PROFITABILITY OF FINGER MILLET PRODUCTION IN EASTERN UGANDA

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DECLARATION

I **Bushoborozi Jimmy**, hereby declare that this thesis titled "**Profitability of finger millet production in Eastern Uganda"** is original and has not been submitted for any award of a degree in a University or any higher learning institution.

Signed …… Date …….

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LIST OF ABBREVIATIONS

CBO	Community Based Organization
CES	Constant Elasticity of Substitution
FAO	Food and Agriculture Organization
IFPRI	International Food Policy Research Institute
MGLSD	Ministry of Gender, Labour and Social Development
NAADS	National Agricultural Advisory Delivery Services
NGO	Non-governmental Organization
OVC	Orphans and other Vulnerable Children
SPSS	Statistical Package for Social Scientists
UBOS	Uganda Bureau of Statistics
FM	Finger Millet
ICRISAT	International Crops Research Institute for the Semi Arid Tropics
SARD	Serere Agriculture Research Development

ABSTRACT

Finger millet is among the most important crop in Uganda that has seen a rapid growth in recent years as an emerging cash crop after the decline in cotton production especially in Easter Uganda. It has created jobs to various groups in the chain of finger millet production, marketing and processing.

The study was aimed at understanding finger millet profitability at farm level with the following objectives. Characterizing finger millet farmers as objective one, determining profitability of finger millet enterprise as objective two and to understand the drivers of finger millet profitability objective three.

Findings were generated from a survey of 190 randomly selected farmers producing finger millet and reviewing secondary data. Data was entered and analyzed using SPSS and STATA. Descriptive statistics were used to characterize farmers (objective one). Microsoft Excel was used for quantitative analysis techniques including gross margin, returns to labour, returns to management and return per USh invested (objective two). A linear regression type of production function was used to determine drivers of finger millet profitability (objective three) that affect profitability.

Explanatory variables that were significant are; contact with extension service, level of farmer's education, number of household labor, access to credit, farmer group, and land ownership.

CHAPTER ONE
INTRODUCTION

1.1 Background information

Millets are in the family of cereals grown globally with differential importance across continents and within regions of the world. They form a diverse group of small grains cultivated in diverse and adverse environments, mostly in the dry, semi-arid to sub-humid drought-prone agro ecosystems. Worldwide, there are nine species of millets with total production of 28.38 million tons, out of which 11.36 million tons (40%) are produced in Africa (Obilana, 2004).

In Asia, finger millet is planted in rows and managed much like other cereals. But in Africa it is usually handled differently. According to Nyende et al., (2001), the crop is planted using the broadcast method which demands a very fine seedbed and this means that the farmers must work hard and long, both to prepare the land and to weed the young plants.

Obalina (2002) reported that millets are extremely important in the African semi-arid tropics, produced in 18.50 million ha by 28 countries covering 30% of the continent. This is a significant 49% of the global millet area, with a production of 11.36 million tons by 1994. There are nine species which form major sources of energy and protein for about 130 million people in Sub-Saharan Africa. Among these, only four are produced significantly in Africa; including pearl millet the most widely grown in 76% area, finger millet 19% area, tef 9% and fonio 4%. Its production is distributed differentially among a large number of African countries; largest producers being in West Africa led by Nigeria 41%, Niger 16%, Burkina Faso 7%, Mali 6.4%, Senegal and Sudan 4.8% each.

Finger millet (*Eleusine coracana*) is a grass crop grown in many countries of Africa and Asia. It grows 40-130 cm tall, taking between 2.5 and 6 months to mature. The head consists of a group of digitately arranged spikes. The plant and grain are resistant to drought, pests, and pathogens. It is rich in polyphenols and particularly in calcium (Kidoido et al., 2002).

According to Mgonja, Lenné, Manyasa and Sreenivasaprasad (2007), finger millet production in Uganda is under small-scale producers growing mainly traditional varieties. As a result, crop

yields are low, averaging 1,550 kg/ha (1999 – 2005 average). This yield level still is one of the highest among finger millet producing countries. The current demand for the crop, which out-strips current supply, could easily be met if new improved varieties capable of producing up to 3,000 kg/ha under good management were grown. In other finger millet producing countries such as India, Kenya and Mozambique, millet is produced on a small scale. Majority of finger millet farmers are therefore small scale.

Smallholder and emerging farmers face difficulties in accessing markets, and as a result, markets do not serve their interests. Factors such as poor infrastructure, lack of market transport, dearth of market information, insufficient expertise on, and use of grades and standards, inability to conclude contractual agreements and poor organizational support have led to inefficient use of markets, hence, results in commercialization bottlenecks. Furthermore, smallholder farmers lack vertical linkages in the marketing channels, which result in their exclusion from the use of formal markets (Makhura, 2001; Wynne and Lyne, 2003). Smallholder farmers have weak financial and social capital and limited access to legal recourse, implying that it is difficult to change these negative market factors individually. As a result, they are trapped and continue to operate within the given market constraints and they do not receive rewarding incomes from their agricultural activities.

Finger millet has good marketing opportunities, especially in local, easily accessible markets. While finger millet is mainly considered a staple crop that farmers grow for subsistence purposes, demand for finger millet is high and finger millet prices in Kenya are far higher than prices for maize or other cereals. Finger millet can also be processed into value added products like cookies or beer by the farmers themselves, or by processors at the local or national levels (Oduori 2005). The crop therefore has the potential to serve as a profitable cash crop for small-scale farmers. However, according to Oduori (2005), little effort has been made to improve the genetic material of finger millet, and while the first modern maize varieties were already available in the early 1960ies, the first improved finger millet varieties were released in the early 1990s (Oduori 2005). The lack of research and development on finger millet is also reflected in most local extension approaches in developing countries. In Kenya, for example, extension programs generally do not provide specific information on finger millet production, but rather focus on maize production systems. Consequently, finger millet production remains very

traditional and the crop's reputation is that of an old-people-crop with little agronomic potential. Farmers often cultivate finger millet on their most marginal plots without adding any organic or chemical fertilizer (Crowley & Carter 2000). Lack of extension services has thus become an impediment to finger millet profitability.

Sorghum and millet have been noted as staple food grains in many semi-arid and tropic areas of the world, particularly in Sub-Saharan Africa because of their good adaptation to hard environments and their good yield of production (Dicko *et al*., 2005). Taylor *et al* (2006 cited in Adeleke, Kamara & Brixiova, 2010) expands on Dicko *et al's* findings by describing sorghum and millet as generally the most drought-tolerant cereal grain crops that require little input during growth and with increasing world populations and decreasing water supplies, represent important crops for future human use. The semi-arid tropics are characterized by unpredictable weather, limited and erratic rainfall and nutrient-poor soils and suffered from a host of agricultural constraints (Maqbool *et al.,* 2001). Given the dual role played by finger millet as both a cash and staple food crop, the farm gate prices are supposed to be higher, hence increased sales turnover and profitability.

In Uganda, finger millet is second to maize as a major cereal crop. The crop is widely grown in northern region which accounts for 40% of the national production, followed by the Eastern region with 21% (Tenywa et al., 1999).In these regions it is a basic staple food playing a very important role in meeting dietary needs (Oryokot 2001).Some of its local names are: Akuma (Ateso), Kal (Luo), Bulo (Luganda),Wimbi (Swahili), Oburo (Rukiga/Runyankole), Bird's foot, Coracana andAfrican millet (English). It is grown in an estimated annual area of 412,000 hectares producing 700,000 mt (FAO, 2005).

Certain finger millet landraces are fully adapted to highland conditions. In Africa the crop is usually grown at altitudes between 1,000 and 2,000 m and in Nepal it is grown at altitudes up to at least 2,400m. It requires a moderate rainfall (500-1,000 mm), well distributed during the growing season with an absence of prolonged droughts. Dry weather is required for drying the grain at harvest. It can grow where temperatures are as high as 35°C and in Uganda, the crop grows best where the average maximum temperature exceeds 27°C and the average minimum does not fall below 18°C.The crop is grown on a variety of soils. It is frequently produced on reddish-brown lateritic soils with good drainage but reasonable water-holding capacity. It can

tolerate some water logging. It seems to have more ability to utilize rock phosphate than other cereals do (Obilana 2004).

However, production of finger millet is not without constraints; for instance, the small size of the seeds is a serious drawback. It makes the crop difficult to handle at all stages. Weeding is another particular problem. In Africa the dominant weed, a wild relative of the crop, looks so much like finger millet in its early stages that only skilled observers and close scrutiny can tell them apart. The problem is compounded by the practice of broadcasting seed (Kidoido et al., 2002). To weed the resulting jumbled stands, people must inspect every plant, with hands complemented by tiny worn out hand-hoes (Tenywa et al., 1999). People prefer growing other cereals like maize, sorghum, and other crops like cassava because producing finger millet takes a lot of work.

The component of labour costs of production especially in non-mechanized countries such as Uganda cannot be underestimated. Labour is quantified into man-days (Gowa et al., 2001). One man-day is measured in hours worked and is based on adult equivalent hours of work. Ministry of Gender, Labour and Social Development (MGLSD) (2006) defined a man-hour as the time spent on an economic activity. A standard man-day is equivalent to the work accomplished by an adult in eight hours. Klingele and Yesus (1995) equated an agricultural labour man-day in Ethiopia to three to four hours.

Criticisms against standard man-day based on hours of work argue that the type of work and energy levels vary from individual to individual and from sex to sex and Labour laws also vary from country to country (Skoufias, 1994). It does not measure the intensity of efficiency with which the work is performed. It also excludes journey time, hours paid for but not worked such as paid leave and sick leave (MGLSD, 2006).

In developing countries like Uganda, women contribute about 75% of the total labour force (FAO, 2000). Uganda's agriculture is dominated by about 60-80% small-scale family based labour. Whereas hired labour is a paid cost, family labour is imputed. Small-scale farmers use meager capital inputs mostly contributed by family. Purchased inputs are valued at market prices and therefore are paid out costs. From the farmer's point of view, paid out costs such as purchase of inputs and hiring labour in resource allocation decision-making is of great relevance.

According to Castle et al. (1987), for actual profitability of an enterprise, net profit should be considered.

In most of Africa the crop is harvested by hand, using locally fabricated blunt edged metal strips and more time is spent on the operation. Individual heads are cut off leaving a few centimeters of stalk attached (Kidoido et al., 2002). These are piled in heaps for a few days, which fosters fermentation whose heat and hydrolysis makes the seeds easier to thresh.

There is some evidence that foods from finger millet have a low gylcaemic index and are good for diabetic patients (Srimathi Kannan, 2010). Decortication, puffing, extrusion, and expansion are some of the new uses that the grain has been put In Uganda, The most affected part is classified as semi-arid hillside systems, including the Teso area. Northern region accounts for 40% of the national production, followed by the Eastern region with 21% (Obilana 2004).

However, despite the immense potential finger millet production has in Uganda, information on its profitability economics is missing and thus calls for attention from researchers and scholars. In addition to risk and utility maximization, profitability has been identified as one of the major factors in an individual's decision to produce if they are to remain competitive and ensure that agriculture remains a vital force in poverty reduction and economic growth.This research addresses this knowledge gap through the determining profitability of finger millet production in Easter Uganda.

1.4 Problem statement

Finger millet remains one of the most known cereal crop rich in food nutrients for human body. It also supplements the struggle for food security since it can be stored for a longer period to cater for hunger eventualities. Its other great importance is attached to it being a source of income for households.

In Uganda, finger millet market has faced supply constrained challenges and the dwindled production has affected its profitability. Farmers have reduced production of finger millet because its associated costs including high labor requirement, limited processing facilities, poor marketing infrastructure, among others which have kept the profitability of the crop not know.

It is also not known whether there are other factors that may affect the profitability of finger millet at farmer level.

Understanding the contribution of a crop to the households in terms of food and cash is paramount in decision making especially in determining the allocation of household resources. Studies concentrated on finger millet profitability but left out a key element of household profit margin at farm level and drivers of profitability.

Production in any enterprise depends largely on its profitability and this is usually a major objective of households at farm level. Therefore households will more likely have to invest more in an enterprise that greatly contributes to its livelihood. The major reason behind this study is that a typical farmer is more likely to invest in a crop when he is convinced of better monetary returns over his investment. Therefore, unless its investment is profitable, farmers will not have an incentive to produce it. In view of this, this study therefore focuses on the profitability analysis of finger millet production in Soroti and Serere district, Eastern Uganda

1.5 Study objectives

The general objective is to examine profitability of finger millet production at farm level in the districts of Soroti and Serere in Eastern Uganda.

