MARKET PARTICIPATION OF SMALLHOLDER CASSAVA PROCESSORS IN NORTH AND NORTH EASTERN UGANDA

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Declaration

I, **Ajok Winnifred** hereby declare to the best of my knowledge that the findings in this research dissertation is a result of my original work and has neither been published nor submitted for any degree award to Gulu University or any other University.

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Approval

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Dedication

I dedicate this piece of hard work to my beautiful daughter Ruth Mich, who is the source of my inspiration. Her presence gives me strength to struggle for excellence. May the good Lord protect you and always favor you.

I also dedicate this work to my parents Mr. Felix Anywar and Natalina Akumu who have always supported me in all my struggles; my siblings; Fred Onen, Agnes Amony, Irene Akello, Fiona Adong, Ivan Kidega and Mildred Ocida Lawino. All of you have contributed greatly towards this work and you can never be forgotten for always being there for me.

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List of Acronyms

FAO	Food and Agricultural organization
NEPAD	New Partnership for African Development
UBOS	Uganda Bureau of statistics
USAID	United States Agency for International Development
FIIRO	Federal Institute of Industrial Research
ISSR	Institute of Statistics, Social and Economic Research
PPD	Post-harvest physiological deterioration
GM	Gross Margin
ASL	altitude above sea level
ABL	altitude below sea level

Abstract

Smallholder cassava farmers in Uganda face many production and marketing challenges including limited access to markets, high transportation costs and low sales volumes for unprocessed fresh cassava. In order to overcome these limitations, the panacea seems to be in cassava processing and value addition. This study sought to: (i) characterize smallholder processors of cassava products, (ii) compare the profitability levels of gari a new cassava product, flour and chips and (iii) determine the factors that influence the smallholder processors' decisions to participate in marketing of processed cassava products in north and north eastern Uganda. Data were collected from 185 randomly selected smallholder cassava farmers in the districts of Gulu, Lira, Kaberamaido and Soroti. Data were analyzed using SPSS and STATA Statistical packages; t-test and chi-square tests were used to compare and determine if there were significant differences between categories. The Heckman two stage model was used to assess the decisions of the respondents to participate in marketing of processed cassava products. Gross margins were generated using Excel to compare the profitability levels of the different processed cassava products. The results revealed that there was a significant difference between processors of gari and cassava chips and non-processors in terms of age ($P \leq 0.01$), annual incomes ($P \leq 0.05$) and family size ($P \leq 0.05$). The gross margin analyses indicated that the mean gross margin per month for gari, flour and chips were UGX1,050,198, UGX2,0217,760 and UGX1,377,649 respectively. The results further revealed that gari had a higher average return to cost at 164%, compared to flour at 102% and chips at 118% respectively. The Heckman two stage model showed that female processors allocated large land sizes for cassava production ($P \leq 0.1$) and obtained more sales revenue from flour at ($P \leq 0.05$) than their male counterparts.

The study recommends that cassava farmers should engage in cassava value addition and cassava processing in the form of flour, gari and chips since they fetch higher returns. To ensure that more women gainfully participate in the cassava value chain, it's important to encourage them to engage more in those cassava value chain segments where value addition is possible and more rewarding.

Key words: Gari, Gross margin, Heckman model, Market participation, Smallholder farmers.

CHAPTER ONE

INTRODUCTION

1.1 Background

In most developing tropical countries, Cassava has been widely acknowledged as a popular staple crop and its role in food security and poverty alleviation can never be over emphasized (Achem *et al.*, 2013). Production of cassava (*Manihot esculenta crantz*) globally lies traditionally in the tropical countries of Latin America, Asia and Africa. Cassava is ranked 19th in the top crop production in the world, with total production at 269,125,963MT (FAO, 2012). It is a drought resistant crop grown mainly in dry areas, it contributes significantly to the nutrition and livelihood of many households (Sewando, 2012). According to Echebir (2008) cassava has gained popularity because of;- its tolerance to extreme weather conditions, its low production resource requirements, its biological efficiency in the production of food energy, its availability throughout the year and its stability in different farming systems.

There are some special initiatives invested on cassava due to its importance; for instance the New Partnership for African Development (NEPAD) has recognized cassava as a crop which can reduce poverty in Africa and has recommended a Pan-African Cassava Initiative based on a broad based strategy which emphasizes better markets, better organization of producers for collective action, and better participation by the private sector (Sewando, 2012).

Globally the production of cassava is for human consumption, animal feeds and extraction of starch for industrial use. It is the starch roots and leaves that are consumed.

Cassava is Africa's second most important staple food in terms of per capita calories consumed and it is a major source of calorie for roughly two out of every five Africans (Onyemauwa, 2010). The importance of cassava as a food crop in Africa becomes obvious when its annual production is compared to the rest of the world; while the world's average production was about 270,293,801 MT in 2014 (FAOSTAT, 2015), Africa's shared production was about 54.7% of the world's total production average between 2010-2014, Latin America at 12.5%, Asia 32.8% and Oceania at 0.1%. Table 1 represents the global cassava production.

Table 1: Regional Cassava production (2010-2014)

Regions	Average production (MT)
Africa	141,094,723
Asia	84,616,537
Latin America	32,144,815.6
Oceania	248,238.2

Source (FAOSTAT, 2015)

Most of the developing tropical countries value cassava not only because it provides food security but because of its ability to be converted into a large number of products ranging from;- traditional and novel food products, livestock feeds, ethanol and starch and its numerous derivatives (Sewando, 2012).

Cassava is widely grown by over 75% smallholder farmers in Uganda for both food security and income generation (Roothaert and Muhanji, 2009; Salami *et al,* 2010). It is a very important crop in eastern, northern, and northwestern parts of Uganda, with per capita consumption of 132 kg/person/year which accounts for about 11% of the total caloric intake (Haggblade and Dewina, 2010). It is ranked second to bananas in terms of area occupied, total production and per

capita consumption, respectively (Prakash, 2014; Mbwika *et al.*, 2001). According to UBOS (2015), over 3 million cassava plots were planted by 1.67 million farm households in Uganda. About 2.9 million MT was produced on an estimated area of 871 Ha. This makes cassava one of the most widely distributed crops in Uganda.

As much as cassava tolerates marginalized conditions during growth; the fresh cassava roots are highly perishable, and must be consumed or processed within 2-3 days after harvest. For this reason, they are commonly "stored" in the soil, and harvested as required (piecemeal) for consumption. Many farmers sell sun-dried cassava chips to traders, which can be processed into cassava flour and used for brewing local alcohol. Gari is eaten as snacks.

Cassava is considered a vital food and cash crop, however, the many years of the devastating Cassava Mosaic and Cassava Brown Streak diseases caused massive crop losses to farmers and affected food security of many households; this was coupled with war and displacement, which led to the near extinction of the crop (FAO, 2012). Nevertheless, the project "Regional Cassava Initiative in support of vulnerable smallholders in Central and Eastern Africa" launched by FAO in northern Uganda revamped cassava production after massive crop losses to farmers which affected food security of many households (FAO, 2012).

1.1.1Cassava production and utilization in Uganda

Given the importance of cassava in Uganda's farming system, cassava is recognized as raw material for several agro-industrial products, such as flours for food and bakery, animal feeds, ingredient for the breweries and industrial starch. Statistics on utilization of cassava by communities indicated that, about 75% of farmers grow cassava for home consumption; 19%

grow cassava for commercial purposes and 9% grow cassava for other uses (Otim-Nape et al., 1990). The other uses of cassava include brewing (local alcohol), animal feeds and use of brewing waste as a cementing agent in local construction (Otim-Nape et al., 1990). Cassava plays an important role in the diet of the people of Uganda as it provides calories (Kizito, 2006). Peeled sweet cassava roots are eaten raw, boiled, fried, roasted or after drying and pounding, they are turned into bread. The crop is predominantly grown by subsistence farmers as a staple crop on plots averaging 1 to 3 acres (Mugisha, 2004). Its planted during the long rainy season of March-May with varying maturity time ranging from 6 months to 24 months depending on the variety (USAID, 2010). In the same report by USAID (2010) the authors noted that the average yield is between 6 to 10 tons of fresh cassava per hectare with 3:1 ratio of conversion. Its significant attributes include amongst others; it can be intercropped with other crops, it has high yielding abilities, it can do well in marginal lands, the crop demands low labor requirements and it is resistant to pests and diseases, particularly locusts (Jameson, 1970).

There are two broad varieties of cassava:- the bitter variety; has high levels of gluco-cyanides and it is not healthy for human consumption especially in fresh form, and the sweet varieties, which have lower levels of the gluco-cyanides and are mostly consumed fresh. In regards to regional production, the eastern region was reported to have the highest production level with a total of 1,007,091 MT (36.7%) followed by the northern region with 933,000 MT (34.0%) and central with the least output of about 410,000 MT (14.25%) (UBOS 2013).

While cassava is grown throughout Uganda, this research was clustered in the northern and north eastern Uganda where cassava is a staple food crop (Table2). In addition, efforts have been made

to promote cassava processing into various products such as; gari, sun dried cassava chips and cassava flour among others in these regions.

Table 2: Cassava production by Districts (2008/2009)

District	Area (Ha)	Production (MT)
Gulu	10964	28933
Lira	17417	13821
Kaberamaido	10982	23989
Soroti	30951	141331
Katakwi	12051	11569
Amuria	15641	10870

Source: UBOS (2015)

1.1.2 Processed Cassava products.

The main traditional cassava products in north and north eastern Uganda include; gari, flour and chips. Gari is roasted cassava granules with slightly fermented taste, consumed either as snack with tea, or as a basic staple food with cooked vegetables or meat. (Mcnulty and Adewale, 2015; Salvador *et al*., 2014). The consumption of Gari is slowly picking up in Uganda although it is a common cassava food in West Africa (Olagung *et al*., 2012; Udoro *et al* ., 2013). Processing gari is on the rise because it's seen as a convenient food that is easy to cook and can be stored for long (Mcnulty and Adewale, 2015). This has made gari to be accepted by both the poor and rich but it's consumption is being limited by the presence of cyanides especially when inappropriate processing technology is used (Akande, 2013). Traditional cassava processing methods involve several activities which include; peeling, washing, grating, drying, milling, roasting, sieving, steaming, pounding and mixing in cold or hot water (Tivana, 2012; Ameny, 1995). Specific combinations of these processes lead to a myriad of different cassava products with acceptable

tastes to a wide range of consumers. Generally, these steps are intended to reduce toxicity and improve palatability. Production of gari involves peeling, washing and grating of the roots. The grated mash is put in jute sacks which are pressed using a hydraulic or screw press and the dewatered mash is then sieved and fried. The average moisture content of gari ranges from 8 to 14% which makes it suitable for long term storage (Udoro *et al*., 2013). It is usually eaten in the form of snacks by soaking in water, or in the meal form where it is reconstituted by stirring in hot water to form dough which is eaten with soup (Udoro, 2012).

Cassava chips are unfermented dry products of cassava (Udoro *et al*., 2013). The freshly harvested cassava tubers are sorted to remove bruised or rotten tubers and then washed with water to remove extraneous materials such as plant debris, stones, sand and dirt. The washed cassava tubers are manually peeled using a sharp knife. The peeled tubers are sliced manually into chips. Roots are chipped into smaller sizes that vary in size, usually not exceeding 5cm in length and about 2 ± 1mm for fast drying that also helps the process of detoxification (Tivana, 2012 and Oghenechavwuko *et al*., 2013). Cassava chips are either dried naturally in the sun or artificially in an oven (FIIRO, 2014) to produce cassava chips with very low moisture content.

The sun dried cassava is normally milled into flour (Kleih, 2012). Sun dried cassava chips may also be fermented when brewing in order to produce local alcohol. Cassava flour is usually eaten as bread or mixed with millet flour to make bread which is less sticky.

Cassava is usually consumed in processed forms. In the report presented by The federal Ministry of Trade and Investmnet (2011) indicated that cassava processing by traditional methods is labour intensive, therefore improving cassava processing technology is a key factor in reducing drudgery associated with cassava processing and ultimately encourage cassava enterprise. The

report of The federal Ministry of Trade and Investmnet (2011) recognizes women as central players in production, processing and marketing of cassava. It further reported that, women are almost entirely responsible for processing cassava which provides them with additional income-earning opportunities that enhances their ability to contribute greatly to household food security. As a traditional crop of the poor, expanding cassava processing enterprises can bring direct economic benefits to the farmers, and increase investments in the downstream segments of the cassava commodity chain (Achem *et al.*, 2013). However, the broad based strategy which emphasizes better markets, better organization of producers for collective action, and better participation by private sector needs to be initiated (Sewando, 2012). Cassava appears to be a 'food choice' even in the face of alternative food options in urban areas. Cassava's starchy roots produce more food energy per unit of land than any other staple crop (Achem *et al.,* 2013). It therefore becomes crucial to step-up processing and utilization to absorb the increase in national production and also guarantee higher prices for farmers.

1.1.3 Post harvest physiological deterioration (PPD)

Cassava is harvested by hand by raising the lower part of the stem and pulling the roots out of the ground, then removing them from the base of the plant (Onyenwoke and Simonyan, 2014). The upper parts of the stems with the leaves are plucked off before harvest. Cassava undergoes Postharvest Physiological Deterioration (PPD) once the tubers are separated from the main plant (Onyenwoke & Simonyan, 2014). The tubers, when damaged, normally respond with a healing mechanism. However, the healing mechanism produces coumaric acids, which is initiated about 15 min after damage, and fails to switch off in harvested tubers (Beeching *et al.*, 2003). It continues until the entire tuber is oxidized and blackened within two to three days after harvest, rendering it unpalatable and useless. PPD is one of the main obstacles currently preventing

farmers from exporting cassava abroad and generating foreign exchange income (Zidenga, 2012;Naziri *et al*., 2014). Post-harvest strategies include the development of effective and simple machines and tools that reduce processing time and labour, and production losses, above all consuming the harvested cassava roots as soon as possible. Cassava can be preserved in various ways such as coating in wax or freezing (Zidenga, 2012). Plant breeding has resulted in cassava that is tolerant to PPD (Onyenwoke & Simonyan, 2014). Two types of postharvest deterioration are recognized: Primary physiological deterioration that involves internal discoloration and is the initial cause of loss of market acceptability and secondary deterioration due to microbial spoilage (Bartz & Brecht, 2002). The former is thought to be a consequence of tissue damage during harvesting, in most cases it is seen as a blue-black discoloration of the vascular tissue referred to as vascular streaking. These initial symptoms are followed by a more general discoloration of starch bearing tissue (Bartz & Brecht, 2002).

Cassava contributes to development of both national and regional development of the economy through trade. Post-harvest activities like, processing, packaging, marketing, storage, distribution and transportation enhances sustainable cassava production creating substantial benefits and food security in terms of calorie dietary consumption. It is therefore against this background that this study was motivated to assess the determinants of market participation, compare the profitability levels of different processed cassava products and characteristics of different cassava processors in north and north-eastern Uganda.

1.2 Problem statement

Despite the fact that north and north eastern regions are the major producers of cassava in Uganda (UBOS, 2013), a lot of what the rural farmers produce is not marketed. This is due to a range of production and marketing challenges that smallholder cassava farmers face in the cassava value chain. Cassava processing and value addition is fronted as a viable option to alleviating challenges faced by smallholder farmers in the cassava value chain. The need for cassava processing and value addition as noted by (Achem et al., 2013) arises in order to reduce bulkiness of fresh cassava roots (contains 60-70 percent water), remove toxicity of fresh roots of the bitter variety (cynogenic glycoside), increase shelf life (rots within 3-4 days of harvest), facilitate transportation to the urban markets, increase on the nutritive content (its low in other nutrients especially in proteins), to convert cassava root into other usages (Confectionary and industrial extraction of starch) and to stabilize products prices and supply (FAO and IFAD, 2005). The common secondary products; cassava chips and flour barely yield good returns at the farm gate. Basing on this, it therefore becomes imperative to identify those constraints that hinder smallholder cassava processors from gainfully participating in the cassava value chain and marketing.

Whereas, processed cassava products are important cassava based foods in Uganda, there is limited information on smallholder participation in cassava processing and value addition. This has created a big challenge in promoting the marketability of currently available processed cassava products (gari products, flour and chips) in the markets as most cassava processors and consumers do not have information on gari, processing of high quality cassava flour and chipping that make economic sense. It is against this background that the study sought to identify the factors that determine the decisions of smallholder cassava farmers to participate in the

marketing of processed cassava products and compared the profitability levels of gari, a recent cassava product, processed cassava flour and chips amongst smallholder farmers in northern and north-eastern Uganda.

1.3 Objectives of the study

The overall objective of this study was to explore the conditions for smallholder cassava processors' market participation and the profitability levels for processed cassava products in north and north-eastern Uganda.

1.3.1 Specific Objectives

1. To characterize the smallholder processors of cassava products in northern and north-eastern Uganda.
2. To compare the profitability levels of gari- a recent cassava product, cassava flour and chips among smallholder processors in north and north-eastern Uganda.
3. To determine the factors that influence the smallholder processors' decisions to participate in the marketing of processed cassava products in north and north-eastern Uganda.

1.4 Research Questions

To achieve the above objectives the following three research questions have been answered.

1. What are the characteristics of smallholder cassava processors in northern and north eastern Uganda?
2. What are the profitability levels of gari (a recent cassava product) as compared to cassava flour and chips among smallholder processors in north and north eastern Uganda?

3. What factors influence the decisions of smallholder processors to participate in the marketing of processed cassava products in north and north eastern Uganda?

1.5 The significance of the study

The study is believed to:

Provide knowledge to the smallholder cassava farmers on the various factors that affect market participation and the benefits of marketing processed cassava products.

Provide useful information to the smallholder cassava farmers on the profitability levels of the processed cassava products and on those elements that are key drivers of production and processing costs.

Provide useful information to the students on which areas need further investigation especially in the field of cassava marketing.

