RESEARCH PROGRAM ON Roots, Tubers and Bananas

CGIAR

Technical Report:
Market Opportunities and Value Chain Analysis of Fresh Cassava Roots in Uganda

Extending the shelf-life of fresh cassava roots for increased incomes and postharvest losses reduction

Expanding Utilization of Roots, Tubers and Bananas and Reducing Their Postharvest Losses

RTB ENDURE

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IFAD
Enabling poor rural people to overcome poverty

A broad alliance of research-for-development stakeholders & partners

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Expanding Utilization of Roots, Tubers and Bananas and Reducing Their Postharvest Losses (RTB-ENDURE) is a 3 year project (2014-2016) implemented by the CGIAR Research Program on Roots, Tubers and Bananas (RTB) with funding by the European Union and technical support of IFAD. http://www.rtb.cgiar.org/endure

The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a broad alliance led by the International Potato Center (CIP) jointly with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute for Tropical Agriculture (IITA), and CIRAD in collaboration with research and development partners. Our shared purpose is to tap the underutilized potential of root, tuber and banana crops for improving nutrition and food security, increasing incomes and fostering greater gender equity, especially among the world's poorest and most vulnerable populations.

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ACRONYMS AND ABBREVIATIONS

AVH	Average holding size
CIAT	International Centre for Tropical Agriculture
CIP	International Potato Center
CGIAR	Consultative Group on International Agriculture Research
EC	European Commission
GoU	Government of Uganda
IFAD	International Fund for Agricultural Development
IIRR	International Institute of Rural Reconstruction
IITA	International Institute for Tropical Agriculture
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
NAADS	National Agricultural Advisory Services
NARO	National Agricultural Research Organization
NGOs	Nongovernmental organizations
PPD	Postharvest physiological deterioration
RH	Relative humidity storage
RTB	Roots, Tubers and Bananas
SSA	Sub-Saharan Africa
UBOS	Uganda Bureau of Statistics
UGX	Ugandan Shilling
USD	US Dollar

EXECUTIVE SUMMARY

Cassava is an important source of food and income in Uganda. The crop is an essential part of the diet, provides essential nutrients like carbohydrates and is available all year round, thus contributing to food security. In addition, cassava provides a livelihood for millions of farmers and thousands of processors and traders.

Fresh cassava is widely consumed both in urban and rural areas as a snack and main meal. Fresh cassava marketing is currently an important source of income. Demand for fresh cassava in Uganda is increasing with urbanization. Despite the opportunity that cassava presents, its full potential in terms of contributing to food security and income generation has not yet been fully realized. Cassava is very susceptible to postharvest physiological deterioration (PPD) and begins to deteriorate within 48 hours. This supposedly causes high levels of postharvest losses. However, technologies that extend the shelf-life of fresh cassava have already been adopted in other parts of the world (e.g., waxing in Colombia and Costa Rica for the export market) but the demand and viability of such technologies in Uganda is unknown. The adaptation of such shelf-life extension technologies to Uganda requires understanding their technical, economic and social feasibility in the country.

This report presents the main findings of a study aiming at depicting the fresh cassava root's value chain in Uganda and helping understand the opportunities for marketing roots with extended shelf-life. Furthermore, findings from this research are to be used for selecting the areas where to pilot the new technologies for shelf-life extension. Both production and consumption situations and trends were analyzed, with specific attention to varietal preferences and cassava attributes sought after by both producers and consumers. The linkages and coordination among value chain actors were also investigated since they have implications on the level of postharvest losses incurred by each of them. Finally, the study attempted to estimate the extent of postharvest losses at each stage of the value chain and ascertaining the use of deteriorated cassava roots in order to identify the actors that can mostly benefit from the new technologies.

The study was conducted in Kabarole/Kyenjojo and Masindi/Kiryandongo axes being major suppliers of fresh cassava to the main urban markets of Kampala. Results from the study revealed that the totality of respondents consume cassava in fresh form while 75% consumed it in dried form as well. On average, about 50% and 30% of cassava produced by farmers in these areas is sold or consumed in fresh form, respectively. The preferred form to consume cassava is as fried chips, followed by boiled and steamed.

The study further revealed that an average of 16 tons of fresh cassava is supplied by each wholesaler to the major markets in Kampala weekly, while each retailer procures and sells an average of 1,200 Kg of fresh cassava roots weekly.

Unlike other actors in the fresh cassava value chain, retailers, the vast majority of whom are women, incur high level of losses due to the rapid postharvest physiological deterioration of the roots. In fact, they are the value chain actors that keep the cassava for longer having to sit the whole day in open markets or at their roadside kiosks awaiting for buyers. While the amount of roots that have to be thrown away (physical losses) is rather limited, almost half of the roots are sold at discounted price due to PPD, particularly when the demand is low. The annual overall financial loss due to PPD in Uganda can be estimated at over USD 30 million.

In order to minimize the consequences of PPD, all value chain actors tend to purchase just the amount of cassava that they are confident to be able to quickly sell or consume. Furthermore, retailers tend to charge high initial prices for fresh roots so to offset the future losses they expect to incur as a result of PPD. Therefore, PPD is likely to limit the utilization of fresh cassava and, thus, indirectly affects incomes of both producers and traders as well as the purchasing power of consumers.

The technologies for extending shelf-life provide a good opportunity to traders, growers and consumers to increase utilization of fresh cassava and incomes from marketing. Given that the market for fresh cassava is increasing due to demographic factors, rural-urban migration and a reduction in poverty levels, there is a clear market opportunity for testing these technologies.

The findings of this study suggest piloting the technologies in western Uganda since this region is the major supplier of fresh roots to Kampala. Within the western region the Kabarole/Kyenjojo axis seems particularly suitable because of the high number of varieties to be tested, the good productivity, the lower pest and disease pressure, the lesser competition (since the area is far from the largest towns), and the potential for impact, being a large number of farmers depended on cassava cultivation and marketing. Furthermore, the sale of fresh root to more distant and lucrative markets by farmers located in some locations within this area, is specifically constrained by their remoteness and the consequent concern of buyers to incur losses during the transport to the end markets.

While most of the value chain actors revealed that the technologies were acceptable, on-going research aims at understanding their economic viability and social acceptability in Uganda. However, the development of best-bet marketing models for selling roots with extended shelf-life will be a gradual process requiring back and forth assessments of the demands and proper pricing based on the cost of applying the technologies and the consumers' willingness to pay. Concerted effort will be required to attract potential entrepreneurs to invest in the technologies after the on-ongoing research has provided evidence of business viability.

1. INTRODUCTION

1.1. BACKGROUND

Cassava is an important source of food and income in Uganda and most developing countries at large. It is a major source of dietary energy for low income consumers in many parts of tropical Africa, including major urban areas (Dahniyaet al., 1991; Berry, 1993; Nweke, 1994).

It is important to know whether with expected changes in technology, policy and prices, cassava could play an even greater role in improving the quality of urban diets by increasing supplies of a low cost staple foodstuff in "easy to cook" forms. This will depend on the evolution of production and marketing costs, as well as the price of cassava relative to those of other staple foods, particularly cereals.

Cassava is a major staple in Africa where consumption per capita is above 80kg compared to the world average of 17kg in 2001(Aerni,2005).The crop is an essential part of the diet, and it provides essential nutrients like carbohydrates. It is available all year round, thus contributing to food security (Naziri et al., 2014). In addition, cassava provides a livelihood for millions of farmers and thousands of processors and traders (Abass et al., 2013). It has also proven successful as a poverty fighter among small scale farmers and poor urban consumers (Nweke et al., 2004).

Cassava is one of the ten commodities that have been prioritized by the Government of Uganda in its Agriculture Sector Development Strategy and Investment Plan (DSIP). It is estimated that in some parts of Uganda, nearly 60% of the people grow cassava and nearly 90% of the people consume cassava in different forms at least once a day (EAAPP, 2011).

Fresh cassava is widely consumed in both urban and rural areas as a snack and main meal. Fresh cassava marketing has been growing and it is currently an important source of income (Scoping study, 2014). Fresh root total consumption is estimated at 1.32 million metric tonsper annum out of which 309,528 tons is marketed (Scoping study 2014). Market demand for fresh cassava in Uganda is growing with urbanization and it is estimated that it will increase by about 25% by 2018 (Scoping study, 2014).

Despite the opportunity that cassava presents, its full potential in terms of contributing to food security and income generation has not yet been fully realized. This is due to a number of challenges including its bulkiness, high perishability, poor postharvest management and high postharvest losses.

One of the major challenges facing cassava marketing is its rapid Postharvest Physiological Deterioration (PPD) which reduces its shelf-life to 2 to 3 days after harvest. This results into short marketing channels, price discounts, and lower incomes to growers and traders. PPD is also responsible for initial high prices that retailers charge in order to cater for subsequent expected postharvest losses. High prices lead to lower than potential utilization, low demand, low sales, low income and hence a vicious cycle of underdevelopment of the cassava fresh root value chain. Moreover, due to PPD retailers usually procure low volumes which they can sell over a short period of time.

1.2. THE CASSAVA SUB-PROJECT

"Extending the Shelf-life of Fresh Cassava Roots for Increased Incomes and Postharvest Losses Reduction" is one of the four sub-projects of the EU/IFAD-funded "*Expanding Utilization of Roots, Tubers and Bananas and Reducing Their Postharvest Losses"* project (RTB-ENDURE). This initiative aims at introducing, testing, validating and assessing the efficacy of two technologies for extending the shelf-life of fresh cassava roots, thus benefit growers, traders and consumers along the entire value chain in Uganda. The two technologies include high relative humidity storage (RH) and waxing. Furthermore, additional research is being conducted to identify effective pre-harvest practices and best-bet marketing models that will enable increased utilization of fresh cassava roots with extended shelf-life in Uganda.

This initiative is implemented by IITA, CIAT, NARO and IIRR in collaboration with Kyambogo and Makerere Universities, the private sector and the Government of Uganda (GoU). CIP provides technical backstopping to research team.

The sub-project research team has adopted the steps for product development proposed by Wheatley et al. (1995) comprising of idea generation and screening, market research (scoping study), location/beneficiary selection, technical and consumer research, and pilot testing.

The project is testing, validating and piloting commercial, technical, and institutional innovations that:

1) Reduce postharvest losses of fresh cassava roots
2) Increase shelf life of cassava roots
3) Increase income from cassava roots and its products, for rural producers and other value chain actors
4) Promote and strengthen the participation of women in higher and more profitable nodes of the value chain
5) Lead to more equitable distribution of benefits between men and women in the community.

The proposed technologies for shelf-life extension, i.e., waxing and RH, are in commercial use in other parts of the world (e.g., waxing in Colombia and Costa Rica for the export market). However, they have not yet been evaluated and validated in the Ugandan context. An initial scoping study was conducted in 2014 to make a business case for research. During the scoping study, a number of information gaps were highlighted. Consequently, a more in-depth market and value chain study was necessary to provide clear understanding of the market conditions that would either hinder or facilitate uptake of the technologies. The main findings are presented and discussed in this report.

1.3. OBJECTIVES OF THE STUDY

The main objective of this study is to depict the fresh cassava root's consumption pattern and value chain in Uganda and help understand the opportunities for marketing roots with extended shelf-life. Furthermore, findings from this research are to be used for selecting the areas where to pilot the new technologies for shelf-life extension. The study required the analyses of both production and consumption situations and trends, with specific attention to varietal preferences

and cassava attributes sought after by both producers and consumers. The linkages and coordination among value chain actors were also investigated since they have implications on the level of postharvest losses incurred by each of them. Margins within the supply chain were also estimated in order to assess the extent to which additional costs can be absorbed. Finally, the study aimed at estimating the extent of postharvest losses at each stage of the value chain and ascertaining the use of deteriorated cassava roots in order to identify the actors that can mostly benefit of the new technologies.

