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*Review*

## **Review on market re-orientation of extension services for value chain development in Borno State, Nigeria**

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**Hitherto the primary focus of agricultural extension in Borno State has been to ensure increasing agricultural production for food security. However, the current emphasis is on enhancing rural incomes through market re-orientation. This change was necessitated by the realization that subsistence food production can no longer provide for a decent living and therefore increased engagement in commercial food production and markets has become a necessity and reality for the rural farmers. The paper explored the significance of agricultural extension in improving the marketing system in Borno State with focus on how market-oriented agricultural advisory services (MOAAS) could assist in addressing the marketing constraints faced by actors along the value chains and plethora of agricultural marketing bottlenecks in the state. To avail value chain actors of required information and extension services and enable them take advantage of market opportunities entails the need for the adoption of market-led extension approach by the Borno State Agricultural Development Programme (BOSADP); the pursuance of deliberate and conscious strategy for pro-poor MOAAS and Borno State government as a matter of policy undertake the recruitment and deployment of market-oriented extension workers and engage in capacity building to develop the marketing skills of the existing staff.**

**Key words:** Market re-orientation, extension services, value chain development, marketing extension.

### **INTRODUCTION**

The primary focus of agricultural extension today unlike the situation before should no longer be on increasing production but rather on enhancing rural incomes through market-orientation and responding to farmers' demand (Christoplos, 2010). The agricultural environment is changing with unprecedented speed and in very diverse ways as a result of market liberalization and globalization (Kahan, 2013). Some of the significant changes include changes in quality and food safety standards; changing

prices and emerging niches in global community markets; changing consumer food preferences at national and international levels and consequences of mega-trends such as urbanization and climate change (Neuchatel group, 2008). These dynamics affect rural people as subsistence food production can no longer provide for a decent living and therefore increased engagement in commercial food production and markets has become a necessity and reality for the vast majority of the rural

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population in Nigeria including Borno state. These trends have an effect on farmers who need to develop stronger management skills and competencies to cope with the ever changing farming environment. For farmers to be better managers and to run their business for profit they need assistance from those working at various levels in agricultural extension. In order to survive and prosper farming needs to become competitive and profitable (Schwartz, 1994).

The objective of making profits is central to the idea of farming as a business. Extension workers and small-scale farmers need to be familiar with and knowledgeable about the changes that are occurring in farming and the opportunities and risks that the new farming environment offer. These farmers have to begin to farm as a business if they are to prosper in the future. Many of the constraints facing small farmers are related to a lack of adequate know-how and skills. Market-oriented agricultural advisory services can play an important role in helping small farmers to overcome these constraints, and are an essential component of the wider range of services that are needed to contribute to poverty alleviation.

## CONCEPTUAL BACKGROUND TO EXTENSION AND MARKETING EXTENSION

Agricultural extension in many countries has come to encompass a wide range of activities in both the public and private sectors, yet the exchange of information continues to be the primary focus of all extension activities. The traditional concept of public agricultural extension involves a professional body of agricultural experts (generally government employees) who teach improved methods of farming, demonstrate innovations, and organize farmer meetings and field days on a wide range of topics (Agbarevo and Obinne, 2010).

According to CTA (2011) and USAID (2011) extension and advisory services were designed to help farmers boost crops and livestock production. These services enable farmers to adopt new technologies for increase production and profitability. According to them the specific objectives of agricultural extension and advisory services were to: i) provide advice to farmers on problems or opportunities in agricultural production, marketing, conservation and family livelihood; ii) facilitate development of local skills and organisations, and to serve as links with other programmes and institutions; iii) transfer new technologies to farmers and rural people thus an effective delivery of agricultural extension services is expected to play a significant role in agricultural production, processing, storage and marketing of food commodities.

Public extension is sometimes used as a channel to introduce – and sometimes enforce – agricultural policies. Extension also functions informally as farmers transfer

their best practices and experiences to each other through what is termed 'farmer –to-farmer extension'. In addition, extension activities are carried out by a wide range of organizations in the private business and non-profit sectors (Moris, 1991).

The word "extension" has been criticized as inherently emphasizing the "top-down" dissemination of information while ignoring other types of information flow between farmers, extension and research-particularly activities that involve farmers as equal partners in the process. This paper uses the term "extension" recognizing that extension functions are multi-faceted and go beyond "top-down" dissemination of new technologies. This author takes the position that the existence of multiple (sometimes conflicting) information sources is an advantage for farmers in that they can best select the information mix most suited to their goals as producers and the most reliable information source. The term 'extension' encompasses a diverse range of socially sanctioned and legitimate activities which seek to enlarge and improve the abilities of farm people to adopt more appropriate and often new practices and to adjust to changing conditions and societal needs. It has now become recognized as an essential mechanism for delivering information and advice as an "input" into modern farming.

In the context of the value chain, extension according to Adedoyin (2002) can be defined as a comprehensive programme of services deliberately put in place for expanding, strengthening and empowering the capacity of the present and prospective farmers, farm families, other rural economic operators (processors, marketers, rural agro-industrialists, farm managers, farm labour force), farmer associations and communities entrepreneurial, management and communication skills that they need to succeed in farming and farm related occupations.

The concept of agricultural marketing extension may be new, however it could be regarded as the most neglected part of extension activities. This is due to the fact that hitherto agriculture in Nigeria has mainly been practiced for subsistence not as a commercial venture. With current emphasis and need to promote farming as a business marketing extension have assumed increased significance. Agbarevo and Obinne (2010) conceived of marketing extension as the act of assisting farmers by teaching them how best to acquire agricultural inputs, transform them to output and market the output effectively to maximize profit while minimizing costs. In specific terms as opined by the authors agricultural marketing extension is concerned with making the farmer understand and take advantage of market opportunities by being in a position to provide answers to the following six critical production and marketing questions:

**(i) What to produce:** There are varieties of crops as well as breeds of animals to produce in any locality as

determined by factors such as cost of production, suitability of the soil, climate as well as availability of market for produce, land and labour input.

**(ii) When to produce:** The farmer will make the greatest profit when he/she produces during periods of scarcity. Market information regarding expected price variations for produce, meteorological information determining rains, droughts, pests or floods would be of immense benefit in timing farming operations.

**(iii) What method of production to use:** Enterprise recommendations on what method of production to use, input substitution and least cost combination of variable inputs to maximize profit and the most appropriate technology to use are addressed by agricultural marketing extension.

**(iv) How much to produce:** It is common for people to make lofty business plans without proper feasibility study. A farmer needs to know what area (hectares) to devote to a particular crop or mix of crops that could be financed by a given amount of capital. A poultry farmer for instance needs to know how much capital is required to raise 500 broiler chicks to market weight. The quantity to be produced has to be balanced against available resources.

**(v) Where to buy and sell:** There are alternative markets for procuring inputs and disposing produce. Different marketing channels equally exist. The farmer should purchase where the prices of best quality inputs are cheapest and products are highest. Von Thunen's principle or model of land use regarding its implication on 'farm gate' prices, if understood by farmers would help them make the best decision as to where to sell their products. In this regard the transportation cost of produce to market, the risks involved, time and labour requirements need to be balanced against expected higher prices of products in distant markets compared to farm-gate price which is usually lower.

**(vi) When to buy and sell:** Small scale farmers have limited choices as to when to buy or sell because of little capital and need for regular income for subsistence. Moreover lack of processing and storage facilities constrain farmer's ability to sell at times when prices are high. Marketing extension could assist farmers with skills of wise use of resources and utilization of low cost technology of processing and storage to avoid glut in the market. Availability and access to market information provides a guide as to the right time to buy and sell to get more profit.