1.6 Scope of the Study

This research was limited to the potential of processed cassava products namely; - gari, flour and chips. The study examined the effect of adoption of value addition innovation on the livelihood of rural farmers, including women who are at the center of production and processing of cassava products. The study was conducted in northern and north eastern Uganda in the districts of Gulu, Lira, Kaberamaido and Soroti.

1.7 Research Limitations

The study encountered a number of limitations as highlighted below;-

i) Language barriers. This was because the study covered 4 districts in north and north eastern Uganda who speak totally different languages and different tribes. This was overcome by employing translators and working with research assistants who are from those local communities and speaking the local languages.

ii) Expectation of research assistants: The study was not in position to meet all the needs and expectations of the research assistants both financially and socially. But never the less, there were mutual consents. The study sought consent from research assistants given the terms and conditions of the work. Those who could work within the terms and conditions were the ones worked with.

iii) Demand of the local leaders: Most local leaders and contact persons demanded for money in exchange for the access to the local areas and access to the women' groups. This was overcome through proper introduction and explanations of the purpose and benefits of the study to those local communities.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a literature review on the importance of farmers' participation in the market, factors influencing market participation and their extents, strategies for improving market participation.

2.2 Concept of smallholder market participation and its importance.

The practical definition of market participation covers both inputs and outputs involved in market participation. Market participation can be defined as increasing engagement with markets (Mwongoso *et al*., 2015). Sebatta *et al*., (2014) defined market participation as the quantity or proportion of the harvested output that is marketed. It is about accumulating portions of crops and animal products meant for sales. In order for it to be effective, other factors of production; most notably hired labour, land and borrowing funds for investment and working capital from banks and other financial agencies (Mwongoso *et al*., 2015), have to be obtained from the market.

On the other hand, smallholders have been defined in terms general attributes possessed including farm size, asset accumulation (proxy for wealth), market positioning, level of vulnerability to risk and access to labor and technology (Sigei and Kibet, 2014). Smallholders' market participation generates employment opportunities to the local communities through activities like sorting, grading, transportation among others and this eventually leads to the

development of rural roads and industries (Sigei et al., 2014). Most smallholder farmers who participate in the market are food secure because the income derived from the sales of their outputs enables them to purchase staple foods and meet other basic requirements. From the foregoing, it can be concluded that smallholders' participate in the market to access inputs, sale of outputs (economic gains), networking and food security. The economic gains act as push factors for the smallholder farmers' engagements in the markets.

2.2.1 Factors influencing market participation

Market participation of smallholder farmers is affected by many factors including socio-economic factors, institutional factors, market factors and external factors such as political instability of the nation, natural disasters and calamities. These factors could have negative and/or positive effects, which could either improve or cause a decline in the welfare of the actors. In the study conducted by Sebatta *et al*., (2014) the authors noted that, socio-economic factors like age, gender, education, experience, household size and land size had an impact on sweet potato market participation in Uganda. Age of the household head may have a negative or positive impact on the market participation depending on the direction of the coefficients. Increasing age is associated with wealth accumulation, experience and social networks which enable smallholder farmers to participate more in market. However, there should be a threshold in terms of age beyond which the agility to participate in the market may decline (Sebatta et al., 2014 and Abu et al ., 2014)

In a study by Geremew, (2013) Gender of the household head had a significant impact on the level of sesame market participation. Male headed households were found to have a positive and significant impact on market participation because they are the decision makers and possess

more resources than their female counterparts. The findings in the study by Omiti & Mccullough, (2009) indicated that education had a positive effect on maize market participation in Kenya. Increasing education level of smallholder enhances skills and knowledge needed for the utilization of market information, which in turn reduce marketing costs hence more market participation. In the study by Osmani & Hossain, (2015) on market participation decisions of smallholder farmers and determinants in Bangladesh revealed that household size had a positive impact on market participation. The implication is that large households provide cheaper labour and produced more output in absolute terms such that the proportion sold remains higher than the proportion consumed.

Institutional factors like group membership, access to extension services and infrastructure had an influence on market participation. Membership to the group may have both positive and negative impacts on market participation. A positive sign reflects that the joint mobilization of resources and actions which reduces on the transaction costs. On the other hand, it can negatively impact on market participation in case of emergencies of disagreements among group members, distorting marketing decisions (Omiti and Mccullough, 2009; Jagwe *et al*.,2010). Bahta & Bauer, (2007) found out that access to extension service had a positive impact on market participation. The implication is that access to extension services enables farmers to acquire more skills and knowledge needed in marketing.

Physical resource endowments like ownership of transportation and communication equipment have an impact on market participations. The communication equipment noted by Abeykoon *et al*., (2013) include mobile phones, radios, and televisions which had a positive significant impact on market participation. The implication is that such communication gadgets make it easier for

smallholders to have easy access to production and marketing information. Meanwhile, Bahta, (2012) asserted that possession of transport means enables easy transportation of goods hence more market participation. Poor market information access has been reported to negatively impact on market participation (Sigei and Bett, 2014). Poor access to market information resulted into information related problems namely; limited knowledge of output prices and traversing long distances to the markets in search of buyers. The study conducted on cassava market participation decision of producing households in Africa by Enete and Igbokwe (2009), revealed that; price, market access, availability of information of prices of cassava products, farm size and level of formal education were significant in influencing market participation among producers. Different studies have identified different factors responsible for market participation. However, basing on the literature reviewed, it is evident that there is consensus on the factors that influence market participation.

2.2.2 Factors that influence the choice of marketing outlets

Choice of market outlets is the farmers' decision on which particular outlet to sell their processed cassava products (Sebatta *et al*., 2014). The choice of market outlet is motivated by a number of factors including the prices the farmers receive from the sales of the processed cassava products, distance to the market outlet, and availability of transport means, marketing costs and other dues. The farmer is likely to choose the one market outlet which that confers higher perceived benefits. The study conducted by Sigei and Bett, (2014), identified the following factors to have positive and negative significant impact on the choice of marketing outlets. The first factor was related to the farm household characteristics which include (farmers' experience, asset endowments and attitude towards risk), the second factors dealt with production system (farm size and production

scale); the third determinant was price attributes; and the last was market context (contract arrangements, geographical location and distance to urban markets). However, Enete and Igbokwe (2009) noted that price, market access, household size, availability of price information, farm size, level of formal education were responsible for the choice of marketing outlets.

2.2.3 Factors that influence the extent of market participation

In a study by Sigei *et al*., (2013) it was revealed that six variables (gender, group marketing, price information, marketing experience, vehicle ownership and contract) were significant in influencing the extent of market participation. Meanwhile, the study by Sebatta *et al*., (2014) it was pointed out that off farm income, farmer's membership in a group and marketing cooperative were significant in influencing the extent of market participation. In a related study by Elias *et al*., (2013) it was reported that age, ownership of livestock, education level of household head, owned land size were significant in influencing extent of livestock market participation. In the study by Munyua *et al*., (2010) the authors found out that motor-able road, age, household asset wealth, degree of commercialization, membership in farmer groups and marketing experience had impact on the extent of market participation of certified maize seed. Maziku, (2015) found out that farmers' age, education level, family size, transport mean, market distance had impact on the extent of maize market participation. Relatedly, Gobena et al., (2012) found out that farm size, age and family size had an impact on the extent of market participation. Meanwhile, Zamasiya et al .,(2014) found out that market distance had an impact on the extent of soybean market participation. In a similar study by Bahta & Bauer, (2007) the authors found out that acreage cost, extension services and non-farm income were responsible for the extent of livestock market participation. All these variables had significant impacts on the extent of market

participation as indicated by various researchers. However, there is no consensus on particular set (s) of variables that influence market participation.

2.3 Strategies for improving market participation among smallholder farmers

The study conducted by The federal Ministry of Trade and Investmnet (2011), revealed that Market participation should be enhanced to increase the marketable surplus. A household's production technology choice affects its market participation choice by affecting its productivity. Improving market access resulted in the production of marketable surpluses which enhances the extent of market participation. The intensity of market participation brings in more income gains from agricultural activities which translates into high revenues saved and investment in productivity enhancing technologies. Contract arrangement system is another strategy to enhance market participation (Sigie *et al*., 2013). Value addition to cassava as a marketing strategy acts to extend the shelf-life and thereby increase the profit margins (Wilhemina *et al*., 2009). Processing of cassava root tubers into products that increase the shelf-life of cassava helps to reduce the seasonal glut effects and bridge the food gap in developing countries. It also serves as a means of job creation and provide linkages between production and marketing processes (Awoyinka, 2009).

2.4 Profitability of cassava processing enterprises.

In the survey conducted by National Agricultural Research Project in Ghana NARP on the traditional methods of cassava processing, the survey found both negative and positive gross margins of gari processing enterprises with variations in the scale of operation (NARP, 1998). However, in a recent survey conducted by Wilhemina *et al*., (2009) it was found out that large scale productions were profitable although its focus was on small scale processing. Profit is a

major incentive for farmers to increase agricultural production and nutrition improvement. In a 2006 publication of "The State of the Ghanaian Economy" by the Institute of Statistical, Social and Economic Research (ISSER) there was doubt on the profitability of gari processing by traditional methods. According to ISSER (2006), estimates show that using the traditional method about 8 kg of fresh cassava is required to produce 1 kg of gari. In value terms about 0.95 GH¢ is required to produce about 0.45 GH¢ worth of gari indicating a loss of about 0.5 GH¢.

Various economic analyses carried out by researchers have indicated that cassava processing can be profitable. Many studies have used gross margins to analyze data from cassava processors (Obadina *et al*., 2013; Achem *et al*., 2013). The merits of gross margin analysis are that: it is a reasonably straight forward and easily understood system which enhances the study of enterprise management; it enables processors to compare the financial performance of their enterprises with those of similar enterprises so as to help find possible technical weaknesses; it enables the detailed results of different enterprises to be compared in similar units. Gross margin analysis is a popular technique in enterprise budgeting that enables enterprises to be compared (Obadina *et al*., 2013; Achem *et al*., 2013).

The study conducted by Achem *et al* ., (2013) on comparative profitability assessment revealed that cassava processors make profits. The same study further revealed that all the three (Gari, flour and chips) cassava products had conversion ratios of 4 (roots) to 1 (product) and this was realized as a result of the traditional method of processing predominantly employed by the processors. The low profit margin found in the study conducted by (Achem et al., (2013) was attributed to the fact that most households consumed their processed products without attaching

monetary value. The study took cognizance and actually valued the contributions of family labour in cassava processing operations.

In Ghana, (Bampoe, 1991) studied the profitability of cassava processing into gari on the traditional and small-scale levels. Out of thirty processors interviewed, 13 (43%) obtained daily economic profits greater than the agriculture wage rate, while 27 (90%) earned daily accounting profits greater than the wage rate. (Bediako, 1978) examined the economics of traditional and modern (improved) gari processing technologies. This author reported that both technologies used in cassava processing make some profits in their operations. The profits in traditional processing methods were however lower due to economies of scale. While the traditional processing method yielded GH ¢29.61 per month, the modern method recorded GH¢254.00 per month. Similarly, the study conducted by Oluwasola, (2010) revealed that the gross margin to the enterprise was Nigerian Naira N329, 178.00 while the net profit was N68.119.00. The rate of return to enterprise was 1.84 and indicates that with every N100 invested the return would be N184. The Benefit-Cost Ratio was 1.17.

According to Sanni et al., (2009), the findings revealed that there was absence of information on the profitability of embarking on the production of cassava products (gari, ethanol, adhesive, flour, starch, syrup and chips) to communities. They witnessed that an average of 268.58kg of gari is produced from 1000kg (1 ton) of fresh cassava tubers. When valued at an average unit price of N25.30/kg, this amounted to N6795.00. Variable costs accounted for about 90% with tubers alone accounting about 35%, while the fixed cost accounted for about 20%, and labour operations accounted for about 30% of the total cost of gari production. Similarly, the study

conducted by Bonabana-Wabbi *et al*., (2013), found out that the cost of planting material and labour costs had the largest percentage of production costs.

James *et al*., (2012) have examined the processing of cassava into gari in Oyo State, Nigeria. Cost and returns analysis revealed that gari processing is profitable and lucrative, with a gross margin profit of N7, 360.00 per bag (50kg). Profit was regressed against socio-economic factors and results showed that age, marital status, level of education and years of experience had positive effects on the levels of profit made by processors. Conversely, gender and family size had inverse relationships. The study found out that constraints included: inadequate raw materials supply, lack of credit facility, poor road networks and lack of availability of labour

In conclusion, cassava processing is profitable especially when modern technologies of processing are used. The traditional method yields low profits due to the small-scales of operation and it is time consuming. Cassava inputs and labour are the major production costs.

2.5 Conceptual framework

A farm household will choose to participate in the cassava market where the net present value of the benefits from participation was greater than the net present value of remaining autarkic-net of costs. Costs here included all transaction costs the household faces in the process of market participation. Previous studies on market participation (Enete and Igbokwe, 2009; Sebatta *et al*., 2014), revealed that failure of many households to participate in the commodity markets is explained mainly by transaction costs theory. In areas with imperfect markets and high transaction costs, it is costly to discover trading opportunities (Enete and Igbokwe, 2009).

Similarly, some socio-economic factors and institutional factors may either increase or reduce the probability of the household to participate in the marketing of processed cassava products and as such it increases the household's cost of observing market prices to make transaction decisions. The extent of market participation increases the household income (Figure 1).

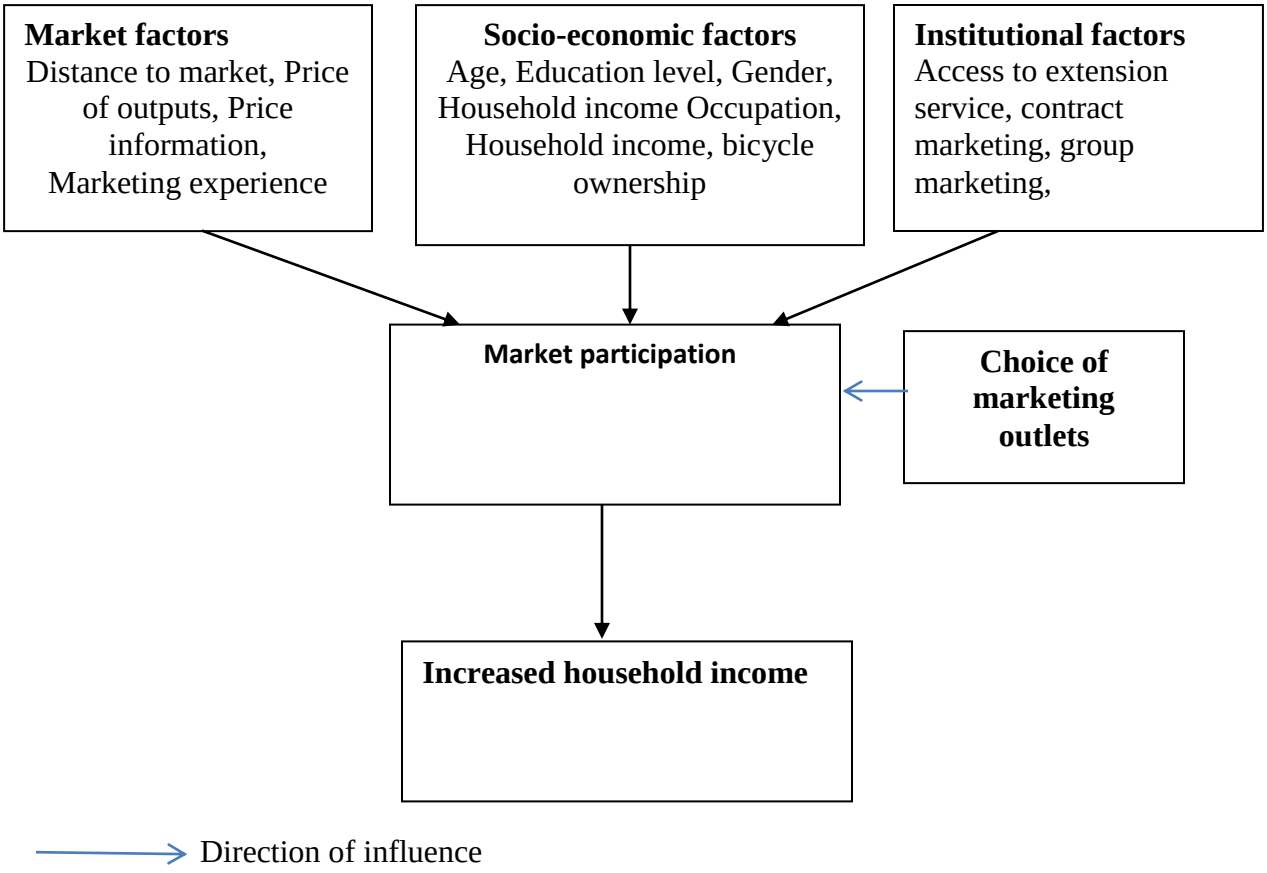

Figure 1: Diagrammatic representation of the conceptual framework

Source: modified from Sigei et al., (2014)

CHAPTER THREE

METHODOLY

3.1 Introduction

This chapter explains how this research was conducted. It focuses on the following areas: research area, research design, study population and sample, target population, sample size and selection, sampling techniques, data collection, data analysis, and ethical considerations.

3.2 Area of the study

The study was conducted in north and north eastern Uganda covering the districts of Gulu, Lira, Kaberamaido and Soroti respectively. Gulu is located in the Para savannah ecological zone. It receives rainfall of about 1259mm with high variability from about 800mm within the Albert basin to about 1500mm over the western parts. Gulu experiences one rainy season of about 8 months from late march to late November with peak in August to October and a secondary peak in April and May. Gulu experiences also one long dry season of about 3 and half months stretching from December to mid-march with driest months in December to February. Gulu receives temperature ranging from 17.5 to 32.5^0c, with altitude ranging from 351-1341m above sea level (ASL). The main enterprises are; spices (ginger, cardamom, white and black pepper, birds' eye chilli, and red chilli), fisheries, cassava, apiculture, beef, goats/skins, cattle/hides and mangoes (NEMA, 2009).