2. METHODOLOGY

The research team adopted both a value chain and end-market analysis approach. Information was collected by semi-structured questionnaires, informal interviews with key informants, direct observations of the critical activities along the different nodes of the value chain and a review of relevant literature.

Following a literature review, interviews with key informants and brainstorming sessions, data collection tools were designed to collect data at farmer, rural assembler, wholesaler, retailer and consumer levels.

2.1. SURVEY AREAS

Cassava is produced in almost all districts in the country. However, according to the project design, the Kabarole/Kyenjojo and the Masindi/Kiryandongo axes were purposively selected, being the largest suppliers of fresh roots to main urban markets in Kampala (Scoping study, 2014).For the former, the districts of Kabarole and Kyenjojo were purposively selected. For the latter the study focused on the Masindi and Kiryandongo districts. For the end-market analysis Kampala district was selected being the largest market for fresh cassava roots in the country. The survey areas are shown in Figure 1.

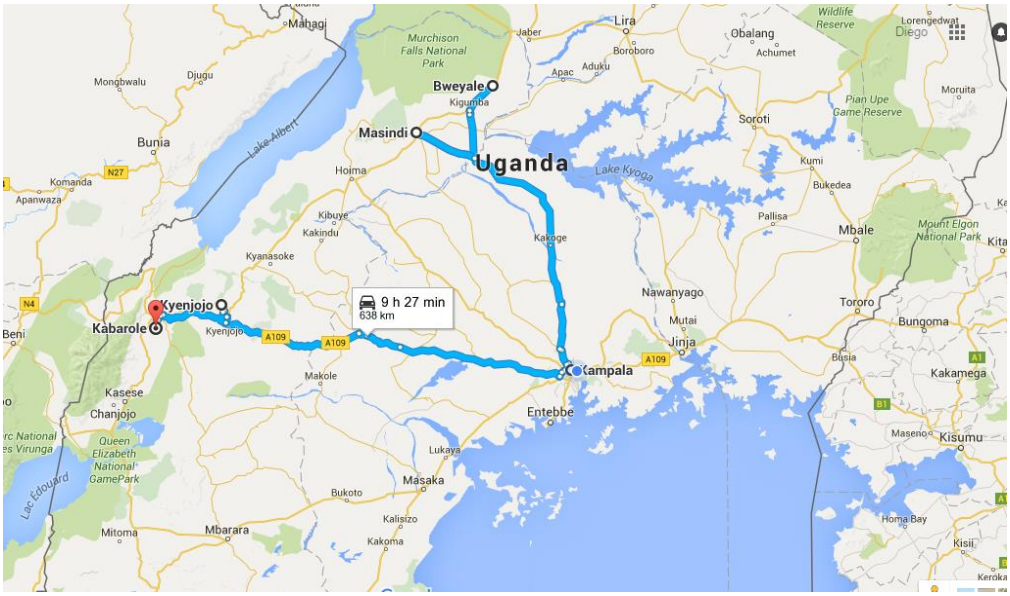


Figure 1: Map of the Kabarole/Kyenjojo and Masindi/Kiryandongo axes

The focus on the two axes contributed to a better understanding of the fresh cassava market segments and the impact of PPD along the value chain, in particular with regard to limiting the utilization of fresh roots, the marketing over longer distances and the incomes of producers and traders.

2.2. SAMPLING AND DATA COLLECTION METHOD

Purposive and random sampling techniques were used to select both the markets to be visited in Kampala and the farmer groups in Kabarole and Masindi axes. Within Kampala, five major markets were selected. These included Owino, Kalerwe, Nakawa, Busega and Kasubi. Furthermore, Nakasero market was also targeted. Nakasero is a semi-open upper-class market with a good display of higher quality fresh produce. Prices in this market are usually higher than in other open markets. Currently, however, this market does not retail any fresh cassava due to PPD. It was therefore chosen due to the opportunity that it offers since the project aims at marketing higher quality fresh cassava roots with extended shelf-life, targeting both existing and potentially new market outlets. Finally, the research team also visited one market nearby the cassava supplying areas, Kabundaire, the main market in Kabarole district. In these markets, cassava traders and other opinion leaders with knowledge and experience in the cassava supply chain were selected and Focus Group Discussions (FGDs) held with them. A total of four FGDs were held with traders from Nakawa, Kalerwe, Kabundaire and Nakasero markets.

Retail outlets were further stratified by size (small, medium and large) and typology (including, restaurants, bars, hotels, supermarkets and road-side food vendors). Broadly these categories were targeted in order to assist in capturing information about mass and niche markets. Finally, respondents were randomly sampled. A total of 60 farmers, 3 rural assemblers, 7 wholesalers, 115 retailers and 66 consumers participated in the study. In terms of gender distribution 35% of farmers, 33% of rural assemblers, 12% of wholesalers, 68% of retailers and 75% of consumers were female. Data collection was conducted between August and September 2015.

In addition, key informant interviews were also held with representatives of organizations involved in the fresh cassava value chain. They included both the private and public sectors such as the National Agricultural Advisory Services (NAADS), several district agricultural offices and NGOs such as PRICON.

2.3. DATA ANALYSIS

Data collected were entered into MS Excel, for easy cleaning and coding. Analysis of means and frequencies was conducted using SPSS (version 18). Where necessary, data were grouped by district in order to compare the descriptive statistics that were generated.

3. PRODUCTION

3.1. NATIONAL PRODUCTION

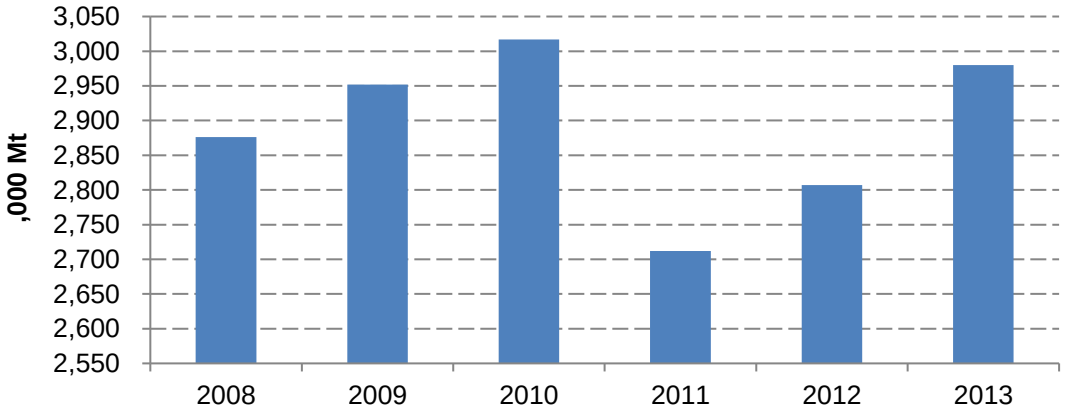
3.1.1. Production volume

In Uganda cassavas one of the most widely grown crops and the second most important staple food crop after bananas. Over one million out of an estimated 3,946,000 agricultural households grew cassava in 2008/09 (UBOS, 2010). Other sources indicate that it is grown by over 75% of farm households in the country (Anderson et al., 2016).

Information sourced from available literature revealed that Uganda is the sixth largest producer of cassava in Africa. Annual production averaged about five million metric tons over the period 2005 to 2007 (Haggbladeand Dewina, 2012). However, cassava production has considerably fluctuated since the early 2000s, the main cause being the re-occurrence of viral diseases and especially the cassava brown streak disease.

According to the 2008/09 agricultural census, annual national production was at 2.9 million metric tons. This was produced from an estimated area of 871,000 ha resulting in a national average yield of 3.3 Mt/Ha. The number of plots under cassava was estimated to be 3.1 million out of which 1.9 million (61%) were under pure stand. The national mean cassava plot size (MPS) was estimated to be 0.28 Ha.

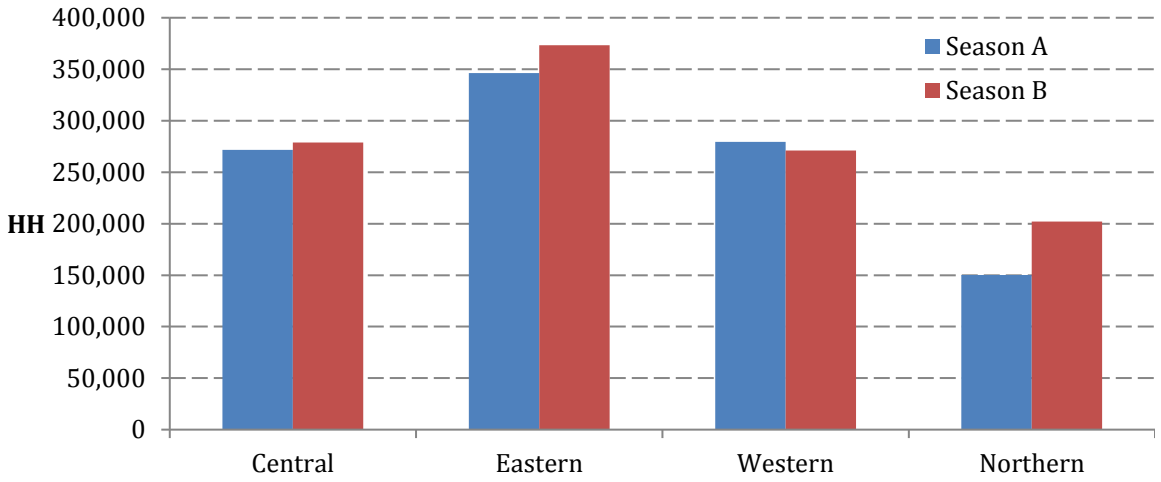
Figure 2 below presents the production trend over the period 2008 to 2013. It shows a lower production compared to the figures that were reported over the period 2005 to 2007. According to Figure 2 production volume increased from 2008 up to 2010. It declined in 2011 due to a drop in productivity but thereafter started increasing again.



Source: Analyzed from UBOS data, 2014

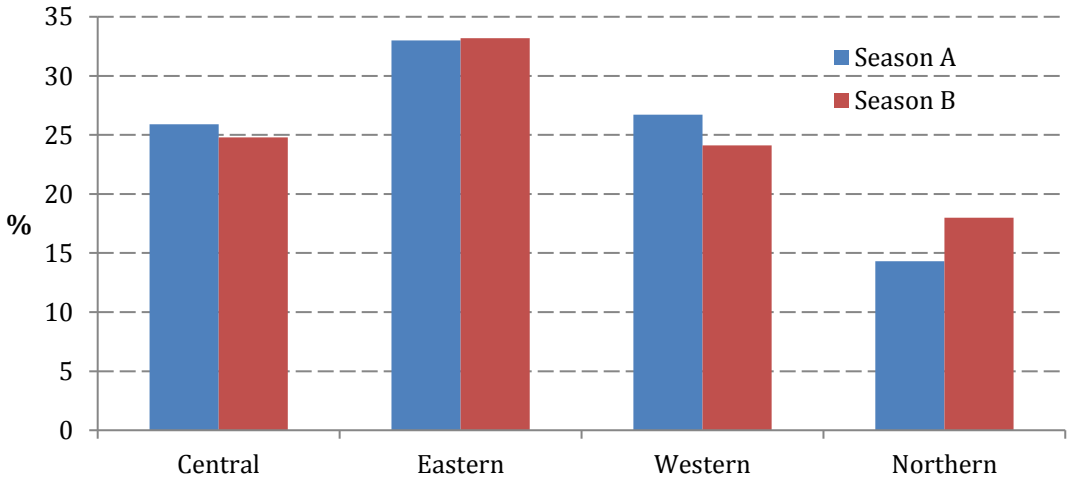
Figure 2: Annual cassava production, 2008 – 2013

Figure 3 shows the number of agricultural households growing cassava in 2008/09. Cassava is grown by over a million households throughout the country. Over 200,000 households grow the crop in the western region, which comprises the areas where this survey took place. In this region 24% of the households grew cassava in the second season of 2008 (Season B) and this figure increased to 27% in season A of 2009 (Figure 4). Season B comprises months of August to early December while season A comprises the months of March to May.