### **MARKET ORIENTED AGRICULTURAL EXTENSION SERVICES AND ITS SIGNIFICANCE IN VALUE CHAIN (VC) DEVELOPMENT**

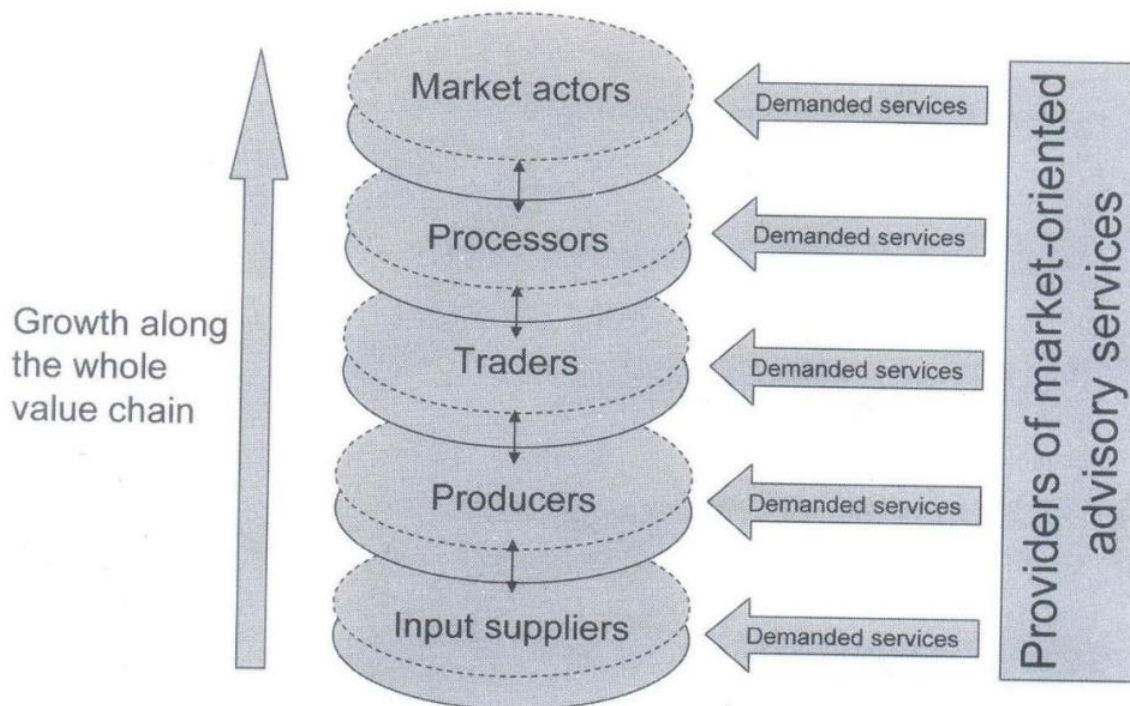
Inherent in the VC approach is an acknowledgement that in addition to the farmers there are other stakeholders in the chain such as processors or other downstream actors

who exert a positive influence on the small holder farmers who are the target to meet food security and poverty reduction in most agricultural transformation initiatives (Berthe, 2015). In fact as noted by the author in most African countries, including Nigeria small scale farmers constitute the major part of the supply base and improvements in productivity and food production will need to come from them. However, endogenous constraints (small scale production, poverty, high illiteracy and ill-health) and exogenous constraints (poor transport, infrastructure, poor access to credit, insufficient government and institutional support, etc.) make it difficult for them to compete. Consequently, because of lack of economies of scale (low volume of marketable surplus), they need to collaborate among themselves and with other actors in the market chains. However, they do not do so, as they lack information on the market and business skill and that is where market-oriented extension services has an important role to play. Market-Oriented Agricultural Advisory Services (MOAAS) as defined by the 'Common Framework on Market-Oriented Agricultural Advisory Services' are knowledge services which assist small-to-medium scale farmers and other actors in agricultural value chains to increase their access to markets and secure benefits from commercialization (Neuchatel Group, 2008). The definition entails looking beyond the problems of rural producers and farmers to focus on the challenges faced by a range of actors throughout the value chain in order to enhance the functioning of the whole chain. Figure 1 illustrates the value chain approach to provision of extension services.

It is apparent from the diagram that there are advisory service clients at each tier in the value chain. The clients can range from input providers, producers or producer organizations, micro-processors or multinational processing companies, to small and large traders or export companies. Even other organizations, such as financial service providers may need advisory services to better understand the market prospects for their potential clients. It is important that the clients at all levels are viewed as businesses which demand and use services provided along the value chain as depicted. Each of the actors requires know-how and advice and must therefore develop a sustainable and trusting relationship with the extension advisory service providers they deem competent and valuable (Neuchatel Group, 2008).

Markets are the driving force in agricultural development. This suggests that technological and organizational changes are in most instances driven by efforts to participate in markets. This is why, in recent years, extension has been steadily moving beyond its past role in technology transfer to greater involvement in facilitation, coaching and brokerage in market chains. Market demands are changing rapidly and becoming more stringent. Increased provision of market oriented extension is essential if poor producers and rural





**Figure 1.** Diagram showing the value chain approach to advisory services.  
**Source:** Neuchatel Group (2008).

entrepreneurs are to have the knowledge and information they need to respond to these challenges. Good market-oriented extension thus requires looking beyond the market opportunities that exist right now to focus more on helping farmers prepare to compete in the markets of the future. Iterative approaches are needed to help clients to adapt to the range of factors that are impacting on agricultural markets, from climate change to the expanding dominance of supermarkets and global supply chains (Christoplos, 2010).

Market-orientation demands a value chain orientation; which in turn implies that extension must meet the needs of a range of actors – not just farmers. Extension must be concerned with local economic development and empowerment, and not just farming itself. In effect, market-oriented extension is about making sure a range of actors are able to collaborate with one another. For example, if traders or input vendors want to invest in a particular product, they may need to provide advice to farmers about varieties and planting methods. The other value chain actors who are advising farmers about what they want to sell (inputs) or buy (farm produce) therefore also need to understand the technology themselves in order to provide such advice. These other market actors require access to extension as well. Such a broader approach to the extension agenda is controversial. It raises questions about whether extension is just about 'helping farmers' or if it requires advice to a variety of

stakeholders so as to contribute to developing the rural economy (and with that, rural livelihoods). A genuine value chain approach implies the need for facilitation and brokerage efforts to address constraints and bottlenecks to market access. Merely 'helping farmers' may not provide much help if the rest of the market chain is dysfunctional.

Traditional approaches to agricultural development tend to emphasize only food security which means helping farmers to grow enough to feed themselves and their families, and perhaps a surplus to sell. However, more recently concern with markets has become prominent because subsistence farmers need cash to meet up other obligations such as payment of school fees and health care. This implies that they should be able to grow things they can sell. And if they have a market for their produce, they have an incentive to grow more to earn more. This ushers in a virtuous cycle of higher yields and production, greater incomes, higher living standards, and more investment in production.

Market oriented agricultural advisory services are important by providing advisory support for producers as well as other actors in the agricultural value chain including processors, marketers and consumers. The scope of services includes technical know-how, understanding of markets, business management and facilitation of change in value chains. This entails that the farmer will have the appropriate knowledge of what

he/she wants to produce, the appropriate skills and techniques to produce for the appropriate markets and prices. The value chain actors need to develop critical competencies in contemporary issues in extension and markets so as to be able to successfully take advantages of benefits accruing along the value chain.

## **OVERVIEW OF AGRICULTURAL MARKETING CONSTRAINTS IN BORNO STATE AND EXTENSION STRATEGIES TO COUNTER THEM**

The agricultural marketing system in Nigeria is complex because of the myriad of independently operating small-scale farmers constituting about 95% of the farming population and 75 to 80% of the entire work force. Agricultural marketing however is devoid of complexity in developed countries such as the United Kingdom and United States of America where the farming population is only 5 to 10% of the entire work force. The complexity of the marketing system has given rise to several challenges to marketing of agricultural products in developing countries such as Nigeria. The major constraints include poor prices for the agricultural products, exploitation by middlemen, transportation problems in moving products from rural to urban markets; lack of alternative markets and lack of or poor processing and storage facilities (Agbarevo and Obinne, 2010). Related but context specific marketing challenges abound in Borno State. Amaza (2006) and Gaya (2007) highlighted the crop based agricultural marketing problems in Borno State. These constraints according to the authors affect market development and commercialization of agriculture in the state. Moreover, the bottlenecks constitute challenges for effective market extension services delivery for the rural farmers. A succinct description of the problems are as follows:

### **(i) Lack of market information**

Farmers, input dealers, output dealers and processors in Borno State have no access to regular and reliable sources of market information. A study by Amaza et al. (2005) revealed that 80% of farmers in Southern part of Borno State sought for information on prices within their locality before they made sales. These information could be biased and may provide the wrong signal to the farmers. Effective market information services (MIS) help to increase the efficiency of agricultural markets and help overcome market failures that are based on weak and asymmetric access to information.

Basically there are three main types of information disseminated through MIS (Shepherd, 1997). These include traditional market information systems that provide regular spot prices of agricultural goods to the farming community; market intelligence that provides

forecasting information on a narrow range of products and that mainly supports the needs of traders and market linkage information that focuses on a single product and specifically aims to bring together buyers and sellers. All these types of market information are either lacking completely or are not regularly updated or the farmers do not get access to such information due to bureaucratic bottlenecks associated with its collection and dissemination in Borno State. Generally Agricultural Market Information System (AMIS) makes food commodity markets more transparent (FAO, 2019). For instance the global experience as reported in FAO (2019) publication 'FAO: Challenges and Opportunities in a Global World' pertaining the sudden rise in food prices between 2007 and 2008 which had a devastating effect for the world's poor. One of the measures adopted to address international food price volatility was the creation of the Agricultural Market Information System. AMIS was launched in September 2011 to enhance transparency in international food markets and facilitate policy coordination when food security is at risk.