1.5.2 Specific Objectives

1 To characterize farmers involved in finger millet production.

2 To determine and compare profitability of finger millet enterprise by the district, scale of farmers, type of production and technology among others.

3. To identify the drivers of finger millet profitability

1.6 Hypotheses

1 There is a positive significant relationship between education and finger millet production.

2 Finger millet enterprise is profitable.

3 Improved finger millet seed varieties positively influence enterprise profitability.

1.7 Justifications of the study

The rationale for the study is justified by the importance and benefits of finger millet in improving rural farmer's welfare by providing impoverished households with an alternative source of income, improving the nutritional content of food consumed by the household members especially the vulnerable groups such as children, women and immune-compromised individuals, convalescents and people living with HIV/AIDS (Svirskis, 2003; Myers, 2009).

While profitability of finger millet has been studied by authors including for example literature provides a gap of profit margins while analyzing the profitability of finger millet. Therefore, knowledge gaps exist about profitability of finger millet .The critical issue to investigate was profitability of finger millet production at farm level; determine whether farmers realize positive returns and factors which determine its profitability. The focus of this study is to bridge this gap so as to make useful suggestions that would increase its productivity and profitability.

The findings will be useful to farmers, extension workers, non-governmental organizations and persons interested in investing in finger millet either locally or internationally by availing information especially on the productivity and profitability. Finally the results provide information for the formulation of appropriate policies that provide opportunities to increase yield and return on investment in finger millet.

CHAPTER TWO
LITERATURE REVIEW

2.1 Empirical Studies on Profitability Analyses

Profitability analysis is a common tool used by many managers of different enterprises to make decisions on whether to participate in the enterprise or not. Many studies have been done concerning profitability of different enterprises in different fields. In agriculture profitability analysis are done on different crop and livestock enterprises.

Maganga and Matchaya (2012), conducted a study on unexploited profit among small holder farmers in Central Malawi. The purposes of the research were to measure the profit efficiency of sample Irish potato farms and subsequently to explore determinants of profit inefficiency in the Dedza district of Malawi. Flexible Stochastic Profit Frontier Analysis was used to measure profit efficiency of 200 farmers that were randomly selected and interviewed for plot level data. Research results revealed that the average profit of Irish potato farmers in Dedza could increase by 26% under prevailing technology. The profit efficiency of the sample Irish potato farms ranged from 0.31 to 0.99 (0.74 average). Their findings further revealed that policy variables like non-farm employment, education, extension visits, credit status, farm Experience, degree of specialization and frequency of weeding negatively affected profit inefficiency. Conversely, age affected profit inefficiency positively.

Akegbejo-Samsons and Adeoye (2012), measured the profitability in small scale aquaculture enterprises in South West Nigeria. The study focused on measures based on classical techniques which examined returns to resources used, benefit/cost ratios, welfare contribution to households/society, improvement to rural livelihoods and value addition. The authors used past and current records of net returns above costs and a cost of living allowance to evaluate the economic and financial sustainability of the farms in the study area. The results show that only 25% were profitably operated, while 75% were not. These findings imply that most of the fish farmers operated on losses, irrespective of their massive engagement in aquaculture.

Tsegaye (2012), examined the profitability of contractual bread wheat seed production in Kudmi village of Mecha district in Amhara region, Ethiopia. Primary data were collected from fourteen seed growers using structured questionnaire. The analytical tools employed include descriptive statistics and average net farm income. Results revealed that the average total cost of production per hectare was $ 493.82; the average gross revenue per hectare was $ 1,035.74; and hence the average net profit per hectare was $ 541.93. The findings also showed that an index of 1.10 economic efficiency of certified bread wheat seed production indicating that contractual bread wheat seed production was a profitable venture in the study area. The study identified non application or improper application of inputs (fertilizers and seed) and not exercising the recommended management practices as major problems in seed production. This study implies that it is necessary to provide adequate extension service for farmers to promote better seed management technologies and efficient use of agricultural inputs.

Akramov and Malek (2012), conducted a study that combined policy analysis matrix (PAM) and data envelopment analysis (DEA) techniques to evaluate the profitability and competitiveness of maize, rice, and soybean production in Ghana. The efficiency of a sample of maize, rice, and soybean growers from four districts of Ghana was analyzed using DEA, while profit maximizing groups of farmers were also identified. Then, PAMs were computed under observed average and profit-efficient farming conditions. Two alternative profit functions were considered: including family labor in domestic cost factor and excluding family labor from domestic cost factor. The results were distinctively different under observed average and profit maximizing conditions. Average maize, rice, and soybean farmers were not viable in the long term because they were making losses at social prices. However, efficient farmers made substantial positive profits and the society also made welfare gains from resources allocated to maize and soybean production. Therefore, policies based on dissemination of best practices could improve overall efficiency of these cropping systems. Rice production never seemed profitable in social prices even for efficient farmers. Finally, excluding family labor from domestic cost factor provided different perspectives that point to the ability of maize, rice, and soybean production to create value for farmers and added welfare gains to the society.

A study by Osotimehin *et al*. (2006) examined the profitability as well as operational efficiency of milk processing enterprise in Kogi state, Nigeria using budgetary analysis. This resulted in the calculation of net farm income for processors hence omitting the profitability for dairy farmers. Otieno *et al*.(2009) carried out some work on economic evaluation of relative profitability in small holder dairy farms in western Kenya. He used farmers' profit levels generated by gross margin analysis in comparing their relative efficiency in dairy farming using regression analysis. This empirical literature on profitability of smallholder dairy enterprise formed the basis for carrying out an economic analysis of the viability of smallholder dairy farming in Zambia. However, unlike the previous ones, the current study took into account the socio-economic factors affecting smallholder dairy farmers using multiple regression analysis

Vukoje, Psodorov and Živković (2013), analyzes the most important parameters for profitability of production of pasta made from spelt flour produced in an organic farming system. Research pertains to plant of medium capacity which is also suitable for construction on family agricultural households. In order to obtain a more reliable assessment of profitability, the comparison is performed with the production of wheat flour pasta. Comparative analysis of the profitability level is based on analytical calculations of production and additional derived indicators. The main raw material, spelt flour, dominated the total costs with 59.4% (whereas for wheat flour it was 37.5%). As expected, significant share of cost was assigned to labor (12.9%), as well as fixed costs (12.4), while energy had a relatively small share (4.6%). Assuming that the high level of productivity was achieved, the average wholesale price of about € 2.11 per kilo would provide an annual income of € 30,766.00 (whereas annual income for wheat is € 12,260.00). Taking into account a solid economy ratio (1.32) and payback period of investment (6.9 years), it is evident that this would be a very profitable business. The analysis of economic parameters shows that production of whole-wheat pasta made from spelt can be very profitable. The observed production volume at the medium-sized plant (about 60 t/year) brings in a profit of € 30,766. Considering other relevant indicators (economy ratio: 1.32; rate of return: 24.3%; payback period of investment: 6.4 years), it can be concluded that it is a very profitable business. Higher market prices of pasta made from spelt flour were the key factors to much higher levels of profitability in relation to the production of wheat pasta, which provides about 2.5 times lower returns (€ 12,260/year).

Ibro (2008), carried out a study on the profitability of cow peas in Kano State in Nigeria and suggested that cowpea vending is a profitable business and greater profits could be achieved by enlarging the scale of operation. These vendors are part of the supply chain of cowpeas in Kuto and they were found to be profitable. However this study did not determine the profitability of farmers who produce and supply the cowpeas. Mishili (2009), also suggested that pulses have high market value in his study on the value of pulse production in West Africa. Deboer (2004 cited in CRISP, n.d) encouraged farmers to grow these pulses one of the reasons being their high market value. These studies all suggest that cowpea production is profitable but they did not consider the factors that influence profitability of cowpeas production.

Gireh and Giroh (2012), studied the profitability of sugarcanes in Nigeria. Findings revealed that sugarcane production in the area was profitable. From this analysis it was observed that all the respondents were able to recover their investment expenditure and generate positive net farm income from their business. Hence, one may deduce that sugarcane farming if given the required support and attention, is a business worth going into, this is because it has a ratoon effect which does not require additional expenses for land preparation, setts acquisition in the subsequent years besides this, other uncertainties affecting agricultural production can be controlled starting from land preparation up to harvesting and processing provided that the necessary inputs are not only provided adequately but timely especially under the out-growers scheme in the study area which is located close to water source (Kiri Dam). This provides water throughout the year to supplement the water requirement of the plants which is highly water dependent during the critical periods of their growth.

Tschering (2002), conducted a profitability analysis of bean production in Honduras ,the focus of the study was on record keeping data collected from Honduran bean farmers in the main bean-growing regions during the period 1998-2000 .In the study, Tschering identified ways to improve record keeping to reduce the cost of future data collection. An assessment of the cost pattern of input and labor and consequently a profitability analysis of bean production for farmers growing traditional and improved bean varieties was conducted. It was observed that farmers growing

modern varieties had higher average yields and earned higher profits or suffered less loss than the farmers growing traditional varieties.

2.2 Gross margin as a measure of profitability

Gross margin is defined as the difference between the sales revenue for an enterprise and the variable costs directly associated with the enterprise (Rural Solution SA, 2010). Previous researchers (Adeyemo et al., 2010; Mohammed et al., 2010) calculated gross margin by subtracting the total variable cost from gross revenue. In such studies, gross margin was assumed to be equal to farm net income because fixed costs were not included (Mohammed et al., 2010). Herbert (2005) noted that gross margin is also a useful tool for comparing performance of activities or predict the performances of alternative activities. Gross margins were therefore used in this study as a measure of profitability of finger millet production in a short run.

According to Firth (2002), gross margins should only be compared with figures from farms with similar characteristics and production systems. With this reservation in mind, the comparisons can give a useful indication of the production and economic efficiency of an enterprise. Comparison of gross margins between enterprises with different fixed cost structures can be misleading. In the current study, finger millet farmers had similar characteristics and production systems. The gross margin does not measure net profit of an enterprise as it only takes variable costs into account. Therefore, it should be clearly stated that the results obtained in the current study are gross margins and not net profits, even though the former is a good measure of enterprise profitability.

Ahmad (2004), in studying the factors affecting the profitability and yield of carrot production in two districts of Punjab included a partial budgeting model that was used to determine profitability of carrot growing. This methodology included a gross margin analysis which was used to determine the costs of various inputs and the profitability of carrot cultivation. According to Ahmad (2004) the gross margin was used because of its accuracy in estimating profit. Factors affecting yield in this study were determined by carrying out a regression analysis using a Cobb-Douglas production function which was used due to its ease in computation and interpretation.

In another research that was done on the profitability of sorghum farming in Tanzania, a gross margin analysis was also used to determine the profitability of sorghum. In this study gross margin analysis was done using Microsoft excel in which the total variable costs were subtracted from the total revenue (Erbaugh, 2008). A regression model was then carried out in this study in order to test factors that might have influenced gross margin and hence profitability of sorghum production. The gross margin variable was regressed on the farm size used to produce sorghum, farm gate price, farm production costs, farm location, the interaction between production costs and farm gate prices, seed variety used, technology used such as fertilizer, the interaction between seed variety and fertilizer applied and production technology used.

However, the interaction between Production cost and farm gate price was positive and significant while farm gate price alone was not significant. In addition, the variety used, application of fertilizer and tillage method were not significant but the interaction between variety used and fertilizer application was positive and significant. (Erbaugh, 2008).

Kudi and Abdulsalam (2008) on their study of Costs and Returns Analysis of Striga Tolerant Maize Variety in Southern Guinea Savanna of Nigeria found out that labour and fertilizer inputs accounted for greater parts of the total variable costs incurred in both improved and local varieties. Labour cost of the improved Striga tolerant maize variety and farmers' varieties were 56.82 and 58.81 % while fertilizer cost were 36.65 and 37.96%, respectively. It was also found that cultivation of Striga tolerant maize variety was highly profitable as indicated by a gross margin of 94,479.21 Naira/ha compared to a gross margin of 15,683.73 Naira/ha for the farmers varieties.

Baiyegunhi and Fraser (2009) used gross margin analysis to determine the Profitability of Sole Sorghum Production on Small and Large Scale Farms. Empirical results indicated that the farmers were making profits, given the benefits relative to costs involved in sorghum production on both the small and large scale farms. The authors recommended that farmers should access improved technologies on sorghum production through extension services to fully tap the potential of increasing productivity and farm income.