Source: UCA, 2010

Figure 3: Number of agricultural households growing cassava by region and season, 2008/2009



Source: UCA, 2010

Figure 4: Proportion of households growing cassava by region and season, 2008/2009

Table 1 indicates production by region in 2008/2009.The eastern region was the largest producer of cassava in Uganda in 2008/2009. Acreage under cassava was estimated to be 342,387 Ha, which was the largest. This was followed by the northern region with an area of 269,886 Ha. Although these two regions had the highest production figures, findings from the scoping study and market assessment indicate that they are not major suppliers of fresh cassava. These areas mainly supply dried cassava (chips or flour). In addition, they are also major consumers of cassava. These two factors therefore limit their competitiveness in terms of investing and trading in fresh cassava roots.

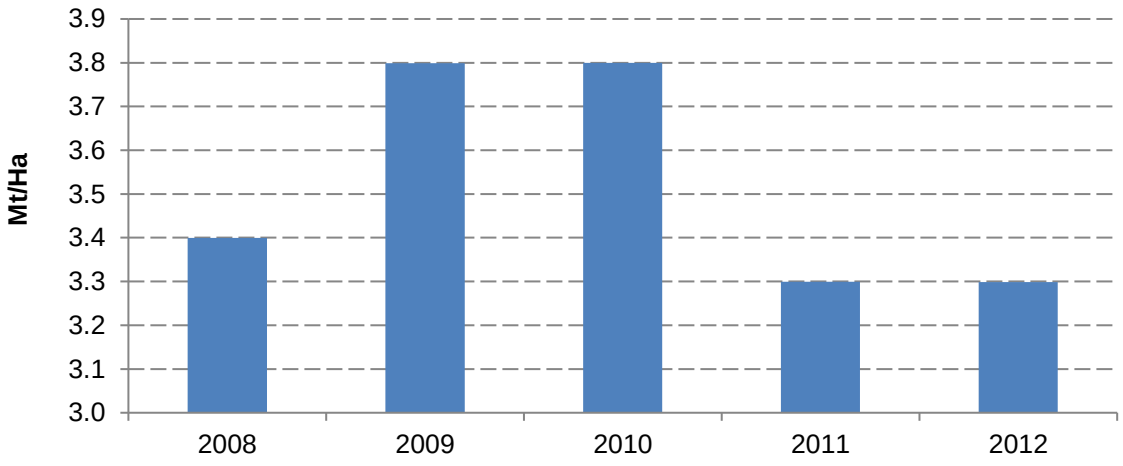
Table 1: Cassava production and yield by region, 2008/2009

	Central	Eastern	Northern	Western
Area (Ha)	127,788	342,387	269,886	131,328
Production (Tons)	409,812	1,061,186	983,124	440,189
Yield (Tons/Ha)	3.2	3.1	3.6	3.4

Source: UBOS, 2014

3.1.2. Yield

Figure 5 below shows the trend in cassava average yield over the period 2008 to 2012. Yield figures show a sharp decline in 2011. This is mainly attributed to the spread of the cassava brown streak disease.



Source: Calculated from UBOS data

Figure 5: Yield trend, 2000 – 2012

In terms of productivity, the northern region shows the highest average yield, estimated at 3.6 Mt/Ha, followed by the western region with 3.4 Mt/Ha (Table 1). The eastern region has the lowest yield followed by the central region with 3.2 Mt/Ha.

As previously mentioned, both the eastern and northern regions have a larger proportion of cassava traded and consumed in dry form while the central region and the western region mainly consume and trade cassava in its fresh form. However, production of cassava in the central region is primarily for home consumption although the region is nearer to the main trading center (Kampala) which would have allowed it to enjoy better market access. The other factor limiting the competitiveness of fresh root trade in the central region is the high disease pressure. Consequently, traders of fresh cassava have moved out to some areas within the western region to obtain supplies at competitive prices. On the other hand, other areas within the western region, farer from Kampala, such as Kabarole enjoy considerably less access to the lucrative markets in capital city due to distance. Therefore, fresh cassava produced from distant locations of the western region usually ends up being marketed and consumed locally, thus offering limited opportunities for local producers to benefit from the higher prices offered in the major urban centers. Therefore this region is better positioned to test the business case for technologies for extending the shelf-life of fresh roots which would provide this area with an opportunity to access more distant and potentially lucrative markets, particularly in Kampala.

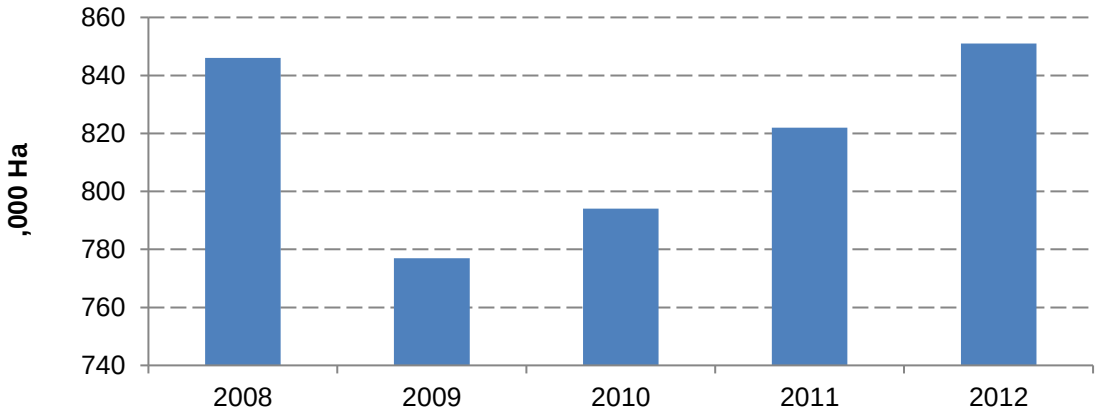
3.1.3. Acreage

According to the Uganda agricultural census, the average holding size (AHS) is the total agricultural land operated by agricultural households whether owned, rented in or borrowed. The national AHS in 2009 was estimated to be 1.1 Ha (2.7 acres), varying from 1.6 Ha (4 acres) for the northern region to 0.8 Ha (2.0 acres) in the western region. The AHS in the eastern and central regions was1.1 Ha (2.7 acres) and 1.0 Ha (2.5 acres), respectively.

A household usually manages several plots. The national average plot size was estimated to be 0.28 Ha (0.7 acres).This varied from 0.31 Ha (0.8 acres) in the eastern region to 0.25 Ha (0.6 acres) in central and western regions. The average plot size in northern region was reported to be 0.27 Ha (0.7 acres).

Secondary data revealed that the vast majority of households growing cassava in Uganda in 2008/09 allocated between 0.25 and 8 acres to this crop. The total land under cassava production comprises all the different cassava plots that a particular household grows. In 2008/09 cassava plots equaled 3.1 million, of which 1.9 million (61%) were pure stand and the rest were intercropped (UBOS, 2010).

Literature review, key informant interviews and survey respondents agreed that increases in acreage planted to cassava has been the main factor contributing to growing cassava output over the last few years. As Figure 6indicates, the acreage allocated to cassava has been increasing since 2009.



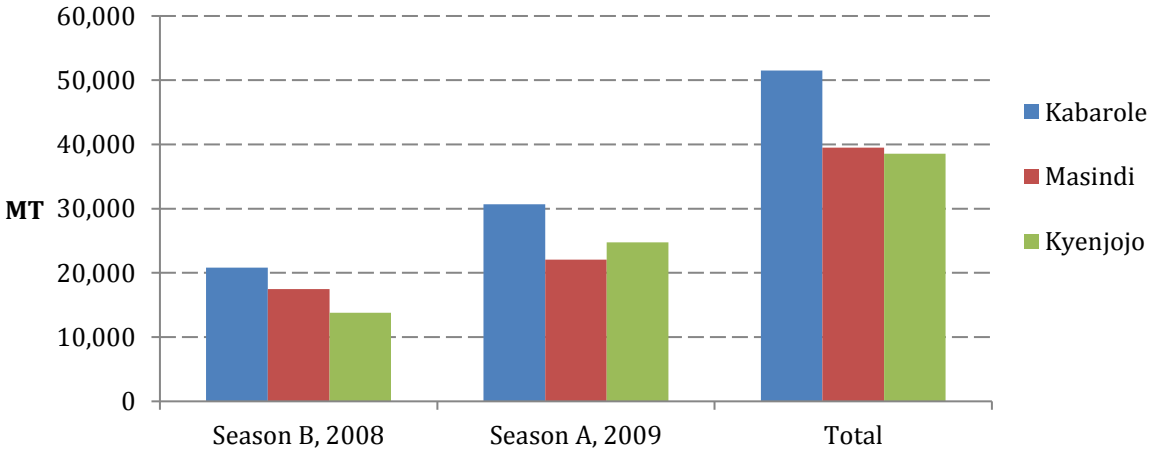
Source: UBOS, 2014

Figure 6: Acreage under cassava production, 2008-2012

3.2. PRODUCTION IN THE STUDY AREAS (AS PER LAST CENSUS)

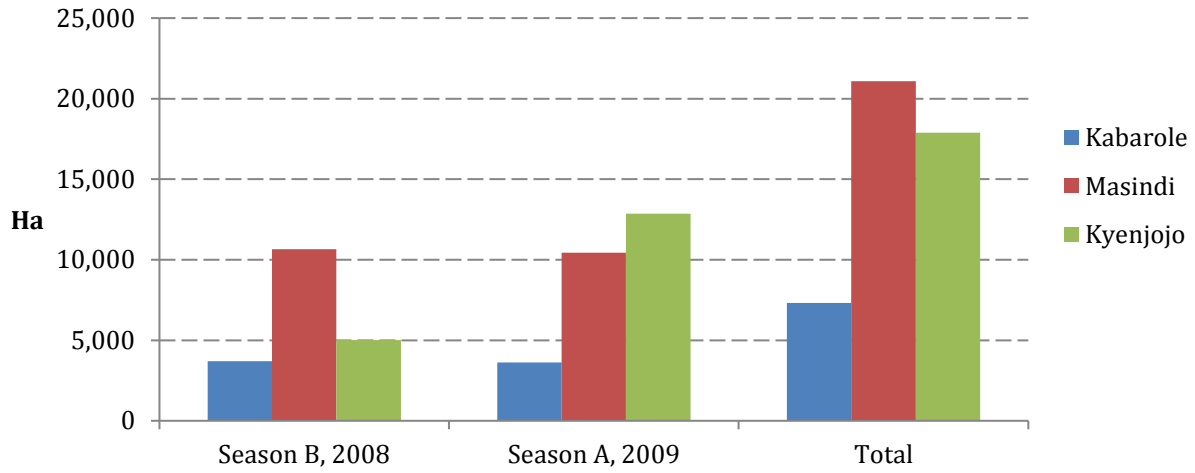
3.2.1. Volume, acreage and yield in study areas

In all areas that were surveyed cassava is a major crop grown for both household consumption and income. Total production in Kabarole district was estimated to be 51,486 tons in 2008/2009 agricultural census year. Production in Kyenjojo district was estimated to be 38,552 tons while Masindi district had a production of 39,515 tons (Figure 7).