### **(ii) Poor infrastructure**

Infrastructural deficiencies constitute market imperfections and are likely to affect both factor and product markets. Most of the markets in Borno State lack good road network and drainages thus increasing farmers costs. Lack of electricity and storage facilities are a common occurrence in the state. The poor state of infrastructure has been worsened by the destruction of vital public and private social and economic infrastructure such as roads, electrical and telecommunication infrastructure, bridges, health and educational facilities and banks since 2009 by *Boko Haram* insurgents in most Local Government Areas of the state.

### **(iii) Poor bargaining power of producers**

In Borno State there exists poor bargaining power of producers vis-à-vis middlemen in agricultural marketing. The situation is exacerbated by the absence of market information which could have empowered them through reliable, impartial and cheap access to information on prices and demand structures.

### **(iv) Lack of standard weights and measures**

In Borno state agricultural products are sold under a variety of weights and measures. According to Gaya (2007) market transactions in agricultural commodities especially crop based products in the state are conducted using a local measure called 'mudu' which is approximately 2.5 kg weight for cereals and legumes.

This applies to crops such as maize, sorghum, rice, cowpea, soyabean and groundnut which are commonly grown and marketed in the state.

## **EXTENSION STRATEGIES FOR EFFECTIVE AGRICULTURAL MARKETING**

In order to address the challenges to agricultural marketing identified in the previous section of this paper the following extension strategies are proposed for implementation in Borno State as a means to ensure effective marketing of agricultural products in the state.

### **(i) Adoption of market-led and market-oriented extension services delivery approach**

Market-oriented services focus on the principle of market orientation, which is broadly based on customer satisfaction and competitive marketing of products. This entails that the extension service in the Borno State Agricultural Development Programme (BOSADP) should be market-led-that is, they should provide a product in the form of extension services based on the needs of the farmers. From an extensionist perspective, market orientation is needed to ensure that: Farmers are able to produce a marketable product; the necessary tools are available for processing and good farming practices are observed such as fertilizer application, pest control and crop rotation; and farmers have access to a market for their crops and livestock (GFRAS, 2012). Market-led extension provides services focused on linking farmers to the market, often to improve their income. This type of extension often also extends to other actors in the value chain. In line with the need to adopt market orientation, it has been suggested that the Nigerian agricultural extension system should address the critical challenges of agricultural extension and advisory services to transform it into a participatory, demand-response, market-oriented and ICT driven service that will provide for all the extension needs of all actors along the targeted commodity value chains of interest (Izuogu and Atasié, 2015).

### **(ii) Capacity building for extension workers in marketing extension skills**

As farmers become more market oriented, so extension workers need to be in a position to advise them not only on how to grow crops and raise livestock but also on how to market them. Knowledge of produce handling, storage and packaging is also essential. The envisaged training programme is aimed to address lack of knowledge and skills on market-led agricultural extension as extension workers in the state needed strong capacity-building support. The other areas requiring priority assistance will

include the development of training programmes on futures markets, agri-insurance and risk management, and farmer capacity building for collective activities and, in particular, market access and quality management which are complementary and essential marketing skills needed to operate in a dynamic business environment. It is therefore recommended that the Borno State government not only undertake the recruitment and deployment of market-oriented extension workers but also take deliberate effort to develop skills of existing extension workers in marketing through range of training materials and context specific courses tailored to the needs of a particular location, value chain crops or agricultural activity of interest.

### **(ii) Use of information and communications technology (ICTs) in dissemination of market information**

Information and communication technologies (ICTs) exerts an influence and impact positively on the agribusiness value chain. ICTs are veritable tools with potential for use in MOAAS. For instance for farmers the explosion of mobile phone ownership facilitates access to better market and agronomic information on crop prices and weather conditions, and financial resources and products such as credit and insurance. This enables them to improve the efficiency of their transactions. In the case of food companies and retailers, social media has become an integral part of their marketing strategies and engagement with customers (World Bank, 2012). ICT not only impacts individual stages in the value chain but also helps integrate them by tracking the progress of crops and foodstuffs from production to consumption, providing the information needed for traceability.

Radio- based dissemination of data has also become a common practice. In Uganda, for instance it was found that from 2000 to 2007, rural radio was the most effective means of delivering information to the large number of farmers (Ferris and Robbins, 2004). In many countries including Nigeria, this may continue to be the case as rural radio overcomes literacy issues and enables mass coverage. However radio dissemination is costly and in most cases is limited by a one-way information flow. The use of call-in options and call centers to the radio companies was one way of providing two way communication.

### **(iii) Adoption of pro-poor MOAAS**

The dynamic nature of agricultural markets at national and international levels can be expected to continue to accelerate and penetrate areas that have been isolated from significant market change in the past especially in the rural areas of Borno State where subsistence

agriculture has been the norm. This means that a conscious strategy for pro-poor MOAAS is essential if agricultural development is to be a route for poverty reduction in the future and in the context of the state.

#### **(iv) Provision of inputs and facilitation of collaboration among stakeholders**

Market-orientation relates to value chain development as a whole. Markets demand new varieties, breeds and processing, but technologies are just one aspect. Value chain development may require effective communication and facilitation of linkages, coaching of interactive learning and collaboration among a broad spectrum of actors within the value chain. Extension's role in supporting market-orientation in these platforms may thus be to encourage a dialogue wherein these stakeholders can come together to negotiate and build social capital. This will often involve training and capacity building in negotiation skills and contracting which require facilitation by the state and local government areas for their respective extension and agricultural officers.

#### **CONCLUSION**

It is important to understand that adopting the value chain approach to economic development and poverty reduction in Nigeria and indeed in Borno State is a step in the right direction at the most opportune and appropriate time. In Nigeria, previous strategies employed, which mainly focused on improved production has yielded unsatisfactory result of perpetuating poverty through the continued practice of subsistence agriculture.

It is important to note that in Borno State as revealed by the review that the dawn of commercial agriculture have come based on the understanding that the value chain approach involves not only addressing major constraints and opportunities faced by farmers or producers, but also those of processors, traders and other businesses at multiple levels and points along a given chain. The process has also included facilitating a wide range of activities such as ensuring access to inputs, strengthening the delivery of business and financial services, enabling the flow of information and facilitating improved linkages between actors to higher-value markets. To avail value chain actors of required information and extension services along the value chain so as to be able to take advantage of market opportunities there is an urgent need to consider and adopt the extension strategies proposed in this paper.

#### **CONFLICT OF INTERESTS**

The authors have not declared any conflict of interests.

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*Full Length Research Paper*

# Enhancing community participation to improve sustainability of irrigation projects in Geita District, Tanzania

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The research on which this paper is based was conducted in Geita District, Tanzania, to assess the nature of community participation in irrigation projects in three villages (Nzera, Lwenge and Nyamalulu) to find out whether community participation used in the projects was likely to lead to their long term sustainability. A cross-sectional research design was adopted in which a combination of purposive and simple random sampling techniques was employed to select a sample of 120 respondents. Quantitative and qualitative data were collected through questionnaire survey, key informant interviews and Focus Group Discussions. Quantitative data were analysed using the Statistical Package for Social Sciences (SPSS) to compute descriptive statistics and do inferential analysis while qualitative data were analysed using content analysis. The results showed that community participation in the projects was inadequate to lead to their long term sustainability due to low (< 50% except in terms of contribution of resources) participation in all implementation stages. The understanding of community participation among the beneficiaries was limited (<50%) in all aspects. Women participation was limited (37.5%). Hence community participation was used more as a means than an end. Therefore, it is argued that community participation needs to be enhanced in order to improve sustainability of irrigation projects. Hence, it is recommended that that there should be concerted efforts to sensitise and mobilise the community members to participate effectively in all aspects of the projects from problem identification to implementation.

**Key words:** Community participation, participatory approaches, community empowerment, project sustainability.

## INTRODUCTION

Community participation is considered critical for the sustainability of irrigation schemes, especially when used both as a means and as an end. Community participation, defined as engaging users of schemes in the decision-

making processes for the planning and implementation of irrigation projects, is critical for the sustainability of irrigation schemes (Yami, 2013). However, community participation is likely to lead to long term sustainability of

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development projects if it is used both as a means and as an end (Komalawati, 2008).

According to Komalawati (2008), when used as a means community participation is used only as a tool to achieve project sustainability by developing the sense of ownership of the people concerned. On the other hand, community participation as an end is an active and dynamic form of participation that leads to an increasing role of local people at every development activity (Howllett and Nagu, 2001; Russell et al., 2008; Mwakila, 2008).

Irrigation, as Kayandabila (2013) points out, plays a very important role in mitigating vagaries of weather due to climate change. In the right environment and with correct practices irrigation provides more yield than rain-fed agriculture (Tekana and Oladele, 2014). According to Svendsen et al. (2009), it stands out strongly among other productivity-improving capital investments and technological inputs (fertilizer, advanced seed delivery systems, post-harvest processing facilities, and access to markets) because of its role in stabilizing yields in the face of climatic variability, which has increased notably in recent times. However, reports show that the irrigation sector's contribution to agricultural output is relatively small (Lebdi, 2016).