Erbaugh et al., (2008) found that farm size, production costs, farm location, interaction between production costs and farm gate price as well as the interaction between the varieties used and fertilizer applied were significant in explaining the observed sorghum gross margins. However, contrary to literature farm size was found to negatively influence the gross margins. Their view on the relationship between farm size and gross margins contrast with findings elsewhere such as those by Sulumbe et al., (2010) and Ibro, (2008) who found positive relationships between gross margins and farm size. The interaction between Production cost and farm gate price was found to be positive and significant while the farm gate price alone was insignificant. The findings also showed that the variety used, tillage method, and the application of fertilizer were not significant but the interaction between variety used and fertilizer application was significant and positive. In another study, Sulumbe, et al., (2010) looked at the profitability of cotton production under sole-cropping in Nigeria; they reported that, family size, income and extension were positively related to cotton output. Farming experience, was, however negatively related to the cotton output.

In another study that was done on the performance and profitability of the banana sub-sector in Uganda by Bagamba (1998), a gross margin analysis was used to determine the profitability of banana production. The gross margin analyses involved cost benefit trade -offs where total variable costs were subtracted from total revenue. Budgeting techniques were used to measure comparative advantage of various crops to the farmer in terms of income earned and return to family labor. Regression analysis was used to determine the factors affecting banana productivity and profitability in the study area. Yield of bananas was regressed against variables thought to influence farmers 'decisions to invest in agricultural production. Thus yield of bananas was regressed on the total farm size, total farm income, off-farm income, age of the farmer, weevil damage, interaction with government extension agents, gender of the farmer, distance from the farm to the tarmac, years spent in school and number of cattle owned (Bagamba, 1998).

Gilbert (2001) carried out a study in which he compared gross margin analysis to total revenue in terms of which method was better in estimating profit. He concluded that gross margin was a more accurate estimate of profit compared to total revenue. From these studies the most accurate and common method of estimating profits is gross margin analysis, whereas the most common

method of identifying factors that influence profitability is multiple regression in which gross margin is regressed on different factors expected to affect profitability.

2.3 Determinants of finger millet profitability

A study by Crowley and Carter (2000), found out that although western Kenya is a high potential area with enough rainfall and two cropping seasons, agricultural yields are stagnating or declining for many farmers. However, high population pressure has provoked unsustainable cropping practices on very small farms and plots. Fallow periods, crop rotation and the incorporation of crop residues or other organic materials were reduced in the past. This development led to a dramatic decrease in soil fertility and stagnating or declining maize yields over the years (Crowley & Carter 2000). In addition, climate change is causing more unpredictable weather conditions in the region. While maize is growing well in favorable agro-ecological conditions, finger millet is better adapted to poor soils, high temperatures, and erratic rainfall and can therefore play an important role for improving food security in the region (Gill & Turton 2001). The good storability of finger millet is a further advantage, especially against the background that grain post-harvest losses constitute up to 40% of the grain yields in Kenya (CIMMYT 2013). In contrast to maize, finger millet can be stored for several years and hence improves food security for small-scale farmers who face persistent risks of crop failure and poor market access (Oduori 2005). While the storability of finger millet mentioned above could largely have an effect on the steady supplies to the market thus influencing the sales and profitability of the crop, the authors related good storability to food security, hence leaving a gap that was bridged by the current study which established that better storage facilities owned by a farmer provided for steady supplies to the market hence improving on the profitability levels of the farmers.

Finger millet is rich in important micronutrients like iron and vitamin A and contains high amounts of essential proteins such as methionine as compared to maize (National Research Council 1996 cited in Mitaru & Githiri, 2007). Its high calcium content makes finger millet a valuable food for pregnant and nursing women as well as for small children. The crop is furthermore seen as particularly valuable for HIV patients and diabetics (Mitaru et al, 2007). Last but not least, finger millet has the potential to make an important contribution to farm incomes in the region. As opposed to typical cash crops like cotton or sugarcane, food crops can be marketed within the village or on local markets. This makes food crops an important income option, especially for those farmers who do not access high value cash crop markets. While the production of finger millet has been declining, there is still a significant demand for the crop and finger millet prices in Kenya have been far above maize prices or any other cereal prices over the past years (Oduori 2005). Prices are therefore a determinant of finger millet profitability. However, the case examples given are based on Kenyan experience and not Ugandan context, thus, leaving a gap.

Finger millet is a more nutritious food than other cereals (Bhandari et al., 2005; Dida & Devos, 2006). It is usually converted into flour and made into *Roti* (cakes), Dhindo (puddings) and *Khole* (thin porridge). It is also popular for making of fermented beverages among certain communities of the country which is needed for their religious and cultural rituals. The straw of finger millet is an important animal fodder particularly, during the feed deficit months and helps to sustain animal management, improved compost application, soil fertility and crop yield. Finger millet is one of the underutilized crop species in Nepal. Underutilized crops are the lesser known species in terms of trade and research, and often adapted to marginal and stress conditions (Joshi et al., 2002). Although, it possesses promising nutritional and industrial importance for a variety of purposes, its commercial importance and market value is still unknown to majority of the people. It is being devalued and graded as low grade food item in Nepal due to the wrong and narrow perception of the people. This implies that improved marketing of finger millet is a key determinant of profitability of the enterprise.

According to Nagarajan, Smale, and Glewwe (2005), in semi- arid regions of India, millet crops are produced mainly for consumption as food or fodder on the farm. They are cultivated mostly in marginal (dry) lands with inconsistent weather conditions. Markets for millet grains, especially for the farmers' varieties or varieties of finger millet, foxtail millet, or small millet, are 'shallow', and in many instances, absent. Markets for the grain of improved or modern varieties are also limited, or 'thin'. The millet crops sold in markets obtain low (procurement) prices compared to the millets purchased for consumption at the retail level, creating a wide band between sales and consumer prices. For instance, the price range in case of sorghum varies between Rs.100 to 150 per 100 kg of grains sold and bought in the market. Adding to this, Nagaraja et al (2005) observed that farm households in these areas also face higher transaction costs. Normally farm households in these dry regions do not make their transaction decisions based on market prices because they have limited access to markets. Rural road networks are poor in most of the millet growing communities, augmenting transactions costs. In particular, poor rural roads restrict the ability of farmers to travel from their own community to another community to transact in local seed or grain markets. Hence, the farm households who grow millet crops remain self-sufficient, consuming what they produce. Transaction costs in finger millet production are likely to affect the levels of profitability.

According to Mgonja, Lenné , Manyasa and Sreenivasaprasad (2007:7), localized markets and seasonality characterize the market for finger millet in Uganda. Marketing factors include poor marketing infrastructure, limited processing facilities, etc. Domestic trade is brisk but international trading is yet to develop – prices of finger millet in Uganda vary between $0.2 and $0.3/kg depending on season and distance from producing area. Manufactured products from finger millet are not widespread but there are finger millet flour, Soya-millet by Maganjo Grain Millers, East African Foods Ltd., Kasawo Grain Millers Ltd., Family Diet, and other processors to be discovered. As a food source and local brew, finger millet is the second most important cereal in Uganda but needs value addition for transformation into a powerful commercial commodity. Mgonja et al (2007) made it categorically clear that finger millet in Uganda is the most important cereal crop that has a variety of domestic and industrial uses. However, the value of the crop appreciates when there is value addition. The profitability levels will increase when there is value addition. The researcher was however skeptical in the possibility and ease with

which the small holder farmers can afford value addition in finger millet produced. Hence, there was need for this study to fill the knowledge gap.

Market information is vital to market participation behaviour of smallholder finger millet farmers. Market information allows farmers to take informed marketing decisions that are related to supplying necessary goods, searching for potential buyers, negotiating, enforcing contracts and monitoring. Necessary information includes information on consumer preferences, quantity demanded, prices, produce quality, market requirements and opportunities (Ruijs, 2002). Of equal importance is the source of market information because it determines accuracy of the information. According to Montshwe (2006), smallholder farmers have difficulties in accessing market information, exposing them to a marketing disadvantage. Smallholder farmers normally rely on informal networks (traders, friends and relatives) for market information due to weak public information systems (FAO, 2004). However, such individuals may not have up to date and reliable market information, making the usefulness of the information doubtful. Additionally, farmers relying on informal networks for market information are at risk of getting biased information due to opportunistic behaviour of the more informed group. For instance, Mangisoni (2006) explained that smallholders usually accept low prices for their crops when the broker informs them that their produce is of poor quality. Smallholder farmers accept these low prices mainly because they are unable to negotiate from a well-informed position. The revenues realized from the low prices lead to low levels of profitability.

Consumers demand high quality for the goods they buy. In addition, they will not buy food products unless there is a guarantee that they are safe to eat (Kherallah and Kirsten, 2001). In other words, consumers make purchasing decisions depending on packaging, consistency as well as uniformity of goods. Most smallholder crops have no clearly defined grades and standards and, therefore, cannot meet the consumers' demands (Reardon & Barrett, 2000). Produce from Smallholder farmers do not meet certain market grades and standards because the farmers lack the knowledge and resources to ascertain such requirements. In addition, institutions for determining market standards and grades tend to be poorly developed in smallholder farmers environments. Due to uncertainty on the reliability and quality of their goods, they usually cannot get contracts to supply formal intermediaries such as shops and processors (Benfica,

Tschirley and Sambo, 2002). This indicates that only well organized farmers can benefit from trade liberalization by adopting strict quality control measures and obtaining the necessary certification for their goods. Well organized groups of farmers producing finger millet will therefore realize high levels of profits.

In a globalised world, there is increasing vertical integration and alliance formation in the agricultural marketing channels and markets, in an effort to meet consumer needs. Such alliances include contract farming, cooperatives and farmer organizations. Agribusiness firms favour contracts with medium to large-scale farmers, such that individual smallholder farmers cannot be part of these contracting arrangements (Kherallah and Kirsten, 2001). Lack of facilitation in the formation of producers associations or other partnership arrangements makes it more difficult for smallholder producers to participate in formal markets. The greater the degree of organization in the market, the smaller the transaction costs are likely to be and the easier it is to benefit from the exchange opportunity. Unfortunately, lack of collective action among smallholder farmers denies them entry into formal market channels. Such affects their levels of profitability.

In agricultural production and marketing, smallholder farmers tend to be lagging in the use of improved technology (Carre` and Drouot, 2002). Machethe (2004) pointed out that most small producers in South Africa lack appropriate transportation facilities and road infrastructure, communication links and storage. Further, smallholder farmers have limited ability to add value to their produce. Lack of such facilities usually constrains farmers' supply response to any incentives in both agricultural production and marketing (Dorward *et al*, 2003).

Physical infrastructures, as noted by Machethe (2004), that include communication links, electricity, storage facilities, transportation facilities and roads are determinants of profitability of an enterprise. Good roads, transportation and communication links are prerequisites to market access, particularly to those potential market participants who reside in rural areas because of the relatively longer distances between them and the markets. In South Africa, smallholder farmers are mostly found in areas remote from market places where there is a serious lack of the aforementioned facilities, resulting in high transaction costs (Kherallah and Minot, 2001). Sometimes transaction costs are too high for farmers and traders to get any meaningful benefits

from potential trading activities, discouraging farmers to participate in marketing activities. Machethe (2004) pointed out the importance of developing and maintaining the physical infrastructure after recognizing high transaction costs as one of the major factors constraining the growth of smallholder agriculture in African countries. It can be concluded that inadequate physical infrastructure in rural areas, particularly in the former homeland areas of South Africa remains a major obstacle to smallholder agricultural growth.

The ability to deliver a quality product to the market and ultimately to the consumer, commands buyer attention and gives the grower a competitive edge (Bachmann and Earles, 2000). Therefore, if crops are to be available for consumption throughout the year, proper storage facilities have to be implemented by both farmers and traders. Amongst farmers, storage may have some added advantages because it increases market flexibility. Households with proper storage facilities do not need to market their produce immediately after harvest when prices tend to be low. They can store their produce and sell when prices are higher. Most smallholder farmers do not have access to adequate storage infrastructure and end up selling their produce soon after harvest, also because they need the money involved. Smallholder farmers often rely on open-air storage (Gabre-Madhin, 2001). Due to lack of storage facilities, most smallholder producers are keen to sell produce almost immediately after harvest in order to ease congestion, leading them to sell their produce at lower prices. In studies carried out in Malawi and Benin, Gabre-Madhin (2001) explained that storage practices are relatively limited in both countries. Further explanation shows that most smallholder farmers rely on open-air storage. This affects the quality of their product and leads to spoilage all of which affect the profitability of the enterprise.

Smallholder farmers are usually served by poor market infrastructure. In some instances, market infrastructure is unavailable and farmers sell from the back of their trucks (Makhura, 2001). These conditions are not conducive for fresh produce, contributing to perishability and loss of produce. Additionally, produce sold under poor market conditions may not be attractive to consumers, putting farmers at risk of losing customers. Fresh produce tend to have a limited shelf life, therefore, they cannot be stored for longer periods (van Tilburg, 2005 cited in Jari,

2009). That implies that such produce needs to be processed or to be sold while it is still fresh. When selling them, it is important to be cautious of market place conditions to keep them fresh.