Source: Uganda Census of Agriculture, 2010

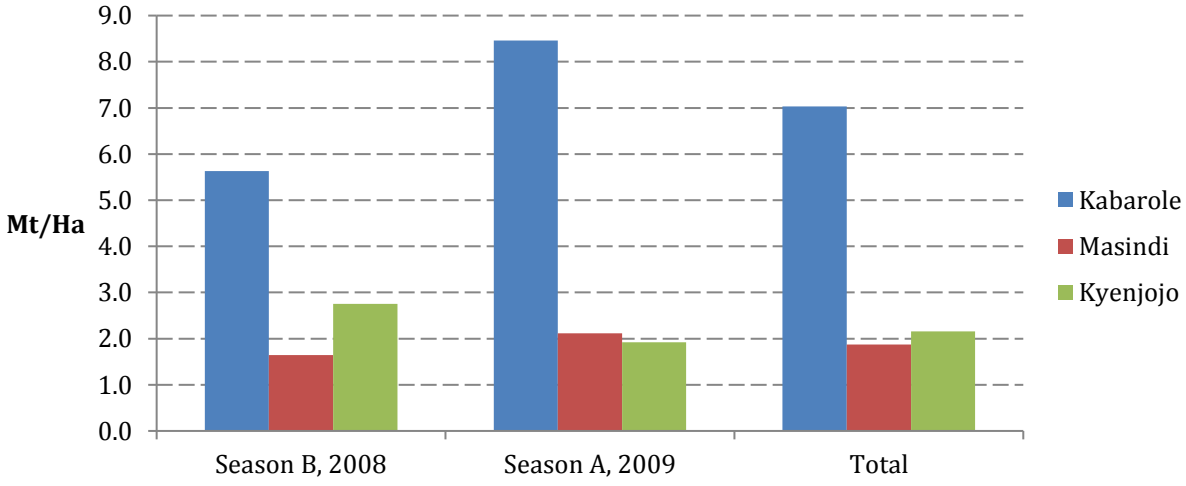
Figure 7: Total and seasonal cassava production in the survey areas, 2008/2009



Source: Uganda Census of Agriculture, 2010

Figure 8: Total and seasonal land allocated to cassava in the survey areas, 2008/2009

Figure 8 above shows that in 2008/09 the Kabarole district had the smallest area allocated to cassava production (7,322 Ha for both production seasons) among the three districts selected along the two axes where the survey took place. In the same period, the area planted to cassava in Kyenjojo and Masindi districts was estimated to be 17,885 Ha and 21,082 Ha, respectively. Average yield is considerably higher in Kabarole (7 Mt/Ha) than Kyenjojo and Masindi (2.2 and 1.9 Mt/Ha, respectively) as reported in Figure 9.

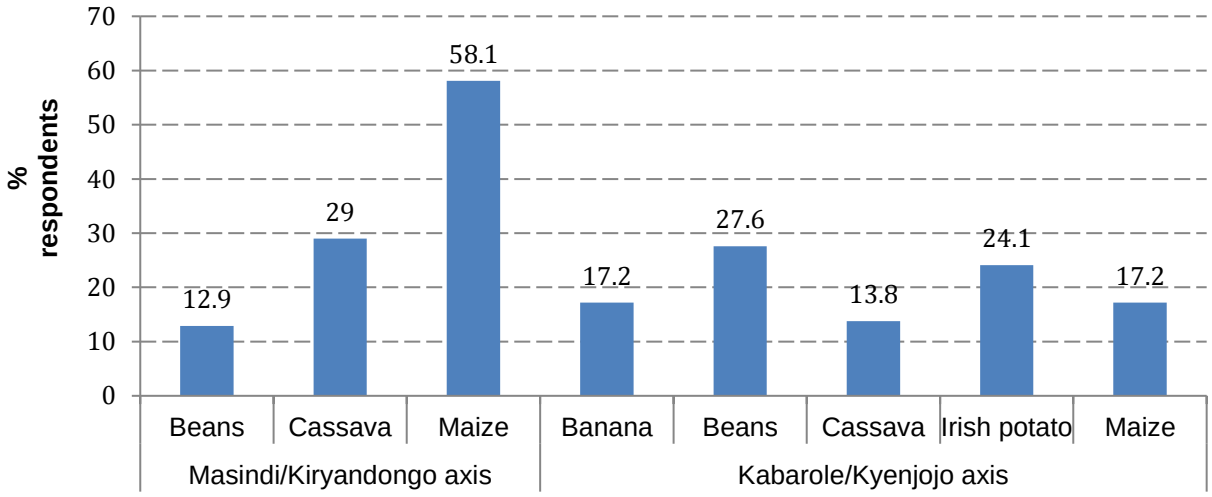


Source: Uganda Census of Agriculture, 2010

Figure 9: Total and seasonal cassava yield in the survey areas, 2008/2009

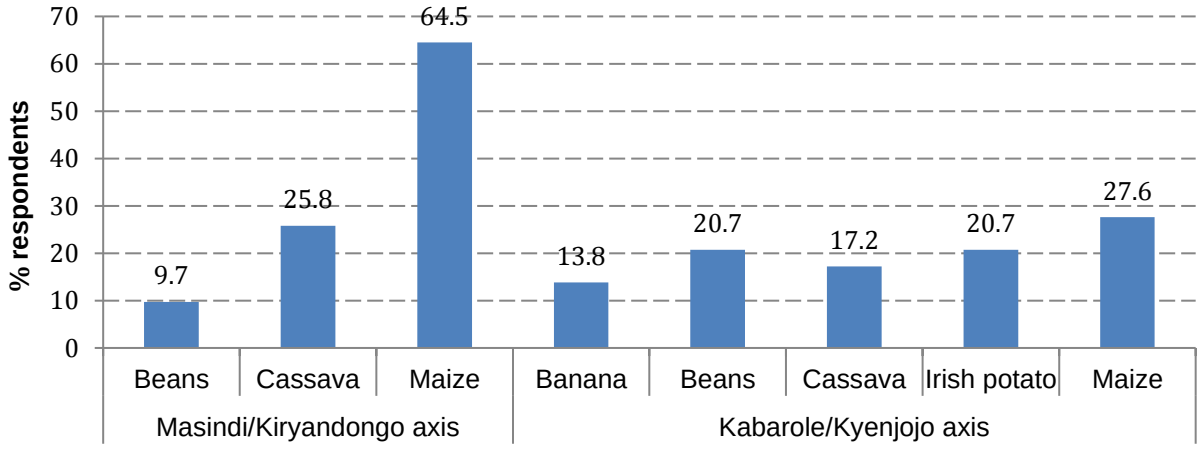
3.3. PRODUCTION (FROM SURVEY RESULTS)

Figures10 and 11below show the importance of cassava production within the farming systems of the two different survey areas. For the Masindi/Kiryandongo axis, about 29% of farmers mentioned cassava as the most important crop in season A (the highest proportion after maize), while for the Kabarole/Kyenjojo axis about 14% of farmers indicated cassava as the most important crop. For season B be the proportion are 26% and 17%, respectively.



Source: Survey data, 2015

Figure 10: Most important food crop in season A by area surveyed



Source: Survey data, 2015

Figure 11: Most important food crop in season B by area surveyed

As reported in Table 2, the average land holding for farmers in the study area is about six acres. This ranges from 4.7 (Kyenjojo/Kabarole axis) to 6.8 acres along the Masindi/Kiryandongo axis. Table 3 shows that out of the total available land about three acres are under crop production (again higher in Kiryandongo than in Kyenjojo). In both locations, male-headed farming households have more land than female-headed ones. These gender disparities were more pronounced in Kyenjojo (Table 4). This translates also in gender inequalities in the land actually allocated to crop production (Table 5).

Table 2: Average land holding per farmer

District	N	Minimum	Maximum	Mean	Std. Deviation
Kiryandongo	31	1	50	6.8	8.49
Kyenjojo	29	1	25	4.7	5.15
Total	60	1	50	5.8	7.10

Source: Survey data, 2015

Table 3: Average acreage allocated to crop production per farmer

District	N	Minimum	Maximum	Mean	Std. Deviation
Kiryandongo	31	0.33	10	3.7	2.63
Kyenjojo	29	0.33	9	2.7	2.20
Total	60	0.33	10	3.2	2.47

Source: Survey data, 2015

Table 4: Average land holding by gender

Gender	District	N	Minimum	Maximum	Mean	Std. Deviation
Male	Kiryandongo	25	2	50	7.4	9.32
	Kyenjojo	14	1.3	25	7.2	6.50
Female	Kiryandongo	6	1	7	4.2	2.31
	Kyenjojo	15	1	5	2.4	1.31

Source: Survey data, 2015

Table5: Average acreage allocated to crop production by gender

Gender	District	N	Minimum	Maximum	Mean	Std. Deviation
Male	Kiryandongo	25	0.75	10	4.0	2.65
	Kyenjojo	14	0.33	9	3.2	2.57
Female	Kiryandongo	6	0.33	6	2.6	2.36
	Kyenjojo	15	0.50	6	2.3	1.77

Source: Survey data, 2015

The average land usually allocated to cassava production is estimated to be 1.3 acres, varying from 1.3 acres in Kiryandongo/Masindi axis to 1.4 acres in Kabarole/Kyenjojo axis (Table 6). This implies that a higher proportion of land is allocated to cassava in Kyenjojo than in Kiryandongo (50% vs 34%). The explanation for this is that maize production in Kiryandongo/Masindi axis has been growing to commercial levels with larger acreage being devoted to its production.

Table6: Acreage usually allocated to cassava in the study areas

District	N	Minimum	Maximum	Mean	Std. Deviation
Kiryandongo	31	0.05	7	1.26	1.22
Kyenjojo	29	0.25	7	1.36	1.63
Total	60	0.05	7	1.31	1.42

Source: Survey data, 2015

As shown in Table 7, the average land usually allocated to cassava production was higher for male-headed farming households (1.7 acres) than female-headed ones (1.0 acres) in Kyenjojo, while the reverse is true in Kiryandongo where (1.1 vs 1.9 acres).

Table 7: Acreage allocated to cassava by gender

District	Gender	N	Mean	Minimum	Maximum	Std. Deviation
Kyenjojo	Female	15	1.01	0.5	2	0.52
	Male	14	1.74	0.25	7	2.2
Kiryandongo	Female	6	1.88	0.05	7	2.58
	Male	25	1.11	0.25	2	0.57

Source: Survey data, 2015

The study revealed that cassava is mainly intercropped. In line with national figures, an estimated 62% of the farmers indicated that cassava is intercropped, mainly with maize and beans. This could be attributed to scarcity of land available given the increase in population.

Table 8: Cassava cropping system

District	% mono-crop	% intercrop
Kiryandongo	39%	61%
Kyenjojo	38%	62%
Total	38%	62%

Source: Survey data, 2015

As already indicated, cassava is a major crop grown by most households in the study area. Between 2013 and 2015 the average output per household increased by an estimated 39%, from 3.1 tons to 4.3 tons. This was mainly driven by an increase in the average acreage allocated to cassava by farmers. This increased by about 23%, from less than an acre to 1.2 acres (Table 9), most probably as response to population changes and rising demand for cassava that is increasingly an important cash crop for these rural households.

