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# Potential Determinants of Profits and Market Efficiency of Potato Market Chains in Uganda

## Abstract

**Purpose** – The study aimed at understanding the level of inefficiencies in the potato market chain. Farmers sell potato to traders but continue to complain of limited market access and low profits. The objective was to determine market efficiency and profits of the potato market chain, and factors that influence the profits.

**Design/methodology/approach** – The study focused on potato farmers, traders and small-scale processors. It was conducted in Kabale and Mbale districts being the major potato producing areas in Uganda, and Kampala being a major potato market. Data were collected from 180 farmers, 60 traders and 32 small-scale processors. Descriptive and regression methods were used to analyse the data.

**Findings** – There were three major potato market chains and all were profitable and efficient. The farmer-buyer node was the most efficient (efficiencies of 128-159%). The trader node efficiency ranged between 56 and 81%. Sex of the chain actor, group marketing, contract duration and distance to market were among the factors that affected profits.

**Research limitations/implications** – Processors considered were those operating on very small scale, hence results do not apply to large scale processing. Consumers were not included but the data and results are adequate for the study objective.

**Practical implications** – Encouraging chain actors to operate collectively, creating and maintaining contracts between actors, and establishing market infrastructure that benefits distant farmers are recommended.

**Originality/value** – This paper provides empirical information that serves as a basis to adopt market options for increased benefits to various chain actors.

**Key words:** Efficiency, market chains, potato, profits, Uganda

**Article Type:** Research paper

## 1 Background

Potato (*Solanum tuberosum* L.) was introduced in East Africa by the British in the 1880s and since then, its production has been increasing in the region (Africa 2000 Network, 2007). In Uganda, especially in the highland areas of South Western region notably in Kabale and Kisoro districts, and Eastern region in Mbale and Sironko districts, farmers grow the crop for both home consumption and income. About 60% of the production occurs in South Western Uganda, while the rest comes from Eastern and other parts of the country (Ferris *et al.*, 2001 Wang'ombe, 2008). The country's rapid urbanization offers new market opportunities for farmers to supply potato to the emerging and growing urban consumers and fast food restaurants (Kaganzi *et al.*, 2008). However, farmers have continued to complain of limited market access in terms of low prices, limited outlets, exploitation by traders and mistrust amongst themselves and other market chain actors. On the other hand, traders also complain of low volumes produced by farmers, poor quality potato and mistrust by the farmers, especially where farmers do not respect the contractual agreements. Limited market access has been associated with inefficiencies along the market chain (Africa 2000 Network, 2007). The chain actors generally lack sufficient information and lack of trust in other chain actors especially brokers and traders, obstructs them from investing in the market in areas of product quality, standards and hygiene norms (Devaux *et al.*, 2008).

For a market to be efficient and profitable, several factors have to come into play. For instance, Devaux *et al.* (2008) pointed out such factors as changes in policies, markets and technology availability, production or marketing experience and collective action. Soft

infrastructure such as access to credit facilities, market information and access to extension services were also reported by Minten (1999) to have a positive effect on access to output markets, information flows as well as increased producer prices thus enhancing actors' market efficiency. Ravald and Gronroos (1996) asserted that adding value to a product is one of the most important factors that affect market efficiency and profits. This study assessed the value added in terms of profits and efficiency of the existing potato market chains in Uganda in situations of existence and absence of contractual arrangements among the chain actors. In this study, contractual arrangements are of interest because they form a sub-chain of the market (market segment) that could influence the efficiency of the market and the profits actors realise. Most contracts are designed to facilitate risk sharing for price, quantity and/or quality (Masakure and Henson, 2005).

Some scholars have done research on profitability of agricultural products in Uganda. However, there has been limited information about the factors influencing the profits earned by the market chain actors and yet this information is vital in devising interventions to help them improve their returns. This study therefore sought to study the existing potato market chain in order to understand the source and level of its inefficiencies as a basis to recommend strategies for increased benefits to the market chain actors. The objective of the study was to assess the profits and efficiency of the existing potato market chains in Uganda and determine potential factors that influence the profits. It was hypothesized that the presence of contractual arrangements between market chain actors increases the profits realized along the chain, and farmers who market potato collectively earn significantly higher profits than those who market individually. It was also hypothesised that long distances between the actors in a vertical link reduce profits and market efficiency resulting from high transport costs and limited information at either side of the market chain.