Agricultural commodities must move from the farms where they are grown to the retail outlets where they are bought. Road infrastructure and transport availability have an influence on smallholder market participation, especially if they are located distant from the consumption centres (Gabre-Madhin, 2001). According to Bachmann and Earles (2000), one of the most important constraints facing agricultural markets throughout sub-Saharan Africa is transport infrastructure and the need to reduce transport. The majority of villages in rural areas are served by an inadequate and poorly maintained road network (Montshwe, 2006). The poor conditions of roads, which are often impassable during the rainy season, have an adverse effect on the transportation of the produce. If roads are in bad condition, travelling time is long, implying that it will be difficult to sell fresh produce within the required time limit (Dijkstra, Meulenberg and van Tilburg, 2001 cited in Jari, 2009). Thus, farmers who own their own vehicles are more likely to meet many buyers and reach several markets. In southern Africa, most smallholder farmers without their own transport usually pack their goods (especially vegetables) in sacks, which are then transported to the market places using public transport (Jayne, Govereh, Mwanaumo, Nyoro & Chapoto, 2002). This leads to bruises and damage and, thus, drastically reduces the quality of the agricultural produce being transported. Additionally, produce transported this way are bought by brokers, where the brokers play an essential role in determining the prices at which the produce is sold. Faced with all these problems, smallholder farmers may opt to sell their products to middlemen at the farm gate or around the villages. This affects their levels of sales and profitability since the bargaining power is low.

According to Robbins (2005), prices of primary agricultural produce fall steeply, but retail prices for the same packaged, cut and processed products in industrial countries, have increased. This means that value adding activities can earn, farmer's additional income. Value adding can be in the form of grading, sorting, cutting, packaging in standard weights and processing of produce (Mather, 2005). Lack of value adding and agro-processing is part of missing markets amongst smallholder farmers in marketing. Agricultural produce from smallholder farmers usually are poorly packaged. With few exceptions, most smallholder farmers cannot add value to their

produce because they do not know its importance and lack processing technology (Louw, Madevu, Jordaan and Vermeulen, 2007). Inability to add value to agricultural produce by smallholder finger millet farmers excludes them from lucrative markets

Abou et al. (2006); Olupot et al. (2004) observed that organic manure affects the Above Ground Biomass (AGB) of crops variably by contributing to the vegetative and root growth in terms of efficient utilization of light and water absorption. High AGB enables the crop to accumulate assimilates that are channeled to grains during the grain filling stage and helps a crop to suppress weeds which are found to reduce grain yields (Kidoido et al., 2002). Kraal manure application gives high yield and enriches the grain with iron and crude protein which is very important in human nutrition (Mhlontlo et al., 2007). Hamad et al. (2010); Olugbenga; Olumanyowa (2008); Bamire et al. (2005); Gowa et al. (2001) observed a strong relationship between the size of land and output. The importance of land comes in two ways. First, land differs in fertility and there is a lot of variation in the size of holding between farmers. Second, land variable caries the effect of other variables added to the land such as labour and manure.

Understanding the influence of gender gives a complete picture of participation and role of both men and women in agricultural production and marketing. Descriptive statistics in the study by Gabre et al. (2001) indicated that female headed households have smaller farms and lower marketed crop surplus. Female headed households in developing countries have less assets and less family labour to rely on to generate income and are usually less well off than male headed households (IFPRI, 2001). Female headed households also are known to experience constraints such as weak land rights, limited contact with agricultural extension and lower level of education (Matungul et al., 2001). However, credit institutions, NGOs and other Community Based Organizations (CBOs) can enhance female headed household to own farm assets and participate in production and marketing.

Bamire et al. (2005) found that farmer's age affects crop yield because much as younger farmers are willing to bear risk and adopt new technologies for improved production, older farmers rely on their experience to select crops that may be economically advantageous. The more years a farmer spends growing a crop, the more experienced such a farmer is empowered to manage

various risks involved in the production of the crop (Okoye et al., 2008; Kidoido et al., 2002). Younger farmers are energetic and enterprising, capable of using their resources (such as land and labour) appropriately to enhance their farm productivity. Ekunwe and Emokaro (2009), however, observed that the age bracket of 30-50 years represents an active age bracket in agriculture.

Nyagaka et al. (2010); Ekunwe and Emokaro (2009); Barungi et al. (2005) noted that formal education attained by the farmer affects yield. More educated farmers are very receptive to innovations in their methods of production. They easily learn new technologies, synthesize information and apply them to their farming situations and increase their awareness about the benefits of finger millet. This becomes critical particularly since finger millet is relatively a new crop in Uganda (Muyonga et al., 2008).

Myers (2009) reported that the level of income earned by farmer affects finger millet yield. The author noted that grain amaranth production requires adequate labour to accomplish various activities such as ploughing, planting, manure application, thinning, weeding and harvesting. Bamire et al. (2005); Barungi et al. (2005) found that such activities are timely done when a farmer has a certain level of income. This is assumed to be an important factor affecting production in terms of investment in agriculture.

Mugisha et al. (2004) observed that training of farmers carried out by extension link farmers is instrumental in promoting agricultural practices. Use of demonstration as a training method equips the farmer with improved technologies and innovations that improve the farmer's efficiency leading to high yields.

The difference in seed rates is of great importance for the yield of finger millet and other yield contributing attributes. Kabir and Syed (2011) found a positive and significant relationship ($p<0.05$) between various levels of applied seed rates, both on yield per plant and yield per hectare. Moderate seed rate produced maximum grain yield, beyond that non-significant change in grain yield was observed. Esechie et al. (2002) also reported an increase in grain yield as seeding rate increased due to enhanced tillering in rice. Increased seeding rate resulted in taller plants, which however, increased lodging susceptibility. Other authors including Turk et al. (2002) in their study on the effect of seeding rate and Ethrel spray on the morphology and yield

traits of irrigated Faba bean found no significant effect between seed rate and seed yield. Bashir et al. (2000) also noted no significant effect on millet grain yield and seed rate at improved practices.

CHAPTER THREE
METHODOLOGY

3.1 Description of the study area

The study was conducted in Soroti and Serere districts located in Eastern Uganda because of its history of finger millet production. It was purposively selected because farmers in this area were among the most actively involved in finger millet production and CGIAR supports growing of cereals and food security program in the area had been providing support to most of the farmers in promoting finger millet production. According to 2002 National housing and population census, Soroti district is located in eastern Uganda, with a population of 193300 of whom 51.2% female and 48.8% male with growth rate 2.8% annually.

While Serere district is located in eastern Uganda, it was enacted by act of parliament and became functional effective on 1stJuly 2010. Prior to that it was part of soroti district. Major food crops grown include cassava, sweet potato, groundnut, millet, beans, simsim. It has a bimodal rainfall peaking in March to June and August to November with an annual average of 1,350 mm, and monthly mean of 75 to 100 mm. It also has fertile soils and vast lands that make agriculture one of the best livelihood options for the population.

3.2 Research Design

A cross-section survey was carried out to collect primary data from finger millet farmers. Data were collected using a structured pre-tested questionnaire administered through direct interviews with respondents. The questionnaire covered issues ranging from socio-economic characteristics of farmers including household size, age of farmer, gender, marital status, level of education and

income to economic variables house hold labour, cost of inputs, farmer groups, access to extention services, acces to credit, land ownership, distance to market and seed type.

3.3 Sample selection and sample size

Two Sub Counties in Soroti Arapai and Asuret and Olio Sub County in Serere district were purposively selected basing on their variations in climate and soils. To get a representative sample, proportions were used because some Sub Counties had more finger millet farmers than others. Thus, in Arapia 65 farmers were randomly selected in Asuret 55 farmers were selected and Olio Sub County in serere district 70 farmers were randomly selected using a random start giving a total sample size of 190 respondents.

3.4 Data analysis

Data collected were entered and analyzed using a Statistical Package for Social Scientists. Descriptive statistics were used to characterize finger millet farmers (objective one). Microsoft Office Excel was used for quantitative analysis techniques including gross margin, return per Uganda shilling invested (objective two). A linear regression was used to identify critical factors that affect finger millet production at farm level (objective three).

3.4.1 Descriptive statistics

Frequencies, means, percentages and standard deviations were used to characterize finger millet farmers (objective one).

3.4.2 Gross Margin analysis was used to determine profitability of finger millet

To determine profitability of finger millet (objective two), gross margin analysis was used as follows:

i) Gross margin per hectare of finger millet

$GM = TR - TVC$……..……..…….. (1)

Where,

GM= Gross margin per hectare of finger millet

TR= total revenue (total output * unit price)

TVC= total variable costs used in production

The variable costs that relate to production of a given level of output were computed as follows:

$TVC = \sum_{i=1}^{n} PiXi$; for i=1, 2, 3 ……n ……..…… (2)

Where,

P_i= unit cost/price of a given input (UShs/ha)

X_i= level of input used in production (UShs/ha)

In computing return on investment, the variable costs involved in grain amaranth production were considered. The cost of manure and labour were considered because they were the only

significant variable costs incurred in production. The cost of labour included labour for land preparation/ploughing, planting, weeding, and harvesting.

The return per Uganda shilling invested was used to assess the return on investment which was determined as follows:

Return per Uganda shilling invested = $\frac{GM}{TVC}$ …… (3)

ii) Return to labour

Regarding returns to labour, the labour involved was estimated on the basis that men and women work equally, thus, one adult day (for both man and woman) was equated to one man-day and a child-day was equated to 0.5 man-days. One man-day was equated to four working hours. Children below 15 years were equated to half of adult labour. Child shadow labour cost was got by multiplying their imputed labour man-days by the current wage rate in the area. However, the Uganda law prohibits child labour (MGLSD, 2006).

Returns to labour was therefore computed as follows:

$$R = \frac{\left(Y.pa - \sum NL_i\, pn_i\right)}{L.W}\,.\,100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where;

R = returns to labour

Y = yield of finger millet (kg/ha)

Pa = farm gate price of grain amaranth (UShs/kg)

NL_i = quantity of non-labour i^{th} input used/ha

Pn_i = price of non-labour i^{th} input (UShs/kg)

L = total quantity of labour used (man-days/ha)

W = wage rate (UShs/day)

3.4.3 Factors which affect finger millet profitability

To identify the factors that affect finger millet profitability in Soroti and Serere districts (objective three), econometric method, specifically regression was used to estimate coefficients were used as follows:

$$Y = AX_1^{\alpha} X_2^{1-\alpha} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

Y = dependent variable

X_1 and X_2 = independent variables

A and α = parameters to be estimated

The regression generalized to include more than two variables, and was defined as;

$Y = AX_1^{\alpha 1} X_2^{\alpha_2} \ldots X_n^{\alpha n}$ …… (2)

Where,

Y = dependent variable

$wX_{1,\ldots\ldots} X_{n,}$ = independent variables

A = constant

u = error term

α- = coefficients to be estimated

The explanatory variables (X_i) and their *a priori* expectations are presented in Table 3.1. The amount of labour input $(X_{1)}$ measured in man-days per hectare per season did not separate gender of respondents as there was no significant difference between male and female but separated age difference; (1 man-day = 4 adult working hours, 0.5 man-days = 4 child working hours).

Table 3.1: A priori expectation of variables in the model on output

Label	Variable name	Description	Hypothesized effect
X_1	Distance to Market	Measured in kilometers	+
X_2	Membership in farmer group	Number of years	+
X_3	Weeding frequency	No. of weeding/season	+
X_4	Level of education	Years spent in school by the farmer	+
X_5	Level of income	Uganda shillings/month	+
X_6	Seed type	1=local, 0=improved	+
X_7	Household size	Number of Persons	+
X_8	Age of the farmer	Measured in years	+
X_9	Extension service	Number of times	+
X_{10}	Gender of H/H	1=Male 0= Female	+

Distance to market (X1) measured in kilometers

Membership to Farmer group(X2) measured in number of years

Weed management measured as weeding frequency (X_3) was expected to positively affect finger millet yield because weeds compete with crops for soil nutrients, moisture, air and space. Finger millet requires a weed free environment at least before end of two month after planting because it competes well with weeds once it has well established.

The formal education (X_4) attained by the farmer was expected to positively affect finger millet yield. More educated farmers are very receptive to innovations in their methods of production. They easily learn new technologies, synthesize information and apply them to their farming situations and increase their awareness.