Table 9: Trend in cassava acreage and output per farming household from 2013 to 2015

Acreage/Output	N	Minimum	Maximum	Mean	Std. Deviation
Acreage 2015 (acres)	60	0.25	7	1.2068	1.42997
Output 2015 (Kg)	56	900	20,000	4,264.29	3,991.556
Acreage 2014 (acres)	60	0.25	4	1.0208	0.85407
Output 2014 (Kg)	53	600	10,000	3,032.08	1,986.907
Acreage 2013 (acres)	37	0.25	2	0.9773	0.56835
Output 2013 (Kg)	31	300	9,000	3,061.29	2,298.503

Source: Survey data, 2015

Table 10: Trend in cassava acreage and output per farming household by axis from 2013 to 2015

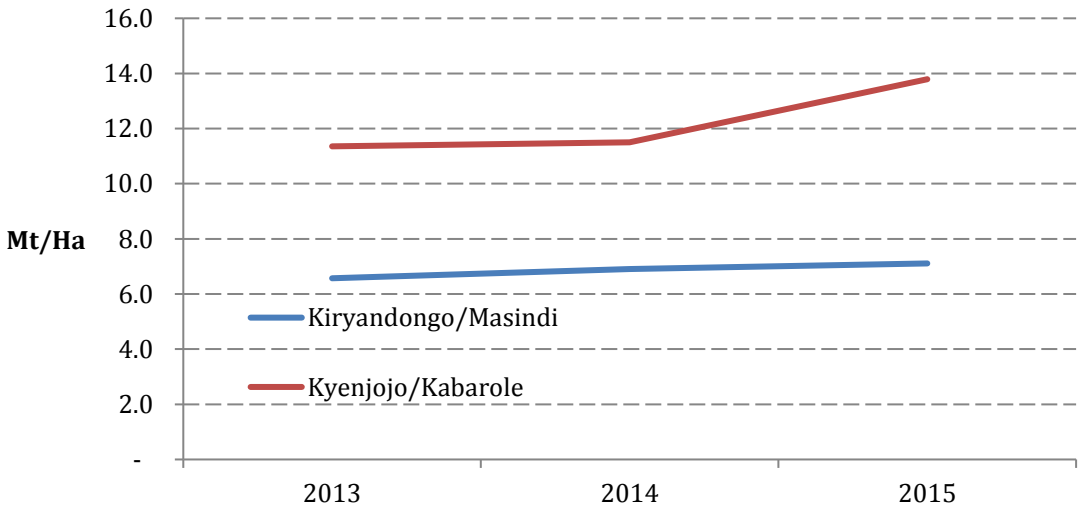
Axis	Acreage/Output	N	Min.	Max.	Mean	Std. Deviation
Kiryandongo /Masindi	Acreage 2015(acres)	31	0.25	7	1.0994	1.207
	Output 2015(Kg)	29	900	15,000	2,844.83	2,752.997
	Acreage 2014(acres)	31	0.25	4	1.00	0.75829
	Output 2014(Kg)	27	600	7,000	2,442.59	1,575.943
	Acreage 2013(acres)	20	0.25	2	0.9415	0.44458
	Output 2013(Kg)	17	300	4,000	2,247.06	1060.14
Kyenjojo /Kabarole	Acreage 2015(acres)	29	0.25	7	1.3217	1.64965
	Output 2015(Kg)	27	1000	20,000	5,788.89	4,569.492
	Acreage 2014(acres)	29	0.25	4	1.0431	0.95914
	Output 2014(Kg)	26	900	10,000	3644.23	2,205.327
	Acreage 2013(acres)	17	0.25	2	1.0194	0.69899
	Output 2013(Kg)	14	1000	9,000	4050	2,981.417

Source: Survey data, 2015

Table 10 above shows the trend in acreage allocated to cassava and the resultant output in the two selected axes. The average acreage allocated to cassava in the Kiryandongo/Masindi axis increased from 0.9 acres in 2013 to 1.1 in 2015, an increase of 17%. The average output per household also increased from 2.2 tons in 2013 to 2.8 tons in 2015. This represents an increase

of about 27%. The Kyenjojo/Kabarole axis saw a more substantial increase in average acreage allocated to cassava production, from 1.0 acres in 2013 to 1.3 acres in 2015, signifying an increase of 30%. The resulting average output per household increased by about 43%, from 4.1 tons in 2013 to 5.8 tons in 2015. Therefore, while in both axes there has been an increase in both acreage allocated to cassava and the resulting output, this has been more pronounced in the Kyenjojo/Kabarole axis.

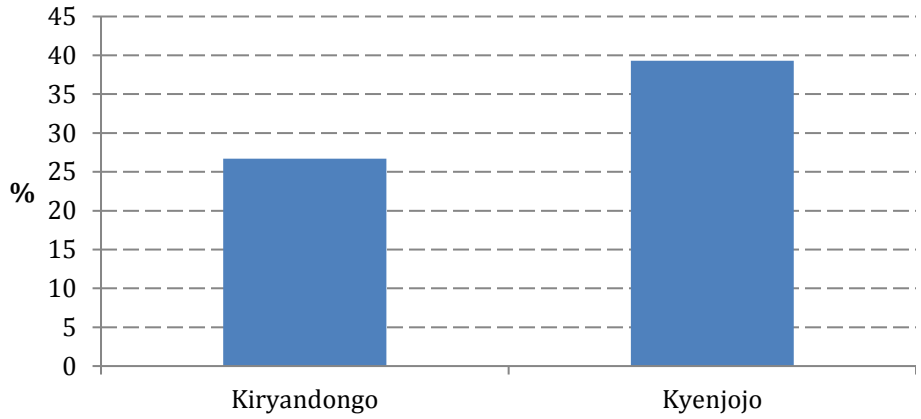
Figure 12 shows the trend in cassava productivity for both axes over the last few years. Between 2013 and 2015 the yield in the Kiryandongo/Masindi axis increased by 8%, from 6.6 Mt/Ha to 7.1 Mt/Ha. Over the same period the yield in the Kyenjojo/Kabarole axis increased by 21%, from 11.4 Mt/Ha to 13.8 Mt/Ha. This is due to an improved availability of clean and higher yielding planting material following a massive government seed distribution program targeting cassava.



Source: Survey data, 2015

Figure 12: Trend in cassava productivity in the survey area

Some households in the survey areas grow more than one plot of cassava. While 39% households maintain more than one plot of cassava in Kyenjojo, only 27% of the households in Kiryandongo/Masindi axis grow cassava in more than one plot (Figure 13). This could be explained by differences in the land tenure system in the two locations.



Source: Survey data, 2015

Figure 13: Proportion of households growing more than one cassava plot

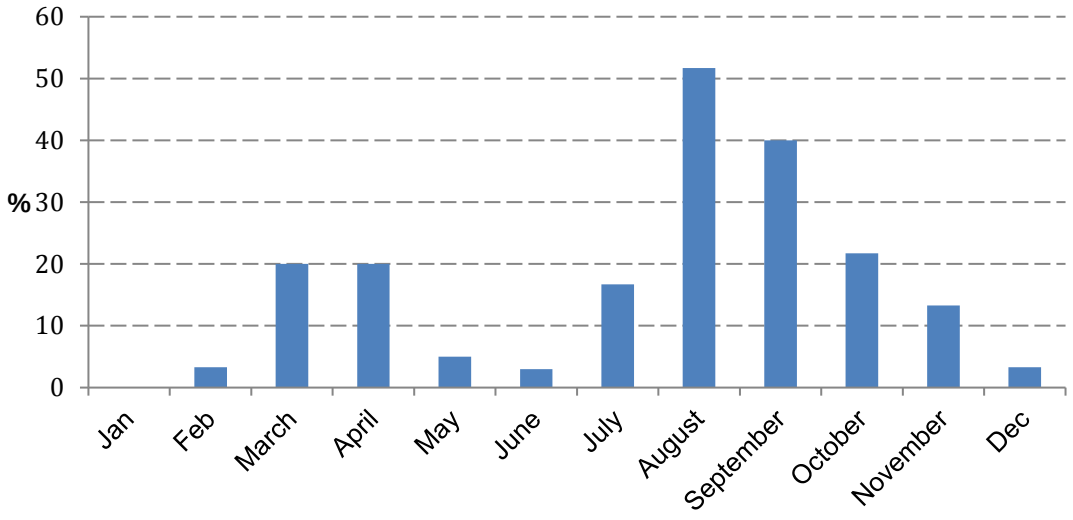
3.3.1. Production seasonality

All farmers in both locations indicated that both planting and harvesting are seasonal. Planting follows the rainfall pattern that comprises two rainy seasons. The first rainy season usually begins around March to mid-June while the second commences in late July and ends in early December. Planting and harvesting are easier during the wet season.

Most farmers (51.7%) mentioned that they plant cassava in August. This is followed by September which was mentioned by 40% of the farmers (Figure 14).

On the other hand, harvesting coincides with high demand/consumption periods. Cassava consumption is high during the period January to April and again in July to August. From November to December consumption is low. Cassava consumption is high when supply of cooking banana (matooke) and sweetpotato reduces and vice versa.

In both axes harvesting is moving away from being piecemeal to involving bigger acreage due to the increasing demand in fresh cassava roots. This demand is both from internal and foreign markets although the regional market provides the largest pull. Most respondents mentioned that Rwanda was among the main destination of cassava. The Kabarole/Kyenjojo axis is closer to the Rwandan border and has therefore been more targeted by traders from Rwanda.



Source: Survey data, 2015

Figure 14: Proportion of cassava farmers planting in the different months

3.3.2. Farmers' varietal preferences

Most of the cassava varieties were referred to by their local names. Varieties released by the national cassava program were thus difficult to identify. Varietal choice depends on a number of factors which include:

- Expected yield
- Period to maturity: early maturing varieties were preferred
- Underground storability after maturity: varieties that can be stored in the ground for longer periods were preferred for food security purposes
- Taste: sweeter varieties with a higher dry matter content were preferred.

3.3.3. Production challenges

The respondents in both locations indicated the following as the major constraints affecting productivity:

1. Use of inferior and low yielding varieties
2. Lack of good quality planting material
3. Pests including the cassava mealybug (*Phenacoccus manihoti),* the green spider mite (*Mononychellus tanajoa*), whitefly*(Bemisia tabaci)* and the elegant grasshoppers *(Zonocerus variegatus)*
4. Diseases including the cassava brown streak disease (CBSV) and the African cassava mosaic disease (ACMD). Others include cassava bacterial blight disease (CBB), cassava bacterial leafspot (CBL) and *Xanthomonas campestris pv.cassavae*
5. Declining soil fertility.

About 80% of the respondents in both locations mentioned that lack of clean planting material was a major constraint. A similar proportion mentioned pests and diseases as major constraints while 70% and 10% of respondents mentioned declining soil fertility in the Masindi/Kiryandongo and Kabarole/Kyenjojo axes, respectively. However, according to interviews with NARO scientists, Kabarole/Kyenjojo axis has less disease pressure. This may partly explain the fact that respondents mentioned better soil fertility which implied higher cassava productivity.

A number of constraints limiting the increase in land cultivated to cassava were mentioned by farmers. They included the following:

1. Unavailability of labor. This is mainly due to the high rate of rural-urban migration by the youth, who mostly are the major supplier of good quality labor, unlike children and the elderly
2. Limited access to agriculture equipment such as tractors, planters, harvesters, etc. The few machinery that are available are expensive thereby limiting access and use
3. Limited access to credit by smallholders. Consequently, they are unable to increase investments in agricultural activities such as land leasing and cultivation
4. Decreasing land available for cultivation in some areas due to population pressure
5. Competing crops, especially maize, have also led to less land being allocated to cassava.

In Kyenjojo about 90% of the respondents mentioned limited access to machines for ploughing as a major constraint compared to 60% Kiryandongo.

The following were indicated as the main factors limiting producer incomes and also affecting farm gate prices:

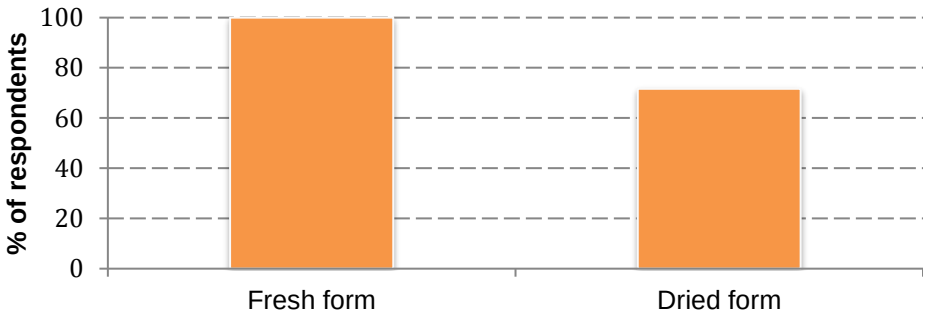
1. High cost of production
2. Pest and disease pressure
3. Low yields
4. Lack of access to more stable markets
5. Poor access to market information
6. Poor pricing strategy.