Lira district is located in the north eastern ecological zone, with an average rainfall of about 1197mm with moderate variability, from about 1000mm over the north eastern parts to about 1300mm over the western parts. Lira district has one long rainy season of about 7 months, from

April to late October with the peak in July, August and a secondary peak in May. It has one long dry season of about 4 months form mid-November to late March. Driest months are from December to February. Temperature ranges from 15-32.5^{0}c. Altitude ranges from 975-1524m above sea level (ASL). The major enterprises are Apiculture, beef, cattle and hides, goats/skins, sesame, cassava, pulses and sunflower.

Kaberamaido and Soroti districts are located in the Kyoga plain ecological zone. They receive an average rainfall ranging from 1215-1328mm. They have two rainy seasons with the first one being experienced from March to May with peak in April and secondary season from August to November with peak in October and November. Main dry season is from December to February, with secondary dry season from June to July. These districts experience temperature ranging from 15-32.5^{0}c, with altitude ranging from 914-1800m above sea level (ASL). The major enterprises here include; fisheries, Apiculture, maize, pulses, beef, cattle, cassava and goats.
These regions were chosen because cassava is the main economic crop for most of the smallholder farmers. In each of the districts chosen, two sub counties and a parish consisting of women farmers' groups were identified.

The women's groups were chosen because of their active involvement in growing and processing of cassava or carrying out cassava value addition. Specifically for this study, the groups chosen were those that processed cassava into gari, flour and chips in the last 12 months and marketed them. Table 3 shows the summary of the study areas.

Table 3: Selection of the study areas

District	Sub-county	Parish
Gulu	Unyama	Oding
	Koro	Labora
Lira	Amach	Banya
	Bar	Alebere
Kaberamaido	Ochero	Kagaa
	Kobulubulu	Katinge
Soroti	Arapai	Arapai

3.3 Study design

A cross sectional survey design was used to collect both qualitative and quantitative data from both cassava processors and non-processors. Household data were collected from four (4) purposely selected districts using pre- tested household questionnaires.

3.4 Sources of data.

The study used mainly primary data collected during the household survey conducted between November and December 2015. The sample household questionnaire used for data collection is presented in appendix A.

3.5 sample size and sample size determination

The sample size was estimated using a standard formula which applies the principles of proportion (Krejcie and Morgan, 1970). The study targeted 60 respondents in each district making a total of 240 respondents in four districts. However, the study also made adjustments for the cases of non-responses and uncertainties by adding an extra 204, thus making a sample frame

of 444. Out of the 444, the study assumed that 80 respondents per district would be accessible thus making the population proportion likely to participate to be 320.

$$n = \frac{no}{1 + \frac{no}{Pop}} \quad \text{---------- (1)}$$

Where no = is the sampling frame used in the study

Pop = population proportion assumed to participate in the study was 320.

$$n = \frac{no}{1 + \frac{no}{Pop}}$$

$$= \frac{444}{1 + \frac{444}{320}}$$

$$= \frac{444}{1 + 1.4}$$

$$= \frac{444}{2.4}$$

$$= 185$$

Therefore, Sample size (n) of 185 cassava processors was used in the study.

3.6 Sampling procedure

A multi- stage sampling procedure was used. According to Kothari, (2004), multistage sampling refers to a big inquiries usually extending considerably to a large geographical area like entire country. First four (4) districts (Gulu, lira, Kaberamaido and Soroti) were purposely selected based on their locations and extent of cassava production and processing (two districts in the

north (Gulu and Lira) and two in north eastern Uganda (Soroti and Kaberamaido)). Secondly, two sub-counties were purposively sampled from each of the selected districts based on the relative extent of cassava production and processing. Thirdly, two parishes from each sub county were purposely selected based on relative extent of cassava production and processing. Finally, the households interviewed were randomly selected in the fourth sampling stage using the list of all cassava processors in the parish as a sampling frame. The total number of households interviewed was 185. However, not all respondents were processing the three products at the time of the study. Therefore the processors and non-processors were from the same sample.

3.7 Study Population

The study respondents were women actively engaged in cassava farming, cassava processing, value addition and marketing of processed cassava products. These women were selected to give household information because previous studies have shown that women have knowledge on the various processes of cassava processing and value addition, costs incurred and marketing information. (Achem *et al*., 2013; Ijigbade et al., 2014). The inclusion criteria were that the cassava farmer had to be the one responsible for processing, value addition and marketing of the processed cassava products, willing to participate in the study and be of adult age; above 18 years.

3.8.0 Data collection technique

The study embraced the use of questionnaire technique in the collection of primary data for the research. The structured questionnaire had both open and closed ended questions. Closed ended questions facilitated the collection of specific information which was easy to categorize. On the other hand, open ended questions ensured more details were provided by the processors freely.

This technique of data collection allows privacy and anonymity of the respondents. Data were collected on each objective using questionnaire as indicated in following subsections.

3.8.1Objective one: Descriptive statistics

Semi-structured closed and open ended questions were used to collect information regarding the various factors responsible for cassava processing. The variables included; age, gender, household size, years spent in school, ownership of land, land size allocated for cassava production, production and marketing experiences, group affiliation, contract arrangements, accessibility of financial resources, off farm income, market distance, transport cost, price per kilogram of processed cassava products as reflected in table 4.

Table 4: Definition of the Variables used (Objective one)

Variables	Description
Age	Age of household head (Years)
Gender	Sex of household head (Female=1, Otherwise =0)
Education level	Years spent in school
Household size	Number of persons in a household
Off farm annual income	Annual off farm income of household head (Shillings)
ownership of transport mean	Ownership of transport mean(Yes=1, Otherwise=0)
Distant to market	Distance to the nearest market (KM)
Outcome of Processed cassava	Annual production of processed cassava(Kilograms)
Source of market information	Production and marketing information (NGOs=1, Universities=2, Phones=3, Neighbours=4, Radios=5, Extension Agents=5)
Price of processed cassava products	A unit price per kilogram of processed cassava products (Shillings)
Credit access	Credit access by household (Yes=1, Otherwise=0)
Contract arrangement	Contract arrangements for marketing processed cassava products (Yes=1, Otherwise=0)
Group Marketing	Group marketing (Yes=1, Otherwise=0)
Marketing experience	Years spent in marketing
Group membership	Membership to a group (Yes=1, Otherwise=0)
Extension service	Access to extension services (Extension agents=1, NGOs=2, Universities=3, BDS=4)

The information collected was subjected to descriptive statistics in order to compare the means of variables common with both cassava processors and non-processors (Ibrahim and Wojciech, 2012; Adeoti, 2009). T-tests were used to compare means of continuous variables, while chi-square tests were used to compare means of categorical variables.

3.8.2 Gross margin analysis (Objective Two)

The household questionnaire was used to collect information on household cassava production and the various cost activities incurred in cassava processing. These activities included uprooting, transporting, peeling/slicing, grating, dewatering, roasting, fortification, drying, milling, and packaging. Household information on the type of cassava product processed, cassava input costs, and size of farm land allocated for cassava production and quantity of processed cassava products were assessed. The revenue obtained from marketing of each processed cassava products produced by the household in 12 months was estimated using local market prices and the total output reported by respondents during the interview. The study summed the production costs for all the three cassava products. Total revenue was also generated for each cassava product processed and marketed to ascertain the profitability levels.

The study then computed and compared gross margins of different processed cassava products that exist in north and north eastern Uganda using the information collected. The gross margin analysis technique was employed as used in other studies (Achem *et al*., 2013; Odoemenem and Otanwa, 2011, Bonabana-Wabbi., *et al*., 2013). From these studies, the gross margin analysis is then as stated in equation 2.

$$GM = TR - TVC \quad \text{.....2}$$

Where, GM=Gross margin

TR=Total revenue

TVC = Total Variable Cost

And according to Achem *et al*.,(2013), to calculate the Gross Margin (GM), the Total Variable Cost (TVC) was computed by aggregating the cost of roots, processing and marketing. Processing costs included the cost of peeling, washing, grating, pulverizing, and toasting (frying). Similarly, marketing costs involved bagging, cost of packaging materials (bags, polyethylene) and transportation to points of sale (markets) and cost of roots included cassava input costs. The enterprise Total Revenue (TR) was computed by multiplying the quantity (Q) of processed product from 1 ton of roots by the price (P) i.e. Quantity (units) * Price per unit.

3.8.3 Heckman two stage model (Objective Three)

The Heckman's two-stage model (Heckman, 1979) was used to determine the socio-economic, institutional and market factors that affect the decisions of cassava processors to participate in the marketing of gari, flour and chips as used in (Abeykoon *et al*., 2013; Sebatta *et al*., 2014 ; Kansiime *et al*., 2014; Sigei and Bett, 2014). The model consists of two steps; firstly, the selection equation was estimated using a Probit model and secondly, an outcome equation was estimated using OLS regression. A Probit model predicts the probability of whether an individual household participated in the marketing of processed cassava products or not (equation 3).

$$\Pr(Y_i = 1/X_i,\alpha) = \phi\,(h(X_i,\alpha)) + \varepsilon_i \quad \ldots\ldots 3$$

Where:

Y_i is an indicator variable equal to one for smallholder cassava processors that participated in the marketing and zero otherwise.

ϕ is the standard normal cumulative distribution function,

X_i, are the factors affecting the decision to participate in processed cassava products markets,

α is the vector of coefficients to be estimated, and ε_i is the error term assumed to be distributed normally with a mean of zero and variance δ^2.

The variable Y_i takes the value of 1 if the perceived benefits that the household ***i*** get from participating in marketing of processed cassava products is greater than zero, and zero otherwise. This is shown as follows,

$$Y_i^* = \alpha X_i + u_i \quad \ldots\ldots 4$$

Where Y_i^* is the latent level of utility the smallholder cassava processors get from participating in the market, $u_i \sim N(0,1)$ and,

$$Y_i^* = 1 \text{ if } Y_i^* > 0 \quad \ldots\ldots 5$$

$$Y_i^* = 0 \text{ if } Y_i^* \geq 0 \quad \ldots\ldots 6$$

In the second step, an additional regressor in the sales equation was included to correct for potential selection bias. This regressor was Inverse Mills Ratio (IMR). The IMR is computed as:

$$\frac{\varphi\left(h(X_i, \alpha^{\sim})\right)}{\varphi(X_i, \alpha^{\sim})} \quad \ldots\ldots 7$$

Where φ is the normal probability density function. The second-stage equation is given by:

$$E = (Y_i|X = 1) = f(X_i\beta) + \lambda \frac{\varphi(h(X_i,\alpha^{\wedge}))}{\varphi(X_i,\alpha^{\wedge})} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 8$$

Where E is the expectation operator, Y_i is the (continuous) proportion of cassava products sold, X_i are the independent variables that affect the sales revenue/ volume of processed cassava products, and β is the vector of the corresponding coefficients to be estimated of the independent variables. Therefore, Y_i can be expressed as follows

$$Y_i^* = \beta' X_i + u_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 9$$

Y_i^* is only observed for those cassava processors who participates in the marketing, Where $u_i \sim N(0, \sigma_u)$. ($X_i = 1$), in which case $Y_i = Y_i^*$

The model can thus be estimated as follows; in the first step of deciding whether to participate in processed cassava marketing or not. This can be specified as in equation10:

$$P_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots \beta_n X_n + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 10$$

Where participation is denoted by 1 and non- participation is denoted by 0, β_0 is a constant, β_1…..n are the coefficients of the independent variables. X_i are the explanatory variables.

The Second step which involves a decision on the extent of processed cassava marketing was estimated by the use of an (Ordinary Least Square) OLS as follows;

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots\ldots \beta_n X_n + e \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 11$$

Where Y denotes the proportion of processed cassava sold, β_0 is a constant, $\beta_1 \ldots .n$ are parameters of the independent variables estimated X_{is} are the explanatory variables.

3.8.4: Empirical model

Heckman two-step procedure

Heckman , (1979) suggested a two-step procedure which involves; the estimation of a standard probit and a linear regression model. The two equations for the two steps are specified as follows. The variables used in Heckman two stages are shown in Table 5.

Step1. (Selection equation)

$$P_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_3 X_3 + e$$

$$P_{i(0,1)} = \beta_0 + \beta_1 Age + \beta_2 Gender + \beta_3 Hsize + \beta_3 Educ + \beta_3 FrmExp + \beta_4 MrktExp + \beta_5 ProcsExp + \beta_6 LandCas + \beta_7 OffrmActs + \beta_8 OffrmInc + \beta_9 TrspCost + \beta_{10} MktDisc + \beta_{11} CasBuyers + \beta_{12} MktProxmty + \beta_{13} MktInfo + \beta_{14} Contract + \beta_{15} Grouomembership + \beta_{16} Finance + ei$$

……12

Step2. (Outcome equation)

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_3 X_3 + e$$

$$W_{i(0,1)} = \beta_0 + \beta_1 Age + \beta_2 Gen + \beta_3 Hsiz + \beta_4 Educ + \beta_5 FrmExp + \beta_6 ProcExp + \beta_7 MktExp + \beta_8 LandCas + \beta_9 OffAct + +\beta_{11} OffarmIncome + \beta_{12} Transport + \beta_{13} TransportCost + \beta_{14} MarketDistc + \beta_{15} CassBuyers + \beta_{16} MrktInfo + \beta_{17} ContractArrang + \beta_{18} GroupMembership + \beta_{19} Finance + \beta_{20} IMR + ei$$

…………………………………………………………………………...………………13

Table 5: Variables used in Heckman Two Stage Model

Variables	Description	Expected sign
Age	Age of household head (Years)	
Gen	Sex of household head (Female=1, Otherwise =0)	+/-
Educ	Years spent in school (Years)	+/-
Hsize	Number of persons in a household (Numbers)	+
OffrmInc	Annual off farm income of household head (Shillings)	
Transport	Ownership of transport mean(Yes=1, Otherwise=0)	+/-
MktDisc	Distance to the nearest market (Kilometer)	
CasOcm	Annual production of processed cassava(Kilograms)	+
FrmExp	Farming experience of household head (Years)	+/-
MktExp	Cassava marketing experience (Years)	+/-
ProExp	Cassava processing experience (Years)	+/-
MrkInfo	Production and marketing information (NGOs=1, Universities=2, Phones=3, Neighbours=4, Radios=5, Extension Agents=5)	+/-
Landcas	Land allocated for cassava production (Acres)	+/-
OffAct	Off farm activities (Civil servant=1, brewing=2, Petty business=3, Others=4)	+
TransportCost	Transport cost to the market (shillings)	-
CasPrice	A unit price per kilogram of processed cassava products (Shillings)	+
Finance	Credit access by household (Yes=1, Otherwise=0)	+
ContractArrang	Contract arrangements for marketing processed cassava products (Yes=1, Otherwise=0)	+/-
GroupMarketing	Group marketing (Yes=1, Otherwise=0)	+/-
Marketing experience	Marketing experience (Years)	+/-
GroupMembership	Membership to a group (Yes=1, Otherwise=0)	+
Extension service	Access to extension services (Extension agents=1, NGOs=2, Universities=3, BDS=4)	+/-

The expected signs in the table indicated that, there was either market participation of processed cassava products (gari, flour and chips) or no market participation.

3.9 Analytical soft wares

Data were processed and analyzed using SPSS version 20, Excel 2007 and STATA version 13. Independent *t*-test was used to determine the mean of continuous variables that exist between cassava processors and non-processors and the level at which these variables are significant. This was followed by *Chi*-square (χ^2) test to determine any significant variation in different categorical variables related to the characteristics of cassava processing. Probit analysis was used to establish the factors that affect decisions of smallholder cassava farmers to engage in cassava processing. This was followed by OLS regression to determine the factors that affect the sales volume of processed cassava products. In the analysis for objectives one and three, the study conducted a frequency tests in SPSS for all the different cassava products in the study (gari, flour and chips).

3.10 Ethical consideration

The study followed a number of ethical considerations among them includes those identified by Odiya, (2009) as described below.

Informed consent, the study was able to seek authorization of the participants to be included in the study. This was done by first asking the respondents right from the beginning of the study whether it was okay for them to participate and it was upon them to decide. Those who gave in their consent were the ones allowed to be part of the study.

Access and acceptance, the study sought permission from the local leaders in order to gain access and acceptance to their areas. The local leaders and the group leaders were consulted

immediately upon reaching their local areas and the groups. In most of the areas and groups the study visited, access and acceptance was granted which enabled the study to reach the study areas and the targeted population.

Privacy and confidentiality, the identity of the respondents was kept confidential and anonymous so that they are not discovered.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents descriptive results of socio-economic, institutional and market characteristics in relation to market participation and economic viability of processed cassava products. It also presents empirical results of the Heckman two-stage model and gross margin analysis, highlighting the significant variables.

4.2 Descriptive summary of socio-economic characteristics for gari and chips processors

Table 6 presents the descriptive results for those who processed gari and chips and non-processors. The results revealed that those who processed cassava gari were 21, flour was 86 and cassava chips were 145. When descriptive analysis and Probit analysis were done for gari and chips processors, most variables turned out not significant. Therefore, the study generated a new variable known as Gari-chips combining those processing gari and chips together. The new variable had 151 respondents, which was then subjected to further tests and gave out good significant results.

According to table 6 family size, age and off farm annual income were significant. This implied that these variables had relationship between processors and non-processors.

Table 6: Descriptive characteristics for cassava processors and non-processors

Variables	Processors (n= 151) Means	Non-Processors (n= 34) Means	mean diff
Age (Years)	40.32(13.58)	44.71(14.08)	-4.38*
Family size (Numbers)	7.41(3.55)	8.59(3.75)	-1.18**
Years spent in education (Years)	6.93(4.00)	6.88(3.91)	0.05
Farming experience (Years)	21.71(14.77)	22.56(13.51)	-0.85
Cassava farming experience (years)	15.81(13.38)	16.85(13.13)	-1.04
Marketing experience (Years)	9.36(10.43)	8.09(7.14)	1.27
Cassava processing experience (years)	9.95(31.62)	6.76(7.25)	3.18
Land acreage cost (in Uganda Shillings)	93079.5(44052.47)	90000(29024.55)	3079.47
Total land size (Acres)	6.56(16.7)	3.56(1.86)	3.00
Off farm annual income (in Uganda Shillings)	1979344(2590284)	1138824(1044972)	840520.8**
Transport cost (in Uganda Shillings)	4841.06(70567)	4529.41(3466.16)	311.65
Distance to the nearest market (Kilometer)	5.02(5.54)	0.80(4.08)	0.6713089

Note that the figures in parentheses are standard deviations, ** and * imply that variables are significant 5% and 10% respectively.