Level of monthly income (X_5) earned by farmer in Uganda shillings was expected to have a positive effect on finger millet yield because its production requires adequate labour to accomplish various field activities such as ploughing, planting, weeding and harvesting and post harvest material like and storage, which are timely done when a farmer has a certain level of income.

Seed type (X_6) improved seed was expected to positively influence finger millet yield. Broadcast seedlings are always exposed to high competition. To have a high survival rate the seed should be improved such that it high yielding and resistant to drought and diseases.

The household size (X_7) measured in number of persons was expected to have a positive effect on finger millet yield. Large family size with active members increases agricultural production. Such families have adequate family labour which positively contributes to the enterprise.

Age of farmer (X_8) was expected to positively affect finger millet yield. Younger farmers who are energetic and enterprising, willing to bear risk involved in production and capable of using their resources (land, capital and labour) appropriately to enhance their farm productivity while older farmers rely on their experience to choose the most advantageous enterprises.

Contact with agricultural extension service (X9) farmers who have received extension services many times are expected to positively affect finger millet yield. Training of farmers carried out by extension link farmers is instrumental in promoting agricultural practices. Use of demonstration as a training method equips the farmer with improved technologies and innovation that improve the farmer's efficiency leading to high yields.

Gender participation and role of both men and women (1= female, 0= male) in agricultural production (X_{10}) was expected to positively affect on finger millet yield. Credit institutions, NGOs and CBOs can enhance female headed households who have smaller farms, less family labour, limited contact with agricultural extension, lower level of education and experience constraints such as weak land rights to own farm assets, access farm inputs, and access extension service and participate in better methods of production which increase crop yield as their male counterparts.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter gives an account of study findings and their detailed discussions. It focuses in addressing the objectives set for the study whose findings have been summarized in tables of means, standard deviations, and percentages, coefficients the t and F-statistics with their statistical significance levels indicated where applicable. This chapter is organized in three sections in line with the flow of objectives.

The first section gives characteristics of farmers involved in finger millet production which includes their social economic characteristics, description and comparison of selected variables. Gross margin analysis is presented in second section beginning with returns and their corresponding total variable costs. Finally, regression results to determine the determinants of finger millet production.

4.2 Socio-economic characteristics of Finger millet production

These characteristics are important in explaining the behavior of respondents in most studies. In this study they help understanding such behaviors as well as in understanding the production environment within which farmer operated.

Among others, these characteristics included age, sex, level of education, experience in farming, land size and house hold size.

The study revealed that the mean age of respondents was 44 years old (Table 4.1). This is within the age group (30-50 years) believed to be active in agriculture (Ekunwe *et al*., 2009). Additionally, four members from each household were above sixteen years old. This is within the ages defined as economically productive (15-64) years (Beiyegunhi and Fraser, 2009). Further, the mean household size was eight persons. The average family size of respondents (8 persons per family) is higher than the national average family size (5 persons per family) (UBOS, 2002). This is not surprising in a village setting where women and children are viewed as source of labor. According to Mugisha *et al.* (2004), large family size with active members is

believed to increase production. Such families have adequate family labor which positively contributes to the enterprise.

Results also revealed that finger millet farmers had spent 7 years in school. Education is an important form of human capital which helps farmers to make informed decisions that increase productivity and finally translate into increased profit. Farmers who attain some level of education are more likely to adopt better farming practices such as timely planting, better weed management and proper use of equipment's like ox plough. Similar results have been reported in studies focusing on the association between formal education and technical efficiency (Uaiene and Arndt, 2009; Bozoglu and Ceyhan, 2007). This gives finger millet a bright future because the government is implementing a policy of Universal Primary Education (UPE) and Universal Secondary Education (USE) which have increased enrollment in primary and secondary schools (Louise, 2006; Aguti, 2002).

Table 4.1. Socio-economic characteristics of finger millet farmers

Characteristic	**Mean**	**SD**
Age of household head (Years)	43.8	12.5
Household size (Persons)	8	4
Education level of household head (years)	6.5	3.9
Experience in finger millet farming	19.3	12.6
Members above 16 years		

Source: Field data

4.3 Land ownership and finger millet production

Results show a strong relationship between land and output. Farmers who grew finger millet on a large scale got more gross margin than farmers who grew on small scale. However the type of land and soil fertility differ from place and application of fertilizes was not used, the land size and output relationship remained unchallenged. This is supported by Hamad et el., (2010); Bamire et al.,(2008) who observed strong relationship between land and output and effects of variables added to the land such as labor and manure.

Table 4. 2. Land ownership and Finger millet production

Land (ha)	Mean	SD
Total land owned	2.6	1.8
Total land under cultivation	1.7	1.1
Land under finger millet last season	0.6	0.4
Land under fallow	0.4	0.9

Source: field data

The study revealed average land holding size is reported to be 3 hectares, the average farm size is 2 hectares while land under finger millet last season was 0.6 hectares. This average farm size considered rather larger relative to other regions of Uganda, for instance south western Uganda where farm size is as low as 0.2 ha per household (Kidoido et al;2002). With relatively lager size of land and its importance, gives finger millet production a profitable crop. Similar results have been reported, Hamad et al. (2010); Olugbenga; Olumanyowa (2008); Bamire et al. (2005); Gowa et al. (2001), observed strong relationship between the size of land and output and its importance.

4.4 Finger millet Production status

Among the four most profitable crops as ranked by the farmers were finger millet, maize, sorghum and cassava. Table 4.3 presents farmer ranking of major crops grown. Finger millet was ranked first in Soroti and Serere. Though finger millet is associated with cultural and social benefits, it's an emerging cash crop and this is evident by the high percentage (56%) men and (44%) women. This is because men are mostly involved in marketed crop for income while women tend to produce for consumption. This is supported by Gabra et al., (2010) who indicated those female headed households have smaller farms and lower marketed crop surplus.

Table 4. 3. Finger millet land coverage in relation to other crops

Crop	Land (ha)
Finger millet	0.61
Maize	0.48
Sorghum	0.37
Groundnuts	0.36
Beans	0.31

Source: Field data

Much as finger millet was ranked first, the area planted to finger millet is still low and this may be associated with labor intensive nature of the crop (Nabbuma, et al, 2010). This crop is exclusively sown in broadcast and this eventually leads to high labor requirement. Labor is also required at weeding and harvesting and this is a hindrance to opening up large pieces of land.

4.4.1 Source of seed and information on Finger millet by farmers

Results show finger millet being a traditional crop, majority of farmers (51%) had known it from their parents. However (49%) of farmers had known finger millet improved seeds from Serere agricultural research station led by ICRISAT a CGIAR center. Source of the seed for planting, results show 36% of seed was recycled, 32% was obtained from local market while 17% and 15% was got from research station and neighbors respectively.

Some improved seeds include Pese 1, Seremi-1 and Seremi-3. These are brown seeded varieties, yielding between 2,300 - 2,800 kg per hectare and mature at between 100 - 110 days. These yields represent over a two fold increase over local cultivars.

According **to** (SAARI 2010) Seremi-2 has been developed for areas with erratic or short duration rainfall, such as parts of Karamoja, Teso and northern Uganda. It matures in 85 - 90 days and yields up to 2000 kg/ha and can be grown in the second rains in most finger millet producing areas.

Table 4. 4. Source of information on finger millet and seed for planting

Source of information & seed (n=190)	Percent of farmers
Source of information	
Fellow farmers	51
Serere Research station	49
Source of seed	
Previous harvest (recycled)	36
Local market	32
Serere Research Station	17
Neighbors	15

Source: Field data

4.4.2 Reasons for producing Finger millet

Results show that finger millet was rated highly both as a food and cash crop. The crop is increasingly becoming a cash crop, in part due to the shift in national economic policy, which entails transformation of food crops into cash crops. Additionally, the resource base that usually provides farmers with alternative income generating crops is on the decline. For instance, the frequency of drought conditions is on the increase, to the extent that only drought tolerant crops such as finger millet can be depended upon for both nutrition and income. Finger millet is sold as local beer or directly as grain.

Generally, farmers grew finger millet for different reasons such as being a traditional food crop and liked by most members of their families (reported by 47% of the farmers), and since finger millet is an emerging cash crop, (32% farmers) grow it for sale. This can explain the decline in cotton production which used to be a cash crop in that region. In addition result show farmers

growing finger millet for (ajono) local brew (20%) because it's the most consumed brew in that region while 1% of farmers grow finger millet for cultural practice's like during marriage and even funerals because certain practices cannot be practiced minus millet.

Finger millet is generally grown once a year in the long rains of March to July, There were a few cases of farmers who grow the crop twice a year (March-July and September-November). The single season growers reasoned that the crop was labour intensive and two crops a year would be a burden to the family. Additionally, the second season is characterised by unreliable rainfall in the second season. Over all, yields in the second season were reported to be too meagre to warrant family re-investment.

4.4.3 Capital, equipment and tools for finger millet production

Major tools and equipment's in finger millet production included hoes, pangas, havesting bags, oxen, ploughs, bicycles and motorcycles. Oxen, plough are largely accessed through hiring and were unevenly distributed throughout the study area. For instance, it was common to find farmers with plough but without oxen and vice versa. A low distribution of plough per house hold was established. This low distribution of implements and tools within the region suggests a very low investment into these assets for finger millet production and consequently, difficult in timely execution of production operations.

4.4.4 Harvesting and post-harvest handling of Finger millet

In Soroti and Serere districts finger millet took an average 6 month to reach maturity. Farmers determine maturity of the crop by observing when the head turn red and grains harden and that's majority (95%) start harvesting. They harvest using knives by cutting head by use of hands.

Results indicate majority 67% transport finger millet on head, from the field to home, 24% were using bicycle and 9% was using motor cycles. Generally majority carrying on head as commonest means of transporting finger millet from the field explains the subsistence nature of finger millet production.

Majority of farmers (85%) incurred post- harvest crop losses more especially during drying due to lack of drying materials and birds that feed on seeds while drying.

Finger millet grain storage is a corner-stone in ensuring extended quality food shelf-life for households. Grain storage is in granaries constructed from locally available materials reported by only 40% of the respondents. The rest stored it in their houses in gunny or polythene bags. Granaries were reported to be the traditional storage facilities in the study, but a general rise in theft among communities has forced farmers to keep their produce in more secure places reported by 60% of the farmers. Millet that is kept by farmers for a period of time is used for home consumption and planting in the new season.

4.4.5 Farmer involvement in groups/associations in finger millet production

Result indicates the majority of famers 76% were in farmer group associated to finger millet production while 24% didn't. This could explain the fact that finger millet production being labor intensive, group associations accessed additional exchange labor from groups, in addition to sharing information on crop production and management.

Results showed that by joining groups, farmers had higher chance of increasing their gross margin than those who were not in groups. Farmers in the area were organized in groups like farmer associations, informal groups of labour exchange. These informal groups of labour exchange are agreed upon by individual farmers who work on farmer's gardens together on rotational basis. This is done because finger millet production is labour intensive and requires collective effort especially during weeding and harvesting times.

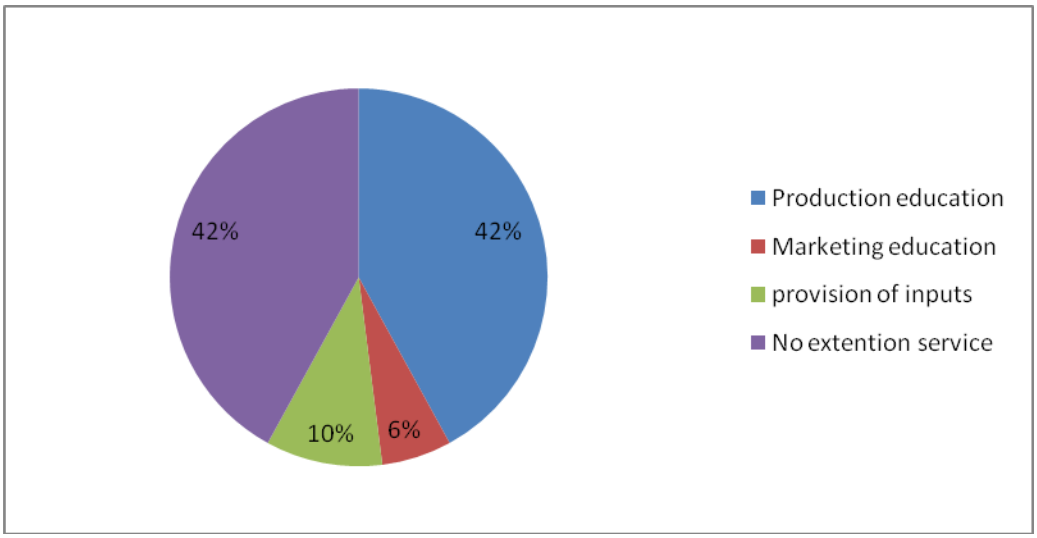
On the other hand, farmer associations are important because it is a perquisite for farmers to access inputs from Serere Agricultural Research Station. According to Bosena et al 2011, gives evidence that group's help in increasing bargaining power of producers hence increase their gross margin. Oluoch-Kosura (2010) further gives evidence from Sub-Saharan African countries that producer groups enable them to get opportunities to improve their performance

4.4.7 Access to agricultural extension by Finger millet farmers

Results indicated that majority of finger millet farmers (58%) were accessing extension service at least once in a season while 42% were not accessing extension servicers. The major (42%) type of extension services received was related to production, 11% was input provision and 6% farmers received education on marketing. Extension and use of demonstrations as a training

method equips the farmer with improved technologies and innovations that improve the farmer's efficiency leading to high yields. The significance of this as reported by Mugisha et al. (2005) observed that training of farmers carried out by extension link farmers is instrumental in promoting agricultural practices.