## **2 Methods**

This study was done on potato with focus on the main actors (farmers, rural and urban traders and small scale processors in the existing potato market chains in Uganda.

### **2.1 Study area and data collection**

The study was conducted in Kabale district located in South Western Uganda, Mbale district in Eastern and Kampala district in Central. They were selected because they are the major potato producing and marketing districts in Uganda hence a good representative for the study. A cross-section survey of potato market chain actors (farmers, traders and processors) was carried out between March 2011 (when preliminary visits and respondent mapping was done) and May 2012 (when interviews were done). Traders were in two main categories. There were those located in rural areas and those in urban areas, referred to in this study as rural traders and urban traders, respectively. The processors in this study were those using simple tools (mainly charcoal stove and pan) and on very small scale to produce chips and crisps. Most of the potato that is processed in Uganda is done by this category. Due to resource constraint, this study did not include the final potato consumers including individual households, supermarkets, hotels and restaurants.

Structured questionnaires were used as the key tools to collect primary data. Different questionnaires were designed for the different chain actors. In sampling of farmers, there was purposive selection of sub-counties in each of the study districts which were commonly known for potato production. At the time of this study, two sub-counties in Kabale, (Kamuganguzi and Muko) and one sub-county in Mbale (Wanale) were the most popular

producers, hence selected for this study. In each of the selected sub-counties, two parishes were randomly selected. In each parish, extension workers under the National Agricultural Advisory Services (NAADS) provided a list of potato farmers from which 30 farmers were selected randomly. This gave a total sample size of 180 farmers; 120 from Kabale and 60 from Mbale. In selecting the traders, the selected farmers gave a guide on the locations of the traders who bought potato from them. Some locations (potato collection centres/markets) were in rural areas, while others were in urban areas within the study districts, where the traders had stalls and/or stores. Snowball method was mainly used for those in rural areas. For the traders with stalls, a list of all of them was compiled with the help of Market Leaders followed by random selection from the lists. In each district 20 traders were randomly selected making a sample of 60 traders.

The selected farmers and traders assisted in locating the potato processors. The small scale-processors were purposively selected because they were relatively few at the time when the study was carried out. In total, 32 processors were interviewed. Eight processors were selected from Mbale, 18 from Kampala and only six from Kabale. Few processors were identified from Kabale (the most common potato producing area), because consumers in that area were mostly interested in raw ware potato; hence processing had not yet picked up as a business. More processors were found in Kampala because of growing urbanization and consumer desire to have more convenient forms of food (Pandey *et al.*, 2006; Jansky *et al.*, 2009). They were selected by snowball sampling due to their scattered nature and lack of clear physical address.

## **2.2 Analytical methods**

Quantitative methods were used to analyse the data to describe the profiles of the various market chain actors, estimate the costs, profits and efficiency of the market chains, and determine the factors that influence the efficiency. SPSS and STATA were the computer software used. Actors' profiles were described in terms of products handled, quantity handled, linkages with other actors (vertical and horizontal integration) and activities performed.

The study used a value addition approach (Tallec and Bockel, 2005) to determine profits and efficiency of the potato market chain. This approach is in line with the description of the value chain by Kaplinsky and Morris (2003) as a range of activities that bring a product from its conception to the final consumer including transportation, transformation, processing, marketing and trading. It determines the value added by each of the chain actors, and consequently the total value added for the entire chain. Value added (*VA*) by an actor in the market chain was defined by Tallec and Bockel (2005) as the difference between the value of output (*Y*) and the value of inputs (*X*) the actor used, which is also a measure of profits for a given node of the chain. Based on this, the analysis considered the value addition functions of the different potato market chain actors as:

$$VA_a = P_a Q_a - \sum_{i=1}^{i=n} r_{ai} X_{ai} - MC_{ai} \dots \dots \dots (1)$$

Where;

$VA_a$  = Value added or profit earned by actor *a*

$P_a$  = Price of potato sold by actor *a*

$Q_a$  = Quantity of potato sold by actor *a*

$r_{ai}$  = Unit cost of input *i* used by actor *a*

$X_{ai}$  = Quantity of input *i* used by actor *a*

$MC_{ai}$  = Potato marketing costs incurred by actor *a*

$a = 1, 2, 3$  represents the market chain actor (farmer, processor and trader).