The results in table 6 revealed that age was negative and significantly different ($P \leq 0.01$) between those who process (gari and Chips) and non-processors of cassava. The average age of those processing cassava was 40.3 years and that of non-processors was 44.7 years. The processors were younger than non-processors. This implied that increase in age reduces the energy needed to actively engage in cassava processing. This result is consistent with the

findings of Munyua *et al*, (2010) and Omiti and Mccullough (2009) who found out the elderly are more of food security than selling.

Household size was found to be negative and significantly ($P \leq 0.05$) different between cassava processors and non-processors. Processors had an average family size of 7 members and non-processors 8 members. Processors had smaller family sizes than non-processors. This finding matches the results in (Persson, 2009) where the study found out that processors had small family sizes than non-processors. This implies that with small family sizes the marketable surplus is obtained which is not possible in large family size where most of what is produced is consumed.

The results of this study also indicated that the household's off farm annual income had positive relationship ($P \leq 0.05$) between cassava processors and non-processors. Processors earned more annul off farm income of 840,520 shillings than non-processors. The results showed that averagely processors earned higher annual off farm income of UGX1,979,344 than the non-processors UGX1,138,824. This finding matches the findings in Essono *et al*., (2008) where the authors found out that off farm annual income had a positive relationship between cassava processors and non-processors.

Other socio-economic characteristics like education, marketing experience, farming experience, and distance to market were not statistically different between processors and non-processors of cassava (Table 6).

4.3 Descriptive summary of socio-economic characteristics for cassava flour processors

The results in table 7 revealed that cassava farming experience, off farm annual income and distance to the nearest market were found to have relation between cassava flour processors and non-processors.

Table 7: Descriptive characteristics of cassava flour processors

Variables	Processors of flour(n= 86) Means	Non-Processors(n=99) Means	Mean Diff
Age (Years)	41.22(14.37)	41.05(13.24)	0.17
Family size (Numbers)	7.77(3.42)	7.51(3.78)	0.26
Years spent in school (Years)	7.09(3.86)	6.78(4.09)	0.32
Farming experience (Years)	21.97(14.66)	21.78(14.46)	0.01
Cassava farming experience (Years)	17.81(14.58)	14.42(11.95)	3.39**
Marketing Experience (Years)	9.95(10.16)	8.40(9.66)	1.55
Cassava processing experience (Years)	8.66(9.87)	9.97(38.29)	-1.31
Land acreage cost (Shillings)	94767.44(39099.47)	90555.56(43845.09)	4211.87
Total land size	4.80(5.77)	7.06(19.98)	-2.26
Off farm Annual income (Shillings)	1541209(1541209)	2071283(2598661)	-1541209*
Transport cost (shillings)	5058.14(6455.46)	4545.46(6635.59)	512.685
Distance to the nearest market (Kilometer)	5.94(4.24)	4.45(6.00)	-4.247088**

Note that the figures in parentheses are standard deviations, ** and * imply that variables are significant at 1%, 5% and 10% respectively.

The descriptive findings for flour production revealed that cassava farming experience was negative and significant ($P \leq 0.05$) between processors and non-processors. Those who process flour had a mean farming experience of 17 years while non-processors had a mean farming experience of 14 years. This implied that more farming experience increase on the skills and knowledge on cassava production and marketing. This matches findings presented in (Masuku & Dlamini, 2012). The implication is that more cassava farming experience brings in knowledge which is a necessity in cassava processing and value addition.

The results of this finding also revealed that there is a positive relationship ($P \leq 0.05$) between the distance covered by the processors and non-processors. The mean market distance covered by flour processors was 6km while for non-flour processors was at 4km. This result matches the finding in Sigei and Bett, (2014). The authors found out that, potato distance to the nearest town had a positive relationship between potato sellers and non-sellers. This implies that the nearer to market the easier it is to access buyers who can offer better payment terms than in cases where farmers are far away from markets.

The findings also indicated that there was a negative relationship ($P \leq 0.05$) between the annual off farm income of processors and non-processors. Processors earned an average off farm annual income of 1,514,209 shillings and non-processors 2,071,283 shillings respectively. The explanation could be that more labour and time is devoted to non- farm activities than in cassava processing. This result is in line with the finding in (Sebatta et al., 2014),where the study found out that non -monthly income was significant and that non -sellers of potato earned higher monthly non-farm incomes than sellers.

Some descriptive findings for flour processors revealed that, some characteristics were not significant but they had high means than that of non-processors. These variables included age, family size, education level, farming experience, marketing experience and land acreage cost were reported to have higher means for flour processors than that of non-processors.

Processors had an average age of 41.22years while non-processors had an average age of 41.05 years with a mean difference of 0.17years. This implied that the both processors and non-processors fall within the same age bracket and possess the same strengths.

Family size, processors had an average of 7.77 members in a household while non-processors have 7.51 members in a household with a mean difference of 0.26. This implied that marketable surplus is attainable in a family with few family members than in a family with large family members due to the consumption levels.

Statistically, the study findings revealed that majority of the household heads took almost the same years in school. Processors spent an average years of 7.09 years in acquiring education, while that of non-processors are 6.78years. This result revealed that, there was no statistical relationship in the number of years spent in school between the processors and non- processors. In other words, both took same years in school. However, processors had more years in school than non-processors with a mean difference of 0.05.

Farming experience was found to be higher among cassava processor with an average of 21.79 years, while among non-processors it was reported to be 21.78. This showed that both cassava processors and non-processors had the same years of cassava processing experience. However processors' experience was higher by 0.01years.

Marketing experience was also found not significant among cassava processors and non-processors. Processors had 10.16 years while non-processors 8.40 years with a mean. Although processors had more marketing experience with a mean difference of 1.55, statistically both processors had relatively the same years in marketing experience.

Land acreage cost was found relatively the same between the processors and non-processors. Processors were able to pay an average of UGX94767.44 for an acre of land and non-processor paid UGX90555.56 for the same. Statistically, they all paid the same amount for an acre of farm land although processors paid more by UGX4211.87

Nevertheless, the mean variables of certain continuous variables for non-processors were also higher than that of processors they include processing experience where non processors have the mean processing experience of 10 years and processors 9 years. Total farm land sizes, Processors had an average total land size of 5acres while non-processors had 7acres. This matches the study by Abeykoon *et al*., (2013) where the findings revealed no statistical significant difference between certain variables.

4.4 *Chi*-square test for gari and chips processors

Findings indicated that off farm activities had a positive relationship ($P \leq 0.1$) between the processors and non-processors. The implication was that cassava processor engaged themselves in off farm activities which were more rewarding and with enough proceeds for reinvestment into cassava processing than non-processor. This findings matches results in Jaleta *et al*.,(2010), where the study found out that, off farm activities had positive relationship.

Table 8: Chi square results for off farm activities

	Frequency of Off farm activities(Civil servant=1, Otherwise=0)					
	Civil servant	Brewing	Small shop	Petty shop	others	Total
Non-Processors	0	6	0	15	13	34
Processors	3	37	12	69	30	151
Total	3	43	12	84	43	185

Chi^2 =7.9820 and Pr=0.092

The *chi*-square result also revealed that there was a positive relationship ($P \leq 0.1$) in contract arrangements between processors and non-processors of gari and chips. This implied that cassava processors marketed processed cassava gari and chips under contract arrangements than their counterparts who did not. Marketing under contract arrangements guarantees ready market as indicated by Sigei and Bett,(2014).

Table 9: Chi square results for contract arrangements

	Contract arrangements with buyers (Yes =1, Otherwise=0)		
	No (Frequency)	Yes (Frequency)	Total
Non-processors	23	11	34
Processors	11	140	151
Total	34	151	185

Chi^2=3.1812, Pr=0.071

Furthermore, chi-square findings revealed that availability of production and marketing information obtained from NGOs had a positive ($P \leq 0.05$) relationship between processors and non-processors of gari and chips. This implies that the NGOs provided the processors with more

information regarding production, processing, cassava value addition and marketing. As such, processors attained more, skills and knowledge than non- processors as reported by Sebatta *et al*., (2014).

Table 10: Chi square result for information provided by NGOs

	Production and marketing source (NGOs =1, Otherwise=0)		
	No (Frequency)	Yes (Frequency)	Total
Non-processors	26	08	34
processors	08	143	151
Total	34	151	185

Chi^2=5.6116, Pr=0.018

Production and marketing information provided by universities was found to have a positive relationship (P≤0.05) between cassava gari and chips processors and non-processors. This could imply that the easily accessible universities educated processors on the marketing and processing technologies. This made processors more informed about the processing technology as well as marketing knowledge. In a study conducted by Omiti and Mccullough,(2009) the authors found out that, access to production and marketing information had positive impact.

Table 11: Chi square result for information obtained from Universities

	Information source (Universities =1, Otherwise=0)		
	No (Frequency)	Yes (Frequency)	Total
Non-processors	34	0	34
processors	0	151	151
Total	34	151	185

Chi^2=5.3340, Pr=0.021

Furthermore, chi square revealed that extension services provided by Universities had positive relationship ($P \leq 0.05$) between the cassava processors and non -processors. This implied that the universities provided these processors with better extension services in terms of demonstration of new technology, production and marketing information than any other extension workers. In a study by Sebatta *et al*., (2014) the authors found out that having access to extension services had a positive relationship.

Table 12: Chi square results for the extension services provided by the universities

	Extension Services(Universities =1, Otherwise=0)		
	No (Frequency)	Yes (Frequency)	Total
Non-processors	33	1	34
Processors	1	150	151
Total	34	151	185

Chi^2=3.9838, Pr=0.046

4.5 *Chi*-square test for flour processors

Meanwhile, the *chi*-square findings for flour production revealed that, the general public and traders were the major consumers. These all had positive relationship at ($P \leq 0.01$) between cassava flour processors and non-processors. This indicated that those consumers provided ready markets for processed cassava flour and at relatively fair prices.

Table 13: Chi square results for consumers of cassava flour

Consumers of cassava flour (General public =1, Otherwise=0)			
	No (Frequency)	Yes (Frequency)	Total
Non-processors	52	47	99
Processors	47	39	86
Total	99	86	185

Chi^2= 6.5340 and Pr=0.011

The results revealed that, proximity to the market had positive relationship ($P \leq 0.05$) between cassava flour processors and non-processors. This implied that flour processors were situated nearer to the markets, and as a result they did not incur huge transaction costs in transportation and marketing which increased the volume of flour processed, which translates into high profits. In the study conducted by Sebatta *et al*., (2014) found out that there was being situated nearer to the market enables regular marketing and this finding had also a positive relationship between potato sellers and non-sellers.

Table 14: Chi square results for proximity to the market

Proximity to the market (Yes =1, Otherwise=0)			
	No (Frequency)	Yes (Frequency)	Total
Non-processors	57	42	99
Processors	42	44	86
Total	99	86	185

Chi^2=3.8995 and Pr=0.048

The *chi*-square findings indicate that there was a positive relationship (P≤0.05) between the information source obtained from the universities and NGOs for flour processors and non-processors. This implied that those sources of information were crucial in providing cassava flour processors with information and skills needed for cassava flour production, processing and value addition plus marketing. In a study conducted by Jagwe *et al*., (2010) the authors found out that, having access to production and marketing information had a positive relationship.

Table 15: Chi square results for information obtained from Universities

	Marketing and production information(Universities =1, Otherwise=0)		
	No (Frequency)	Yes (Frequency)	Total
Non-processors	83	16	99
Processors	16	70	86
Total	99	86	185

Chi^2=4.8970, Pr=0.027

Extension services provided by NGOs were found to have positive relationship (P≤0.05) between flour processors and non-processors. This implied that NGOs provided more extension visits, trainings and demonstration which enhanced the skills and knowledge needed in cassava processing. In a study conducted by Zamasiya *et al*., (2014) the authors found out that having access to extension services had positive relationship between sellers and non-sellers .

Table 16: Chi square result for extension services provided by NGOs

	Extension services(NGOs =1, Otherwise=0)		
	No (Frequency)	Yes (Frequency)	Total
Non-processors	26	73	99
Processors	73	13	86
Total	99	86	185

Chi^2=6.5340 and Pr=0.011

The result of *chi*-square of this study showed that gender, land type for cassava production and financial resource accessibility statistically had no significant relationship between cassava flour processors and non-processors.

4.6 Gross margin analysis for selected cassava products (Gari, Flour and Chips)

Table 17 present the various cost elements that cassava processors undertake while carrying out cassava processing and value addition.

Table 17: Cost elements in cassava processing

Cost elements in cassava processing/Cost analysis			
Input category	Gari(Uganda Shilling)	Flour(Uganda Shilling)	Chips(Uganda Shilling)
Fresh cassava roots	339175	1286011	917333
Uprooting	38700	67140	61296
Transporting	49100	33079	41131
Peeling/slicing/Washing	41818	50325	55634
Grating	17299	21281	19808
Dewatering	11762	N/A	N/A
Roasting	16389	N/A	N/A
Soy beans	90000	N/A	N/A
Fortification	24667	N/A	N/A
Drying	N/A	58420	61986
Milling	N/A	444286	N/A
Packaging	11200	15678	15163
Total Variable Cost	**640110**	**1976220**	**1172351**

Note: At the time of research the dollar rate was at 3384 Uganda Shilling. N/A is not applicable

In a similar study conducted by Achem *et al*., (2013) the authors noted that cassava input cost took the largest percent of the total production cost. Cassava input cost used in processing cassava products constitute about 53%, 65% and 78% of the total production costs for gari, flour and chips respectively. The second key element that needed huge investment in cassava

processing as noted by (Bonabana-Wabbi et al., 2013) was the element of labour. Costs comprising of the labour component is one of the most important contributors of the total production costs in cassava processing (gari, flour and chips) as presented in Figure 2. Labour components for cassava production included charges for uprooting, transporting, peeling, grating, drying and packaging. Findings in Figure 2 revealed that labour costs vary considerably according to the level of value addition undertaken in processing a specific cassava product.

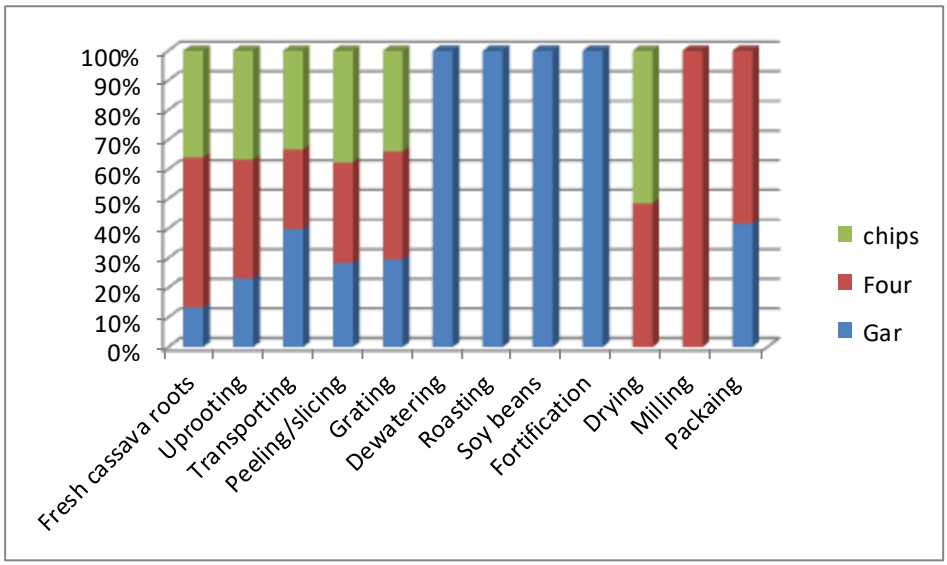

Figure 2: Build up costs for the inputs in percentage of the total cost

4.6.1 Production of processed cassava products.

The average seasonal productions of cassava products obtained in Kilograms by processors were at 876, 3788 and 2090 for gari, flour and chips respectively. The implication was that traditional cassava processing technology suits flour and chips processing but not gari (Ijigbade *et al*., 2014). Basing on these averages it was clear that cassava flour processors had the highest average production costs followed chips and finally gari. The reasons for the low gari production were; (1) the product was a new product therefore the demand was still relatively low, (2)the traditional cassava processing technology that was labour intensive, produced low output and

time consuming and lastly (3) was associated with the issue of price fluctuation of cassava gari in the market. This has made the marketing of cassava gari difficult because price fluctuation discourages processors. The result interestingly revealed that, the traditional cassava processing technology mostly favor flour and chips production and that explained the reason why gari production was still being done on a small scale than other cassava products (Ibekwe *et al* .,2012).

4.6.2 Average prices for processed cassava products and their returns

The average price per kilogram for cassava gari was higher than those of flour and chips. Gari was at Uganda shilling 2538, flour at UGX1330 and chips at UGX850. This implied that gari processing needs huge capital investment in the processing equipment at the initiation of the enterprise but once established processors normally operate at optimum level hence enjoying the economies of scale. The economies of scale enable processors to enjoy better prices (Ibekwe *et al*., 2012; Saediman *et al*., 2015; Emerole *et al*., 2014). This finding suggests that switching to gari production would save smallholder farmers in northern and north eastern Uganda significant production resources which are currently employed in producing cassava flour and chips.

4.6.3 Gross margin analysis

The results in table 18 present the gross margin analysis and variable costs for selected cassava products (Gari, Flour and chips).