4. CONSUMPTION

4.1. RURAL CONSUMPTION

4.1.1. Forms cassava is consumed in farming households

Figure15 below indicates forms of consumption within farming households. All respondents indicated that they consumed cassava in fresh form while 75% indicated they consumed it in dried form as well. This result suggests that fresh cassava is possibly the most common and preferred way to consume cassava in the survey areas. Technologies for extending the shelf-life of cassava roots can therefore be important to increase access to fresh roots for consumers located in urban areas where daily availability of fresh cassava may be more challenging than in rural areas.



Source: Survey data, 2015

Figure 15: Main forms of consumption at rural level

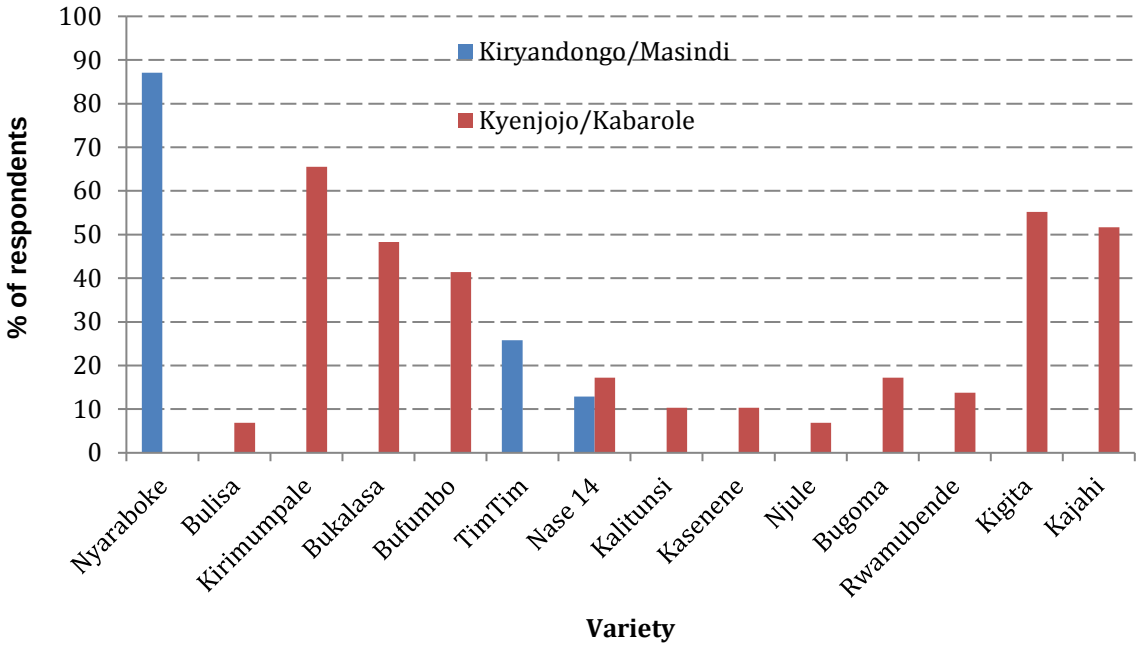
4.1.2. Varietal preferences by farming households for own consumption

Although many cassava landraces of different quality and attributes exist in the survey areas, there are also improved varieties that were released by the national breeding program specifically for the fresh market in the two areas.

Figure 16 shows the preferred varieties by farmers for home consumption. From the survey findings, Nyaraboke variety was by far the most preferred by the farmers from the Masindi/Kiryandongo axis (preferred by almost 90% of respondents) while those along the Kabarole/Kyenjojo axis showed a preference for the Kirimumpale variety (about 70%).

Table 11 shows varietal preference by gender and location. In Kiryandongo, Nyaraboke is liked by both men and women (88% and 83% of the farmers, respectively). In Kyenjojo/Kabarole axis both men and women reported their preference for the Kirimumpale variety, with 73% of women and 57% of the men indicating so.

Table 12 below indicates the reasons for varietal preference. Sweetness, productivity and softness appear to be the most important attributes the farmers look for. About 77% of farmers in Kiryandongo mentioned they liked Nyaraboke because of its sweetness, 58% because it is soft and 40% mentioned its high productivity. Kirimumpale was particularly appreciated in the Kabarole/Kyenjojo axis because it is sweet (about 60% of farmers) and high yielding (about 20%).



Source: Survey data, 2015

Figure 16: Farmer varietal preference for home consumption by location

Table 11: Farmer preferred varieties for home consumption by gender

Variety	Kiryandongo		Kabarole	
	Male	Female	Male	Female
Nyaraboke	88	83		
Timtim	20	50		
Nase 14	8	33.3	14.3	20
Bulisa			7.1	6.7
Kirimumpale			57.1	73.3
Bukalasa			42.9	53.3
Bufumbo			28.6	53.3
Bugoma			7.1	26.7
Kalitunsi			7.1	13.3
Kasenene			7.1	13.3
Njule			7.1	6.7
Rwamubende			7.1	20
Kigita			35.7	73.3
Kajahi			35.7	66.7

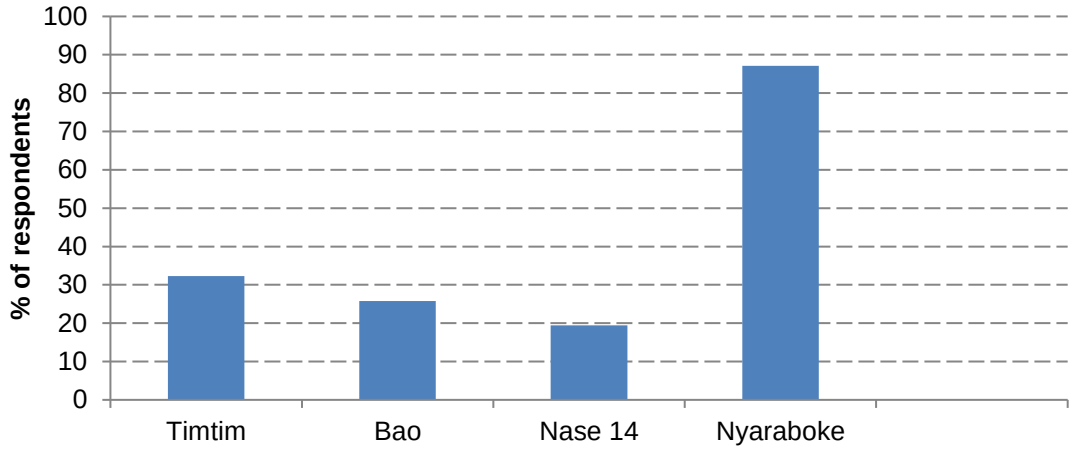
Table 12: Reasons for varietal preference

District	Variety	Soft	Sweet	High yielding	Big tubers	Medium tubers	Early maturing	Disease resistant
Kiryandongo/ Masindi	Nyaraboke	58.1	77.4	41.9				
	Timtim	9.7	12.9					
	Nase 14		9.7	12.9				9.2
Kabarole/Kyenjojo	Bulisa		6.9					
	Kirimumpale		62.1	20.7		24.1		
	Bukalasa	34.5	44.8			10.3		
	Bufumbo	13.8	17.2		17.2		37.9	
	Nase14		17.2	12.9				13.8
	Kalitunsi		6.9					
	Kasenene		3.4					
	Njule		3.4				3.4	
	Bugoma		17.2					
	Rwamubende		10.3					
	Kigita	41.4	55.2					
	Kajahi	34.5	48.3					

Source: Survey data, 2015

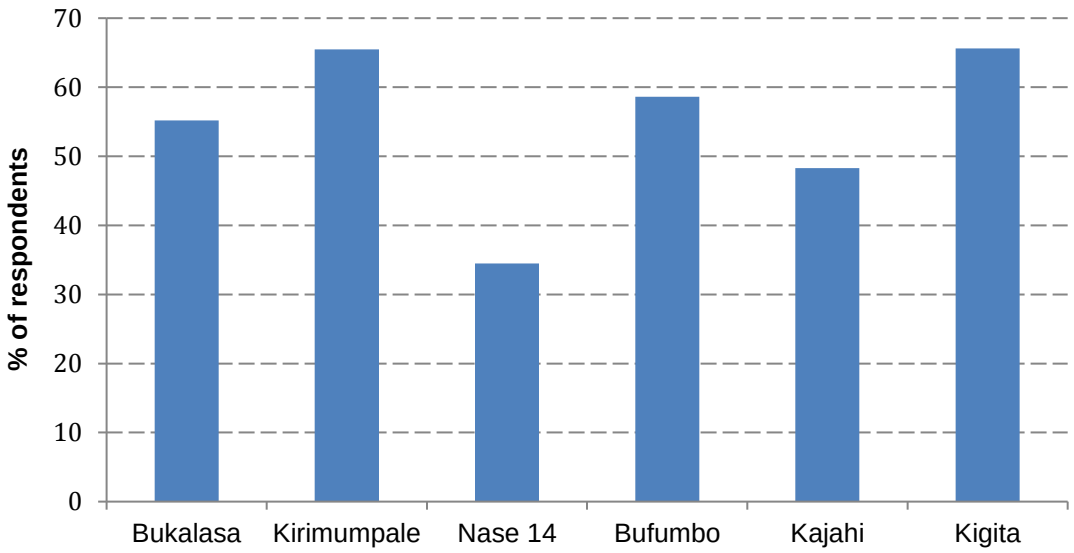
4.1.3. Varietal preferences by farming households for marketing

Figures 17 and 18 show the preferred varieties by farmers for marketing in the two study areas. Similarly to what found for preferences for household consumption, farmers in Kiryandongo prefer the Nyaraboke variety while those in Kyenjojo show preference for the Kirimumpale variety. These preferences are attributed to the fact that these two varieties are sweeter, an attribute that consumers also seek for.



Source: Survey data, 2015

Figure 17: Varieties preferred by farmers for marketing in Kiryandongo district



NB: NAADS was used to refer to all and any of the varieties distributed through the GoU's extension service

Source: Survey data, 2015

Figure 18: Varieties preferred by farmers for marketing in Kyenjojo district

Table 13 below indicates how cassava is utilized. This includes consumption by the farmer's household and sales to the market in either fresh or dried form. The results indicate that in both areas sales of fresh cassava is an important source of income. In both areas about 50% of the cassava produced is sold in fresh form. It is interesting to note that a higher proportion of cassava is marketed in the Masindi/Kiryandongo axis than in the Kabarole/Kyenjojo axis, probably due to the existence of a more developed marketing channel in the former. About 37% of cassava in the Kabarole/Kyenjojo axis is consumed as fresh roots, while the proportion is lower in the Kiryandongo/Masindi axis (23%). Farmers have indicated that the sale of fresh roots is usually more profitable than the sale of dried products. For instance, farmers in Kyenjojo sell a typical bag of fresh cassava at about UGX 50,000 while a bag of dry chips is sold at about UGX 100,000 but indicatively three bags of fresh roots are required to produce a bag of chips.[1] Furthermore, additional labor is required for peeling and drying the roots. Despite the marketing of fresh cassava being more profitable, farmers at times have to clear their field for the next planting season and process the roots into storable dry products because unable to sell the fresh cassava at a fair price. Furthermore, some varieties have a high level of cyanide and therefore are not suitable for fresh consumption.

[1] At the time of the survey 1 USD = 3,400 Ugandan Shillings

Table 13: Proportion of fresh and dry cassava for own-consumption and sale by location

District	Usage	%
Kiryandongo	Consumed fresh at household	22.6
	Consumed dried at household	10.8
	Sold fresh	48.2
	Sold dried	18.4
Kyenjojo	Consumed fresh at household	36.5
	Consumed dried at household	9.1
	Sold fresh	51.0
	Sold dried	3.5

Source: Survey data, 2015

4.2. URBAN CONSUMPTION

According to the scoping study (2014), and as mentioned earlier, market demand for fresh roots in Uganda is increasing and this is attributed to growing population, income, and urbanization.

Ugandan farmers are highly responsive to market opportunities and they tend to shift production accordingly. For instance, former areas under cassava have been devoted to sugarcane production in much of Busoga region, which was a major cassava growing area in eastern Uganda.