The marketing costs included transport, market fees and communication (airtime) costs incurred during market search. Others were cost of the potato and inputs used in product marketing and distribution. Efficiency of the market chain at each node, the percentage of value added or profit of the total marketing cost (Sreenivasa *et al.*, 2007; Achike and Anziku, 2010; Feizabadi, 2011) was computed as in equation (2). The bigger the percentage, the more efficient the market chain is. A negative percentage means that marketing costs exceed the value added implying that the chain actor is incurring losses.

$$ME_{an} = \frac{P_{an}Q_{an} - \sum_{i=1}^{i=n} (r_{ai}X_{ai} + MC_{ai})}{\sum_{i=1}^{i=n} (r_{ai}X_{ai} + MC_{ai})} \times 100 \dots \dots \dots (2)$$

Where,

$ME_{an}$  = Market efficiency of actor  $a$  at  $n^{th}$  node of the chain

$r_{ai}X_{ai}$  = Input costs incurred in marketing potatoes by actor  $a$  at  $n^{th}$  node of the chain

$P_{an}$  = Price of potato sold by actor  $a$  at  $n^{th}$  node of the chain

$Q_{an}$  = Quantity of potato sold by actor  $a$  at  $n^{th}$  node of the chain

$r_{ai}$  = Unit cost of the input  $i$  used by actor  $a$  at  $n^{th}$  node of the chain

$X_{ai}$  = Quantity of input  $I$  used by actor  $a$  at  $n^{th}$  node of the chain

$MC_{ai}$  = Marketing costs incurred in marketing of potatoes by actor  $a$  at  $n^{th}$  node of the chain

$$P_{an}Q_{an} - \sum_{i=1}^{i=n} (r_{ai}X_{ai} + MC_{ai}) = \text{Value added at } n^{th} \text{ node of the chain}$$

To determine the factors that influence the profits of the potato market chain, multiple regression analysis was used for the different identified chain nodes (farmer, trader and

processor), where the dependent variable was VA as measured in equation (1). The regression equation for each of the identified potato market chain nodes was specified as:

$$VA_a = \beta_0 + \beta_a X_a + \varepsilon \dots\dots\dots (3)$$

The empirical model that was used is presented as:

$$VA_a = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_{15} X_{15} + \varepsilon \dots\dots\dots (4)$$

Where;

$VA_a$  = Profits of actor  $a$  in the potato market chain

$B_0$  = Constant

$\beta_1 \dots \beta_{15}$  = Coefficient of the independent variables

$X_1 \dots X_{15}$  = independent variables

$\varepsilon$  = Error term

Three different regression models for the three actor categories (farmers, traders and processors) were run. The independent variables considered to influence profits at farmer, trader and processor nodes are, respectively indicated in Tables 1, 2 and 3.

Regression diagnostics were conducted to ensure that the model was correctly specified and in line with the assumptions of Ordinary Least Squares (OLS). OLS regressions were used in this study because of the robust nature of the output and ability to detect outliers in the data. The data were checked for heteroskedasticity, consequences of which the estimated coefficients are unbiased but inefficient leading to erroneous conclusions. A Variance Inflation Factor (VIF) test for multicollinearity was also done to ensure that no correlation between independent variables existed. Results of the diagnostic tests show that the models were significant at 1%, indicating a good fit. The VIFs were less than 10 with a mean of 1.38 for the farmer model, 1.50 for the trader model and 1.76 for the processor model, indicating that there was no multicollinearity among the independent variables.

### **3 Results and discussions**

#### **3.1 Description of potato market chains in Uganda**

The potato market chain included farmers, rural traders, urban traders, brokers, processors and final consumers as the key actors. Various potato market chains existed. However, the study identified three major ones (Figure 1). The first chain composed of farmers who sold potato to rural traders that finally sold to final consumers. The second chain involved farmers who sold directly to urban traders. The traders then sold the potato to final consumers. The third and longest chain consisted of farmers who sold to urban traders but through brokers. The traders then sold to processors who processed the potato into either chips or crisps for final consumption. Consumers in the first and second chains purchase raw potato, while those in the third chain buy processed potato. The ware potato was transported from farmers in raw tuber form which was also the common form it was sold to final consumers.

#### **3.2 Socio-economic characteristics of key actors in potato market chains**

Results in this section are summarized in Tables 4 and 5 as means comparing different characteristics of the market chain actors. Potato farmers were categorized into two: those with contracts (written or unwritten) with their trading partners and those without. Farmer characteristics that were considered include farmer's age, household size, income received from potato per season, years of formal schooling, off-farm monthly income and total land owned (Table 4). For this study, a season stands for about three months of potato production plus about two months of trading. In the study area, potato is produced two to three times a year hence some seasons overlap.