Table 18: Gross margin analysis results

Gross margin analysis for Gari, Flour and Chips			
Variables	Gari	Flour	Chips
Total revenue	1690308	3997980	2550000
Total Variable costs	640110	1976220	1172351
Gross margin/Net returns	1050198	2021760	1377649
Net return on Cost	**1.64**	**1.02**	**1.18**

Note: At the time of research, the dollar rate was at 3384 Uganda Shillings

The findings in Table 18 revealed that cassava processors incurred different costs depending on the level of operation and value addition. Variable cost for those processing flour were higher at UGX 1,976,220, chips processors had UGX 1,172,351 investments on gari had UGX640110 as the total variable costs. The variation in cost was due to scale of operation and the traditional production technology that was being used.

The gross margin analysis results however revealed that gari processors earned a net return (gross margin) of UGX1,050,198, flour processor UGX2,021,760 and cassava chips UGX2,550,000 per season. The returns to variable costs among cassava processors were all positive. Gari processors had 1.64, indicating that every shilling invested in gari production yielded a net returned of 164%, flour processors had returns to variable costs at 1.02, implying that every shilling invested in flour production processors got returned of 102% of the cost. And lastly, cassava chips processor had returns to variable costs at 1.18which also implied that every shilling invested in chips production returned 118% of the total variable costs. These findings matched other studies conducted on gross margin where the authors found different return on cost for the different cassava products (Achem *et al*., 2013; Alqouqa, 2009; Odoemenem and Otanwa, 2011; Oluwasola, 2010). The differences in the gross margin/net return occurred due to

the different prices received by the different cassava processors. Out of the three processed cassava products gari was the most profitable and the main source of this profitability was the low relative production costs compared to the cassava flour and chips.

Thus, holding other factors constant the findings indicated that all the three cassava products' enterprises were profitable.

4.7 Probit analysis for marketing processed cassava flour

In table 19, the results revealed the log likelihood ratio statistics as indicated by chi-square was 104.77014 and highly significant at ($P \leq 0.0003$), suggesting that the model had a strong explanatory power. The pseudo R^2 was 0.1800 indicating that the model specification fitted the data well. The variables included in the model explained 69.73% of the variation in the decision of cassava flour processors to participate in the marketing. Appendices K is Correlation test which was performed to ascertain variables that were highly related and they were dropped. Appendices B and C present the results used in the model.

Following the use of Heckman two stage model, table 19 revealed results on the coefficients and standard errors of the variables fitted in the model. The explanatory variables with positive coefficients included age, land size allocated for cassava production, transport payment, market distance, market access and contract arrangements. On the other hand, farming experience, total land size owned, transport mean, transport cost, cassava buyer (Traders) and information source obtained from the university had negative coefficients. Positive coefficients meant those variables increased on the probability of marketing processed cassava flour while negative coefficients meant that the variables reduced on the probability of marketing processed cassava flour. Contrary to the earlier expected signs variables such as gender, household size, off farm

activities, information (Obtained from Neighbours) had no significant impact on the decision of the smallholder processors to market processed cassava flour.

Table 19: Results for Probit and Marginal effect analysis

Variables	**Probit regression Coefficients**	**Marginal effect Coefficients**
Age of household head (Years)	0.026(0.013)*	0.010(00.005)*
Gender of household head (Female=1, 0= otherwise)	0.090(0.242)	0.035(0.095)
Size of household (Numbers)	0.023(0.032)	0.009(0.012)
Farming experience (Years)	-0.026(0.013)*	-0.010(0.005)*
Total farm Land Size (Acres)	-0.098(0.051)*	-0.038(0.019)*
Farm land size for Cassava Production(Acres)	0.257(0.109)**	0. 100(0.042)**
Off Farm Activities(1= Civil servant; 0=otherwise)	0.148(0.097)	0.058(0.038)
Transport mode used(on head=1, otherwise=0)	-0.179(0.089)**	-0.070(0.035)**
Pay Transport(Yes=1, 0=Otherwise)	0.450(0.243)*	0.171(0.089)*
Transport Cost(Shillings)	-0.000(0.000)*	-0.000(0.000)*
Market Distance(kilometers)	0.091(0.036)**	0.035(0.014)**
Cassava buyer (Traders=1, Otherwise=0)	-0.491(0.239)**	-0.193(0.093)**
Proximity to the market(Yes=1,0=Otherwise)	0.374(0.217)*	0.145(0.084)*
Information (Neighbours=1, 0=Otherwise)	0.287(0.233)	0.112(0.090)
Information (Universities=1, 0=Otherwise)	-1.232(0.428)***	-0.379(0.086)***
Contract Arrangement(Yes=1, 0=Otherwise)	0.748(0.313)**	0.291(0.115)**
	Log Likelihood:-104.77	No of Observation 185
	P-Value: 0.0003	PseudoR^2: 0.1800

Note that the figures in parentheses are standard errors, ***, ** and * imply that variables are significant at 1%, 5% and 10% respectively

Age of cassava processor was positive and significantly ($P \leq 0.01$) influenced on the decision to participate in the marketing of processed cassava flour. An increase in processors' age by one year increased on the probability of marketing cassava flour by 0.010. This implied that an increase in age shows one's position in the family. Elderly persons are usually the central decision makers in households. This is because of the experience knowledge that they have acquired in life. Positive decisions regarding the marketing of processed cassava flour increased on the probability of the household's to market participate and vice versa. This agrees with the findings in Sebatta *et al*., (2014)the authors found out that age is an indicator of one's position in the family that enables decision making. Bahta (2012) found out that old farmers had better market information and experience which promoted market participation. However contrary to that, Abu *et al*.,(2014) asserted that old people are more concerned about food security than the young people who mind of quality of life, Sigei et al., (2013) asserted that that young people are more enthusiastic than older people.

The threshold test done on age in Appendix L on Probit analysis for flour with age being squared (age^2) turned out not to be significant. This therefore made it impossible to determine the point at which age^2 either increase or decrease on marketing of processed cassava flour.

Farming experience was found negative and significantly ($P \leq 0.01$) influenced the decision of cassava processors to market processed cassava flour. One year's increase in the farming experience of cassava processors reduced the probability of marketing processed cassava product by 0.010. This implied that the more experienced a famer becomes in farming they are most likely to trade off cassava production for other crops.

Farm land size was also negative and significant (P≤0.1) in influencing the decision of cassava processors to participate in the marketing of processed cassava flour. Increase in farm size by one acre of land for cassava production decreased the probability of marketing flour by 0.038. The implication was that farmers with large farm land would rent off their land to others and survived on the proceeds of the rent. However, contrary to this finding, Gobena *et al*., (2012) asserted that large farm encouraged market participation. Omiti and Mccullough, (2009) found out that large farm land results into surplus production which promoted market participation.

Farm land size allocated for cassava production was positive and significant (P≤0.05) in influencing the decision of cassava processors to market participate. Allocating an additional acre of land for cassava production increased the probability of marketing processed cassava flour by 0.1. Large farm size brings in more economic power especially when it is efficiently utilized hence promoting market participation. Similar to this finding Abu *et al*., (2014) found out that large farm land act as motivation factor for marketing due to the economies of scale attained regarding the cost incurred in input purchase, large production and related transaction costs.

Ownership of transport mode was found to negatively and significantly (P≤0.05) influence on the decision of cassava processors to participate in the marketing of flour. Acquisition of transport mode by cassava processor reduced the probability of flour processors market participation by 0.070. This implied that the transport mode possessed was not used for transporting flour hence reducing on the chances of marketing processed flour. Contrary to this finding Bahta (2012), found out that ownership of transport means overcame transaction costs especially fixed transaction costs that prohibit marketing participation hence market participation.

Being able to pay for the transportation of processed cassava products was found to positively and significantly (P≤0.01) influence the decision of cassava processors to participate in the marketing of processed cassava products. Payment for the transportation of processed cassava products increased the probability of marketing of processed cassava flour by 0.171. The implication was that being able to pay for the transportation of flour enabled processors to access better markets where good prices were offered.

Distance to the nearest market was positive and significantly (P≤0.05) influenced the decision of cassava processors to participate in the marketing of processed cassava flour. An increase in the market distance by one kilometer increased the probability of marketing processed cassava flour by 0.035. The implication was that those processors who were nearer to the market were able to market participate regularly than those who were situated far away from the markets. This was because of the easy access to the buyers with whom they can negotiate on good marketing terms. Similar to the findings in Bahta and Bauer (2007) the authors asserted that those who were nearer to the market participated more than those who were far away from market and on regular basis.

Market provided by urban traders for processed cassava flour was found negative and significantly (P≤0.05) influenced the decision of cassava processors to participate in the marketing of processed flour. Availability of urban traders reduced on the probability of marketing processed flour by 0.145. This implied that prices offered by urban traders were much lower than those offered by other buyers which limited marketing of processed cassava flour. Lower prices kill marketing incentives leading to low participation.

Proximity to the market was positive and significantly influenced the decision of cassava processors to participate in the marketing of processed cassava flour. Being nearer to the market

increased the probability of marketing cassava flour by 0.145. The implication was that those who were nearer the markets were more likely sold regularly cassava flour than those who are far. This was because of the easy access to the buyers.

Production and marketing information provided by universities was found to negatively and significantly ($P \leq 0.001$) influence cassava processors' decision to participate in the marketing of processed cassava flour. The findings revealed that production and marketing information provided by universities reduced on the probability of marketing flour by 0.379. The implication was that universities could not have provided information on cassava production and marketing resulting to lack of information on production and marketing of processed cassava flour. Usually inadequate information makes it impossible to market because of the difficulties in identifying potential markets. In the study by Omiti & Mccullough, (2009) the study found out that having access to production and marketing information made it easier for the processors to sell.

Contract arrangements positively and significantly ($P \leq 0.05$) influenced the decision of cassava processors to participate in the marketing of processed cassava flour. Having contract arrangement increased the probability of marketing flour by 0.291. This implied that contract arrangements guaranteed ready market and better prices which facilitated market participation. This result matches with the findings in Sigei *et al.*, (2013) where the authors found out that availability of contract arrangements enhances market participation.

4.8 Probit analysis for marketing processed cassava gari and chip

In Table 20 it was observed that the log likelihood ratio statistics as indicated by chi-square statistics was -85.712697 and highly significant at ($P \leq 0.0000$) suggesting that the model had a strong explanatory power. The pseudo R^2 was 0.1985 indicating that the model specification

fitted the data well. The model explained 78.38% of the variations in the variables that affected the decision of cassava gari and chips processors to participate in the marketing of processed cassava gari and chips. The results of the model are presented in Appendices E and F.

Table 20: Probit and marginal effect results for gari and chips processors

Variables	Probit Regression Coefficients	Marginal Effect Coefficients
Age of household head (Years)	-0.009(0.008)	-0.002(0.002)
Gender of household head (Female=1, Otherwise=0)	-0.301(0.257)	-0.091(0.082)
Size of household (Numbers)	-0.083(0.33)**	-0.024(0.009)**
Acreage cost (Shillings)	-0.403(0.456)	-0.116(0.131)
Off farm activities (civil servant =1, Otherwise=0)	-0.152(0.104)	-0.043(0.029)
Annual off farm Income(Shillings)	0.285(0.138)**	0.083(0.039)**
Transport Cost(Shillings)	-0.516(0.163)***	-0.148(0.047)***
Consumer Brewery(Yes=1,Otherwise=0)	1.371(0.766)***	0.208(0.045)***
Information Phone(Yes=1, Otherwise=0)	0.708(0.386)**	0.157(0.062)**
Information Extension Agents(Yes=1,Otherwise=0)	1.273(0.391)***	0.263(0.052)***
Extension Services (If Ngos=1, Otherwise=0)	0.346(0.278)	0.103(0.083)
Contract Arrangement(Yes=1, Otherwise=0)	-0.777(0.279)****	-0.257(0.095)***
-Cons	6.787(5.557)	
	Log Likelihood: -85.712697	No. of observation: 185
	P Value: 0.0000	Pseudo R^2: 0.1985

Note that the figures in parentheses are standard errors, ***, ** and * imply that variables are significant at 1%, 5% and 10% respectively

The estimated coefficients of the independent variables in Probit regression revealed that explanatory variables such as off farm annual income, cassava buyer (Brewers), information

(Obtained from phones), information (obtained from extension workers), Extension services (provided by NGOs) positively influenced market participation of processed cassava gari and chips. On the other hand household size, transport cost and contract arrangement negatively influenced the decision of cassava processors to participate in the marketing gari and chips.

Contrary to earlier expected signs variables age, gender and off farm activities had no significant impact on the decision of the smallholder processors to participate in the marketing of processed gari and chip.

Table 20 results revealed that size of household negatively and significantly ($P \leq 0.05$) influenced the decision of cassava processors to participate in the marketing of processed gari and chips. An increase in a household size by one person reduced the probability of market participation by 0.024. This implied that with large family size most of what is produced is consumed leaving little or no marketable surplus which prohibited marketing of gari and chips. This confirms results in Abu *et al*., (2014),who argued that with a large family size most of what the family produced are consumed. However, in a similar study conducted by (Gebremedhin & Jaleta, 2010) the authors asserted that large family size was associated with high cost. Omiti and Mccullough (2009) argued that large family size enhanced surplus production.

Off farm annual income was positively and significantly ($P \leq 0.05$) influenced the decision of cassava processor to sell gari and chips. An increase in the household's off farm income by one shilling increased the probability of marketing processed gari and chips by 0.083. This implied that large capital enhances economic power, large scale production and acquisition of inputs leading to market participation. This result confirms the results in (Abu *et al*., 2014) who argued that off farm income enhances large scale production and input acquisition.

Transport cost was found negative and significant (P≤0.001) in influencing the decision of cassava processors to market gari and chips. An increase in transport cost by one shilling reduced the probability of marketing gari and flour by 0.148. Implying that cassava processors are more likely not to sell in urban markets with better prices due to high transaction cost that reduce on their earnings. This result agrees with the results in (Omiti & Mccullough, 2009) the authors found out that transport cost was associated with distance covered in marketing. Farmers sold in markets with low transport cost.

Availability of those engaged in those brewing provides market for processed gari and chips. This was found to be positive and significant (P≤0.001) in influencing the decision of cassava processors to participate in the marketing of processed gari and chips. An increase in the number of those engaged in breweries by one person increased the probability of marketing processed gari and chips by 0.208. This was true because processed cassava chips and gari are used as inputs in brewing. The other explanation was the ready market provided by those engaged in breweries.

Access to production and marketing information via phones was found positive and significant (P≤0.05) in influencing the decision of cassava processor to participate in the marketing of processed cassava gari and chips. Having a phone increased on the household participation in the marketing of processed cassava gari and chips by 0.157. The implication was that information obtained via phones was reliable, accurate and above all, that information could easily be accessed by processors which made it easier to persuade processors to sell their gari and chips than those without phones.

Access to production and marketing information through extension agents was found to positively and significantly (P≤0.01) influence cassava processors' decision to participate in the marketing of processed cassava gari and chips. Availability of extension agents who provided cassava gari and chips processors with production and marketing information increased on the probability of marketing gari and chips by 0.262. This implied that extension agents provided processors with information on new technology, helped in the identification of market opportunities where they were which facilitated production and marketing of processed cassava gari and chips. In a study conducted by Sebatta *et al*., (2014) the authors asserted that extension agents provided marketing information and new improved variety to farmers which enhanced market participation. Bahta and Bauer (2007) and Persson (2009), found out that information provided by extension agents promoted market participation.

Contract arrangements negatively and significantly (P≤0.001) influenced the decision of cassava processors to participate in the marketing of gari and chips. Having contract arrangement reduced the probability of marketing gari and chips by 0.257. This implied that cassava production environments are unreliable with lots of uncertainties which made processors reluctant to commit themselves to any contract arrangement due to the fear of unexpected losses that they may incur resulting to breach of the contract.

4.9 Factors influencing the sales revenue of processed cassava flour

Table 21: OLS regression results for sales volume of cassava Flour sold

Variables	OLS Regression Coefficients	Robustness Test Coefficients
Inverse mills Ratio	-1528.716 (3026.945)	-1528.716(1448.978)
Age of household head (Years)	-1219.63(886.8233)	-1219.63(620.0254)**
Gender of household head (Female=1, 0=Otherwise	51842.22(28874.87)*	51842.22(46100.3)
Education Level(Years)	-3040.405(3347.919)	-3040.405(2460.449)
Farm land size for Cassava Production (Numbers)	19133.17(5954.95)***	19133.17(7588.635)**
Off Farm Activities	-27042.91(10726.34)	-27042.91(21989.05)
Annual Income of household head (Shillings)	-10894.87(14577.81)	-10894.87(8344.07)
Transport Cost (Shillings)	-5.220596(3.182543)	-5.220596(4.219911)
Distance to the market (Kilometers)	7617.68 (3602.124)**	7617.68(4826.158)
Flour Buyers(Traders=1, 0=Otherwise)	-53599.02(26378.26)**	-53599.02 (31667.25)*
Proximity to the market(Yes=1, Otherwise=0)	-35495.49(24336.61)	-35495.49(17484.44)**
Extension by NGOs(Yes=1, Otherwise=0)	55604.52(24837.85)**	55604.52(27381.47)**
Contract Arrangement(Yes=1, Otherwise=0)	78895.57(30099.9)**	78895.57(46792.87) *
Finance sources (Membership=1, Otherwise=0)	60089(31996.14)*	60089 (65803.12)
-cons	283503.6(208224.8)	283503.6(135442.8)**
	No of observation=185	No of observation=185
	P-Values=0.0001	P-Values=0.2125
	R^2=0.2143	R^2=0.2143

Note that the figures in parentheses are standard errors, ***, ** and * imply that variables are significant at 1%, 5% and 10% respectively.

The results in Table 21 indicated that farm land size allocated for cassava production, extension services provided by NGOs, contract arrangements and the constant had positive coefficients meaning that they increased on the sales revenue of processed cassava flour. However, age of the household head, flour buyers (Traders) and distance to the market had negative coefficients indicating that they reduced on the sales revenue of processed flour.