According to Lebdi (2016), Africa could irrigate 42.5 million hectares, based on available land and water resources. However, although the irrigated area has nearly doubled to 13.6 million ha (from 7.4 million ha in 1960s), in 2006 African countries irrigated just 5.4% of their cultivated land, compared with a global average of around 20% and almost 40% in Asia. Geographical coverage is also skewed since a large proportion of irrigated land is concentrated in five countries, namely South Africa, Egypt, Madagascar, Morocco and Sudan.

Irrigation development is currently very prominent in Tanzania's major agricultural and poverty reduction policies and strategies, and cited as one of the key strategies for achieving food security and agricultural growth (Oates et al., 2017). However, the development of Tanzania's irrigation potential is still modest. According to reports (URT, 2009), it is indicated that irrigation potential is estimated to be 29.4 million hectares (2.3 million hectares of high potential, 4.8 million hectares medium potential and 22.3 million hectares of low potential). Yet, only 450,392 (1.53%) is used. Furthermore, only 5% of households use irrigation facilities.

Reports show that, in line with Tanzania's national Policies the irrigation projects in Geita District form an important part of agricultural development projects that are implemented under the Agricultural Sector Development Programme (ASDP). The projects are reported to be implemented on a participatory basis, giving an opportunity for the community to participate fully in decision making and implementation (GDC, 2009). However, some recent studies in Tanzania, for example Matekere and Lema (2012); and Mahoo et al. (2012)

indicate that there has been a decline in performance of some of the projects which is attributed to ineffectiveness of community participation among other reasons.

Given this low level of irrigation development in Africa, particularly Tanzania, and its attribution to ineffectiveness of community participation, there is a need for understanding the way it is used in the projects, and to find ways to enhance it. This is in order to avoid the shortfalls of community participation practices which contributed to failure of other participatory agricultural development projects in the past.

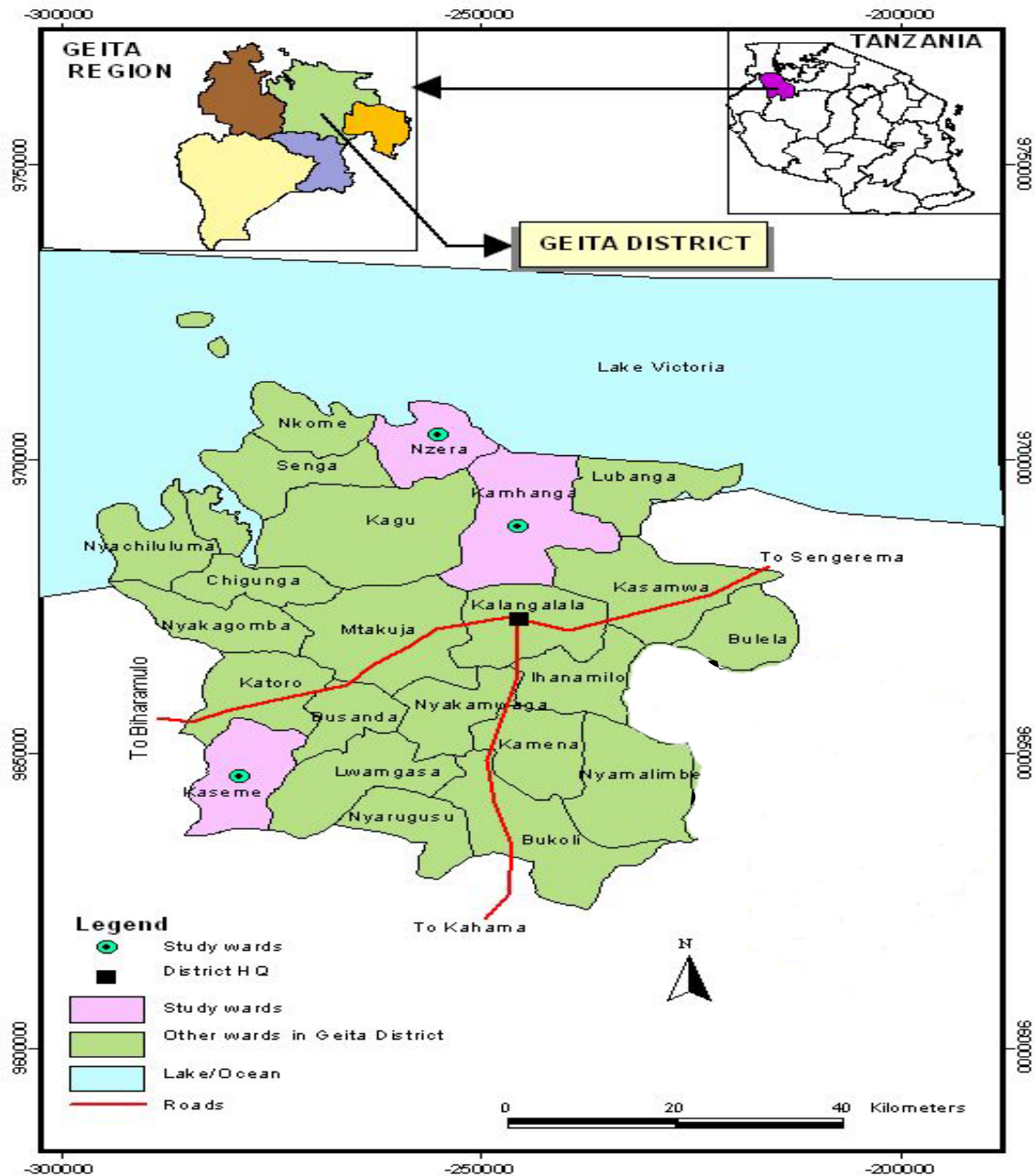
Reports show that Agricultural production in Tanzania has increased slowly, and for some reasons Community participation has not played a major role to make irrigation projects sustainable to benefit farmers. It is reported that from 2006 to 2012, the share of the agriculture sector in total GDP decreased from 27.7 to 23.2%, while the shares of industry and service sectors increased from 20 to 22%, and from 46 to 49% respectively during this period (URT, 2016). In general the Government of the United Republic of Tanzania and decision makers are aware of community participation as an important factor in implementation of the irrigation projects (Kiseto, 2014; URT, 2016; Mwakila, 2008). However, most of the available studies which are closely related to community participation in irrigation projects such as that by Phadnis et al. (2010) Karamjavan (2014) and Yami (2013) pay little attention to how such participation is used. Therefore, it is important to assess the nature of community participation in irrigation projects to determine whether it is used both as a means and as an end. Being in line with the Tanzania's National Strategy for Growth and Reduction of Poverty phase II (NSGRP II) priority of improving food security through community based irrigation schemes for food crops (URT, 2010a), the findings from the study could provide a basis to enhance the likelihood of sustainability of the irrigation projects in Geita and other parts of Tanzania.

## RESEARCH METHODOLOGY

### Description of the study area

As shown in Figure 1, the research on which this paper is based was conducted in Geita District, one of the 5 districts of Geita Region. According to its 2013 Socio-Economic Profile (GDC, 2013), the district covers 5,702 km<sup>2</sup> of which 4,652 km<sup>2</sup> is dry land and the remaining 1,050 km<sup>2</sup> is covered by Lake Victoria. The district is made up by 4 administrative divisions, 35 wards and 146 villages. It is located on the shores of Lake Victoria, lying between 2° 28' and 3° 28' South and 32° to 32° 45' East.

The main economic activity for more than 90% of the population in Geita District is agriculture. The district's location makes access to rice markets of the neighbouring countries of Uganda and Kenya more convenient. All these factors combine to create a high demand for rice which is one of the most important staple cereals next to maize. Therefore, searching for ways to make the rice irrigation schemes sustainable in this district was considered to be important.



**Figure 1.** A map of Geita District showing the study area.  
Source: Adopted from GDC (2013).

### Research design, sampling and sampling techniques

The study adopted a cross-sectional research design, but during the study period there was shortage of time to perform the activity as planned. The design is cost-effective and allows one to collect the required data in a relatively short period of time. According to Bailey (1998), the design involves collection of data on more than one case, at a single point in time and is typically associated with both quantitative and qualitative research.

According to Bailey (1998), the minimum sample or sub sample for a research in which statistical data analysis is to be done is thirty (30)

cases. Therefore, the study covered a sample of 120 respondents from three villages with 40 respondents from each village. To obtain the sample a combination of different sampling techniques, that is purposive sampling and simple random sampling.

