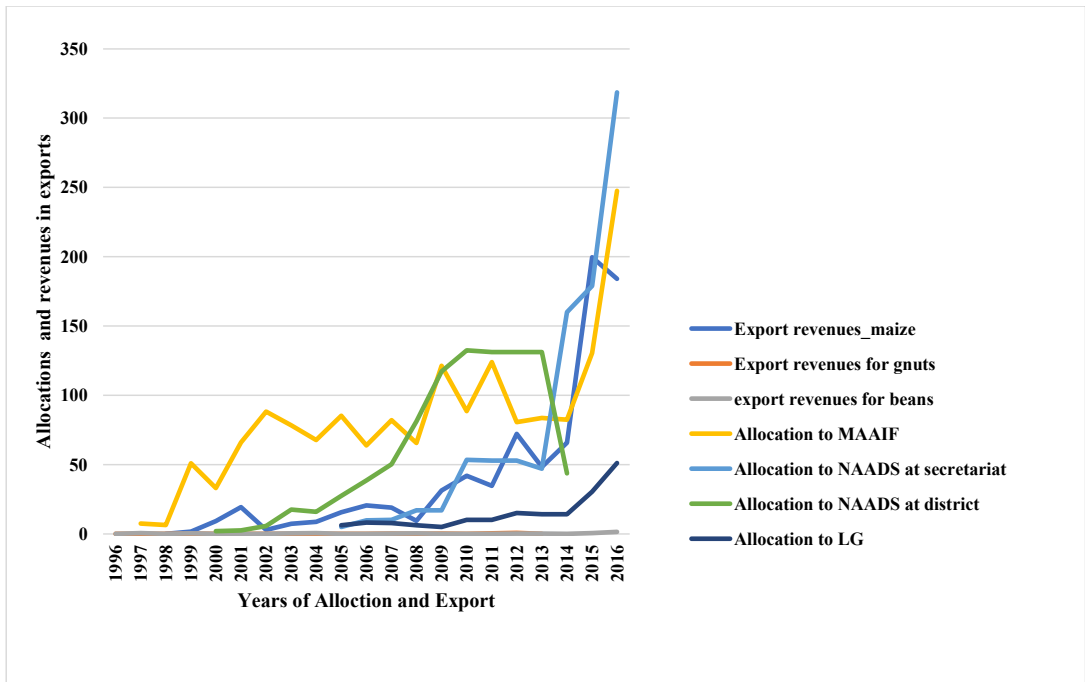
Figure 10: Direct Linkages between Agriculture and Trade and Industry



Agriculture extension can contribute to trade by increasing the quantity of output produced by farmers which directly contributes to proportion of total output supplied to the market. In addition, by promoting good farm practices (farm biosecurity measures) and post-harvest handling, agricultural extension increases farmer participation in the local and international markets. Increased market participation increases income of the rural farmers that in turn is re-invested in the economy through purchase of non-tradable goods and services. The impact of increasing agricultural productivity is wide-ranging and extends to economic growth, food security, poverty reduction, and livelihoods (Waddingthorpe et al., 2010). In Uganda, agricultural exports contribute to the poorest half of the population since they benefit significantly more from agricultural growth than growth in other sectors of the economy (UN, 2008; World Bank, 2007). For example, agricultural growth can provide the economy with much needed stimuli such as capital, labor, and foreign exchange to finance and fuel growth in non-agricultural sectors (de Janvry and Sadoulet, 2009). Using data obtained from UBOS and Ministry of

Finance, we examined the relations between export values of selected crops against allocation to local government agricultural extension department which we consider as a better proxy to agricultural extension as shown in Figure 11 below.

Figure 11: Revenues from exports of commodities and Budget allocations for different sectors in Ministry of Agriculture Animal Industry and Fisheries between 1997-2016



The results suggest that there is a positive relationship between allocations of money to the local governments and exports earnings. This suggests that better and increased agricultural extension service provision has the capacity to increase export earnings from this agro-produce and increased supply of other products. Shenggen et al. (2013) asserts that given the pivotal and substantial presence of smallholders in many developing countries, policies that directly or indirectly affect smallholder farmers have significant effects on the social and economic trajectory of those countries.