Figure 4. 1. Use of agricultural extension by farmers in finger millet production



Source: Field data

In addition results show (table 4.5 below) government as the major extension service provider at 52%, 31% being provided by NGOs like ICRISAT and 17% by fellow farmers. Government provides services like provision of seeds (improved varieties) from Serere agricultural research station, training farmers' better methods of soil conservation, encouraging formation of Sacco's to access financial support. ICRISAT on the other hand provides farmers with information on how to increase crop production especially on how to cope with climatic changes. Fellow farmers form production and marketing organization to increase their bargaining power.

Table 4. 5. Agricultural extension service providers

Agricultural extension service use	Percent of farmers (n=190)
Extension provider	
Government	52
NGO	31
Fellow farmers	17

Source: Field data

4.4.8 Seasonal labor and cost requirement for field practices in finger millet production

Labor requirement for various activities during finger millet production is presented in (Table 4.6) below. The prevailing finger millet broadcasting technology is a factor that brings high labor requirement. The major source of labor was family in the two districts, ox-plough were largely used during ploughing and planting while weeding and harvesting the major labor intensive activities and this is where family labor is mostly used. The ease of sowing finger millet is implicitly reflected in overall minimal labor requirement as compared to other activities. The intervention therefore lies in the ability of providing a technology that reduces labor requirement for row planting given that the technology significantly reduces demand during weeding and harvesting.

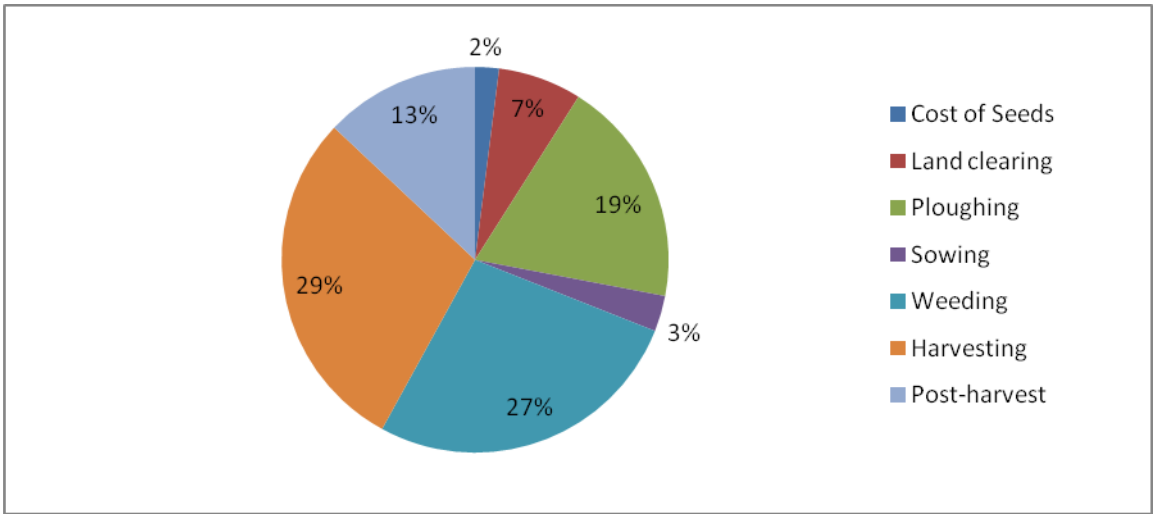
Table 4. 6. Seasonal labor and cost requirement for field practices in finger millet production

Variable cost item	Cost per UShs/ha	Percentage cost share
Buying seeds	10,995	2
Land clearing	47,026	7
Land ploughing	121,944	19
Planting /sowing	22,033	3
Weeding	169,717	27
Harvesting finger millet	183,016	29
Post-harvest activities	79,885	13
Total Variable cost (UShs/ha)		

Source: Field data

The production factors were valued at prevailing market prices for the second season, for the year 2010. Output was valued at market price prevailing at farm gate. The variable cost component considered in this analysis included the cost of buying seeds and labor. Labor involved was cost of land preparation/ploughing, planting, buying seeds, weeding, harvesting. Post-harvest activities also include; drying, threshing and storage

Figure 4. 2. Percentage cost share of finger millet production inputs



Source: field data

From the figure above, it is evident that finger millet production is labor intensive especially harvesting and weeding that account for 29% and 27% respectively of the total labor cost of production.

4.5 Challenges faced by Finger millet producers

Survey findings showed that labor intensive at 63% was a challenge in finger millet production. Since 29% at a cost of 183016 USh per ha was harvesting. This was because traditional method of cutting the head by using locally made knives and distance between home and garden made it labour intensive. Weeding was 27% at a cost of 169717/= per ha, this was because of the planting nature of finger millet which is by broadcasting and small size of the seed. In Africa the dominant weed, a wild relative of the crop, looks so much like finger millet in its early stages that only skilled observers and close scrutiny can tell them apart. The problem is compounded by

the practice of broadcasting seed (Kidoido et al; 2002). To weed the resulting jumbled stands, people must inspect every plant, with hands complemented by tiny worn out hand-hoes (Tenywa et al; 1999). also being careful, which makes the work slow and tire some.

Further results revealed unpredictable climate 17% in that seasons have changed with the current glob warming which affects finger millet production. Findings further reported (7%) field pests and as substantial challenge these more especially birds and loaming animals like cows and goats. Lack of capital to invest in finger millet production and lack of enough land was also identified as a serious problem affecting finger millet production as reported by 6% and 4% respectively.

Further lack of fertilizers was also identified as constraint in finger millet production with famers 3% ranking it substantial since output per hectare has significantly reduced. This significance was observed by Hamad et el., (2010); Bamire et al.,(2008) who observed strong relationship between land and output.The importance of land comes in two ways. First, land differs in fertility and there is a lot of variations in size of holding between farmers. Second, land variable carries the effect of other variables added to the land such as labor and manure.

4.6 Returns on investment in Finger millet production

The production factors were valued at prevailing market prices for the second season, for the year 2010. Output was valued at prevailing market price. The variable cost component considered in this analysis included the cost of buying seed and labour (Table 4.10). The cost of labour involved was cost of land clearing, ploughing, planting, weeding, harvesting and post-harvesting.

Labor input (29) was the most variable cost component in finger millet (Table 4.10). Gross margin was analyzed on family labour because farmers rarely used hired labour constitutes a high proportion of production cost in traditional agriculture (Baiyegunhi and Fraser, 2009).

Table 4. 7. Seasonal cost analysis for finger millet production (n=190)

Variable cost item	Cost per UShs/ha
Buying seeds	10,995
Land clearing	47,026
Land ploughing	121,944
Planting /sowing	22,033
Weeding	169,717
Harvesting finger millet	183,016
Post-harvest activities	79,885
Total variable cost ((Ug. Shs/ha)	**634,616**

Source: Field data

The production factors were valued at prevailing market prices for the second season, for the year 2010. Output was valued at market price prevailing at farm gate. The variable cost component considered in this analysis included the cost of buying seeds and labor (Table 4.7) The cost of labor involved was cost of land preparation/ploughing, planting, buying seeds, weeding, harvesting. Post-harvest activities like drying, threshing and storage.

4.6.1 Returns to labor for Finger millet production

The average size that farmer allocated to finger millet growing was 0.6 hectares while the average yield was 1225 kg/ha. The average was rate prevailing in the area was 2500 and farmers spent about 500 man-day in finger millet farms. Results further showed that farmers had averagely applied 9 kg/ha of finger millet seed each kg valued at 1251 Uganda shillings.

Finally a return to labor of 0.92 Uganda shillings for every man-day spent in finger millet garden was released by farmers.

Table 4. 8. Returns to labor for finger millet production

Resource item per ha	Value of resource
Land under finger millet (ha)	0.62
Yield of finger millet (Kg/ha)	1225
Farm gate price of finger millet (UShs/kg)	940
Labour (man-days/ha)	500
Wage rate (UShs/man-day)	2500
Quantity of seed used (UShs/kg)	1251
Returns to labour (UShs/man-day)	**0.92**

Source: Field data

4.6.2 Returns to management in Finger millet production

Results revealed that farmers realized return to management of 412,710 Uganda shillings (positive) per hectare of finger millet production (table 4.51). The implication of this is that all inputs used in production were paid for leaving positive residual to farmer. This means Soroti and Serere districts, the key resources such as family labour, improved seed, and extension services are put to good use.

Table 4. 9. Returns to management per hectare of finger millet production

Resource item used/ha	Value (UShs)
Variable costs (UShs/ha)	
Labor costs (UShs/ha)	623,620
Seed costs (UShs/ha)	10,995
Total variable cost (UShs/ha)	**634,616**
Total value product (UShs/ha)	1,130,985
Returns to management (UShs/ha)	**412,710**

Source: Field data

Table 4. 10. Gross margin and return per Uganda shilling invested in Finger millet production

Return item per ha	Amount (UShs)
Total revenue (UShs/ha)	1,130,985
Total variable cost (UShs/ha)	634,616
Gross margin (UShs/ha)	**496,369**
Return per Uganda shilling invested (Ug.Shs/ha)	**0.8**

Source: Field data

The total revenue from one hectare of finger millet was 1.130.985 Uganda shillings (table 4.10). A gross margin of 496.985 Uganda shillings per hectare was realized

For every Uganda shilling (which is above) was obtained per hectare. This means that for every 100 Uganda shillings invested 80 Uganda shillings was recovered per hectare. These findings compare with the findings by Baiyeguhi and Fraser (2009) in the study on profitability in sorghum production in Kaduna state Nigeria, where they estimated an average rate of return of 45% implying that farmers realized a profit of about 0.45 Nair for every one Nair invested. They concluded that farmers were marking profit from sale of sorghum production both at small and large scale level.

Other studies have reported conflicting results including Emokoro and Ekume (2010) while studding profitability and viability of cassava marketing in lean and peak seasons in Benin City Nigeria. They found that they benefit cost ratio was less than one in both season (0.02 and 0.01 in lean and peak respectively) implying that business was not profitable. Their findings revealed

for every naira invested only 0.16 naira was recovered in the lean season while the marketers got negative returns in the peak season.

4.7 Regression analysis

4.7.1 Factors affecting Finger millet production in Soroti and Serere districts

The mathematical form specified for finger millet is presented in (table 4.11). The model was significant because the (P-value=0.000) implying a good model fit in view of cross sectional data involved in this study. In addition the R squared value was reasonable there were significant variables. The adjusted R squared of 72% means that the independent variable explains 72% of the variation of the dependent variable.

Table 4. 11. Factors expected to affect producer's gross margin (women and men gender)

MEN AND WOMEN REGRATION

logGM_1 |	Coefficient	t-value	p-value	
Age of |	.0002416	0.09	0.929	
HH_LBR |	.045127	5.13	0.000	
GRP_years |	.0488555	6.51	0.000	
Educ |	.0196681	2.48	0.014	
SEED_type |	.0065821	0.14	0.892	
EXTN_TIMES |	.1443567	4.33	0.000	
Acc_money |	.2170486	2.95	0.004	
MKT_DISTKM |	-.0094775	-0.75	0.454	
LAND_own |	.4254052	5.54	0.000	
_cons |	12.55796	88.10	0.000	

R=0.72 Adj=0.71 std.= 407 p-value= 0.000
n =190

Explanatory variables that were significant are; contact with extension service, level of farmer's education, number of household labor, access to credit, farmer group, seed type and land ownership. The relationship between extension services and finger millet gross margin was positive and significant (p-value = 0.000). Contact with extension service equips the farmer with improved technologies and innovations that improve the farmer's efficiency leading to high yields. Such positive effect was reported by Bakhsh *et al*., (2005) in their study of Factors Affecting Cotton Yield, A Case Study of Sargodha (Pakistan). They recommended extension systems to emphasize training farmers on control of weeds, disease and pest attack. They also recommended field visits and demonstration by extension staff as right steps in the right direction for developing and promoting new technologies to combat disease and pest attack on cotton.