Results in Table 4 show that farmers who had contracts with traders put significantly ( $P \leq 0.10$ ) more land under potato than what their counterparts without contracts did. Contract farmers

had assured markets for their produce which motivated them to allocate more land to potato production. Similarly, average potato output by farmers with contracts per season was significantly higher ( $P \leq 0.01$ ) than that of farmers without contracts. On average, the former produced twice the quantity produced by those without contracts. This could also be explained by the assured markets under contract agreements.

Results further indicate that the average quantity of ware potato sold by contract farmers was significantly higher ( $P \leq 0.01$ ) than that of non-contract farmers (Table 4). This implies that contract farmers in this case were more commercialized than their non-contract counterparts. There was a statistically significant difference ( $P \leq 0.01$ ) between incomes got from ware potato by contract farmers and non-contract farmers. This is correspondingly related to respective quantities produced and sold. Likewise, Gulati *et al.* (2005) established that contract farmers enjoyed higher profits and incomes than non-contract farmers growing the same crop. Nagaraj *et al.* (2008) further argued that contract farming provided better incomes and markets to farmers. At the farmer node also, distance to market was shorter for farmers with contractual arrangements than those without (Table 4).

Potato traders that were involved in the study included rural traders (those that operate within the same locality with farmers) and urban traders, located in urban centres. Some of the socio-economic characteristics that were considered at this node include trader's years of formal education, distance travelled to source for potato, quantity of potato handled per trip and transport costs incurred in marketing potato. Comparing rural and urban traders, Table 5 shows a significant difference in marketing experience, with rural traders having more years of experience. The rural traders being based in the rural areas were stably involved in the potato trading processes than their urban counterparts. Urban traders have other trade

opportunities other than potato. Most rural traders were directly linked to farmers unlike most urban traders who had to go through rural traders or brokers in procuring potato from farmers.

All the other variables considered, including years of formal education, quantity of potato handled and costs incurred were not statistically significantly different. To note is that some standard deviations of some variables are larger than the mean values in Table 5. For instance the mean values for distance covered by both rural and urban traders were lower than their standard deviations. This was because some urban traders were stationed in urban markets and supplied by either rural traders or other urban traders that get the produce from the rural areas. A few of them moved longer distances thus a large variation and bigger standard deviations. This corresponds with the quantity of potato handled per trip, damage costs incurred, income received per season and the main means of transport used. There were few traders who used trucks to transport potato from rural areas and supply the rest of the traders that were stationed in some markets. For market fees, the standard deviations of both rural and urban traders were also higher than their means feasibly because traders were charged depending on where they sold. For example, some traders bought directly from farmers and sold to other traders without necessarily being charged market fees, while those that transported potato to say urban markets were charged hence a higher deviation.

### **3.3 Costs, revenue and profits in the major potato market chains**

Different actors (farmers, traders and processors) in the various potato market chains incurred different costs in their transactions. Table 6 summarizes the costs, quantities, revenue and profits for each of the main potato market chains. The costs incurred depended on, among others, the quantities handled, distance to the market and type of actors in the transaction. These differences resulted into variations in the income earned from potato sold and the

profits realized. Farmers in the chain in which they sold potato to urban traders through brokers produced the highest quantity of potato per season (average of 3,462 kg per farmer) compared to those who operated in chains in which they sold directly to traders. This translated into higher incomes and relatively higher profits. Brokers acted as a link between farmers and traders hence helping farmers to easily secure market access for their produce.

Some of the costs that were incurred at farmer node included costs of transporting potato from home to market, communication costs in terms of telephone calls and messages, storage costs and packaging costs. Farmers who directly sold to rural traders and urban traders incurred a relatively higher percentage of transport costs per kilogram of potato (30 and 41%, respectively) than that incurred by farmers who sold to urban traders through brokers (Table 6). This was because farmers who sold directly to traders travelled relatively longer distances in search of market. The farmers who were linked to markets by brokers covered relatively shorter distances because the brokers usually know exactly where the produce and the market are and this reduces search costs and time (Adetunji and Adesiyani, 2008; Emokaro *et al.*, 2010). Parikh *et al.* (2007) affirmed that some traders lack time and infrastructure to establish long term relationships with farmers. For this reason, they often delegate brokers to facilitate the sourcing and sale of produce (Gor *et al.*, 2012). Haggblade and Nyembe (2007) also established that terminal market brokers were vital in a marketing system as they take on delivery of shipments of traders and farmers. The authors further found that brokers advised farmers and traders on deliveries and fair prices prior to shipment in order to avoid market shortages and surpluses. Results further reveal that on average, communication costs incurred by farmers who sold directly to rural traders were relatively higher (8,700 Uganda shillings<sup>1</sup> per season) as compared to other chains (Table 6). This was largely because farmers had to