We also estimated a basic time series regression for export values of selected crops against allocation to local government agricultural extension department, which we considered as a better proxy to investment in agricultural extension. Other factors kept constant, results reveal that a shilling investment in local government extension produces significant immediate

benefits (impact propensity) in maize, beans and total export value. The impact propensity of a shilling investment in local government agricultural extension is 30 shillings in beans export, 6000 shillings in maize export, and 13000 shillings in total exports as shown in Table 4. This suggests that much of the extension benefit mostly bean and maize. Allocation to NAADs and MAAIF did not have any significant impact propensities on export values. The long run impact propensity or multiplier for export values found to be approximately 42500 per shilling.

Table 4: Correlation between exports of selected crops and local government agricultural departments' allocation

	Bean	Maize	GNUTS	Coffee	Banana	Fruit	Total Crop
	Export Value						
LGA	30.80 [*]	5869.7 ^{***}	20.66	13495.8	12.71	78.68	12708.6 [*]
	(2.56)	(5.05)	(1.20)	(1.04)	(0.70)	(1.96)	(2.66)
L.LGA	-7.569	-5589.4 [*]	-5.744	12442.9	-40.83	-222.4 ^{**}	-13656.5
	(-0.30)	(-2.31)	(-0.24)	(0.46)	(-1.08)	(-4.44)	(-2.29)
L2.LGA	-3.330	5152.9 [*]	-1.466	21795.6	-31.93	210.1 ^{**}	43234.6 ^{***}
	(-0.17)	(2.71)	(-0.08)	(1.03)	(-1.07)	(5.13)	(8.87)
_cons	-72.44	-27460.8	-25.14	40201.8	1137.9 ^{***}	-265.9	-13028.7
	(-0.50)	(-1.98)	(-0.15)	(0.26)	(5.23)	(-0.72)	(-0.30)
N	16	16	13	16	16	10	10
R ²	0.637	0.860	0.202	0.655	0.491	0.824	0.954

Figures in parentheses are *t* statistics. ^{*} $p < 0.05$, ^{**} $p < 0.01$, ^{***} $p < 0.00$

6.0 THE VALUE OF EACH SHILLING OR DOLLAR INVESTED IN AGRICULTURAL EXTENSION OR THE COST OF NOT INVESTING THAT SHILLING TO KEY PERFORMANCE AREAS IN THE SELECTED SECTORS

The relationship between the expenditures incurred and the number of households who received extension services was derived using the chain rule. This process resulted from a costing model for the implementation of the extension activities based on the number of households who received the services. Using the chain rule; the ratio of change in expenditure to change in the number of households who received extension services is defined as the rate of change of expenditure divided by rate of change in households who received the agricultural extension services. This expression is presented mathematically by equation below:

$$\frac{dE}{dHH} = \frac{dE}{dt} * \frac{dt}{dHH}$$

The above parametric function gives the model that was used to estimate the cost of implementing certain agricultural extension services. For the actual implementation of the method, specific models were fitted on the expenditures incurred in each of the sub-sectors. Details of the different models that fitted the observed data are discussed under each section. Figure 12 shows the trend in budget allocations or expenditures for extension services between 2009/10 and 2016/17. From the Figure 12 it is clear that the budget expenditure grows exponentially. For results, we use an exponential growth function to fit the expenditure data and the budget expenditure is expressed as