In their study, Mugisha *et al*. (2004) also noted that training farmers carried out by extension link farmers was instrumental in promoting agricultural practices.

Results show Level of education was also positive and significant at 1% probability level implying that farmers with more years of formal schooling obtained high gross margin than their counterparts. This result indicates that 10% increase in years of schooling could enhance finger millet gross margin by 0.014%. This is due to better management practices and adoption of latest technologies in finger millet cultivation. Such positive relationship was reported by Nyagaka *et*

al. (2010); Ekunwe and Emokaro (2009); Bakhsh *et al*. (2005); Barungi *et al*. (2005) who found that education increases technical efficiency.

The positive impact of education on technical efficiency indicates that increase in human capital enhances the farmer's ability to receive and understand information relating to new agricultural technology. This is particularly important for Uganda where free primary and secondary education is being implemented as one of the government policies which will ensure increased enrollment in primary and secondary schools (Louise, 2006; Aguti, 2002). In general, more educated farmers are able to perceive, interpret and respond to new information and adopt better agronomic practices such as proper spacing, manure application, thinning and weeding and apply them to their farming situations much faster than their counterparts.

Membership to groups which promote finger millet growing and marketing helped farmers to realize higher gross margin in the season. The relationship was significant at 1% level of significance. Results showed that by joining groups, farmers had higher chance of increasing their gross margin than those who were not in groups. Farmers in the area were organized in groups like farmer associations, informal groups of labour exchange. These informal groups of labour exchange are agreed upon by individual farmers who work on farmer's gardens together on rotational basis. This is done because finger millet production is labour intensive and requires collective effort especially during weeding and harvesting times. On the other hand, farmer associations are important because it is a perquisite for farmers to access inputs from Serere Agricultural Research Station.

According to Bosena et al 2011, gives evidence that group's help in increasing bargaining power of producers hence increase their gross margin. Oluoch-Kosura (2010) further gives evidence from Sub-Saharan African countries that producer groups enable them to get opportunities to improve their performance.

Farmers needed credit facilities to help them expand their finger millet production hence their gross margin. Those who had access to credit were able to conduct field operations in good time as they could afford to pay for labour. The relationship, significance at 1% level, showed that gross margin increased with an increase credit access. Simtowe et al. (2010) explains that provision of credit to smallholder growers is necessary pro-poor economic development. They explain that credit alleviates the capital constraint on small holders enabling them to acquire inputs for investing into their production which consequently improves their gross margin. Also those who had access to credit had better gross margin because they were able to by improved varieties for planting. Improved varieties increase gross margin because they are drought resistant and high yielding.

As expected, household labour was positive and highly significant. More family labour enhances adoption of labour intensive strategies and proper season timing such that things like late planting, late weeding and late harvest are avoided. Regression results also showed that quantity of labour used had a positive coefficient (0.045) and was highly significant (p-value = 0.00). This was because some field activities were requiring significant amounts labour during land preparation/ploughing, planting weeding and harvesting. These activities were better done when the farmer had adequate labour hence increasing gross margin. Hamad *et al*. (2010) while

studying Economic analysis of factors affecting crop production reported that shortage of labour is caused by shortage of hired labour participation especially during weeding and harvesting operations. This finding confirms the study hypothesis that labour has a positive and significant effect on finger millet.

Regression result also showed that land ownership had a positive coefficient (0.217) and was highly significant at (p-value =0.000).This was because owning land as a factor of production enables the farmer to make independent decision like crop rotation, farm location, application of sustainable land management technologies and many others. However when you don't have owner ship you can't make those decisions because you don't have control on it. It was also found that majority of women headed households access but have no control on land as most of land in Soroti and Serere region belong to husbands and even if the husband is dead control of land belongs to the clan member. This could be explained by why men have higher gross margin than women. Understanding the influence of gender give a complete picture of participation and role both women and men in agricultural production and marketing.

Descriptive statistics in the study by Gabre et al (2001) indicate female headed households have smaller farms and lower marked crop surplus. Female headed household are known to experience constraints such as weak land rights, limited contact with a extension and low levels of education (Mutugul et al., 2001). However, credit institution, NGOs and other Community Based Organization (CBO) has enhanced female headed household to own farm assets and participate in production and marketing.

4.7.2 Multiple regressions of men and women

In this section the sample was divided into male and female headed house hold and a gender disaggregated analysis was done by running multiple regressions. One was for men headed house hold and second for women headed house hold.

Table 4. 12. Factors expected to affect producer's gross margin (men regression)

logGM_1 |	Coefficient	t-value	p-value
Distance to market (KM)	-.0069207	-0.28	0.782
LAND_own (1=yes,0=no)	.336881	3.39	0.001
Acc_Credit (1=yes,0=no)	.1874112	1.75	0.083
Extention svs (Times)	.1250788	2.87	0.005
SEED (1=local,0=improved)	.1467566	1.56	0.122
HH_Labour (Persons)	.044375	3.75	0.000
Membership (years)	.0404235	3.41	0.001
Age of H/head (years)	.0017262	0.44	0.662
Educ of H/head (years)	.0136965	1.08	0.282
cons |	12.65036	56.39	0.000

R= 0.70 Adj=0.67 std.=425 p-value=0.000
n=107

Results in men regression show the same explanatory variables that were significant in the regression of both men and women and these are; contact with extension service, level of

farmer's education, number of household labor, access to credit, farmer group, seed type and land ownership.

Table 4. 13. Factors expected to affect producer's gross margin (women regression)

logGM_1 |	Coefficient	t-value	P-value
EXTN_TIMES |	.1427871	1.83	0.072
ACC_money |	.1788302	1.70	0.094
MKT_DISTKM |	-.0091018	-0.65	0.518
LAND_OWN |	.5482924	4.24	0.000
SEED_type |	.1620893	1.36	0.177
GRP_years |	.0465197	4.15	0.000
Age |	-.0034293	-0.89	0.378
Educ |	.0192074	1.80	0.076
HH_LBR |	.0445439	3.28	0.002
_cons |	12.38059	59.25	0.000

R=0.79 adj=0.76 std=.370 p-value=0.000
n=83

The regression of women however was different that is education of house hold head is not significant. This could be because early marriages of girls in Soroti and Serere districts.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The productivity and profitability of finger millet in Uganda is still low. The purpose of this study was establishing the profitability of finger millet production, constraints that have hindered its profitability and then identify mitigation strategies for its improving profitability.
Descriptive statics, gross margin analysis and linear regression type of production function were adopted to achieve the objectives of the study.

Descriptive results showed that a typical finger millet farmer was a married female who was 44 years old, had spent 7 years in school and was mainly getting income from sale of crop produce. Return on investment was positive. A gross margin of UShs 496369 per hectare and a return of UShs was recovered for every Uganda shilling invested per hectare, literally meaning that for every 100 Uganda shillings invested, 170 Uganda shillings was obtained per hectare. Additionally, return to labor of UShs 092/man-day and returns to management of UShs412710 was also realized per hectare. Labor input (98%) accounted for the greatest portion of the cost component while weeding and harvesting(29% and 27% respectively) dominated the overall labor requirement among the various farm activities.

Econometric results of linear regression type of production function estimation revealed that access to agricultural extension, household size, membership in farmer groups, access to credit, land ownership and education of house hold head were the most important factors which were significantly affecting finger millet profitability.

5.2 Conclusions

Returns on investment in finger millet production were profitable. With the current prevailing market conditions/prices for inputs and output, farmers were able to recover the cost of

production and remain with profit. Production largely depends on profitability which influences the farmers' economic objective of earning positive economic return on resources invested including land and labor. Therefore, the potential of finger millet to improve the welfare of household members will be realized.

Further, it can be concluded that increasing yield of finger millet depends on increased use of access to agricultural extension service, household size, membership in farmer groups, access to credit, education and land ownership

5.3 Recommendations

More permanent solutions for sustainable finger millet production lie on use of labor cost saving technologies, to reduce and make production quicker to avoid delays.

The government should intensify farmer training programs through various innovative and extension delivery systems as more practical means of increasing finger millet since there might be limited opportunities of raising farmers' formal education in the short term. In the medium-term, local farmer organizations should be supported.

Organizations responsible for providing credit to farmers need to sensitize them on importance of credit on finger millet business. Also government should intervene and check credit institutions which are charging high interest rate to farmers since farming is on season basis unlike monthly basis of lending.

Farmers are encouraged to work in groups in order for them to strengthen their price bargaining power over prices set by buyers more especially middle men. Finger millet groups would help them in consolidating their influence on prices by agreeing amongst themselves on the price at which to sell their commodity. Additionally, through pooling of their millet in strategic places, farmers would raise farm gate prices by the cost of harvesting and of moving their millet to such strategic places.

5.4 Areas for future research

It was observed by the study that production of finger is profitable and farmers are getting positive returns on investment. However, there is limited empirical work on its contribution to food security.

There is need to identify appropriate labor saving technologies during row planting, weeding and harvesting which should enable this crop to be produced at a commercialized level.

There is need to search for possibilities of adding value to finger millet yield and its interaction with lower soil fertility is still lacking.

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Appendices

Appendix 1: Questionnaire for Respondents

Determining the profitability of finger millet production in Soroti and Serere Districts, Eastern Uganda

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0.0 Survey quality control

Date of interview: Day:……Month……Year:.....
Interviewed by:.....
Starting time: ……Ending time: …….
Date checked: Day: ……...Month:……Year:.....
Checked by: .....
Date entered: Day: .....Month:……Year: .....
Entered by: .....
Household ID:.....contact.....

1.0 Respondent and site identification

Please confirm that the person you interview is the head of the household or that she/he is able to answer questions concerning the agricultural production and other household issues. If the respondent is not able to do so please stop the interview and arrange another date to interview the head of the household. Please explain the respondent that we also like to ask some questions to his/her spouse. Ensure that s/he is available around 3 hours after the interview started.

1. Respondent's name……..……..……
2. Respondent sex 0 male 1 female
3. District……. County…….
   Sub county ……..parish…….. Village……
4. Phone number……..
5. Number of years the respondent is living in the village……..
6. How many years have you spent in farming?
7. Experience **(years)** in own farming activities ……
8. Experience **(years)** in cultivating: i) Finger Millet……

2.0 Household portfolio and members

2.1 Kindly fill the following Table for your various income sources

Source of income	Income is available from this source 0=No; 1= Yes	%share of this income source in overall hh income
Non-farm income		
Farm income		

Source of income in farm income	Income is available from this source 0=No; 1= Yes	%share of this income source in overall hh income
Finger millet production		
Maize production		
Other crops		
Livestock		
Renting out land		

2.2 Household composition *(Please fill the table for all household members who were in the last 12 month living in your household,* ***fill also for non-permanent members)***

ID	NAME	Sex 1-Male 2-Female	Age in Years	Relation to head **(D1)**	Marital status **(D2)**	Years in school	Ability in English? **(D3)**	Months living at home in last 12 months?	If this person stayed home less than 12 months , why? **(D4)**
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									

D1	**D2**	**D3**	**D4**
0=Head 1=Spouse 2=Parent 3=Child 4=Grand child 5=Nephew/Niece 6=Son/daughter-in-law 7=Brother/Sister 8=Wife2 9=Wife3 10=Wife 4 11=Wife 5 12=Other relative 13=Other non-relative	1=Single 2=Monogamous 3=Polygamous 4=Widowed 5=Separated/Divorced 6=Other (specify)	1=No ability 2=Can Understand but can't read, or write 3=Can Speak only 4=Can Speak and read 5=Can Speak, read and write 6=Other (specify)	1-To find a job/to work 2-To attend school 3-Married away 4-Passed away 5-Born-in 6-Married-in 7-Others

3.0 Agricultural production

		Plot distance to residence								
		Dist.	Unit **(1=hrs 2=km)**							
1										
2										
3										
4										
5										
6										
7										

3.1 Characteristics of all plots (cultivated or fallow) in the 2009/2010 planting season

Code A	**Code B**	**Code C**	**Code D**
1 Owned male	1 Poor2	1 Black (loam)	1 Gently slope
2 Owned female	Average3 Good	2 Brown (sandy)	2 Medium
3 Owned child		3 Sand clay	slope
4 Rented in		4 Grey (clay)	3 Steep slope
5 Other, specify….		5 Other, specify	