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<sup>1</sup> During the time of this study, the average exchange rate was US\$1 = 2,600 Uganda shillings

take the initiative to search for potato market compared to the other chains, particularly where brokers were involved (Gor *et al.*, 2012).

At the trader node, different traders also purchased potato at varying prices and incurred different costs as shown in Table 7. For instance, potato purchase prices paid by urban traders were about 41% higher than what the rural traders paid. However, the average quantity of potato handled by urban traders was higher than what the rural traders did. This was because the latter did not have enough resource capacity to handle large quantities. Consequently, they earned varying revenues and profits.

### **3.4 Market efficiency and profits of the market chains**

Study results indicate that the potato market chains were generally efficient and profitable, consistent with the study hypothesis. Market efficiency estimations at different chain nodes are presented in Tables 8 and 9. At farmer node, the highest efficiency (159%) was noted where farmers sold potato to rural traders (Table 8). This was attributed to the proximity of the traders and farmers which lowers some marketing costs. In the second chain, farmers sold potato directly to urban traders with relatively higher transport costs; hence a relatively lower market efficiency. In the third chain where brokers were involved, some portion of the profits went to the brokers in form of commissions. Fafchamps (2005) noted that the burden of sustaining brokers in a chain reduces the value of returns/profits available to other actors, farmers inclusive. However, large scale traders lack time to directly link up with many small-scale and scattered farmers who are allocated in the rural areas with poor market infrastructure especially roads and market information. The situation was not different from the Kenyan potato value chain which was described by Kirumba *et al.* (2004) as fragmented with high transaction costs, mistrust, price inefficiencies and quality losses. As a result, the

brokers necessarily fill the market gap, without which the market efficiency would be lower. Although the brokers benefit greatly from mediating sales between farmers and traders as noted by Phillips and Tallontire (2007), the commission they earned was much lower than the cost farmers and traders would have incurred in search for the market. Howells (2006) and Klerkx and Leeuwis (2009) noted that brokers are necessary to help rural farmers improve their collective efficiency and in particular to build the bridge between farmers and market chain traders.

Market efficiencies at trader nodes ranged between 56 - 81% (Table 9). On average, efficiency was highest (81%) among traders who sold potato directly to consumers. Traders in this chain sold the produce in urban markets which offered better prices as compared to the rural traders who operated in rural markets that offered relatively lower prices. Even though some traders in the third chain also sold to urban markets, they had a much lower market efficiency ratio of 56%. This was largely because they sold mostly to small-scale processors with limited capacity to demand large quantities.

### **3.5 Factors influencing profits of potato market chain actors**

Factors considered to influence the profits of potato market chain actors include having a contract with other actors, duration of the contract (time period the contract has been effective), gender of the chain actor and marketing mode used (selling either individually or as a group). Others are actors' years of formal education, means of transport used, and experience in potato trading. Results of the OLS regression model (Table 10) indicate that male farmers earned significantly ( $P \leq 0.05$ ) higher profits from potato selling business than their female counterparts. The explanation is that male farmers were the major decision makers and potato price negotiators. These results are supported by Zhang *et al.* (2004) who

observed that men are more involved in income yielding activities much as females are involved in agricultural production activities.

Results also show that being in a marketing group and marketing potato collectively significantly ( $P \leq 0.01$ ) earned farmers higher profits than selling individually. Operating in groups has several advantages to group members including reduction of transaction costs which constitute a large component of barriers to market access especially by resource-poor smallholders. These transaction costs include costs of searching for a trading partner or buyer and market information, bargaining with trading partners, building trust between the seller and buyer, and market information costs. In a similar study, Ortmann and King (2007) found that horizontal coordination such as producer groups reduces the transaction costs incurred by producers and overcome barriers to production resources, information, services and markets for high value products. Sigei *et al.* (2015) also reported that farmers who market tend to incur a lower transaction costs, and Kamdem *et al.* (2013) revealed that collective marketing had a positive and significant effect on the net price received by farmers.