$$E = A \exp(\beta t)$$

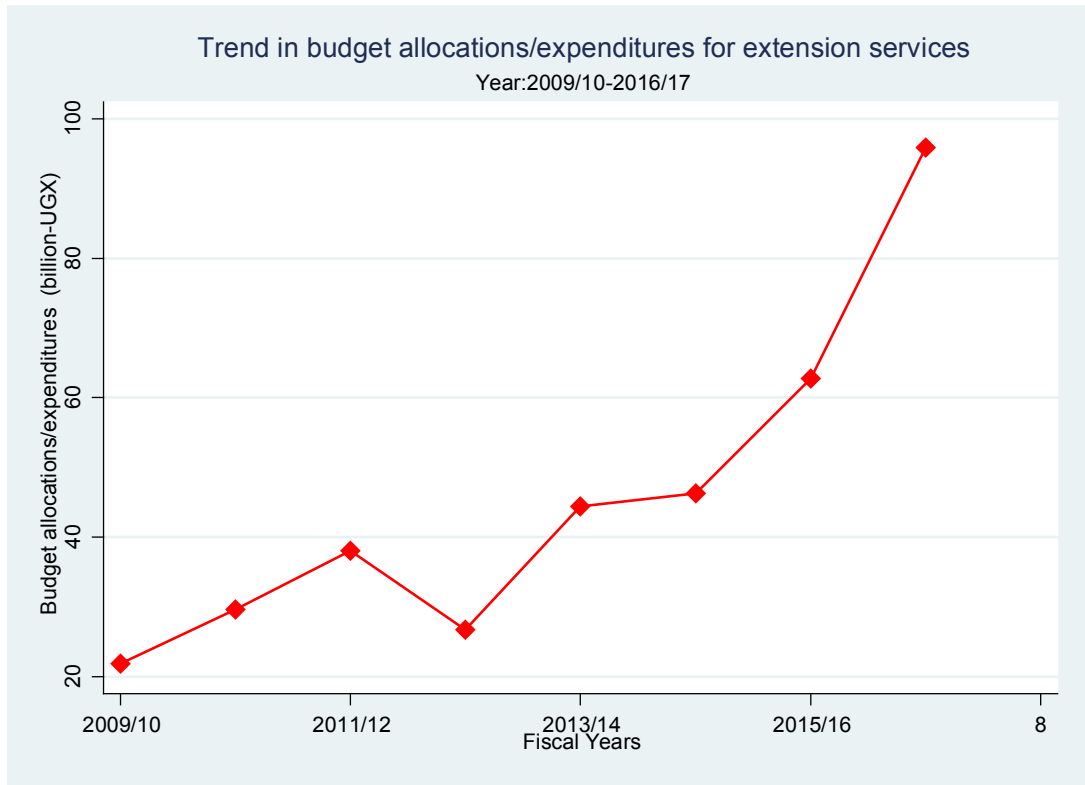
(3) Where A is constant and β is the growth rate of budget expenditure with time. Both A and β are estimates using a regress question. After fitting the data, the budget expenditure equation becomes:

$$E = 10.89 \exp(0.24 * t)$$

(4) To find change in expenditures over time, we differentiated equation (4) to get:

$$\frac{dE}{dt} = \frac{d}{dt} (10.89 \exp(0.24 * t)) = 2.6136 e^{0.24t}$$

Figure 12: Budget Allocations for Extension Services from Recurrent Budget



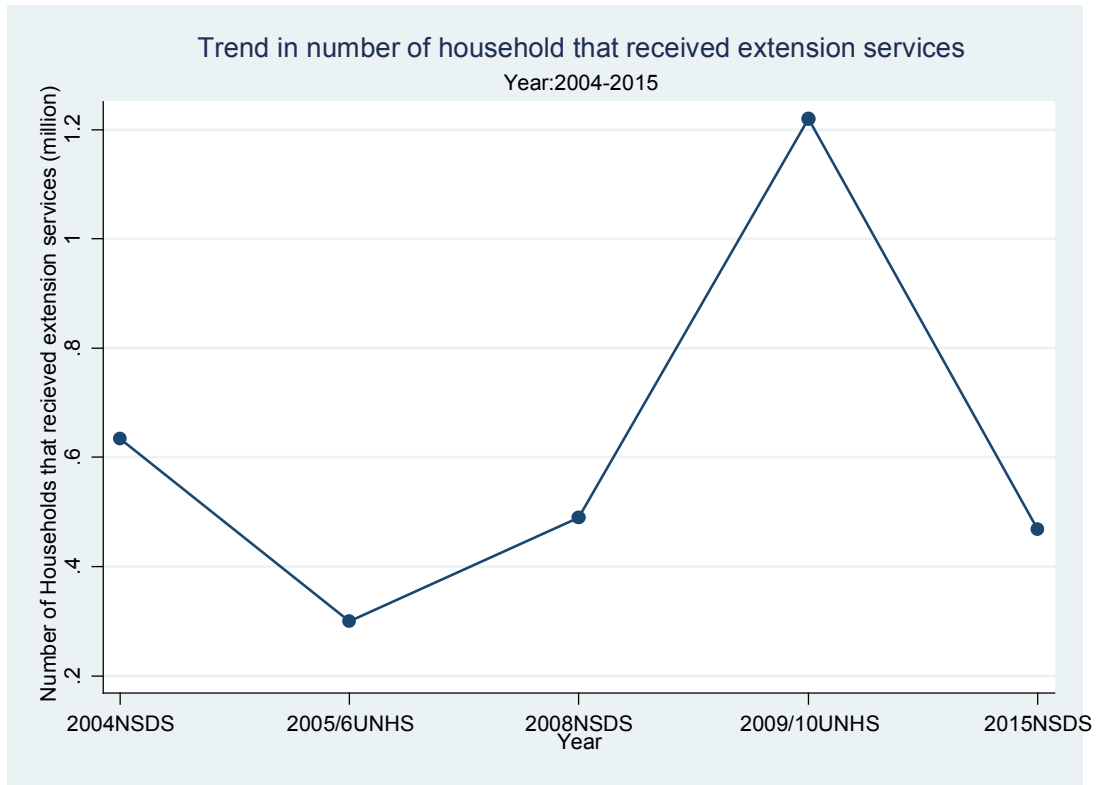
To generate the number of households receiving extension services, we used Uganda National Household Survey and National Service Delivery Survey data on the number of households that received extension services in Uganda and as shown in Figure 13, the data also follows an exponential growth curve. Therefore, we used the exponential growth function to derive the rate of change in the number of households that received agricultural extension services. From the results of the regression equation on the growth function on number of households who received extension services, number of household that received extension services can be shown as:

$$HH = 0.5174623 \exp(.0887t)$$

The rate of change in the number of households that received extension services over the years is obtained by differentiating equation (6)

$$\frac{dHH}{dt} = \frac{d}{dt} (0.5174623 \exp(.0887t)) = 4.5899 \times 10^{-2} e^{0.0887t}$$

Figure 13: Trend in Number of Households that Received Extension Services over Time



Hence, the unit cost of providing agricultural extension to one household is obtained using the chain rule as shown below:

$$\frac{dE}{dHH} = \frac{2.6136e^{0.24t}}{4.5899 \times 10^{-2} e^{0.0887t}} = 56.942e^{0.152t}$$

$$\frac{dE}{dHH} = 1000 * 56.942e^{0.152} = 66,290.$$

Note: The value is multiplied by 1000, since the expenditure is in billions of shillings. Therefore, the value of each shilling or dollar invested in agricultural extension is obtained as the unit cost of providing agricultural extension services that result in increased productivity, better nutrition as well as higher incomes to farmers. This unit cost is Uganda Shillings 66,290.

Below we present the cost of not investing the Uganda Shillings 66,290 per household to key performance areas in health, trade and industry, and water and environment.

Health Sector

Absence of agricultural extension may result in issues of food insecurity among the population. According to UBOS (2015), about 55% of the food consumed at household level in Uganda is from own production or given in kind. This implies that about 3.9 million households are at a higher risk of starvation if extension services are not provided and improved on. The cost of feeding these households per month was estimated at about UGX 112,424. The estimated cost of feeding these households per year if extension services are not provided is about UGX 5,261.4 billion.

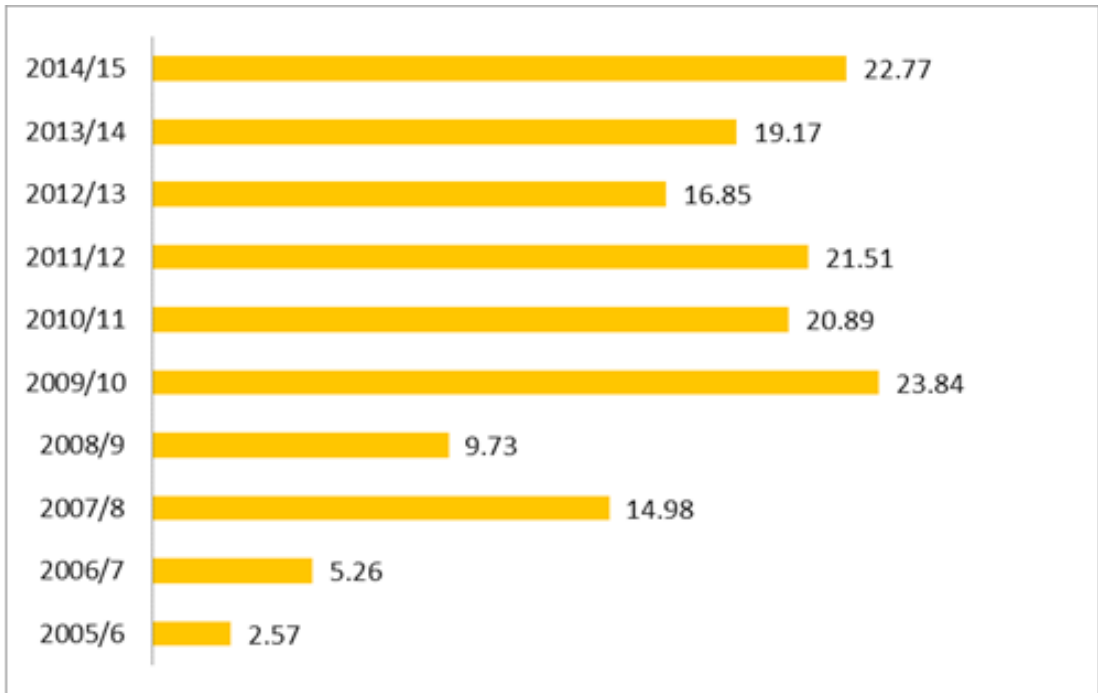
Household Sources of Income from Agriculture