### Data collection

The researcher used both qualitative and quantitative method of data collection. A combination of the methods was suitable for this

**Table 1.** Distribution of respondents by participation in the projects (n=120)..

| Variable  | Yes |      | No  |      |
|---|-----|------|-----|------|
|   | (n) | %    | (n) | %    |
| Participated in initial stages                                    | 58  | 48.3 | 62  | 51.7 |
| Participated in decision making meetings                          | 56  | 46.7 | 64  | 53.3 |
| Participated in irrigators' Associations                          | 44  | 36.7 | 76  | 63.3 |
| Participated by contributing resources for project implementation | 68  | 56.7 | 52  | 43.3 |
| Participated in Monitoring and Evaluation                         | 41  | 34.2 | 79  | 65.8 |

**Table 2.** Beneficiaries' understanding of participation (n=120).

| Understanding                             | No. of respondents | Percentage |
|---|--------------------|------------|
| Contributing in terms of manpower or cash | 33                 | 27.5       |
| Involvement in planning meetings          | 18                 | 15.0       |
| Formation of groups                       | 19                 | 15.8       |
| Learning                                  | 9                  | 7.5        |
| Do not know anything                      | 15                 | 12.5       |
| Involvement in the planning process       | 26                 | 21.7       |

type of research because they helped in soliciting full, in-depth accounts of the levels of participation of the project beneficiaries in the target communities. As observed by Tagarirofa and Chazovachii (2010), this complementary usage of the methods helps in the acquisition of comprehensive data about the variables under investigation.

Quantitative methods were used to measure variables that were linked to the research problem in the study area. The rationale behind using qualitative methods, in addition to quantitative methods, was to increase understanding of the dynamics, opinions and perceptions of people in the study area about the effectiveness of their participation in implementation of the irrigation projects.

#### Data analysis

Descriptive analysis was used to analyse quantitative data. Quantitative data from the questionnaire were collected, edited, summarised, coded and thereafter analysed by using the statistical package for social sciences (SPSS). SPSS was used to generate descriptive statistics which included frequencies and percentages. Analysis of the qualitative data was done through content analysis.

## RESULTS AND DISCUSSION

One of the objectives of the research on which this paper is based was to assess the nature of community participation in the irrigation projects in Geita district, Tanzania. This was achieved by focusing on community participation by stages of a project, the understanding of community participation and participation by gender.

#### Participation by project stages

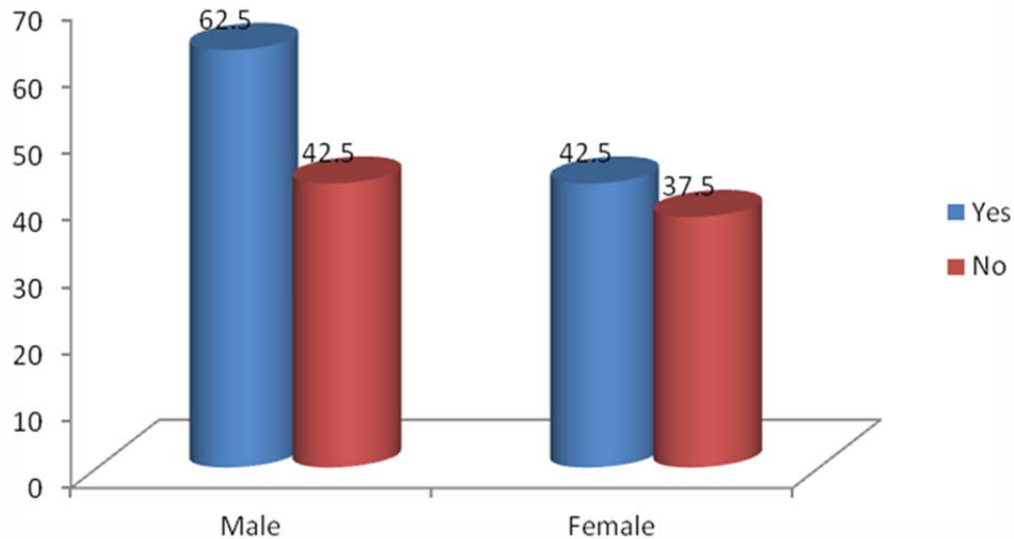
The results (Table 1), show that with the exception of

contributing resources (56.7%) community participation is generally limited (<50%) in various project project stages. This finding is in conformity with other recent studies such as a study by Mbevi (2016). This is a very important finding as far as the projects' sustainability is concerned because as some other studies, for example Masya (2016) demonstrates, in some cases the importance of community participation tend to be underestimated. According to Mbevi, the findings from the study indicated that communities have not fully participated in project cycle especially in monitoring and evaluation, training, resource contribution and decision making. According to Masya (2016) only water availability, technology used in irrigation systems, institutional and financial factors are considered to have a significant influence on success of irrigation projects. However, other recent studies, for example (Oduor et al., 2018) reveal that farmer participation in project control has significant influence on sustainability of smallholder irrigation schemes.

#### Beneficiaries' understanding of community participation

The findings (Table 2) show that over a quarter (27.5%) reported of understanding participation as referring to contributions in terms of manpower or cash. Furthermore, the findings show that involvement in planning meetings had (15%) of respondents, while formation of groups had (15.8%) of respondents. This suggests a lack of clear understanding of community participation among the project beneficiaries. This finding is important because as Kuruvilla and Sathyamurthy (2015) notes, community





**Figure 2.** Gendered participation in the irrigation projects.

participation has not yet got its status in the development circle. In this case the participants seem to have a fragmented understanding of the concept. However, according to Kuruville and Sathyamurthy (2015), participation includes people's involvement in decision making process, in implementing programmes, their sharing in benefits of development programmes and their involvement in efforts to evaluate such programmes.

### Participation in the projects by gender

Figure 2 show that only 37.5% of female respondents reported of participating in the projects as compared to 62.5% of male respondents. The findings indicate that the participation of women were generally limited. The finding is of great importance since as Yami (2013) found, Water User Associations (WUA) committees are male-dominated and the views of women are hardly represented in the decision making. This highlights the need to promote women's participation in decision-making for water management and also suggests ways in which women's access to water can be improved through equitable development (Tekana and Oladele, 2014). However, as Koopman et al. (2001) notes, participation in irrigation projects is more effective when women are involved.

The quantitative findings in relation to the nature of community participation in the projects are further confirmed by the qualitative findings from key informant interviews and FGDs. During the key informant interview it was remarked that:

*“Formulation of the three Irrigation projects (Nyamboge/Nzera, Lwenge and Nyamalulu) was based*

*on a systematic assessment of the existing situation and was developed through a participatory approach involving key agricultural stakeholders. A team of agricultural stakeholders at the district level in collaboration with the field extension officers from the respective wards prepared an initial focus question on how low income households and households with food insecurity problems caused by low agricultural productivity would be addressed, which was later presented to the communities to get a shared perception of the problems they wished to overcome”* (Geita District Irrigation Officer-DIO).

However, for effective community involvement in irrigation projects, it is required that the project team has to spend considerable time with the beneficiaries to outline the strategies for implementation of the project and seek their inputs. It is in this way that effective community participation in initial stages can be ensured (Irrigation Futures, 2011).

The concern for lack of active community involvement in the design of the projects featured in almost all of the Focus Group discussions (FGDs). In all villages the discussants raised concern over lack of effective mobilisation for the communities to participate in early stages of the projects, inadequate community meetings concerning the projects, lack of clear information regarding their involvement in the formed irrigators' associations and setting of the contributions for the projects. One participant remarked that:

*“Generally, I can say that our involvement in this irrigation project, as a community, is limited. We were not consulted to give our views, may be our leaders. The project team came from the district with their ideas and the meeting was just used as a rubber stamp to inform us about their pre-conceived ideas. We are also informed*

*that each beneficiary will be required to contribute a bag of rice per year for the project operations and maintenance fund, but we were not involved in discussing all of these issues” (a young man from Nzera village).*

These remarks further highlight the lack of active community participation in initial stages of the projects. Thus, in the light of ‘community participation as a means’, it can be considered that the communities were just mobilised to get things done, a top down type of mobilisation, which was enforced to achieve the pre-determined project objectives imposed from above. This remains a case while literature on community participation shows that giving the beneficiaries an opportunity to actively participate in all aspects increases their sense of ownership of development projects and in turn leads to sustainability of the projects (Komalawati, 2008; Ahmad and Talib, 2010).

## CONCLUSION AND RECOMMENDATIONS

The findings show that community participation in the projects was generally inadequate. This is indicated by a small percentage of respondents who reported participating (<50% in all aspects except participation by contributing resources to the project); a relatively large percentage (27.5%) of respondents who reported understanding participation as contributing in terms of manpower or cash and a limited use of participatory techniques (mainly relying on O&OD only) as reported in key informant interviews. In the light of ‘community participation as a means versus community participation as an end’ this means that community participation was used more as a means than an end.