According to information from the scoping study and interactions with key market informants, both consumption and sales of cassava are mainly in the dried form in the northern and eastern regions. The central and western regions consume and market cassava mainly in the fresh form. The western region is the main supplier of fresh cassava roots to the major urban markets in Kampala with the Kiryandongo/Masindi area accounting for the largest proportion. This is due to its proximity to Kampala relative to other areas that are farer away such as Kyenjojo and Kabarole. While Kyenjojo/Kabarole axis trades its cassava mainly in fresh form (Table 13), the volumes that reach Kampala district are relatively lower than the ones from other locations in the western region, such as Kiryandongo/Masindi and also Mubende/Kyegewa areas.

For this study, most urban consumers were interviewed in Kampala, being the largest market for fresh cassava. Other consumers were from the Kabarole district. In total, 66 consumers were interviewed, 75% of which were females. Types of consumers interviewed ranged from household consumers (76%), consumers at fast-food joints and restaurants (15%), and small & medium institutions such as hotels and schools (9%).

4.2.1.Preferred purchase forms by urban consumers

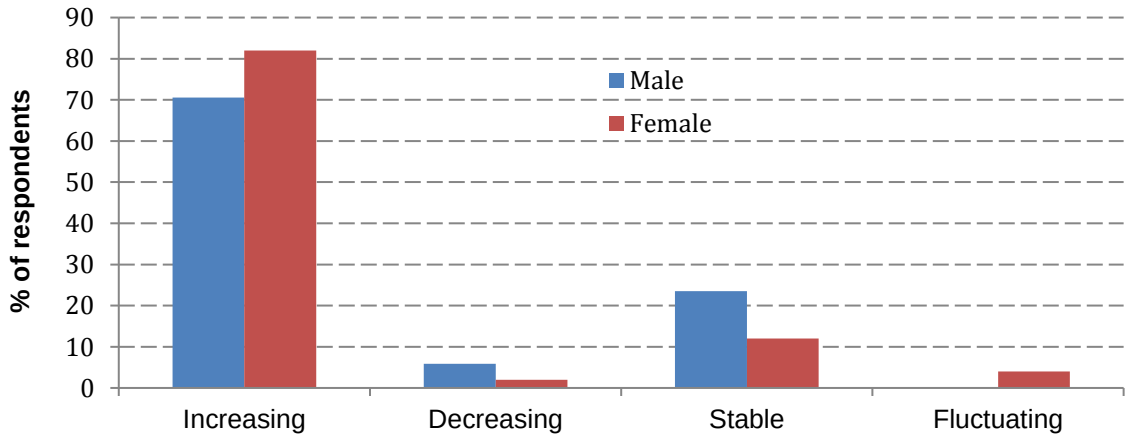
About 83% of the respondents stated that the most common form they purchase cassava is as fresh root (Table 14).

Table 14: The most common form of cassava purchased

Cassava form	Frequency	Percentage
Fresh roots	55	83%
Flour	5	8%
Chips	3	5%
Others	3	5%
Total	66	100%

Source: Survey data, 2015

Survey results indicated that consumption of fresh cassava roots has been increasing over the last five years as revealed by over 70% of the respondents. Both females (82%) and males (71%) indicated that demand for fresh root has grown (Figure 19).This implies that fresh cassava roots have a very high market potential.



Source: Survey data, 2015

Figure 19: Consumption trend of fresh cassava over the last five years

4.2.2. Preferred ways to consume cassava

Fresh cassava is prepared and consumed in various forms. As presented in Table 15, the stated preferred forms include snack as fried chips (most preferred by 37% of respondents), boiled (35%) and steamed in banana leaves (28%).Fried cassava chips are highly preferred because they are one of the easiest snacks to prepare and are relatively cheap compared to other snacks. For instance, it was reported that cassava chips costing UGX 1,000 are sufficient for breakfast to a household of about four persons while the same household would need to spend UGX 2,400 for a bread-based breakfast.

Table 15: Preferred ways to consume cassava in urban areas

Cassava form	Frequency	Percentage
Boiled	23	35%
Steamed	18	28%
Fried (Chips)	24	37%
Total	65	100%

Source: Survey data, 2015

4.2.3. Source of fresh cassava roots for home consumption

About 87% of the interviewed consumers indicated that most of the fresh cassava roots consumed at household level are obtained from open market retailers in urban areas. These urban retailers are mostly women who sell small quantities of cassava roots, mostly by heaps. Each heap consists of 3 to 5 roots, weights 1.5 to 2.2 kg and, at the time of the survey, was sold at about UGX 2,000 to 3,000, respectively (therefore about 1,350 UGX/Kg).

Sources of fresh cassava that is supplied to Kampala include Masindi, Kiryandongo, Kigumba, Bweyale, Karuma, Lira, Apac, Luweero, Mityana, Masaka, Hoima, Kibaale, Mubende, Kyegegwa, Kyenjojo, Jinja, Kayunga, Mukono among others. About 60% of cassava sold in Kampala originates from western Uganda, 20% from central, 15% from northern and 5% from eastern regions.

4.2.4. Seasonality of fresh cassava roots consumption

The majority of respondents (60%) indicated that their demand for cassava fluctuates throughout the year while fewer reported demand to be stable. High consumptions occurs during the months of January to April, and again from July to August. From November to December consumption is low. Consumption of fresh cassava is high when there is less availability of other staples in the market and their prices are high.

4.2.5. Varietal preference by consumers in Kampala

According to the survey findings, the majority of consumers (67%) prefer cassava roots with specific attributes such as sweetness and white flesh.

Consumers within Kampala ranked Bukalasa variety as their first choice (Table 16). It was followed by Gwalanda while Nyaraboke was ranked third overall. This suggests a discrepancy with farmers' preferred varieties for marketing indicated earlier. However, it should be noticed not all cassava consumed in Kampala is sourced from the two production axis selected for this study.

Table 16: Preferred cassava varieties by consumers and related quality attributes

Ranking of preferred cassava varieties	Stated quality attributes
1. Bukalasa	Soft, tasty, white in color and with large roots
2. Gwalanda	Tasty, white in color and with large roots
3. Nyaraboke	Tasty

Source: Survey data, 2015

4.2.6. Consumer perceptions of fresh cassava with extended shelf-life

Consumers were asked about their perceptions and potential acceptability of fresh cassava roots with extended shelf-life. The majority of consumers (72%) reported that having fresh cassava roots with extended shelf life (over seven days) was acceptable to them, while 61% expressed the interest to learn more about the shelf life extended cassava roots. About 15% of consumers expressed concerns about the likely higher cost of these roots.

Table 17: Perceptions about shelf-life extended fresh cassava roots

Perception of cassava roots with a shelf life of over 7 days	Frequency	Percentage
Acceptable	34	72%
Interested to learn about	14	61%
Likely to be expensive	3	15%

Source: Survey data, 2015

5. VALUE CHAIN ANALYSIS

5.1. BRIEF DESCRIPTION OF VALUE CHAIN ACTORS

The study revealed that the various chain actors involved in the production, trade and consumption of fresh cassava roots in Uganda included small, medium and large scale farmers, rural assemblers, wholesalers/travelling traders, retailers and, finally, consumers. These actors exhibited some form of informal relationships. For instance, rural assemblers at times receive financing from wholesalers. They in turn provide credit to farmers. Rural assemblers are in regular contact with wholesalers and they share market information. There are opportunities for formalizing some of these relationships.

Figure 20presents a schematic representation of the fresh cassava value chain. While farmers are still directly involved in some piecemeal harvesting, mostly for local sales, cassava is usually purchased by rural assemblers and traders when still in the garden. The buyer then hires laborers for harvesting, thus relieving farmers of the burden of harvesting. This is due to limited labor and finance available to farmers. The final price is then determined based on the amount of cassava bags that have been harvested from the field.

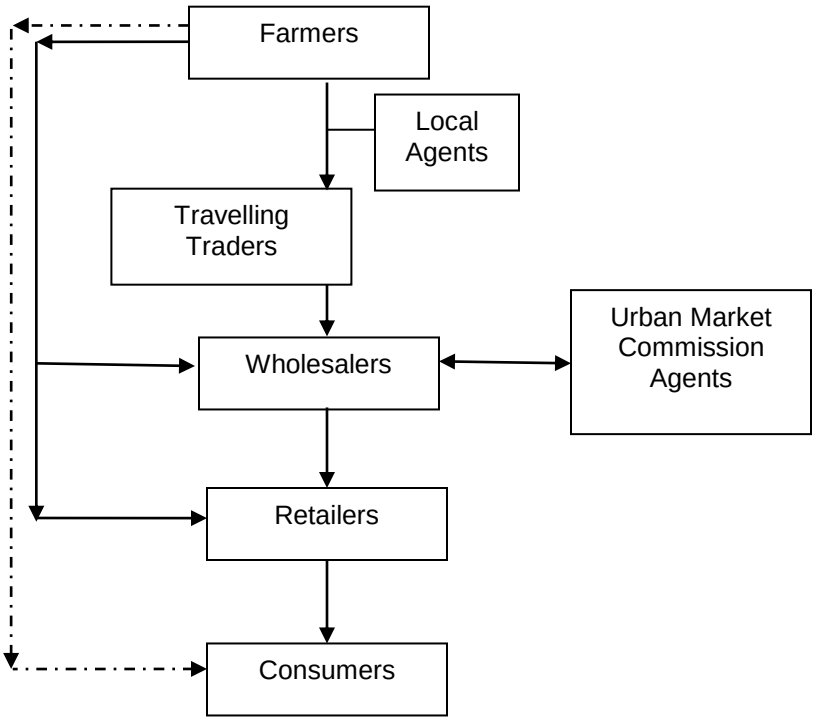


Figure 20: Schematic representation of the fresh cassava value chain

The study revealed that fresh cassava roots are mostly produced by smallholder farmers in their individual plots. Although some farmers belong to associations and groups, they market

cassava almost exclusively individually. While it is usually the local agent to connect them to travelling traders, some traders and wholesalers are able to procure their fresh cassava supplies directly from the farmers.

In certain occasions, farmers carry out harvesting and marketing activities on their own. Consumers also buy directly from farmers, although the volumes transacted in this kind of setting are usually smaller. As Mugisa (2010) pointed out, farmers who intend to sell their cassava do not harvest in speculation of a market but rather wait until there is a buyer. This reduces the possibility of losing the harvested cassava as result of the rapid deterioration of the root.

Local agents play a critical role in the value chain. They scout and identify farmers with mature cassava who are willing to sell. These local agents identify a ready-for-harvest plot (usually of less than one acre) and connect the farmers to wholesalers/travelling traders operating from the main markets in Kampala. Several plots have to be harvested in order to fill a truck and this may cause delays. Buyers are cognizant of the problem of the rapid PPD and try to mitigate the consequences by harvesting and leaving the cassava roots covered by grass and soil until when the transporters arrive.

Fresh cassava roots are most commonly transported in bags that are not usually weighted. It was found that these bags are of different sizes and shapes. Upon interaction with key informants, an attempt was made to obtain estimates of the weight of the different cassava bags used for transporting the roots from farm to market (Table 18).

Table18: Size of different cassava bags

Unit	Description	Estimated average weight
Extra-large bag	100 Kg bag with 3feet extension on top	300 – 350 Kg
Normal bag	100 Kg bag commonly called a 'piece'	180 – 200 Kg
Half bag	Half of a 'piece'	79 Kg

Source: Survey data, 2015

5.2 TRADED VOLUMES AND FREQUENCY OF PURCHASES/SALES

5.2.1. Wholesalers

From the above indicative weights of fresh cassava bags, estimates were obtained on average quantities of cassava procured by traders per week. The results showed that wholesalers/travelling traders, 88% of whom were males, on average supply fresh cassava to the Kampala markets three times per week, with each consignment being 15 bags (350 Kg each), totaling approximately 5,250 Kg per consignment. This translates into an average of 16 tons of fresh cassava being supplied weekly by each wholesaler in the surveyed area to the major markets in Kampala. At the time of the survey, wholesalers obtained supplies at cost of

about UGX 371 per Kg.[2] These travelling traders/wholesalers are responsible for hiring trucks to transport cassava to the urban markets in Kampala. Trucks usually travel at night so as to reach the market the next day, early in the morning. This enables them to quickly sell their produce before day break and reduce spoilage and loss of the roots. It was estimated that about 30 and 20 tons are sold in Kampala daily from the Kiryandongo-Masindi and Kyenjojo/Kabarole axis, respectively.