According to the 2012/13 household survey, about 44% of the households derive their income from agriculture. Therefore, the provision of extension services plays an important role in maintaining their livelihood source. About 3.1 million household's incomes are likely to be affected if no extension services are provided to the population leading to about 15 million people being out of employment. The estimated household monthly income is about UGX 227,000. Therefore, the estimated loss in income at household level is about UGX 8,389.9 billion per year. This implies that failure to invest in extension services might not only lead to loss of jobs, but also income of about UGX 8.4 trillion per year.

Water and Environment (W&E) Sector

Water for production is one of the main resources that the government of Uganda under the Ministry of Water and Environment (MWE) has invested in to ensure increased production throughout the year. Figure 14 shows the trend in annual expenditure in real terms used in provision of water for production. There has been an increasing trend in the investment in water for production by MWE. It is expected that farmers get the extension services on irrigation to effectively utilize the water resources. For example, in fiscal year 2005/6, about UGX 2.6 billion were invested in construction of water facilities for production this has drastically increased to about UGX 23 billion in 2014/15 fiscal year. On average about UGX 15.8 billion is invested in water for production for the period 2005/6-2014/15 fiscal years. This translates into a total investment of about UGX 158 billion for the fiscal period 2005/6-2014/15. Therefore, failure to invest in extension services in Uganda will lead to poor utilization of water for production and hence, making the country lose about UGX 158 billion invested in Ministry of Water and Environment.

Figure 14: Trend in Annual Expenditures in Real Terms at Water for production



Trade and Industry

According to UNHS 2012/13, about 45% of the foods consumed at household levels in Uganda are purchased. This implies that failure to provide extension services will deprive the market of food that could be purchased which subsequently affects trade in food stuff. The expenditure on food at household level in Uganda is estimated about UGX 112,424. Furthermore, 45% households that depend on purchased food translates into about 3.2 million households that might not have access to food from the market. The lack of production resulting from no extension services translates to about UGX 4, 317.1 billion out of the economy. This implies that the country is at a risk of spending about UGX 9.6 trillion on food importation if the investment in extension services is not provided and improved.

SUMMARY AND RECOMMENDATIONS

The emerging picture is that agricultural extension has the potential to generate positive benefits to health, trade, water and environment. Failure to provide agricultural extension services generates negative external costs to other sectors amounting to 18.7 trillion every year. The study also found that agricultural development policies governing the provision of agricultural extension services stress the importance of agricultural extension, but allocations to agricultural extension are still very low compared to required optimal allocation. The legislative and political environment does not favor agricultural extension. Much of the attention seems to focus on input distribution and yet the level of technology misuse is high, thus affecting productivity and generating high costs in other sectors. The recent reforms in agricultural extension present an opportunity for improving agricultural extension service delivery. Below are some of the recommendations that we think would contribute to improvement of the extension system.