Therefore, in view of the finding that community participation in the projects was inadequate; this paper recommends that there should be concerted efforts to sensitise and mobilise the community members to participate in all aspects of the projects from problem identification to implementation. Participation should be enhanced by applying more innovative participatory approaches like PRA in addition to O&OD. Local government officials should be trained on the use of participatory approaches with a focus on participation as a means and participation as an end. Community members should be facilitated to understand deeply the meaning of participation and their roles in participatory processes. Provision of gender education to local government officials and community leaders should be strengthened. Regular monitoring of the projects should be undertaken to identify gaps in participation and act on the situation accordingly.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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*Full Length Research Paper*

# **Causes of losses and the economic loss estimates at post-harvest handling points along the beef value chain in Uganda**

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**Uganda's beef industry has been growing slowly and requires sustained monitoring of actors at post-harvest handling points in order to decrease public health risks and losses. This study documented causes of losses and estimated economic values at post-harvest handling points along the beef value chain. It was carried out at slaughter houses, transporters and butcher shops in the districts of Western, Central and Eastern Uganda. A cross sectional study was conducted among meat handlers who were interviewed to find out the losses incurred in the value chain. Microbial load from carcass swabs were collected and evaluated using standard microbiological methods to determine microbial contamination of beef. The causes of losses varied at different handling points. The actors at slaughter houses indicated the major losses were due to low beef demand (15.3%), insecurity (13.4%) and poor weight estimation methods (11.03%). Losses at the butchery included, beef waste (22.4%), drip loss (19.7%) and beef spoilage (18.4%). Microbial analysis showed the highest microbial prevalence at the butchery (70-100%) followed by slaughter (50-80%) and lastly transport (30-50%). Microbial contamination on carcass leads to spoilage and hence market loss because exportation does not admit contaminated foods. Actors reported beef waste and drip loss as the major causes of losses at the butchery. To reduce losses, public health care education for meat handlers and adherence to strict standard operating procedures (SOPs) are a key.**

**Key words:** Losses, post-harvest, beef value chain, handling points, Uganda.

## **INTRODUCTION**

In Uganda, livestock sub sector contributes 9% of the Gross Domestic product and the sector comprises cattle, poultry, pigs, goats and sheep. Of the 9% of the GDP, cattle contribute about 72% (Mbabazi and Ahmed, 2012).

Actually, cattle population is estimated at 11.4 millions and out of these 93.6% are indigenous breeds (UBOS, 2008). However, cattle are the most important livestock supporting the livelihood of about 4.5 million people in

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in Uganda (Mbabazi and Ahmed, 2012) and are the leading source of meat in the country (FAO, 2018). In Uganda, beef sector is the most vibrant meat sector with the highest per capita consumption and with the highest potential for local and regional growth in demand (Agriterra, 2012). The annual national beef production was estimated at 202,929 metric tons in 2014 (MAAIF, 2016) but could increase greatly if there were reduced losses in the sector.

Safety, quality and quantity losses of meat are however still a challenge in the country. Safety and quality losses by microbiological causes are a hazard for consumers because of pathogenic microorganisms on the product and the economic losses that result from microbial spoilage (Raybaudi-Massilia et al., 2009).

During beef processing and preparation (post harvesting stage), microbial contamination of beef can occur (Lawan et al., 2013; Fearon; Mensah and Boateng, 2014) and this may be as a result of contact with contaminated tools or equipment (Birhanu et al., 2017). The contaminated tools and equipment may harbor and introduce pathogens into beef (Bogere and Baluka, 2014; Chepkemoi et al., 2015). In addition, during unhygienic processing of beef, handling practices are also known to play a role. For example, poor handling practices can contribute to microbial contamination of tools, equipment and beef itself. Yet, consumption of microbiologically contaminated food can bring unimaginable economic losses (Hussain and Dawson, 2013) in various forms including unexpected expenditure on hospitalization bills, treatment costs, lost markets (for exports) and financial loss due to loss of business (Akanele et al., 2016).

Furthermore, microbial food contamination in the food supply chain cause food losses and foodborne illnesses that result in heavy economic losses (Elkhashin et al., 2017). In Ethiopia, a loss equivalent to 28.45 USD was estimated to arise from every infected slaughtered cattle (Fromsa and Jobre, 2012) while in Egypt, direct economic loss was valued at 28544.3 USD and said to arise from condemnation of meat and liver (Elmonir and Ramadan, 2016). However, in Uganda such economic losses have not been adequately evaluated. There are several fragmented studies that have been conducted on the Uganda's beef value chain but very few attempts have been made to estimate the economic losses. Therefore, the present study was made to document causes of losses and estimated economic losses at post-harvest handling points in the beef value chain in Uganda.

## MATERIALS AND METHODS

### Sample collection and preparation

A total of 94 carcass surface swab samples were randomly collected from slaughter houses, transporters and the retail meat outlets (butchery) from the districts of Mbarara (Western region), Kampala (Central region) and Mbale (Eastern region) in Uganda. The carcass surface swabs were aseptically collected. These were

transferred into sterile transport medium (STUARTS), labeled and then placed in a cool box lined with ice packs awaiting transportation to the laboratory for examination. Interviews were conducted to document the perception of meat handlers about the causes and the estimated postharvest economic losses of beef at slaughter houses, transportation and butchery.

### Determination of microbial load

Microbiological analysis was carried out using standard methods (Adams and Maurice, 2008; Da Silva et al., 2013). Total Viable Counts (TVC) was inoculated by surface spreading onto standard methods Plate Count Agar (PCA). Dilutions of  $10^{-8}$  were prepared. Dilutions of each sample were inoculated in duplicate in the standard plate count agar medium just before solidification of the agar. On solidification of agar, the plates were incubated at 37°C for 24 h. After 24 h of incubation, the colonies were counted using colony counter.

*Coliforms* or Total Coliform Counts (TCC) and *E. coli* were inoculated by surface spreading onto Violet Red Bile Agar (VRBA) and incubation done at 37°C for 24-48 h. For *E. coli*, the incubation was done at 45°C for 24-48 h. Total Coliforms Counts formed pink colonies while for *E. coli*, blue/violet colonies were observed. The colonies were expressed in colony forming units (CFU) per  $\text{cm}^2$ .

### Determination of economic loss at post-harvest handling points and loss hot spots along the beef value chain

Face to face interviews were used to collect information on the actors' perception of economic post-harvest losses incurred in the beef value chain. A total of 601 respondents were randomly selected and interviewed and these included actors at abattoirs/ slaughter houses/slabs (105), butchery (355) and transporters (141) from the districts of the study area.

At slaughter, the economic loss due to quality of beef was evaluated based on the microbial data results. All carcass surface swabs that were positive for coliforms were considered to be unfit for human consumption and hence used to calculate percentage quality loss. The data on average weight and cost of carcass was later used to compute economic losses.

Microbial data collected during beef transportation was used to compute for the loss in the transport value chain. Beef transported in unclean and dirty containers could get contaminated. Swabs of transport containers collected were analysed for microbial contamination. The average weight of carcass being transported and the price of beef in kilograms (kg) was used to compute the economic loss.

The economic loss of beef at butchery was also computed based on the microbial data results. All carcass surface swabs that were positive for coliforms were considered to be unfit for human consumption and hence used to calculate percentage quality loss. Additionally, drip loss and beef wastes were measured and used to compute for economic loss based on quantity. The weight of beef waste was obtained by measuring the drops of meat and bones that fall off during the cutting of beef during sale. Drip loss was determined by measuring the weight of beef at the close of business at the butchery and weight of beef at the start of business the next day (the balance). The weight of beef waste and weight of drip loss was taken as the loss in kilograms and hence used to calculate the economic loss.

A formula was developed based on related formulas used in previous related studies (Fromsa and Jobre, 2012; Ejeh et al., 2014; Elmonir and Ramadan, 2016; Rahayu et al., 2016; Jaja et al., 2017). The developed formula was adapted to Uganda's conditions in the post-harvest beef value chain using collected data during the

**Table 1.** Formulae used to estimate economic losses.

| Type of loss  | Formula                   | Explanation  |
|---------------|---------------------------|--|
| Quantity loss | $QL=DL+ BW$               | DL: Drip Loss (daily)<br>BW: Beef Waste (daily)<br>QL: Quantity Loss (daily)                               |
|               | $TQL=QL*n(b)$             | TQL: Total Quality Loss (daily)<br>n(b): number of butcheries samples                                      |
|               | $TDBS=DBS*n(b)$           | TDBS: Total Daily Beef in Stock<br>DBS: Daily Beef in stock  |
|               | $\%TQL=TQL/TDBS*100\%$    |  |
| Quality loss  | $\% CC=n(CC)/n(CS)*100\%$ | CC: Carcass Contaminated<br>n(CS): number of Carcass Sampled<br>n(CC): number of Carcass Contaminated      |
|               | $TCC(kg)=AVG CW*n(CC)$    | TCC: Total Carcass Contaminated<br>AVG CW: Average Carcass weight<br>n(CC): number of Carcass Contaminated |
|               |                           | kg: means Kilograms  |

study. The direct economic losses were associated with microbial contamination of beef (this is unfit for exportation) and wastage due to drip loss and beef waste (Table 1).