Table 21 results indicated that gender of cassava processor positively and significantly ($P \leq 0.1$) affected the sales volume of gari and chips sold in the market. Being a female cassava processor increased on the flour sales revenue by 51842.22. This was because cassava processing being considered as women's activities especially when traditional processing technology used. In the studies conducted by Sebatta et al., (2014) and Sigei et al., (2013) on the extent of market participation. The authors found out that male dominated in market participation because of the contacts and decisions that they have which increased on their sales revenue. Contrary to that, Abu et al., (2014) found out that male headed household had less marketing strengths than their counter parts which limited the extent of market participation.

Land size allocated for cassava production had a positive and significant ($P \leq 0.001$) impact on the volume of flour sold in the market. An additional increase on land by one acre in the land size allocated for cassava production increased the sales revenue of flour sold. This implied that more cassava output was obtained which facilitated marketing. This finding confirms the findings in the study by Abu *et al*., (2014) who found out that allocating more land for production increased on the extent of market participation and the sales volume.

Distance to the market had positive and significant (P≤0.05) impact on the volume of processed cassava flour sold in the market. An increase by one kilometer in the distance to the market increased the sales revenue of cassava flour by 7617.6 8and it does not match with the earlier expected sign. This was because being nearer to the market increased sales volume because of the reduced transaction costs and other marketing costs. This finding is similar with the study by in Abu et al., (2014) where authors also noted that being nearer to the market reduced transaction costs hence realizing more sales volume. However Maziku, (2015) found out that market distance negatively affect the extent of market participation.

Proximity to the market was negatively and significantly (P≤0.05) influenced the volume of cassava flour sold in the market. Poor positioning of cassava processing enterprises far away from the market reduced the sales revenue by 35495.49. This implied there were difficulties in interacting with the buyers. This result agrees with the finding in Sebatta *et al*.,(2014) who found out that being nearer to the market made it easier to access buyers who offered better payments hence more market participation.

Extension services provided by NGOs were found to positively and significantly (P≤0.05) influence the volume of cassava flour sold in the market. This implied that easy access to extension services provided by NGO increased the sales revenue by 55604.52. This was because NGOs provided these processors with better extension services in terms of demonstration of new technology, production and marketing information than any other extension workers. This finding agrees with the findings in Bahta, (2012) where the author found out that extension services had positive impact on the extent of market participation.

Contract arrangement for marketing was found to positively and significantly (P≤0.05) influenced the volume of the cassava flour sold in the market. Having contract arrangement increased the sales revenue for flour by 78895.57. With contract arrangements processors were sure of the price and market that motivated them to work harder in order to meet the required output. This findings confirms the findings in (Geoffrey et al., 2013) where the authors found out contract arrangement had positive impact on the extent of market participation.

Availability of urban traders was found to negatively and significantly (P≤0.1) influence the volume of cassava flour sold in the market. Availability of urban traders offering market for processed cassava flour was found to have a negative impact on the sales revenue for processed cassava flour. The implication was that urban traders offered low prices for cassava flour. These urban traders were middlemen who bought directly from cassava processors and later on resold in urban areas at better prices. These findings are presented in appendix G and H.

4.10 Factors influencing the sales revenue of processed cassava gari and chips

In Table 22 the findings indicated that marketing experience, education level and group marketing of processed cassava gari and chips had positive coefficients. This implied that they increased on the sales revenue of processed cassava gari and chips.

Table 22: OLS regression results for sales volume of cassava gari and chips marketed

Variables	OLS Regression Coefficients	Robustness coefficients
Inverse Mills Ratio	26666.79(199677.8)	26666.75(79390.61)
Gender of household head(Female=1,Otherwise=0)	-83682.4(565995.9)	836826.4(693257.1)
Household size (Numbers)	77384.13(65362.9)	7738.13(71640.47)
Marketing Experience(Years)	110664.7(62592.1)***	110664.7(83322.65)
Education Level(Years)	99365.68(24032.93)*	99365.68(83675.21)
Market Cassava Products(Group=1, Otherwise=0)	887647.4(488078)*	88764.4(803810)()
	No. of Observation; 185	Adj R-squared; 0.1097
	P-values; 0.0002	

Note that the figures in parentheses are standard errors, *** and * imply that variables are significant at 1%, 5% and 10% respectively.

In Table 22 the Study found out that marketing experience positively and significantly ($P \leq 0.01$) influenced the volume of processed cassava gari and chips sold in the market. An increase in a processor's marketing experience by one year increased the volume of processed cassava gari and chips sold in the markets by110664.7 UGX. This was due to the increased skills and knowledge that the processors acquired as a result of their constant interaction with the buyers. This result is in line with the finding in Sigei *et al*., (2013); Maziku, (2015) where the authors found out that marketing experience had positive significant impact on the extent of market participation.

Education level of the household head was positive and significantly (P≤0.1) influenced the volume of the processed cassava gari and chips sold in the market. This implied that an increase in the education level by one year increased the sales revenue obtained from marketing processed cassava flour by 99365.68 shillings. The implication was that the knowledge obtained broadens the information needed for production as well as marketing of gari and chips. This finding concurs the results in (Omiti & Mccullough, 2009) who found out that education level was significant in increasing the percentage of maize sold by rural farmers. Maziku, (2015), found out that education was significant in influencing the extent of market participation.

More interestingly, the study found out that group marketing had positive and significant (P≤0.01) impact on the volume of processed cassava gari and chips marketed. Having joint marketing increased the sales revenue for processed cassava gari and chips by 887647.4 shillings. This implied that with group marketing processors were able to have collective responsibilities and strong bargaining powers, shared costs, and enjoy other benefits associated with social organization. This finding confirms the results in Sigei *et al*., (2013) where the authors found out that group marketing had positive impact on the extent of market participation. The details of OLS regression are in Appendices I and J.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter starts by summarizing and concluding based on the findings, in order to answer the objectives of the study. This was then followed by recommendations that can be drawn from the findings and conclusions of the study.

5.2 Summary

5.2.1 Characterization of cassava processors in north and north eastern Uganda

By use of t test and chi-square, the study was able to determine the various factors that influence cassava processing in north and north eastern Uganda. These factors were either positive or negative meaning that they either had relationship between cassava processors and non-processors or not. Positive coefficients signified that variables had relationship between cassava processors and non-processors while negative coefficients indicated that those variables did not have relationships between cassava processors and non-processors. Basing on that the study found out that, age, household size, Household off farm income, Cassava farming experience, distance to the nearest market, off farm activities, contract arrangements, production and marketing information provided by NGOs and Universities, Extension services provided by both the Universities and NGOs and Proximity to the market were major characteristics of cassava processing. Factors like, gender, Education level, farm land size, group membership and accessibility to finance were found not to have any significant impact on cassava processing.

Whereas some variables were statistically insignificant in cassava processing their means were quite higher than those of non-processors. These included age, family size, farming experience, education level, marketing experience, cassava processing experience, acreage cost and transport cost. Never the less even non-processors had some variables with higher mean than those of the cassava processors although not significant. These variables included distance to the nearest market, processing experience, cassava farming experience.

5.2.2Profitability levels of processed cassava products.

In order to determine how profitable cassava processing enterprises are, the study conducted a gross margins analysis (Measure of profitability). In other words the study wanted to find out whether or not these cassava processing enterprises are profitable. In a bid to achieve that, the study applied this formula as stated in equation 2: GM=TR-TVC, where GM was the gross margin, TR was the Total revenue and was obtained by multiplying quantity of output produced by price (Q.P) and finally TVC was Total Variable Costs. All the cost elements were aggregated together to form the total variable costs (TVC). Cost elements considerably consisted of the components of cassava input and labour. Some of the activities which needed huge component of labour included charges for; uprooting, transporting, peeling, washing, slicing, grating, dewatering, roasting, drying, milling and packaging. Cassava processing enterprise was a profitable one owing to the fact that cassava was a low cost crop to produce, the root was cheap to purchase and it had a fair conversion ratio meaning that high output can be expected from the input depending on the technology and the variety used.

Results from gross margin analysis conducted revealed that most of the cassava processors who processed cassava products had positive average gross margins. Gari at UGX1050198, Flour UGX2021760 and chips UGX1377649 and the net return on cost were also found to be positive (Gari at 1.64, Flour at 1.02 and chips at 1.18). The total variable costs for cassava processing enterprises were varying with gari having UGX640110, flour UGX1976220 and chips UGX1172351. The average seasonal production of cassava products in kilograms were at 876 for gari, 3788 for flour and 2090 for chips. Their prices per kilogram were UGX 2538 gari, UGX 1330 flour and UGX850 for chips.

5.2.3 Factors that influence the decisions of cassava processors to participate in marketing

Heckman two stage model was used to determine the factors that influenced the decision of cassava processors to engage in the marketing of what they process. Following the use of heckman two stage model as stated in equation 3 to equation 13, Probit and OLS analysis were done. The results indicated that various factors influenced the decisions of the processors to market cassava products and the volume of processed cassava products sold. Probit analysis results revealed that age, farm land size allocated for cassava production, distance to the nearest market, proximity to the market, and contract arrangements had positive impact on the decisions cassava processors to market processed cassava flour. Meaning that they increased on the probability of marketing processed cassava flour. However, the same analytical results showed that farming experience, total farm land size, transport mean, transport cost, flour bought by urban traders and production and marketing information provided by universities had negative impact on the decisions of cassava processors to market cassava flour. The implication is that,

they reduced the probability of marketing processed cassava flour because they had negative coefficients.

Similarly Probit analysis was run for gari and chips processors. The Probit results revealed that annual off farm income, presence of market provided by breweries, production and marketing information provided by phones, extension agents were all positively significant in increasing the probability of marketing gari and chips. Other variables such as, household size, transport cost and contract arrangements had negative coefficients implying that they reduced on the probability of marketing gari and chips. On the other hand OLS regression was conducted to determine the factors that influenced the sales revenue of processed cassava products. The results revealed that marketing experience, years spent in school and group marketing had positive significant impact on the sales revenue of gari and chips. Meanwhile, Factors like farm land size allocated for cassava production, market provided by urban traders, extension services provided by NGOs and contract arrangements were found to have positive significant impact on the sales revenue for cassava flour. However, age and proximity to the market were found to reduce on the sales revenue for those marketing flour.

5.3 Conclusions

5.3.1 Characterization of cassava processors

The results showed that cassava gari and chips processors were younger than non-processors. In terms of family sizes, cassava gari and chips processors smaller family sizes than non-processors. Cassava gari and chip processors earned higher off farm annual off farm income than non-processors. Characteristically, cassava flour processors had more cassava farming

experience than non-processors. In terms of off farm annual income cassava flour earned less income than non-processors. Finally, in relation to market distance cassava flour processors covered more distance than non-processors. Therefore in conclusion, cassava processors exhibit different characteristics that enable them to carry on with their processing business.

5.3.2 Profitability levels of processed cassava products

The study investigated the profitability level of cassava processing enterprises in the study area. Results showed a substantial understanding of the cost elements that impacted on the profitability. Findings revealed that cost of cassava input and labour for the various cassava processing activities such as; uprooting, transporting, peeling, washing, slicing, grating, dewatering, roasting, drying, milling and packaging were responsible for the returns received because they accounted for the greatest percentage of production costs. Generally there were positive but low gross margins for the three enterprises (gari, flour and chips). Positive gross margin indicated that cassava processing was a profitable business ventures. The low gross margin was associated with low scale of operation of the processors. The low gross margin was also associated with the manual processing technology that these cassava processors use which produced low output, time consuming and labour intensive.

Therefore in conclusion, the study suggests that cassava processors need to switch to gari production in order to save some significant production resources which are currently employed in the production cassava flour and chips. The study also concludes by stating that, labour charges and cassava input are they major production costs in cassava processing.

5.3.3 Factors influencing decision of cassava processors to participate in marketing

The following factors were responsible for market participation of processed cassava products and they include age of household head, gender, family size farming experience, farm land size, farm land size allocated for cassava production, transport mode used, ability to pay transport, transport cost, market distance, presence of cassava buyers, annual off farm income, proximity to the market, information sources obtained from both neighbors and universities and contract arrangements.

Factors such as marketing experience, education level, group marketing, age of household head, farm land size allocated for cassava production, presence of flour buyers, proximity to the market, extension services and contract arrangements were responsible for the extent of market participation. Many factors are responsible for market participation and their extent. These vary depending on the direction of the coefficients of the variables.

5.4 Recommendations

5.4.1 Policy recommendation

Based on the results more farmers should be encouraged to grow and process cassava. This is not because cassava is a staple food security crop and major household diet but rather the economic potential that the crop possesses. This would generally improve on the livelihood and standard of living of farmers because their incomes would have increased. North and north eastern Uganda have numerous smallholder farmers meaning that improvements on their standards of living would increase the welfare of the country as whole.

Adoption of cassava processing and cassava value chain by smallholder processors would increase the production and consumption of processed cassava products. This is because cassava processing makes the supply chain and pricing of products stables. Not only that cassava is rich in starch and hence it can be used as a raw material for production of animals' feeds, brewing, and industrial extraction of starch for fabrication. Cassava can also be processed into other forms that would make it more attractive and palatable to much of the population.

In light of the above recommendations, it would be beneficial to increase effort in the development of sustainable cassava markets structures and sustainable value chain. Intervention targeting cassava processing technologies would have a large impact on farmers and make them enjoy economies of scale. Trainings of farmers on production and marketing would empower these women to reap more from their cassava processing enterprises.

The study recommends that smallholder cassava processors should be encouraged to focus on group marketing. This is because the study has shown that smallholders processor when they pulled resources together and share responsibilities, it strengthen their bargaining power. Therefore, smallholder processors should engage more in group marketing so that they obtain more sales revenue.

Smallholder cassava processors should be encouraged to have contract arrangements as way of marketing. Contract arrangement not only guarantees better prices and quantity, but also ready market. The study has proven that having contract arrangements in place promote market participation since processors are sure of the market.

More rural women needs to be empowered and encouraged to engage in cassava processing enterprise because this study has revealed that, these enterprises are profitable and that women get more income than men. But in order to achieve this, there is need to have these women in groups for easy access to; finances and suitable processing technologies.

5.4.2 Recommendation for further studies

The study recommends that more studies should be conducted on cassava value chain, consumer preference and market dynamics, production efficiency and cassava waxing technology. These would help processors to take the opportunities of export trading, commercialization and income expansion for cassava processing enterprises.

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Appendix A: QUESTIONNAIRE USED IN THE STUDY

Gulu University

Faculty of Agriculture and Environment

Department of Rural Development and Agribusiness

Marketing of processed cassava products by smallholder farmers in north and north east Uganda

Questionnaire Number……..Name of the interviewer……..

Dear respondent, my name is……..am conducting data collection on behalf of a graduate student of Master of Science in Agri-enterprise Development. This study is about the decisions of smallholder cassava farmers to participate in the marketing of processed cassava products and determining the economic viability and competitiveness of cassava products. You have been selected to participate in this study and your responses will be strictly used for academic purposes only. Kindly provide your candid responses which, we shall treat with strict confidentiality.

1.0 Socio- demographic information

1.1 Name of respondent……1.2 Parish……
1.3 Sub county …… 1.4 District…… Age…….

1.6 Gender of household……1.7 household size……

1.8. Number of years of formal education of respondent…… (Years)

1.9 Farming experience …….. (Years); Cassava farming experience (Years)…….1.10 marketing experience……. (Years)

1.12 cassava processing experience…… (Years).

2. Specifications of processed cassava products

2.1 Were you able to produce the following cassava products in the last 12 months?

Nutritionally improved gari	Yes	No
Cassava flour	Yes	No
Cassava chips	Yes	No

2.2 If yes then indicate in the table below how much was produced and sold

Items	Average Quantity produced in 12 months	Average quantity consumed last year	Average quantity sold last year	Unit Price sold
Nutritionally improved gari				
Cassava flour				
Cassava chips				

2.3Which cassava variety do you use for processing the following cassava products?

Cassava products	Cassava variety
Nutritionally improved gari	
Cassava flour	
Cassava chips	

2.4 Which type of gari were you able to process? (a) Ordinary gari (b) Fortified gari

2.5 What are the major cost incurred in the production of processed cassava products (Nutritionally improved gari, cassava flour and cassava chips)……

2.6 Estimate cost for each activity in the process of producing gari.

Item	No of units (Kilograms)	No. of persons	No of days per activity	No of hours per activity	Pay per person per day (UGX)
Input cost					
Cassava					
soybeans					
Fuel					
Water					
Transport					
Uprooting					
Peeling					
Loading to grater					
Sieving and pressing					
Packaging					
Labelling					
Branding					
Advertisement					
Others (specify)					
1					
2					
3					
Total					

2.7 Whose land do you use for producing cassava? (a) My own (b) Hired (c) Groups'

If owned or groups', How much would you charge for an acre of land?…….(UGX)

If it's your own, How big is your land in Acreage…….

2.8 Of the total land acreage you have, how much land is allocated for cassava production?

……..

2.9 What other off farm activities do you do to earn additional income?

(a) Civil servant (b) brewing(c) small shop (d)others specify……..

And how much do you earn annually?.....(UGX)

2.11 The type of packing materials used for processed cassava products

……..

2.12 How do you transport processed cassava products (nutritionally improved gari, cassava flour and cassava chips) to the market?

(a) Carry on head (b) Bicycle (c) Hired bodaboda (d) Sell from the processing site (e) use own motor cycle (f) others specify…….

2.13 Do you pay to transport processed cassava products to the market? (a) Yes (b) No

If yes, then how much do pay to transport those processed cassava products to the selling point (UGX)……kms…….

If no then how much do think you would pay to transport the same
(UGX)…….

2.14 identify common causes of losses in the production of processed cassava products (nutritionally improved gari, cassava chips and cassava flour)

(a)…….

(b)……..

2.15How much cassava do you think is wasted during the process of processing and fortification into gari (%)…….

Flour (%)……

Chips (%)?.....

Nutritionally improved gari (%)……

2.16 With regard to production of processed cassava products; nutritionally improved gari, flour and chips what has been your strengths and weaknesses?

Strengths

(a)……

(b)……..