Policy advocacy

To make the reformed Single Spine Extension System (SSES) work and deliver desired outcomes, there is a need to advocate for increased financing for optimal operation of the agricultural extension system. More funds are needed to enable extension officers to do their jobs or to run their field operations. They will need transport and communication equipment in addition to demonstration materials. The current allocation is only 4% of what is required for single spine extension system to fully function effectively. In addition to increased funding to the extension system, MAAIF under the Extension directorate and NAADS-Operation Wealth Creation need to restructure input distribution process for increased productivity and reduced technological misuse as well as wastage. The two institutions will need each other. The success of Operation Wealth Creation depends on effective use of technologies. Extension officers can only improve productivity if farmers receive quality input and have access to new technologies. The current set up is very wasteful. The procurement process needs to be decentralized and farmers should be empowered to choose the technology of interest and time for receiving inputs. This will require organizing farmers into farmer groups. For the case of livestock, the Veterinary Surgeons Act should be revised. The current Veterinary Surgeons Act that governs the provision of animal health services is out dated and ineffective improving the provision of quality animal health services. This has led to increase in outbreaks of zoonotic diseases in Uganda and misuse of veterinary drugs. Billions of shillings are lost annually due to acaricides and antibiotic resistance in Uganda. More precisely, the key areas for advocacy designed to improve agricultural extensions are;

- Increased budgetary allocations to minimize the external costs of agricultural extension which are estimated to be 18.7 trillion
- Harmonization of the Directorate of agricultural extension and Operation Wealth

Creation roles for improved efficiency and better technology use.

- Decentralization of procurement and involvement of farmers in enterprise selection to help in improving productivity of the extensions officers.
- Policy advocacy on improved legislation especially for animal health service delivery

Collaboration between NGOs and MAAIF

As it is now, the Single Spine Extension System (SSES) cannot survive without NGOs. NGOs would really play a very important role in enabling the single spine extension system extension officers in delivering their NGO programs. The extension officers will be receiving the demonstration equipment for teaching farmers and some logistical support. Extension officers have limited knowledge on existing technologies, agronomic requirements of these technologies for better performance and avoiding technology misuse. For them to do this, they will need to interact with breeders and crop or enterprise specific information on good agricultural practices in form of manuals. This link can easily be undertaken by NGOs because they can easily reach out to research institutions producing agricultural technologies and they have resources. In addition, agricultural extension officers on the other hand would help NGOs to cut costs of delivering agricultural related programs such as recruitment and salary costs. All NGOs can do is to sign Memorandum of Understanding with MAAIF and the local governments.

Increasing benefits of agricultural extension

In order to reduce the negative costs of agricultural extension and increase benefits, Agricultural extension should promote nutrition sensitive agriculture. Practices and technologies for nutrition sensitive agriculture like agriculture and crop diversification, adoption of nutrition rich technologies like iron and zinc rich beans, Orange fleshed sweet potatoes and “Bio fortified yellow or provitamin” A rich cassava should be promoted. This can be promoted in following ways; (1) directly working with extension officers by providing them with manuals and literature on nutrition sensitive agriculture, and (2) NGOs can also work with schools both secondary and primary schools in teaching and practicing nutrition sensitive agriculture through school feeding programs.

In addition, Agricultural extension systems should promote proper utilization of agricultural inputs. The increased use of inputs like antimicrobial agents in animals, fertilizers, and pesticides are likely to continue to increase disease burden on human health care system because the level of technology misuse is high. Extension should focus on making input use more accurate and controlled by using the right quantity, right doze and right method of administration. In livestock, there is need for skilled animal health practitioners to be trained to reduce misdiagnosis and drug misuse. To reduce the cost of environmental degradation,

technologies like Integrated Pest Management and Integrated Soil Fertility Management Practices should be packaged properly for extension officers to teach farmers. In addition, single spine extension system should also promote agroforestry mostly for nutrition, animal feed and soil fertility.

Increased funding to Agricultural Extension by government and other partners

Our results and estimations show that the unit cost of providing agricultural extension services that result in increased productivity, better nutrition as well as higher incomes to farmers is UGX 66,290 per visit. This amount translates to UGX 662 trillion when multiplied by all households to be visited by extension officers. This is an enormous amount that the government may not be able to provide alone. Therefore, the need for other Civil Society Organizations, NGOs and partners to collectively support the government in resource mobilization and provision. This is important to ensure that the government does not face the cost of losing an estimated UGX 5,261.4 billion in feeding households per year, the population engaged in agriculture does not lose income of about UGX 8.4 trillion per year, the country does not lose about UGX 158 billion invested in Ministry of Water and Environment due to poor utilization of water for production, the country is not at a risk of spending about UGX 9.6 trillion on food importation if the investment in extension services is not provided and improved.

Future research

More research with better methodological designs like Randomized Control Trials with target extension interventions are needed to explore causal linkages between Agricultural extensions and other sectors. In addition, investments in data are needed especially for livestock, fisheries and environment to support tracking of impacts of extension services. Data are also needed in the context of trade and industry.

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