#### Data analysis

Data was analyzed using descriptive statistics and presented as means  $\pm$  standard deviation. Variations in the mean microbial counts among districts and the nodes of the beef value chain were also determined. All analysis was run in SPSS ver. 20.

## RESULTS

### Attributes of economic loss at post-harvest handling points along the beef value chain

The perception of losses from actors at slaughter houses was obtained through interviews. The causes of losses at the slaughter were mainly due to low beef demand (16.1%), too much heat/ dry season (12.5%) and poor weight estimation methods/ Animal fatigue (9.8%) as shown in Table 2. Other causes of losses include animal disease (8.9%), thieves (8.9%), insecurity/ poor monitoring of slaughter process (8.0%), wet season/high diseases (8.0%) among others. Animal fatigue often leads to poor quality of meat and at times death of animals during transit and animal diseases lead to quarantines that prevent cattle movements.

For beef transporters, they indicated that they do not experience losses since their role is to transport the beef meat and they are paid. The loss would come in case of an accident leading to meat falling in dirt but this rarely happens.

Based on the results from face-to face interviews, the actors at butchery perceive the losses based on what causes them to get less money in their business. In Mbarara, the losses at the butchery were attributed mainly to beef spoilage (29.7%) and beef waste (22.9%). In Kampala, the main cause of losses were bad debtors (31.1%) and beef wastes (20.2%) while for Mbale district, it was drip loss (35.8%) and beef waste (24.1%) as shown in Table 3. In all the districts of the study, beef waste (22.4%) was listed as the major cause of losses at the butchery followed by drip loss (19.7%) and then beef spoilage (18.4%). Beef waste results from cutting meat and makes up the small chippings that fall off during the cutting of carcass at the butchery whereas drip loss is the loss of water from meat tissue during storage and is high when meat is left overnight in air (air borne) as witnessed in majority of butcheries.

### Economic loss based on microbial quality

To determine economic loss due to post harvest handling, the microbial load data was used. Prevalence of Total Coliform Counts (TCC) from carcass swabs at slaughter house, transport and butchery were counted per district based on microbial results as shown in Table 4. The estimated economic loss was calculated and results are shown in Table 4 and price of beef per kg was based on samples where the swabs were collected. The trend of quality losses was the highest at the butchery where 70-100% of samples were found contaminated. Transporters were found to experience the least rate of coliform prevalence (30-50%). When these rates of contamination were translated into monetary value,

**Table 2.** Causes of losses encountered at slaughter houses/slabs, % response (n).

| Cause for losses                     | Mbarara    | Kampala    | Mbale      | Overall  |
|--------------------------------------|------------|------------|------------|----------|
| Poor monitoring of slaughter process | 6.8 (n=2)  | 4.3 (n=2)  | 14.3 (n=5) | 8.0(9)   |
| Using eyes to estimate weight        | 13.3 (n=4) | 4.3 (n=2)  | 14.3 (n=5) | 9.8(11)  |
| Emaciated cattle                     | 3.3 (n=1)  | 0          | 0          | 0.9(1)   |
| Too much heat/ dry season            | 3.3 (n=1)  | 17.0 (n=8) | 14.3 (n=5) | 12.5(14) |
| Low beef demand                      | 13.3 (n=4) | 19.1 (n=9) | 14.3 (n=5) | 16.1(18) |
| Poor slaughter shelter               | 3.3 (n=1)  | 0          | 2.9 (n=1)  | 1.9(2)   |
| Condemned meat                       | 3.3 (n=1)  | 0          | 0          | 0.9(1)   |
| Animal disease                       | 6.7 (n=2)  | 10.6 (n=5) | 8.6 (n=3)  | 8.9(10)  |
| Thieves                              | 10 (n=3)   | 8.5 (n=4)  | 8.6 (n=3)  | 8.9(10)  |
| Poor transportation /animal fatigue  | 6.8 (n=2)  | 0          | 0          | 1.9(2)   |
| Insecurity                           | 20.0 (n=6) | 6.4 (n=3)  | 0          | 8.0(9)   |
| Animal fatigue                       | 3.3 (n=1)  | 10.6 (n=5) | 14.3 (n=5) | 9.8(11)  |
| Unfaithful bosses/customers          | 3.3 (n=1)  | 8.5 (n=4)  | 0          | 4.5(5)   |
| Wet season/high diseases             | 3.3 (n=1)  | 10.6 (n=5) | 8.6 (n=3)  | 8.0(9)   |
| Total                                | 100 (30)   | 100 (47)   | 100 (35)   | 100(112) |

**Table 3.** Causes of losses at the butchery in all the Districts of the study; % response (n).

| Nature of losses          | Mbarara (%) | Kampala (%) | Mbale (%)   | Overall     |
|---------------------------|-------------|-------------|-------------|-------------|
| Poor estimation of weight | 2.5 (n=2)   | 5.7 (n=11)  | 0           | 4.1(n=13)   |
| Bad debtors               | 13.6 (n=14) | 31.1 (n=60) | 6.9 (n=4)   | 17.2 (n=78) |
| Beef waste                | 22.9 (n=24) | 20.2 (n=39) | 24.1 (n=15) | 22.4 (n=78) |
| Meat theft butchery       | 0.8 (n=1)   | 0.9 (n=2)   | 2.3 (n=1)   | 1.33 (n=4)  |
| Beef spoilage             | 29.7 (n=30) | 10.5 (n=20) | 14.9 (n=9)  | 18.4 (n=59) |
| Drip loss                 | 10.2 (n=10) | 13.2 (n=25) | 35.8 (n=23) | 19.7 (n=58) |
| Low meat demand           | 13.6(n=14)  | 8.4 (n=16)  | 10.3 (n=6)  | 10.8 (n=36) |
| High tax levy             | 0.8 (n=1)   | 1.8 (n=3)   | 0           | 1.3 (n=4)   |
| Bones and fats            | 5.9 (n=6)   | 3.5 (n=7)   | 5.7 (n=3)   | 5.03 (n=16) |
| Price fluctuation         | 0           | 4.8 (n=9)   | 0           | 4.8 (n=9)   |
| Total                     | 102         | 192         | 61          | 355         |

butcherries were found to be experiencing the highest economic loss. Among the districts, butcherries in Mbale were found to have the highest quality economic loss. In this district, the ten butcherries sampled, all had contaminated meat which totaled to 1410 kg and this was an equivalent of 3095 USD dollars loss per day.

#### **Economic loss based on quantity (drip loss and beef waste)**

Since results from interviews indicated that major losses were due to beef waste and drip loss, the study used these variables to estimate economic loss. At each butchery, the economic loss was determined from the drip loss and beef waste resulting from the daily beef stock. The daily beef waste and drip loss was estimated from several butcherries in the areas of the study. The

sum of drip loss and beef waste gives the quantity loss per butchery. The quantity loss per butchery was higher for Mbale (3.19±2.60 kg) and lower for Mbarara (2.39±1.25 kg) and Kampala (2.39±1.61 kg) on a daily basis as shown in Table 5a.

The total quantity loss as indicated in Table 5a and the sale price of meat per kg in each district was used to compute the economic loss accrued in each district as indicated in Table 5b. Computation was based on the price of beef as of January 2018 (the time when data was collected); the total economic loss experienced per district at the butchery was 2,834,354.24 UGX an equivalent of 787.50 USD dollars on a daily basis.

#### **DISCUSSION**

The actors at the different nodes in post-harvest beef

**Table 4.** Economic loss at slaughter, transport and butchery.

| District | Value chain point | Prevalence of coliform contamination | % contamination | Avg. weight of carcass (kg) | Total carcass contaminated (kg) | Price per kg | Economic Loss (UGX) from contaminated beef | Total Economic Loss (USD) |
|----------|-------------------|--------------------------------------|-----------------|-----------------------------|---------------------------------|--------------|--|---------------------------|
| Mb'ra    | S (n=14)          | 7                                    | 50              | 155                         | 1085                            | 7800         | 8,463,000                                  | 2,351                     |
|          | T(n=10)           | 4                                    | 40              | 155                         | 620                             | 7800         | 4,836,000                                  | 1,344                     |
|          | B (n=10)          | 8                                    | 80              | 155                         | 1240                            | 7800         | 9,672,000                                  | 2,687                     |
| K'la     | S (n=10)          | 5                                    | 50              | 164                         | 820                             | 7800         | 6,396,000                                  | 1,777                     |
|          | T (n=10)          | 3                                    | 30              | 164                         | 492                             | 7800         | 3,837,600                                  | 1,066                     |
|          | B (n=10)          | 7                                    | 70              | 164                         | 1148                            | 7800         | 8,954,400                                  | 2,488                     |
| Mbale    | S (n=10)          | 8                                    | 80              | 141                         | 1128                            | 7900         | 8,911,200                                  | 2,476                     |
|          | T (n=10)          | 5                                    | 50              | 141                         | 705                             | 7900         | 5,569,500                                  | 1,547                     |
|          | B (n=10)          | 10                                   | 100             | 141                         | 1410                            | 7900         | 11,139,000                                 | 3,095                     |

Mb'ra, Mbarara; K'la, Kampala; S, Slaughter; T, Transport; B, Butchery; Avg, Average; UGX, Uganda shillings; USD, United States Dollars.