5.2.2. Retailers

From the survey findings, retailers purchase their fresh cassava roots from the wholesalers six to seven days in a week. On average, a retailer buys between 100 to 200 kg of fresh roots daily, resulting into an average of 1,200 Kgs per week. Retailers pay about UGX 500 per Kg of fresh cassava roots.

6. MARKETINGMARGINS ANALYSIS

The marketing margin of a product is the difference between what a company pays for the product and what it charges for the product.

Marketing Margin = [Selling price – Purchase price]

Since farmers are at the base of the cassava value chain and therefore do not buy the roots, their purchase price is assumed equivalent to the cost of producing cassava. From the results of the study, the cost of production for one acre of cassava was estimated as presented in the next table.

Table19: Estimated production cost per acre

Activity	**Cost (Uganda Shillings)**
Ploughing	80,000
Planting material	70,000
Planting	50,000
First weeding	60,000
Second weeding	60,000
Total cost	**320,000**

Source: Survey data, 2015

From the study results (Table 9), the average yield of fresh cassava roots in Kyenjojo/Kabarole was calculated to be 4.3 tons per acre. Therefore, the cost of producing a kg of fresh cassava roots was estimated to be about UGX 75.

[2] At the time of the survey an extra-large bag of fresh cassava costed UGX 130,000 in Kiryandongo area.

Table 20 shows the marketing margins along the value chain. The marketing margins of farmers are very high because they do not take into account the high amount of family labor used for cassava cultivation and the related opportunity cost. Rural assemblers and retailers show again high margins due primarily to the high costs incurred for harvesting/bulking (by the former) and transporting the cassava to end market (by the latter). The marketing margin (in absolute terms) of retailers is the highest since it is calculated assuming the sale of fresh good quality roots only. However, the figure may be misleading since, as presented in the following section, retailers initially charge very high prices to offset the considerable price discounts they have then to apply over time in order to quickly to sell the roots before they completely spoil. Sometimes the price has to be discounted to the point that no profit is made, and, on occasion, actual financial losses are reported.

Table 20: Gross margin analysis of fresh cassava root

Chain actor	Cost of goods (UGX/Kg)	Selling price (UGX/Kg)	Marketing margin (UGX/Kg and %)	Share of retail price (%)
Farmer	75	250	175 (233%)	19%
Rural assembler	250	371	121 (48%)	27%
Wholesaler	371	500	129 (35%)	37%
Retailer*	500	1,350	850 (170%)	100%

Source: Survey data, 2015

* PPD significantly reduces the margins of retailers due to subsequent discounting of prices that occurs. Retailers' margin is calculated based on initial price obtained (fresh roots with no sign of PPD).

7. POSTHARVEST LOSSES ALONG THE VALUE CHAIN

7.1. TYPES AND CAUSES OF LOSSES AT DIFFERENT NODES OF THE VALUE CHAIN

There are several causes of postharvest losses in the fresh roots cassava value chain, including poor harvesting and postharvest practices. However, the major cause of postharvest losses is the rapid PPD that roots incur once harvested. Two types of losses can be identified: physical and economic losses.

Physical losses refer to product that is deteriorated to the point that is unfit for human consumption. Product affected by physical losses does not have alternative use or residual value (product intended for human consumption and used as livestock feed falls in this category).

Economic losses refer to product that is partially spoiled or damaged and (a) whose market price is discounted or (b) cannot be used for what it was initially meant (e.g., damaged cassava roots processed into lower value products).

7.1.1. On-farm level

The results of the survey indicated that farmers incur minimal physical and economic losses as a result of PPD. This is mainly because farmers transfer the risk of PPD completely to the buyers, by delaying harvesting until when the assembler or trader comes to purchase their produce. Usually the buyer purchases the fresh cassava roots from the field when still on the ground and then it is his responsibility to hire labor for harvesting.

7.1.2. Trading and transport (wholesaler) level

Given the nature of their operations, wholesalers usually do not experience any significant physical losses due to PPD nor did they suffer economic losses during harvesting, as PPD will have not yet taken effect. The reported postharvest losses mostly occur because of drastic delays in transportation and long-term storage of cassava, both of which are rare occurrences. For instance, it has been mentioned that in the exceptional case that the truck breaks down (leading to delays in getting to the market), the wholesaler may not be able quickly sell his entire produce at full price and up to 40% of cassava has to be sold a discounted price to avoid the complete spoilage of the roots.

7.1.3. Retail level

These are the actors (mostly female) who, according to the results of the survey, are mostly affected by PPD. This is mainly because they stay with the roots for up to four days. More details are provided in the section 7.2.

7.1.4 Consumption level

Losses incurred by consumers were reported to be minimal since they purchase only those quantities of fresh cassava that they are able to consume before the onset PPD.

7.2. POSTHARVEST LOSSES AT RETAIL LEVEL

7.2.1. Causes of losses at retail level

As mentioned in the previous section, retailers are the only value chain actors that incur significant physical and economic postharvest losses as a result of failure to quickly sell fresh cassava roots, especially when sales are low. Below are some of the causes as reported by retailers:

- Delay or failure to sell all purchased cassava due to fewer customers or market gluts
- Roots are damaged during transportation and this accelerates PPD
- Deliberate injury to roots whereby consumers demand to see the interior of the roots to ascertain whether they are still fresh
- Long transport distance or remoteness of the cassava procurement areas which increase delivery time (sometimes the roots reach the retail markets after 12hours from harvesting).
- Some roots are affected by pests and diseases, hence they are not easy to sell.

7.2.2. Mitigation measures adopted by retailers

- The retailer buys only the amount of roots that s/he is confident can be sold within one to two days
- The retailer tries to buy good quality cassava (including varieties preferred by consumers) that is easy to market
- Retailers chop off the damaged parts of the cassava roots (usually PPD starts affecting the apical parts of the roots) to make it look fresh and appealing to the customers
- If possible, cassava roots are kept under a shade or in a cool place to keep them moist
- Some retailers mix the old roots with the fresh ones in order to sell them
- Roots that stay overnight are sometimes stored in water or in a pit covered with soil
- The risk is transferred to the wholesaler/trader by delaying the payment until the cassava is sold (this is rare though)
- Delivery and trading commences very early in the morning. As the day progresses, discounts are made to ensure faster sales and limit further quality deterioration of the roots.
- The deteriorated cassava can also be dried and milled into flour, or used as animal feed.

7.2.3. Extent of postharvest losses incurred by retailers

Table 21 presents the share of retailers' roots affected by different level of quality deterioration and their indicative prices.

Table 21: Extent of retailers' roots affected by postharvest losses and their indicative price discounts

Time spent in retailers' hands	Proportion of roots	Type of PHL	Indicative price (UGX/Kg)	Price discount (UGX/Kg and %)
3/4 day (1st day)	50%	No PHL	1,350	0 (0%)
1 day (1st day)	20%	Minor economic PHL	1,100	250 (19%)
1-2 days (2nd day)	15%	Major economic PHL	500	850 (63%)
2-3 days (3rd day)	12%	Extreme economic PHL	100	1,250 (93%)
Over 3 days and chopped off parts	3%	Physical losses	-	1,350 (100%)
TOTAL	100%			

Source: Survey data, 2015

Retailers sell about half of the roots they have bought from the wholesaler in the morning by early afternoon of the very same day. These roots have not yet shown any sign of PPD and

fetch full market price. By the end of the first day retailers start discounting the roots in order to avoid incurring more serious future PPD. About 20% of cassava is sold at this time of the day with a price discount of about 19%. Typically, about 15% of cassava roots are sold the following day when they do not look anymore freshly harvested and prices have to be further lowered. Indicatively cassava is sold at about 37% of the original price. The next day the retailer will then attempt to sell what s/he has been still unable to sell after two days. In day three the roots start showing clear sign of quality deterioration and have to be sold at a very low price to consumers prioritizing the price rather than the quality of the produce. About 12% of cassava is sold in the third day and the indicative price discount is as high as 93%.

Finally, it has been estimated that about 3% of the roots handled by retailers incur physical losses due the rapid PPD. They are thrown away or, in some cases, given away free of charge to be used as animal feed. This includes cassava that remain unsold for more than three days as well as the apical parts of the roots that are chopped off at the market to make the root look fresher.

In conclusion, about 50% of cassava roots handled by retailers incur postharvest losses. Considerable larger amounts of roots are affected by economic losses (47% of roots are sold at discounted price due to some degree of quality deterioration) than physical losses (3%).

Based on Table 21, the weighted average retail price of cassava can be estimated at UGX 984/kg. This implies that postharvest losses lead to a loss of retail value than can be estimated at 366 UGX/Kg (27%). Since it is estimated that in 2014 about 310,000 tons of cassava have been retailed in fresh form in Uganda, the overall annual financial loss due to PPD can be calculated at about UGX 113 billion (USD 33.4 million).

8. CONCLUSIONS

Set up of the fresh cassava value chain in Uganda is informal, with no documented formal relationships or networks between the various actors.

Unlike other actors in the fresh cassava value chain, retailers, the vast majority of whom are women, incur high level of losses due to the rapid postharvest physiological deterioration of the roots. In fact, they are the value chain actors that keep the cassava for longer having to sit the whole day in open markets or at their roadside kiosks awaiting for buyers. While the amount of roots that have to be thrown away (physical losses) is rather limited, almost half of the roots are sold at discounted price due to PPD, particularly when the demand is low. In order to minimize the consequences of PPD, all value chain actors tend to purchase just the amount of cassava that they are confident to be able to quickly sell or consume. Furthermore, retailers tend to charge high initial prices for fresh roots so to offset the future losses they expect to incur as a result of PPD. Therefore, PPD is likely to limit the utilization of fresh cassava and, thus, indirectly affects incomes of both producers and traders as well as the purchasing power of consumers.

The technologies for extending shelf-life provide a good opportunity to traders, growers and consumers to increase utilization of fresh cassava and incomes from marketing. Given that the market for fresh cassava is increasing due to demographic factors, rural-urban migration and a reduction in poverty levels, there is a clear market opportunity for testing these technologies.

The findings of this study suggest piloting the technologies in western Uganda since this region is the major supplier of fresh roots to Kampala. Within the western region the Kabarole/Kyenjojo axis seems particularly suitable because of the high number of varieties to be tested, the good productivity, the lower pest and disease pressure and the potential for impact, being most farmers heavily depended on cassava cultivation and marketing. Furthermore, the sale of fresh root to more distant and lucrative markets by farmers located in some locations within this area, is specifically constrained by their remoteness and the consequent concern of buyers to incur losses during the transport to the end markets.

While most of the value chain actors revealed that the technologies were acceptable, on-going research aims at understanding their economic viability and social acceptability in Uganda. However, the development of best-bet marketing models for selling roots with extended shelf-life will be a gradual process requiring back and forth assessments of the demands and proper pricing based on the cost of applying the technologies and the consumers' willingness to pay. Concerted effort will be required to attract potential entrepreneurs to invest in the technologies after the on-ongoing research has provided evidence of business viability.

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ANNEXES

ANNEX 1. LIST OF KEY INFORMANTS MET

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ANNEX 2. PHOTOS

Cassava heaps at Kalerwe retail market

Rural assemblers show market preferred roots

Roots buried under grass to reduce PPD

Rural assemblers harvesting cassava

Women participate in packaging

Injuries to cassava roots during packaging

Extra-large bag (estimated at 350 kg)

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