3.2 Characteristics of crop production in the 2009/2010 planting season *(information has to be filled per plot and variety for the previous planting season.*

					Total amount harvested				*If intercropping :* With which crop? **Crop codes**	Irrigated **(0=no; 1=yes)**	**Number of years** area is continously cultivated **(99 =continously**
					kg	Bags	Tins				

3.3 Crop Production Input: Please let the farmer choose one of the plots on which s/he grew **finger millet** the 2009/2010 planting season and fill the following Table for labour inputs for this plot

	Male family and exchange labor				Female family and exchange labor				Child family and exchange labor			
	Number of men	Hours /day	Days	% of exchange labor*	Number of women	Hours /day	Days	% of exchange labor	Number of children	Hours / day	Days	% of exchange labor
Activity code	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**	**L11**	**L12**

AID: 1=clearing of fields, 2=1st ploughing, 3=2nd ploughing, 4= manure/compost application, 5 = seed treatment, 6= planting, 7=1st weeding, 8=2nd weeding, 9=scaring birds, 10= chemical application , 11= Irrigation, 12= harvesting, 13= threshing 14= Seed cleaning, purification, 15= Other post harvest activities
(transport outputs to home, drying grains), 16=transporting output to market, 17 = selling produce at the market, 18=other(specify)

3.4 Please fill the following Table for the finger millet plot that was choosen in 3.4 and for the maize plot that was choosen in 3.4.
Plot name finger millet:……. Plot name maize: ……

Operations	**Recommended technologies for finger millet**	**Tick if used**	**Recommended technologies for maize**	**Tick if used**
	Date when rain started		Animal traction	
	Date of planting		Tractor plough	
	Date of harvesting		Power Tiller	
	Animal traction		Animal traction	
	Tractor plough		Tractor plough	
	Power Tiller		Power Tiller	
	Hand hoe		Hand hoe	
	Zero Tillage		Zero Tillage	
	Other, specify……..		*Other, specify……..*	
2. Compost/Manure application	Farmyard manure		Farmyard manure	
	Compost manure		Compost manure	
	Other, specify……..		*Other, specify……..*	
3. Seed treatment	Fungicide		Fungicide	
	Herbicide		Herbicide	
	Insecticide		Insecticide	
	Other, specify……..		*Other, specify……..*	
4. Planting/Sowing	Row planting		Row planting	
	Broadcasting		Broadcasting	
			Other, specify……..	
	Other, specify……..			
5. Fertilizer /manure Application	Broadcasting		Broadcasting	
	Side dressing		Side dressing	
	Top dressing		Top dressing	
	Other, specify……..		*Other, specify……..*	
6. Weeding	Hand weeding 1 times		Hand weeding 1 times	

	Hand weeding 2 times		Hand weeding 2 times	
	Other, specify……..		*Other, specify……..*	
	Intergragted striga management (ISM)		Intergragted striga management (ISM)	
	Other, specify……..		*Other, specify……..*	
	Insecticide for stalk borer		Insecticide for stalk borer	
	Other, specify……..		*Other, specify……..*	
8. Irrigation	In situ water harvesting		In situ water harvesting	
	Other, specify……..		*Other, specify……..*	
	Bird scaring, specify how ……		Bird scaring, specify how ……	
	Other, specify……..		*Other, specify……..*	
10. Harvesting	Manual harvesting (Cutting		Manual harvesting	
	Other, specify……..		*Other, specify……..*	
11. Threshing	Threshers		Threshers	
	Animal tramping		Animal tramping	
	Manual (beating)		Manual (beating)	
	Other, specify……..		*Other, specify……..*	
	Insecticide		Insecticide	
	Other, specify……..		*Other, specify……..*	
	Dehulling		Dehulling	
	Milling without dehulling		Milling without dehulling	
	Hand milling		Hand milling	
	Hammer mill		Hammer mill	
	Other, specify		*Other, specify*	

	Gunny bags		*Gunny bags*	
	Mud pots		*Mud pots*	
	Underground		*Underground*	
	Storage room		*Storage room*	
	Airtight drums		*Airtight drums*	
	Other, specify		*Other, specify*	
	At home		*At home*	
	Specialized faclity		*Specialized faclity*	
14 c Treatment during storage, please describe if any pesticides or other are used.				

3.5 Do you mix different varieties of finger millet and maize during harvesting?

Finger millet 0 No 1Yes maize 0 No 1Yes

3.6 Do you mix different varieties of finger millet and maize during storage/marketing?

Finger millet 0 No 1Yes Maize 0 No 1Yes

4.0 Output for finger millet and maize

4.1 Utilization of finger millet from the 2009/2010 planting season.

Crop variety **(Crop codes)**	Harvest **(kg)** (Table 3.2)	Amount **sold** in **kg**	Saved as **seed kg**	Amount **consumed** in kg	Amount **(kg)** used for other purposes	Amount lossed in kg	Total harvest

4.2 How many month do you consume maize from your own production? ……

4.3 How many month do you consume finger millet from your own production?
…….

4.4 What are the major constraints/limitations in selling finger millet , please rank the first three (*do not read out the reasons. Assign the farmers' answers to the given categories).*

Finger millet

1) **……..**
2) **…….**
3) **…….**
4) **…….**
5) **…….**
6) **……..**

5.0 Finger millet information

5.1 Crop history

5.1.1 Please first rank the importance for growing crops and second the importance of each of the two crops in regard to the given reasons.

Reason	Rank reasons for growing crops **Code A**	Finger millet **Code A**	Maize **Code A**
1. Needed for home consumption			
2. Needed for animal consumption			
3. Cash income			
4. Others (specify)……			

Code A
1 Most important
2 Second most important
3 Least important

5.2 Knowledge of finger millet and maize varieties, sources of information and seed adoption and disadoption

5.2.1 Please fill the following Table for all crop varieties of finger millet and maize a farmer knows (also those s/he does not plant her/himself)

Code A	**Code B**		**Code C**	**Code D**	**Code E**
1 Government extension 2 Farmer club 3 NGO 4 Research centre: on-farm trials/demos/ field days 5 Seed/grain stockist 6 Another farmer/neighbour 7 Radio/newspaper/TV 8 Other, specify…...……	1 Cannot get seed at all 2 Lack of cash to buy seed 3 Susceptible to diseases & pests 4 Poor taste 5 Theft during green stage 6 Cannot get credit	7 Low yielding variety 8 Poor prices 9 No market 10 Requires high skills 11 Seeds are expensive 12 Other, specify……	1 No other variety available 2 Best adapted variety 3 High yields 4 ….. …… *(please fill name)* recommended it to me 5 Other, specify	1 Research PVS 2 Extension officer 3 Bought from local seed producers 4 Bought from local trader or agro-dealers 5 Farmer to farmer seed exchange (relative, friend, etc) 6 Provided by NGOs 7 Other (specify)……	1 Gift/free 2 Borrowed seed 3 Bought with cash 4 Payment in kind 5 Exchange with other seed 6 Other, specify…..

5.2.2 What were your main sources for inputs for finger millet and maize in the 2009/2010 planting season.

Input	Crop (1 finger millet; 2 maize)	Two most important sources **Code A**	Distance **(km)** to the place to buy
Fertilizer			
Fertilizer			
Pesticides			
Pesticides			
Herbicides			
Herbicides			
Other			

Codes A	**Codes B**	**Codes C**
1 Voucher system	1 Cash	1 Human back
2 Other farmers	2 Credit	2 Animal back
3 Local trader/ agro-dealers	3 Other, specify ……	3 Bicycle
4 Provided by NGOs		4 Public transport
5 Extension officer		5 Other, specify……
6 Other, specify ……		

5.2.3 What were your main sources for seeds for finger millet/maize in the 2009/2010 planting season?

Quantity of seed from major sources (kg)							
Source 1				Source			
Code A	Reason for the source **Code B**	Amount **(kg)**	Quality (purity +viability) **Code C**	**Code A**	Reason **Code B**	Amount **(kg)**	Quality (purity +viability) **Code C**

Code A		**Code B**	**Code C**
1 Voucher system	5 Extension officer	0 No other source available	0 Poor
2 Farmer to farmer seed exchange (relative, friend, etc)	6 Research PVS	1 Best price	1 Good
3 Bought from local trader or agro-dealers	7 Bought from local seed producers	2 Run out of own seed	2 Very good
4 Provided by NGOs	8 From own storage	3 Best seed quality	
	9 Other, specify	4 Can buy on credit	
	……	5 Other, specify	
		……..	

5.2.4 What factors do you consider most when purchasing seeds for finger millet, please rank the first two important (*do not read out the reasons assign the farmers' answers to the given categories*

(a) Yielding capacity ……
(b) Early maturity ……
(c) Drought resistance …….
(d) Resistance to pests …….
(e) Fair price ……..
(f) Others (specify) ---------- …….

5.2.4 What are the major constraints in purchasing seed for finger millet, please rank the first two important (*do not read out the reasons assign the farmers' answers to the given categories)*

(a) Lack of information about recommended variety ---------
(b). Non-availability of seed of required variety ---------
(c). Need to travel long distances ---------
(d) Credit facility not available ---------
(e) High seed price ---------
(f) Low seed quality ---------
(g) others (specify) …… ---------

6.0 Access to information and participation in technology transfer

6.1 Do you have access to a governmental extension officer? 0 No (skip to 5.3)
1 Yes

6.2 *If yes in 5.1:* How often **per year** do you consult the extension officer?

6.3 Rank your 3 major sources for information on the issues below. Consider information for all crops. *(Use Codes A to rank the issues)*

Codes A

1 Extension officer
2 Research centre
3 Newspaper
4 Seed traders/Agro-dealer
5 Other private shops
6 Radio/TV
7 Mobile phone
8 Neighbour/ other farmers
9 NGOs
10 Cooperative
11 School
12 Other, specify……
……..

	Finger millet			**Maize**		
Issue	**Rank 1**	**Rank 2**	**Rank 3**	**Rank 1**	**Rank 2**	**Rank 3**
1. New crop varieties						
2. Crop storage						
3. Output markets/prices						
4. Input markets/prices						
5. Crop management						

6.4 Did any member of this household receive agricultural training in the last 2 years?

No. of training	Provider of training / extension See Code below	What kind training / extension? 1=finger millet production 2=other crop production 3=Other (specify)	In which season did you attend the training/ extension?	Type of teaching 1=with practice in the field 2=without practice	Did you apply what you learnt? 1=Yes 0=No	If **ET6** = No, why not?
ET0	**ET1**	**ET2**	**ET3**	**ET5**	**ET6**	**ET7**
1						
2						
3						
4						
5						

6						
7						

Code for ET1:
1=Ag extension agents from government 2=extension worker from NGO 3=extension worker from companies 4=extension worker from NAADS 5=Local Organizations within LC1 6=Fellow farmers 7=JICA 8=Other (specify)……..

6.5 Has any member of this household been a member of group and organization since **January 2009?** 1=Yes, 0=No. _____

6.6 If **yes**, For how many years.

6.7 What was the primary purpose of the group

6.8 Credit access and social assets

6.8.1 Did you **try** to obtain a formal credit in the last 12 month?

0 No 1 Yes *(skip to 6.5.4)*

6.8.2 *If no in 6.6.1*: If you would have been in need of a credit would you be able to get one?

0 No

1 Yes, please rank the two most important sources *(afterwards skip to 6.5.6)*

1 NGOs___ 2 Banks___ 3 Saving sacas___ 4 Village money lenders___

5 Farmers/traders____ 6 SACCOs___ 7 Family/friends___

8 Other, specify …… ___

6.6.3 *If yes in 6.5.1*: Did you get the credit? 0 No 1 Yes *(skip to 6.5.6)*

6.6.4 If yes in 6.6.3: From whom did you get the credit?
1 NGOs___ 2 Banks___ 3 Saving sacas___ 4 Village money lenders___

5 Farmers/traders____ 6 SACCOs___ 7 Family/friends___

8 Other, specify ……

Thank You Very Much for Your Time.

logGM_1 |	Coefficient	t-value	p-value
Age |	.0002416	0.09	0.929
HH_LBR |	.045127	5.13	0.000
GRP_years |	.0488555	6.51	0.000
Educ |	.0196681	2.48	0.014
SEED_type |	.0065821	0.14	0.892
EXTN_TIMES |	.1443567	4.33	0.000
Acc_money |	.2170486	2.95	0.004
MKT_DISTKM |	0094775	0.75	0.454
LAND_own |	.4254052	5.54	0.000
_cons |	12.55796	88.10	0.000

R=0.72 Adj=0.71 std.= 407 p-value= 0.000 n =190