Weaknesses

(a)……

(b)……

3.0 Marketing of processed cassava products

3.1 who are your consumers?

(a) Primary pupils (b) hospitals (c) Lactating mothers (d) others specify……

3.2 Do you find it hard to allocate your buyers? (Yes) (No)

If yes then what are the challenges…….
……

3.3 Where do get your production and marketing information.

(a) Neighbours (b) Ngos (c) Universities (d) Radios (e) Phones (f) Extension Agents

3.4 Who provide extension services to you?

(a)NGO (b) University (c) Extension Workers (d) Business development workers

3.5 How would like to market processed cassava products? (a)Group (b) Individually.

If group why

.....

.....

If individually explain

……
…….

3.6 Rate the significance of the price offered for processed cassava products

Items	Very good	Good	Fair	Poor	worse	Worst
Nutritionally improved gari						
Cassava flour						
Cassava chips						

3.7 Do you any contract arrangements with your buyer (a) Yes (b) No

If yes, specify…….

If No, then why not?……

3.8 Are you a member of any group? (a) Yes (b) No

If yes, what is the name.....

3.9 Are financial resources easily available (a) Yes (b) No?

3.11 Tick appropriate sources of income and please indicate the interest rates.

Bank	VSLA	Group membership

Thank you!!!

Appendix B: Marginal Effects (Post Estimation for flour production)

. mfx effects after probit(predict)

Marginal Y=.42307645 =Pr(Flour_Production)

variable	dy/dx	Std. Err.	z	P>z	[95%	C.I.]	X
HH_Age	.0102458	.00534	1.92	0.055	-.000227	.020718	41.1297
HH_Gen~r*	.0356153	.09557	0.37	0.709	-.151689	.222919	.259459
HH_Size	.0091076	.01256	0.72	0.469	-.015519	.033734	7.62703
Farm_Exp	-.010104	.0052	-1.94	0.052	-.020293	.000085	21.8649
Total_~e	-.0386452	.01975	-1.96	0.050	-.077351	.00006	6.01081
Land_A~n	.100784	.04202	2.40	0.016	.018424	.183144	1.88243
Off_Fa~s	.0580274	.0382	1.52	0.129	-.016844	.132899	3.65405
Tranport	-.0702366	.03515	-2.00	0.046	-.139125	-.001348	3.24324
Pay_Tr~t*	.1713264	.08933	1.92	0.055	-.003765	.346418	.691892
Transp~t	-.0000246	.00001	-1.71	0.088	-.000053	3.7e-06	4783.78
Market~e	.0356766	.01413	2.53	0.012	.007986	.063367	5.14324
Cosume~s*	-.1934703	.09344	-2.07	0.038	-.376602	-.010339	.713514
Diffuc~s*	.1457104	.08404	1.73	0.083	-.019006	.310427	.491892
Infor~rs*	.1121756	.09028	1.24	0.214	-.06477	.289121	.513514
Info~ies*	-.3793026	.08644	-4.39	0.000	-.54873	-.209875	.113514
Exten~es*	.2158027	.14426	1.50	0.135	-.066936	.498541	.135135
Exten~rs*	.127372	.08575	1.49	0.137	-.040688	.295432	.394595
Contra~t*	.2916353	.11599	2.51	0.012	.064302	.518968	.210811

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix C: Probit Analysis for Flour Production

probit Flour_Production HH_Age HH_Gender HH_Size Farm_Exp Total_LandSize Land_AllocatedCassavaProduction Off_FarmeActivities Tranport Pay_Transport Transport_Cost Market_Distance Cosumers_Traders Diffuclties_AllocatingBuyers Information_Neighbours Information_Universities Extension_Universities Extension_ExtensionWorkers Contract_Arrangement

Iteration 0: log likelihood = -127.77509
Iteration 1: log likelihood = -106.55073
Iteration 2: log likelihood = -105.87803
Iteration 3: log likelihood = -104.78033
Iteration 4: log likelihood = -104.77014
Iteration 5: log likelihood = -104.77014

Probit regression Number of obs= 185
LR chi2(18) = 46.01
Prob > chi2 = 0.0003
Log likelihood = -104.77014 Pseudo R2 = 0.1800

Flour_Production	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
HH_Age	.0261705	.0136845	1.91	0.056	-.0006505	.0529916
HH_Gender	.0906383	.2425567	0.37	0.709	-.3847642	.5660407
HH_Size	.0232631	.0320909	0.72	0.469	-.0396339	.08616
Farm_Exp	-.0258083	.0132838	-1.94	0.052	-.0518442	.0002275
Total_LandSize	-.0987099	.051587	-1.91	0.056	-.1998185	.0023987
Land_AllocatedCassavaProduction	.2574285	.1095162	2.35	0.019	.0427807	.4720763
Off_FarmeActivities	.148217	.0975993	1.52	0.129	-.0430741	.339508
Tranport	-.1794025	.0896439	-2.00	0.045	-.3551014	-.0037036
Pay_Transport	.4501491	.2438606	1.85	0.065	-.0278088	.9281071
Transport_Cost	-.0000628	.0000369	-1.70	0.089	-.0001351	9.47e-06
Market_Distance	.0911274	.0361067	2.52	0.012	.0203596	.1618952
Cosumers_Traders	-.4917558	.2398404	-2.05	0.040	-.9618344	-.0216772
Diffuclties_AllocatingBuyers	.3740554	.2179421	1.72	0.086	-.0531032	.801214
Information_Neighbours	.2876944	.2330076	1.23	0.217	-.1689921	.7443809
Information_Universities	-1.232485	.4280755	-2.88	0.004	-2.071498	-.3934727
Extension_Universities	.547716	.3758262	1.46	0.145	-.1888898	1.284322
Extension_ExtensionWorkers	.3247623	.2192767	1.48	0.139	-.1050121	.7545367
Contract_Arrangement	.7482937	.313541	2.39	0.017	.1337645	1.362823
_cons	-1.438517	.6727865	-2.14	0.033	-2.757155	-.11988

Appendix D: MFX for gari and chips production

Mfx
Marginal effects after probit
y = Pr(gari_Chip) (predict)
= .79015435

variable	dy/dx	Std. Err.	z	P>z	[95% C.I.]	X
HH_Age	-.0026114	.00242	-1.08	0.280	-.007347 .002124	41.1297
HH_Gen~r*	.0915944	.08219	-1.11	0.265	-.252691 .069502	.259459
HH_Size	-.0241843	.00971	-2.49	0.013	-.043212 -.005156	7.62703
Acreag~2	-.1162953	.1315	-0.88	0.376	-.374033 .141442	11.2273
Off_Fa~s	-.0438029	.02984	-1.47	0.142	-.10229 .014684	3.65405
Annual~2	.0821233	.03993	2.06	0.040	.00386 .160387	13.7384
Con~wery*	.2083851	.04566	4.56	0.000	.118886 .297884	.037838
Info~nes*	.1574481	.06297	2.50	0.012	.03403 .280866	.108108
Infor~ts*	.2637818	.05266	5.01	0.000	.160573 .366991	.221622
Exten~Os*	.1038883	.08578	1.21	0.226	-.06424 .272016	.654054
Contra~t*	-.2574002	.09863	-2.61	0.009	-.450717 -.064083	.210811
Transp~2	-.148647	.047	-3.16	0.002	-.240766 -.056528	8.1218

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Appendix E: Probit regression for gari and chips production

Probit gari_Chip HH_Age HH_Gender HH_Size Acreage_Cost2 Off_FarmeActivities Annual_Income2 Consumers_Brewery Information_Phones Information_ExtensionAgents Extension_NGOs Contract_Arrangement Transport_Cost2

Iteration	0:	log	likelihood	=	-106.94557
Iteration	1:	log	likelihood	=	-86.365905
Iteration	2:	log	likelihood	=	-85.713623
Iteration	3:	log	likelihood	=	-85.712697
Iteration	4:	log	likelihood	=	-85.712697
Probit regression					Number of obs=185
LR chi2(12)					=42.47
Prob > chi2					=0.0000
Log likelihood = -85.712697					Pseudo R2= 0.1985

gari_Chip	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
HH_Age	-.0090649	.0084229	-1.08	0.282	-.0255736	.0074438
HH_Gender	-.3012073	.2577464	-1.17	0.243	-.8063809	.2039663
HH_Size	-.0839509	.0338779	-2.48	0.013	-.1503504	-.0175514
Acreage_Cost2	-.4036955	.4568655	-0.88	0.377	-1.299135	.4917444
Off_FarmeActivities	-.1520528	.104651	-1.45	0.146	-.357165	.0530595
Annual_Income2	.2850742	.1382683	2.06	0.039	.0140734	.5560751
Consumers_Brewery	1.371646	.7663868	1.79	0.073	-.1304448	2.873736
Information_Phones	.7082394	.3864383	1.83	0.067	-.0491657	1.465644
Information_ExtensionAgents	1.273243	.3911123	3.26	0.001	.5066773	2.039809
Extension_NGOs	.3466594	.2788334	1.24	0.214	-.199844	.8931628
Contract_Arrangement	-.7771431	.2790879	-2.78	0.005	-1.324145	-.2301408
Transport_Cost2	-.515998	.16395	-3.15	0.002	-.8373341	-.1946619
_cons	6.78709	5.557166	1.22	0.222	-4.104754	17.67893

Appendix F: Marginal Effect Test for Gari and chips production

Mfx marginal y=.7901543			Effects after probit=pr(gari_chips)(Predict)			
variable	dy/dx	Std. Err.	z	P>z	[95% C.I.]	X
HH_Age	-.0026114	.00242	-1.08	0.280	-.007347 .002124	41.1297
HH_Gen~r*	-.0915944	.08219	-1.11	0.265	-.252691 .069502	.259459
HH_Size	-.0241843	.00971	-2.49	0.013	-.043212 -.005156	7.62703
Acreag~2	-.1162953	.1315	-0.88	0.376	-.374033 .141442	11.2273
Off_Fa~s	-.0438029	.02984	-1.47	0.142	-.10229 .014684	3.65405
Annual~2	.0821233	.03993	2.06	0.040	.00386 .160387	13.7384
Con~wery*	.2083851	.04566	4.56	0.000	.118886 .297884	.037838
Info~nes*	.1574481	.06297	2.50	0.012	.03403 .280866	.108108
Infor~ts*	.2637818	.05266	5.01	0.000	.160573 .366991	.221622
Exten~Os*	.1038883	.08578	1.21	0.226	-.06424 .272016	.654054
Contra~t*	-.2574002	.09863	-2.61	0.009	-.450717 -.064083	.210811
Transp~2	-.148647	.047	-3.16	0.002	-.240766 -.056528	8.1218
(*) dy/dx is for discrete change of dummy variable from 0 to 1						

Appendix G: OLS regression for flour production

reg flour_Revenue invmillsF HH_Age HH_Gender HH_EducationLevel
Land_AllocatedCassavaProduction Off_FarmeActivities Annual_Income2
Transport_Cost Market_Distance Cosumers_Traders Diffuclties_AllocatingBuyers
Extension_NGOs Contract_Arrangement Finance_GroupMembership

Urce	SS	df	MS	Number of obs = 185
			F(14, 170) =3.31	
Model	1.1271e+12	14	8.0510e+10	Prob > F = 0.0001
Residual	4.1329e+12	170	2.4311e+10	Rsquared = 0.2143
			Root MSE = 1.6e+05	Adj R-squared =0.1496
Total	5.2601e+12	184	2.8587e+10	

flour_Revenue Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
invmillsF	-1528.716	3026.945	-0.51	0.614 -7503.956	4446.525
HH_Age	-1219.63	886.8233	-1.38	0.171 -2970.234	530.9737
HH_Gender	51842.22	28874.87	1.80	0.074 -5157.252	108841.7
HH_EducationLevel	-3040.405	3347.919	-0.91	0.365 -9649.253	3568.443
Land_AllocatedCassavaProductio	19133.17	5954.95	3.21	0.002 7377.996	30888.34
Off_FarmeActivities	-27042.91	10726.34	-2.52	0.013 -48216.88	-5868.944
Annual_Income2	-10894.87	14577.81	-0.75	0.456 -39671.71	17881.97
Transport_Cost	-5.220596	3.182543	-1.64	0.103 -11.50299	1.061797
Market_Distance	7617.68	3602.124	2.11	0.036 507.0271	14728.33
Cosumers_Traders	-53599.02	26378.26	-2.03	0.044 -105670.1	-1527.885
Diffuclties_AllocatingBuyers	-35495.49	24336.61	-1.46	0.147 -83536.37	12545.4
Extension_NGOs	55604.52	24837.85	2.24	0.026 6574.195	104634.8
Contract_Arrangement	78895.57	30099.9	2.62	0.010 19477.88	138313.3
Finance_GroupMembership	60089	31996.14	1.88	0.062 -3071.917	123249.9
_cons	283503.6	208224.8	1.36	0.175 -127535.7	694542.9

Appendix H: Robustness test for flour production

reg flour_Revenue invmillsF HH_Age HH_Gender HH_EducationLevel
Land_AllocatedCassavaProduction Off_FarmeActivities Annual_Income2
Transport_Cost Market_Distance Cosumers_Traders Diffuclties_AllocatingBuyers
Extension_NGOs Contract_Arrangement Finance_GroupMembership, robust

Linear regression Number of obs = 185
F(14, 170) = 1.30
Prob > F = 0.2125
R-squared = 0.2143
Root MSE = 1.6e+05

flour_Revenue	Robust Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
invmillsF	-1528.716	1448.978	-1.06	0.293	-4389.022	1331.59
HH_Age	-1219.63	620.0254	-1.97	0.051	-2443.571	4.310282
HH_Gender	51842.22	46100.3	1.12	0.262	-39160.54	142845
HH_EducationLevel	-3040.405	2460.449	-1.24	0.218	-7897.373	1816.563
Land_AllocatedCassavaProduction	19133.17	7588.635	2.52	0.013	4153.073	34113.26
Off_FarmeActivities	-27042.91	21989.05	-1.23	0.220	-70449.67	16363.84
Annual_Income2	-10894.87	8344.07	-1.31	0.193	-27366.2	5576.467
Transport_Cost	-5.220596	4.219911	-1.24	0.218	-13.55077	3.10958
Market_Distance	7617.68	4826.158	1.58	0.116	-1909.236	17144.6
Cosumers_Traders	-53599.02	31667.25	-1.69	0.092	-116110.7	8912.664
Diffuclties_AllocatingBuyers	-35495.49	17484.44	-2.03	0.044	-70010.06	-980.9159
Extension_NGOs	55604.52	27381.47	2.03	0.044	1553.033	109656
Contract_Arrangement	78895.57	46792.87	1.69	0.094	-13474.34	171265.5
Finance_GroupMembership	60089	65803.12	0.91	0.362	-69807.45	189985.5
_cons	283503.6	135442.8	2.09	0.038	16137.23	550870

Appendix I: OLS regression for gari and chips

reg revenue_gari_chips invmillsG_F HH_Gender HH_Size HH_EducationLevel Marketing_Exp Market_CassavaProducts

```
      Source |       SS       df       MS              Number of obs =     185
-------------+------------------------------           F(  6,   178) =    4.78
       Model |  2.7793e+14     6  4.6321e+13            Prob > F      =  0.0002
    Residual |  1.7250e+15   178  9.6912e+12            R-squared     =  0.1388
-------------+------------------------------           Adj R-squared =  0.1097
       Total |  2.0030e+15   184  1.0886e+13            Root MSE      =  3.1e+06
------------------------------------------------------------------------------
revenue_gari_chips |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
 invmillsG_F |        26666.79   199677.8     0.13   0.894    -367373.5    420707.1
 HH_Gender |          836826.4   565995.9     1.48   0.141    -280099.2    1953752
HH_Size |             77384.13    65362.9     1.18   0.238    -51601.78    206370
HH_EducationLevel |   110664.7    62592.1     1.77   0.079     -12853.3    234182.8
Marketing_Exp |       99365.68    24032.93    4.13   0.000    51939.56    146791.8
Market_CassavaProdts  887647.4     488078     1.82   0.071     -75516.33    1850811
          _cons |     -3024523    1009916    -2.99   0.003     -5017472   -1031575
------------------------------------------------------------------------------
```

Appendix J: Robustness test for gari and chips production

reg revenue_gari_chips invmillsG_F HH_Gender HH_Size HH_EducationLevel Marketing_Exp Market_CassavaProducts, robust

Linear regression Number of obs = 185
F(6, 178) = 0.38
Prob > F = 0.8934
R-squared = 0.1388
Root MSE = 3.1e+06

revenue_gari_chips	Robust Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
invmillsG_F	26666.79	79390.61	0.34	0.737	-130001.1	183334.7
HH_Gender	836826.4	693257.1	1.21	0.229	-531233.9	2204887
HH_Size	77384.13	71640.47	1.08	0.282	-63989.8	218758.1
HH_EducationL	110664.7	83322.65	1.33	0.186	-53762.57	275092.1
Marketing_Exp	99365.68	83675.21	1.19	0.237	-65757.39	264488.7
Market_CassavaPdts	887647.4	803810	1.10	0.271	-698575.9	2473871
_cons	-3024523	2887007	-1.05	0.296	-8721688	2672642