Results further indicate that an increase in land that farmers allocated to potato production had a positive and significant ( $P \leq 0.01$ ) relationship with profits earned by the farmers (Table 10). This relationship could be a result of economies of scale whereby large scale potato production results into lower production costs per unit of produce, and hence increased profits. These results are supported by Helfand and Levine (2004) who pointed out that an increase in farm size has a rising relationship with profitability and efficiency.

It was further noted that the duration spent in the contractual relationship had a positive and significant ( $P \leq 0.05$ ) bearing on the profits farmers earned (Table 10). It is most likely that

when farmers spend more time in such relationships, they get more insights on what is required by the buyers in terms of quality and standards and work towards fulfilling them. This is consistent with the work by Nagaraj *et al.* (2008) who found that increased time of contractual relationships between the market chain actors works as a link between the product characteristics and processes of production to buyer's preferences.

Years of marketing experience was also found to have a positive and significant ( $P \leq 0.05$ ) relationship with farmer's profits (Table 10). As experience increases, the market chain actor gains skills including how to prepare a product for the market, when to sell the product and value addition activities required by the market. In addition, experience reduces search costs as farmers learn by doing (Mpogole and Kadigi, 2012). Escobal (2001) also established that the more the number of years farmers spent in commercial potato trading, the greater was the organisational capital of the community where they lived and the greater was the probability that they would establish more stable trade relation with their buyers. It was also noted by Jari and Fraser (2009) that with acquisition of expertise, sellers increase their participation in selling their produce in the more paying formal markets.

Results also indicate that access to credit facilities is positively and significantly ( $P \leq 0.10$ ) related to the profits farmers earned. Credit facilities in terms of loans helped the farmers easily meet the necessary costs which included communication costs, store renting as they waited for good prices. Okten and Osili (2004) reported that credit markets act as a source of capital for investment projects and enhance one's ability to survive unexpected expenditure shocks. It should, however, also be noted profits facilitate access to credit and credit providers prefer dealing with successful farmers with net returns that enable them to pay back the credit.

In addition, income earned by the farmer from off-farm activities was found to have a positive and significant ( $P \leq 0.01$ ) relationship with the profits earned. Those with extra sources of income apart from potato could easily afford to meet the marketing costs involved. Previous studies, for instance, Shackleton and Shackleton (2004) noted that off-farm income provides an important contribution that complements diverse livelihoods strategies within households, especially for poorer sectors of rural society. The authors argued that incomes from other sources apart from farming allow scarce cash resources to be used in securing other household needs including buying agricultural inputs.

Results of the OLS regression model for factors affecting profits at trader node are presented in Table 11. Similar to farmers, male traders significantly ( $P \leq 0.10$ ) earned more profits than female traders. The business sometimes involves travelling long distances to collect the potato from producing areas and take it to the market. Females usually have other family responsibilities that do not favour them to move long distances. The male traders were able to procure potato from the production areas, and in bulk at relatively lower farm gate prices hence enjoying economies of scale (Elison, 1999). Results indicate that as distance travelled by traders to source for potato from rural areas increased, the profits earned significantly ( $P \leq 0.01$ ) increased. This is contrary to what would be expected because long distances between the product source and the market are associated with high transport costs and hence reduced profits. However, long distances also disadvantage the farmers who end up selling their produce at giveaway prices resulting into higher profits earned by the traders. In the study area, long distances coupled with poor road infrastructure and lack of adequate market information by farmers, made it difficult for farmers to transport potato to high value markets. The traders, on the other hand, with good market information purchased the low-priced potato from farmers in bulk, and sold it in high-price urban markets hence earning higher profits.

Marketing experience as measured by the number of years the trader had been in the potato business also was found to positively and significantly ( $P \leq 0.10$ ) related to the profits they received (Table 11). This could be explained by the fact that spending more time in the business enables the traders to acquire adequate business knowledge, including market information regarding where to purchase potato relatively cheaply, source of low cost transport and where and when to sell the potato. It could also be explained by the accumulation of social capital over time (Emam, 2011). It was further noted that traders who had contractual arrangements with potato farmers earned significantly ( $P \leq 0.10$ ) higher profits than those without. Traders in this case were assured of the required quantities and good quality potato at all times which helped them minimise some costs such as search and collection costs. Kirsten and Sartorius (2002) reported that to get increased profits from agricultural products, market actors should ensure that the products have the characteristics desired by consumers together with risk mitigation and management strategies of buyers and suppliers.