**Table 5a.** The daily drip loss and beef waste and quantity loss of beef.

| District        | Drip loss (kg) | Beef waste (kg) | Quantity loss per butchery (kg) | Daily total quantity loss in a district (kg) |
|-----------------|----------------|-----------------|---------------------------------|--|
| Mbarara (n=102) | 0.89±0.69      | 1.50±0.93       | 2.39±1.25                       | 243.78                                       |
| Kampala (n=192) | 0.70±0.58      | 1.69±1.45       | 2.39±1.61                       | 458.88                                       |
| Mbale (n=61)    | 0.96±0.71      | 2.23±2.49       | 3.19±2.60                       | 194.59                                       |
| Average         | 0.85           | 1.81            | 2.66                            | 299.08                                       |

handling value chain perceived losses in terms of how they impacted on their incomes. It is also important to note that post-harvest losses do not only impact on income of different actors but also contribute to food insecurity as observed by Diei-Ouadi and Mgawe (2011) who studied the fish value chain.

The perceived losses at the slaughter were mainly due to low beef demand, insecurity and poor weight estimation methods. Because of low

demand of beef that is less meat bought in a day, the left over is reported to be sold at a low price. This is as a result of loss of attractiveness to the consumers. In Uganda, good quality beef (attractive meat) is perceived by the freshness that is the shiny fats, whoozing blood and juiciness/wetness of muscle. If meat is not bought on the day slaughtered, by the next day, it appears dry due to drip loss thus fetching less price leading to losses.

The other cause of loss is insecurity which leads to theft of animals. This happens when the animals are stolen when they are being held at the liarage. In this case, the business man loses the whole animal leading to 100% loss.

Poor weight estimation methods were identified as another cause of losses. At slaughter houses, actors rely on visual weight estimations for the live animals without use of weighing scales and this limits their profits. This finding is in agreement



**Table 5b.** The Estimated quantity economic losses per district.

| District        | Avg. daily beef in stock<br>(Avg± SD) | Avg. sale price per kg<br>(Avg± SD) | Total meat in<br>stock (kg) | Total daily stock<br>value (UGX) | Economic loss<br>(UGX) | Economic loss<br>(USD) |
|-----------------|---------------------------------------|-------------------------------------|-----------------------------|----------------------------------|------------------------|------------------------|
| Mbarara (n=102) | 44.43±36.85                           | 9002.45±1406.09                     | 4518.6                      | 398,808.54                       | 2,194,617.26           | 609.75                 |
| Kampala (n=192) | 80.05±96.71                           | 10125±6541.40                       | 15360                       | 810,000.00                       | 4,646,160.00           | 1,290.89               |
| Mbale (n=61)    | 54.11±42.66                           | 9303.27±917.55                      | 3294                        | 502,376.58                       | 1,810,323.31           | 502.98                 |
| AVERAGE         | 59.53                                 | 9476.91                             |                             | 562,928.45                       | 2,834,354.24           | 787.50                 |

Avg,Average; Kg,Kilogram; UGX,Uganda shillings USD, United States Dollars.

with those of Mpairwe et al. (2015). The authors reported that lack of weighing equipment limits profit maximization since size and weight are major determinants of cattle prices. The person buying needs to know the weight of the animal before payments so that it is comparable with the carcass weight after slaughter. It was noted that though beef traders have a high bargaining power in setting up cattle prices, lack of weighing in the process of purchases often lands them into losses.

Other factors mentioned to cause losses included animal disease, emaciated cattle and poor transportation/animal fatigue. This is in agreement with previous studies on food commodities which reported pest and disease and poor transportation facilities to be the leading causes of post-harvest losses (Affognon et al., 2015; Kasso and Bekele, 2016; Jaja et al., 2017). Unlike in other studies, the current study did not quantify the economic losses as a result of pests and diseases. Although a number of factors in the supply chain like transportation (distance and temperature) have been reported to affect meat quality and its shelf-life (Rosenvold and Andersen, 2018; Rani et al., 2017), results from the interviews of actors indicated no losses in beef during transportation in this present study. Much as the actors at transport reported not to experience any losses, microbial load was

observed in the surface swabs from the carcasses at this stage. These findings are comparable to the results of Bogere and Baluka (2014). The authors found that microbial contamination is common among transporters and causes loss of the quality of beef. Containers used for transporting carcasses can act as a vehicle of transmitting microbial loads (Chepkemoi, 2016). This is attributed to the poor hygiene of the containers used for carrying carcasses as transporters usually neglect their hygiene due to lack of direct economic losses accruing from them. Likewise, Rani et al. (2017), reported that poor handling of meat during transportation may result in a high rate of contamination and spoilage.

Unlike actors at transport who reported not to experience losses, actors (respondents) at the butchery indicated to incur losses. They attributed beef spoilage as a major cause of losses which was further explained to be as a result of temperature variation. This response is supported by findings of Aburi (2012), which showed that high temperatures accelerate spoilage leading to unsafe meat. From observations, there is inadequate cleaning of surfaces, personnel hands and tools and this is suspected to have also contributed to microbial contamination which can further lead to losses. Inadequate cleaning practices exposes meat to contamination by spoilage and pathogenic microorganisms and this

causes post-harvest losses of beef (Chepkemoi et al., 2015; Rani et al., 2017).

Beef waste generated during cutting of carcass was reported to be the leading contributor of losses at the butchery. The beef waste consists of beef and bones that fall off during the cutting of carcass and portions could be a lot if the chopping is done by unskilled personnel. Studies by Fearon et al. (2014) reported waste tissue loss and this leads to loss of income. Birhanu et al. (2017) in a study carried in Gondar Northwest region of Ethiopia noted that there were beef weight losses in butcher shops and hence economic loss.

The current study findings indicate that there was careless handling of meat at the slaughter houses, transportation and butcher shops. This practice affects the quality of meat in terms of microbial contamination and this is congruent with the results of Kebede et al. (2014).

Meat condemnation has been reported to be one of the major causes of economic loss for example in South Africa (Jaja et al., 2017). However, in Uganda meat condemnation was found to be a minor cause of economic loss in this current study since it was reported by 3.3% of respondents. Actually, this cause was reported only in one district out of the 3 studied and that was Mbarara district. In Ethiopia, meat condemnation was estimated to cause economic loss of 28.45 USD per every infected slaughtered

cattle (Fromsa and Jobre, 2012). However, in the current study, the amount of economic loss caused by meat condemnation was not estimated.

Drip loss that is the loss in weight due to loss of moisture during storage resulted into quantity losses in the beef value chain in this study. It was revealed that, the weight of carcass stored by the closure of the day, would be found less by the opening of the next business day if its left hanging in air. Drip loss leads to reduction in carcass weight hence causing economic loss. In a study in Ethiopia, reduction in carcass weight was attributed to animal diseases leading to economic loss (Fromsa and Jobre, 2012). Likewise, in the current study, animal disease was reported among the causes of economic loss in the meat sector. It is important to note that animal diseases lead to emaciated cattle which cause reduction in carcass weight at slaughter. Not only in Uganda and Ethiopia, drip loss was also reported in Kenya as one of the leading causes of economic loss (Chepkemoi, 2016). The author further highlighted that meat with a high drip loss has an unattractive appearance. Other studies have reported drip loss to cause financial loss for actors in the meat value chain because it affects meat quality (Aaslynga et al., 2003). This is because drip loss leads to dry meat that has poor appearance, less juicy which attributes to low demand among consumers and leading to less sales.

### Conclusions and recommendations

Microbiological contamination was found at all different post-harvest handling points since, at every point, there were samples that were contaminated. Of all different handling points, butchery showed the highest economic loss. The study recommends for public education in health care, proper handling and adherence to strict standard operating procedures (SOPs) in slaughterhouses, at transportation and butchery in order to reduce microbial food contamination. Based on the findings, handling practices should be improved especially at butchery since this is where the highest levels of contamination and economic losses are experienced.

Beef waste generated during cutting of carcass is one of the major causes of losses at the butchery and so modern cutting tools need to be used to prevent this loss. To reduce on drip losses, meat sales should be made in cold rooms to reduce on carcass weight reduction that are as a result of exposure to harsh dry environmental conditions. Butchery establishments should also utilize refrigeration facilities instead of hanging meat overnight in air so as to reduce drip loss.

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### CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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