Appendix K: Correlation test results

corr HH_Age HH_Gender HH_Size HH_EducationLevel Farm_Exp Cassava_Exp Marketing_Exp CassavaProcessing_Exp Land_CassavaProduction Acreage_Cost Total_LandSize Land_AllocatedCassavaProduction Off_FarmeActivities Annual_Income Packaging_Materials Tranport Pay_Transport Transport_Cost Market_Distance Consumers_GeneralPublic Consumer_Bakery Consumers_Brewery Cosumers_Traders Diffuclties_AllocatingBuyers Information_Neighbours Information_NGOs Information_Universities Information_Radios Information_Phones Information_ExtensionAgents Extension_NGOs Extension_Universities Extension_ExtensionWorkers Extension_BusinnessDevt Market_CassavaProducts Contract_Arrangement Group_Membership Financial_Resources Finance_Bank Finance_VSLA Finance_GroupMembership Finance_Grants
(obs=185)

| HH_Age HH_Gen~r HH_Size HH_Edu~l Farm_Exp Ca~a_Exp Market~p Ca~g_Exp Land_C~n Acreag~t Total_~e Land_A~n
---+---
HH_Age | 1.0000
HH_Gender | 0.0902 1.0000
HH_Size | 0.3125 0.0723 1.0000
HH_Educati~l | -0.2759 -0.3440 -0.0243 1.0000
Farm_Exp | 0.8063 0.0916 0.2856 -0.3520 1.0000
Cassava_Exp | 0.6187 0.0799 0.2847 -0.2299 0.7810 1.0000
Marketing_~p | 0.3825 0.0062 0.1684 -0.1495 0.5091 0.6841 1.0000
CassavaPro~p | 0.1717 0.0393 0.0082 -0.1557 0.2532 0.3040 0.4136 1.0000
Land_Cassa~n | -0.1666 -0.1122 -0.0797 -0.0306 -0.1798 -0.1340 -0.0460 -0.0368 1.0000
Acreage_Cost | 0.0613 -0.0612 -0.1080 -0.0160 0.0800 -0.0077 0.0016 0.0845 -0.0970 1.0000
Total_Land~e | 0.0752 -0.0086 0.1455 0.0682 -0.0487 0.0727 0.1663 0.1109 -0.0469 0.0108 1.0000
Land_Alloc~n | 0.0590 -0.1757 0.1272 0.2704 0.0472 0.1006 0.1706 0.1228 -0.0472 0.0914 0.2994 1.0000
Off_FarmeA~s | 0.0350 -0.1499 -0.0602 0.0574 -0.0159 0.0397 0.0894 -0.0744 -0.0777 -0.0260 -0.0321 0.0601
Annual_Inc~e | -0.0335 -0.0654 -0.0278 0.1157 -0.0179 0.0388 0.1137 -0.0320 0.0221 0.0141 0.2001 0.0814
Packaging~ls | 0.0370 0.0436 -0.0538 -0.0358 0.0924 -0.0667 -0.0383 -0.0138 -0.0224 0.0870 -0.0196 -0.0264
Tranport | -0.0534 -0.0744 -0.1047 0.2425 -0.0847 -0.1249 -0.1141 -0.0688 0.0392 0.0655 -0.0250 0.1657
Pay_Transp~t | -0.2107 -0.1012 -0.0854 0.0522 -0.1259 -0.0759 0.0274 0.0901 0.1338 -0.1022 -0.0914 0.0489
Transport_~t | -0.0088 -0.1057 -0.0033 0.1808 0.0206 0.0302 0.0289 -0.0157 -0.0268 0.0719 0.0702 0.4560
Market_Dis~e | -0.0359 -0.0155 -0.0123 0.0947 0.0380 0.0208 0.0034 -0.0553 0.0145 0.0953 -0.0296 0.1000
Consumers_~c | 0.0408 -0.1746 0.1014 0.1277 0.0861 0.1653 0.1317 0.0765 -0.1980 0.0733 -0.0640 0.0887
Consumer_B~y | 0.0425 -0.0216 0.1203 -0.1055 0.0574 0.0838 -0.0796 -0.0270 -0.0391 -0.1418 -0.0228 -0.0459
Consumers_~y | 0.0085 -0.1411 0.1937 0.0609 0.0175 -0.0064 -0.0513 -0.0322 0.1076 -0.0050 0.0092 0.0209
Cosumers_T~s | -0.0019 0.0341 -0.0989 0.0271 -0.1100 -0.1504 -0.0877 0.0072 0.0512 0.0718 0.0757 0.0813
Diffucltie~s | 0.1106 -0.1083 0.0208 -0.0003 0.2363 0.1866 0.1201 0.1075 -0.0752 0.0721 -0.0533 0.0546
Informati~rs | -0.0066 -0.0087 -0.0498 -0.0840 0.0238 0.0171 0.0276 0.0976 -0.0563 -0.1677 -0.1150 -0.1352

Informati~Os | 0.0464 0.0245 -0.0283 0.0714 -0.0323 -0.1099 -0.1516 -0.0918 0.0355 0.1290 0.1167 0.1069
Informat~ies | 0.0028 0.0563 0.0465 0.0111 -0.0673 -0.1220 -0.0683 -0.0402 -0.0079 -0.2246 0.0285 0.1760
Informati~os | -0.0594 0.0806 0.0831 -0.0211 -0.0875 -0.1519 -0.1423 -0.0525 0.1912 -0.1223 -0.0305 0.0849
Informat~nes | -0.0401 0.0472 0.0312 0.1471 -0.0593 -0.0302 -0.0079 -0.0238 -0.0028 -0.0389 0.0297 0.2142
Informati~ts | -0.0639 -0.0998 -0.0062 0.0036 0.0463 0.0382 0.2358 0.1612 -0.0467 -0.0017 0.0151 0.1296
Extension~Os | 0.0434 0.1399 -0.0501 -0.1342 0.0442 0.0094 -0.1243 -0.1157 -0.0144 0.1724 0.0141 -0.1372
Extension~es | -0.1168 0.0175 0.0014 0.0434 -0.1001 -0.1215 -0.0914 -0.0535 0.0671 -0.2089 0.0458 0.1887
Extension~rs | 0.0860 -0.0520 0.0591 -0.0683 0.1061 0.0983 0.2149 0.1445 0.0165 -0.0445 -0.0354 0.0867
Extension_~t | -0.0015 -0.0372 0.0052 0.0350 -0.0636 -0.0188 -0.0350 -0.0294 0.0203 -0.0729 -0.0231 0.0264
Market_Cas~s | -0.2327 0.0289 -0.1078 0.0939 -0.2144 -0.1573 -0.1031 -0.0460 0.0074 -0.0494 0.0555 -0.0468
Contract_A~t | -0.0397 0.0036 -0.0827 0.1068 -0.0400 0.0260 -0.0213 -0.0888 0.0784 0.0788 0.1400 0.1119
Group_Memb~p | 0.0973 0.0719 -0.0748 0.0768 0.0412 -0.0380 -0.0326 0.0001 -0.0488 0.0298 0.0590 0.0646
Financial_~s | -0.0631 0.1140 0.0136 0.0698 -0.1046 -0.2428 -0.3256 -0.2148 -0.1742 -0.0040 0.0022 -0.0954
Finance_Bank | 0.0477 0.0436 0.0076 -0.1287 0.0414 0.0222 -0.0532 -0.0189 -0.0224 -0.0685 -0.0147 -0.0264
Finance_VSLA | 0.0174 -0.0003 -0.0566 0.0657 -0.0175 -0.0770 -0.0617 0.0114 -0.1570 0.0261 0.0721 0.0875
Finance_Gr~p | 0.0010 0.0344 0.0585 -0.0644 0.0182 0.0742 0.1087 0.0110 -0.0508 -0.0658 -0.0530 -0.0637
Finance_Gr~s | -0.0123 -0.1664 0.0361 0.2465 -0.0192 -0.0252 -0.0508 -0.0187 -0.0453 0.0774 0.0368 0.0975

| Off_Fa~s Annual~e Packa~ls Tranport Pay_Tr~t Transp~t Market~e Consum~c Con~kery Con~wery Cosume~s Diffuc~s
---+---
Off_FarmeA~s | 1.0000
Annual_Inc~e | 0.0956 1.0000
Packaging~ls | -0.1089 -0.0196 1.0000
Tranport | 0.0930 0.2099 -0.1199 1.0000
Pay_Transp~t | -0.1539 -0.0933 -0.1105 0.0073 1.0000
Transport_~t | 0.0705 0.0689 -0.0315 0.2738 0.0003 1.0000
Market_Dis~e | 0.0691 0.1650 -0.0508 0.2925 -0.0761 0.7315 1.0000
Consumers_~c | 0.1113 -0.0009 0.0622 0.0773 -0.1360 0.0720 0.1557 1.0000
Consumer_B~y | 0.0014 -0.0927 -0.0095 -0.0847 -0.0070 -0.0417 -0.0683 0.0216 1.0000
Consumers_~y | 0.0107 0.0923 -0.0146 0.0677 0.0096 -0.0477 -0.0643 0.1100 -0.0255 1.0000
Cosumers_T~s | 0.0819 0.1179 -0.1163 0.1984 0.0174 0.0771 -0.0043 -0.4865 -0.1080 -0.0623 1.0000
Diffucltie~s | 0.1399 -0.0270 -0.0725 -0.0246 0.0946 -0.0005 -0.0021 0.1289 -0.0407 0.1449 -0.0701 1.0000
Informati~rs | -0.0013 -0.1243 0.0718 -0.3066 0.1937 -0.2114 -0.2100 -0.0101 0.1250 -0.0337 -0.2101 0.0491
Informati~Os | -0.1309 0.0006 -0.0622 0.1293 0.0172 0.0658 0.0269 -0.2881 -0.1084 0.0624 0.2440 0.0685

Informat~ies | -0.0873 -0.1114 -0.0264 -0.0013 0.1281 0.0837 0.0064 -0.2855 -0.0459 -0.0710 0.1137 -0.0112
Informati~os | -0.0466 -0.1057 -0.0523 0.0242 0.1514 0.1052 -0.0398 -0.4227 -0.0912 -0.0208 0.1966 -0.1259
Informat~nes | 0.0609 -0.0729 -0.0257 0.1405 0.0438 0.3398 0.2393 -0.0945 0.0931 -0.0690 0.0666 -0.1336
Informati~ts | -0.0327 0.1307 -0.0393 0.0946 0.0742 0.1055 0.1727 0.2129 -0.0685 -0.0376 -0.2088 0.0737
Extension~Os | -0.0420 -0.0800 0.0536 -0.0283 -0.0915 -0.0232 0.0251 -0.1761 0.0934 -0.1536 0.0670 -0.0345
Extension~es | -0.0332 -0.0154 -0.0291 0.0449 0.1268 0.0677 -0.0152 -0.2436 -0.0507 0.0045 0.0406 0.0222
Extension~rs | -0.0666 0.0171 -0.0595 0.1062 0.1076 0.1217 0.1382 -0.0138 -0.0161 -0.0442 -0.0755 -0.0422
Extension_~t | 0.0435 0.0091 -0.0227 -0.0124 0.0804 -0.0591 -0.0575 0.0647 -0.0395 0.0398 0.1099 0.1204
Market_Cas~s | -0.1529 -0.0629 0.0990 -0.2295 0.1059 -0.1232 -0.1099 -0.1037 -0.0063 -0.1477 -0.0522 -0.1233
Contract_A~t | -0.0415 0.2076 -0.0381 0.4180 -0.1717 0.1594 0.2342 0.1676 -0.0664 0.0364 0.1223 -0.0579
Group_Memb~p | 0.0013 0.1505 0.0257 0.1876 0.0693 0.0926 0.0819 -0.1174 -0.0931 0.0690 0.1259 -0.0753
Financial_~s | -0.0665 0.1238 0.0362 0.2153 0.0860 0.0360 0.0999 -0.1657 0.0631 0.0259 0.0811 -0.0626
Finance_Bank | 0.0228 -0.0556 -0.0054 -0.1199 -0.1105 -0.0315 -0.0578 0.0622 0.5742 -0.0146 -0.1163 -0.0725
Finance_VSLA | -0.0816 0.0953 -0.1148 0.3201 0.1381 0.0753 0.0793 -0.0356 -0.0117 -0.0596 0.0402 0.0847
Finance_Gr~p | 0.1257 -0.0925 0.1643 -0.2575 -0.0768 -0.0029 0.0221 0.0559 -0.0576 -0.0890 -0.0358 -0.1519
Finance_Gr~s | 0.0791 0.1113 -0.0110 0.2163 0.0187 -0.0065 0.0100 0.1255 -0.0191 0.3601 0.0942 0.1511

| Infor~rs Infor~Os Info~ies Infor~os Info~nes Infor~ts Exten~Os Exten~es Exten~rs Extens~t Market~s Contra~t
---+---
Informati~rs | 1.0000
Informati~Os | -0.3410 1.0000
Informat~ies | 0.1437 0.3547 1.0000
Informati~os | 0.0266 0.0742 0.3235 1.0000
Informat~nes | -0.0442 0.0239 0.2047 0.2691 1.0000
Informati~ts | -0.1316 -0.1601 -0.1499 -0.2961 -0.1019 1.0000
Extension~Os | -0.0713 0.2683 0.1886 0.1312 0.0702 -0.4327 1.0000
Extension~es | 0.0684 0.3078 0.5564 0.1548 0.1170 -0.0206 -0.0782 1.0000
Extension~rs | -0.0329 -0.1657 0.1295 0.1297 0.1107 0.4479 -0.3661 -0.0280 1.0000
Extension_~t | 0.0302 0.0133 0.0111 -0.0962 -0.0452 0.0210 -0.1805 0.0471 -0.1304 1.0000
Market_Cas~s | 0.2282 -0.1023 0.0181 -0.0267 -0.0412 0.0916 -0.0514 -0.0633 0.1144 -0.0686 1.0000
Contract_A~t | -0.3984 0.1013 -0.1014 -0.0581 -0.0519 0.1390 0.0137 -0.1655 -0.0106 -0.1119 -0.1359 1.0000
Group_Memb~p | -0.1647 0.1527 0.0148 0.0997 0.0652 0.0181 0.0396 0.0358 0.0674 -0.0167 -0.1768 0.0946
Financial_~s | -0.2326 0.1934 0.0037 0.1176 0.0392 0.0322 0.0157 -0.0054 0.0895 -0.0916 0.0525 0.0867
Finance_Bank | 0.0718 -0.0622 -0.0264 -0.0523 -0.0257 -0.0393 0.0536 -0.0291 -0.0595 -0.0227 -0.0549 -0.0381

```
Finance_VSLA |  -0.3157   0.2286   0.0049   0.0276   0.1087   0.2281   0.0330  -0.0244   0.1778  -0.0985  -0.1175
          0.1569
Finance_Gr~p |   0.2630  -0.2614  -0.0237   0.0187  -0.1096  -0.1000  -0.0692  -0.0503  -0.0957   0.1194   0.1191  -
          0.1254
Finance_Gr~s |  -0.0784   0.1761  -0.0532  -0.1055  -0.0518   0.0102  -0.2044   0.1587  -0.0440   0.0865  -0.1107
          0.1054

             | Group_~p Finan~es Financ~k Financ~A Financ~p Finan~ts
-------------+------------------------------------------------------
Group_Memb~p |   1.0000
Financial_~s |   0.4005   1.0000
Finance_Bank |  -0.2117   0.0362   1.0000
Finance_VSLA |   0.2359   0.4953  -0.1148   1.0000
Finance_Gr~p |   0.1096  -0.1085  -0.0331  -0.6988   1.0000
Finance_Gr~s |   0.0518   0.0731  -0.0110  -0.1498  -0.0667   1.0000
```

Appendix L: Threshold test on cassava flour processors' age

```
Probit Flour_Production HH_Age age2 HH_Gender HH_Size  Farm_Exp    Total_LandSize
        Land_AllocatedCassavaProduction Off_FarmeActivities   Tranport Pay_Transport
        Transport_Cost Market_Distance  Cosumers_Traders Diffuclties_AllocatingBuyers
        Information_Neighbours  Information_Universities  Extension_Universities
        Extension_ExtensionWorkers  Contract_Arrangemen

Iteration 0:   log likelihood = -127.77509
Iteration 1:   log likelihood = -106.27645
Iteration 2:   log likelihood = -105.58217
Iteration 3:   log likelihood = -104.45551
Iteration 4:   log likelihood = -104.44474
Iteration 5:   log likelihood = -104.44474

Probit regression                 Number of obs   =        185
                                  LR chi2(19)     =      46.66
                                  Prob > chi2     =     0.0004
Log likelihood = -104.44474 and Pseudo R2       =     0.1826

------------------------------------------------------------------------------
             Flour_Production |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------------------------+-----------------------------------------------------------------
                       HH_Age |  -.0115437   .0487473    -0.24   0.813    -.1070866    .0839993
                         age2 |   .0004472   .0005557     0.80   0.421    -.0006418    .0015363
                    HH_Gender |   .0915476   .2425169     0.38   0.706    -.3837767     .566872
                     HH_Size |   .0266566   .0324005     0.82   0.411    -.0368472    .0901605
                     Farm_Exp |  -.0262348   .0133401    -1.97   0.049    -.0523808   -.0000887
                Total_LandSize |  -.0996001   .0515343    -1.93   0.053    -.2006054    .0014052
Land_AllocatedCassavaProduction |   .2627487   .1095459     2.40   0.016     .0480427
        .4774547
        Off_FarmeActivities |   .1491683   .0977239     1.53   0.127     -.042367    .3407036
                    Tranport |  -.1793076   .0896344    -2.00   0.045    -.3549878   -.0036274
                Pay_Transport |   .4294384   .2456874     1.75   0.080       -.0521    .9109768
                Transport_Cost |  -.0000637   .0000372    -1.71   0.087    -.0001367    9.27e-06
                Market_Distance |   .0902085   .0362737     2.49   0.013     .0191134    .1613036
                Cosumers_Traders |  -.4619928   .2426304    -1.90   0.057    -.9375397     .013554
  Diffuclties_AllocatingBuyers |   .3623929   .2190395     1.65   0.098    -.0669166    .7917024
      Information_Neighbours |   .2847091   .2335597     1.22   0.223    -.1730596    .7424778
    Information_Universities |  -1.284045   .4356794    -2.95   0.003    -2.137961   -.4301288
      Extension_Universities |    .572374   .3789177     1.51   0.131    -.1702911    1.315039
  Extension_ExtensionWorkers |   .3446995   .2209861     1.56   0.119    -.0884253    .7778242
      Contract_Arrangement |   .7328714   .3142394     2.33   0.020     .1169736    1.348769
                     _cons |  -.7484339   1.089082    -0.69   0.492    -2.882995    1.386127
------------------------------------------------------------------------------
Note: 1 failure and 0 successes completely determined.
```