At processor node, gender and location of the small-scale potato processors were the main factors influencing profits they earned (Table 12). Female processors earned significantly ( $P \leq 0.01$ ) less profit than male counterparts. The processors' profits were also positively related ( $P \leq 0.01$ ) to the district from which the processor operated. Processors who operated in Kampala, the capital city, earned significantly higher profits than those in Kabale and Mbale. This was largely attributed to increased urbanisation which translates to increased demand for snack foods, potato crisps and chips inclusive. Pandey *et al.* (2006) and Walingo *et al.* (2007) also reported a sustained positive change in consumption patterns of potato and potato products in most developing countries brought about partly by increased population pressure and partly by growing urbanisation. Ensuring good quality potato for processing chips and

crisps also yielded significantly ( $P \leq 0.10$ ) higher profits made by the processors. Processors preferred specific potato varieties arguing that they make good potato chips and crisps that were highly demanded by consumers.

#### **4 Conclusions and implications**

The study identified three major potato chains: (i) where farmers sold potato directly to rural traders who in turn sold to consumers; (ii) farmers selling directly to urban traders who then sold to consumers; and (iii) farmers selling to urban traders through brokers, and the traders selling to processors who finally sold processed potato to consumers. These market chains were profitable and efficient because on average, all the chain actors realized profits, and the profits in relation to total marketing costs were high. At farmer node, the chain in which farmers sold potato directly to rural traders was the most efficient and profitable. This was followed by the one in which farmers sold to urban traders through brokers. It was therefore concluded that brokers did not necessarily reduce the profits of farmers nor did they reduce market efficiency. They instead enhanced profits by breaking market access barriers such as limited market information and search costs. As a policy recommendation, therefore, farmers should be empowered to have increased access to market information, and to create an environment of trust between them and traders.

Among other factors, the study concludes that membership to marketing groups, having contractual arrangements with traders, and experience in the business influence the profits earned by the potato farmers. Operating collectively rather than individually reduces the unit marketing costs each actor would incur. As such, government agricultural extension agents and marketing departments at national, district and village levels, should promote collective action and encourage chain actors to work together to exploit the associated benefits. The

government of Uganda is currently supporting the formation of farmer cooperatives to enable farmers to easily access agricultural inputs and extension services. This support should not only be limited to production, but should also be extended to marketing of the produce. Group marketing arrangements can also be initiated and promoted by NGOs and private organizations which are already working with farmer groups and facilitating the formation of groups where they do not exist.

In a similar manner, contractual arrangement among market chain actors (farmers and traders) is mutually beneficial compared to where no such arrangements exist. It improves actor's market certainty and it ensures that each actor performs his/her obligation, which in turn enhances market efficiency. Contractual arrangements should therefore be encouraged and facilitated to help the various market chain actors exercise fair business transactions. This can be done through sensitization of the farmers and traders spearheaded by organisations like National Agricultural Advisory Services (NAADS) and local governments (Department of Agriculture). Contracts would benefit potato farmers in terms of assured market and would also help the traders in terms of assurance of good quality potato and availability of adequate volumes from farmers.

In addition, farmers should be encouraged to increase the level of potato commercialisation including expansion of the size of land allocated to the crop. However, technical advisers (extension workers) need to advise the farmers on optimal allocation of the land and other resources to potato vis-à-vis other crops such that the overall farm objective is not negatively affected.

Although long distances between the potato source and the market was positively and significantly related to the traders' profits and yet transport costs increase with distance, farmers were paid very low prices compensating for the high transport costs. Long distances disadvantage the farmer in many ways including limited access to market information, limited choice of market outlets or buyers, and hence limited bargaining power. In addition to improving the road network in the potato growing areas and encouraging farmers to operate in groups, market infrastructure that increases access to market information by the distant farmers should be established. This can be through establishing telecentres with ICT facilities located at strategic points. Uganda has an ICT policy that favours use of ICT in commercialising agriculture. However, the use of ICT although increasing, is still mainly limited to urban areas and non-farm businesses, yet in places where it has been adopted farmers' access to profitable markets has been boosted.

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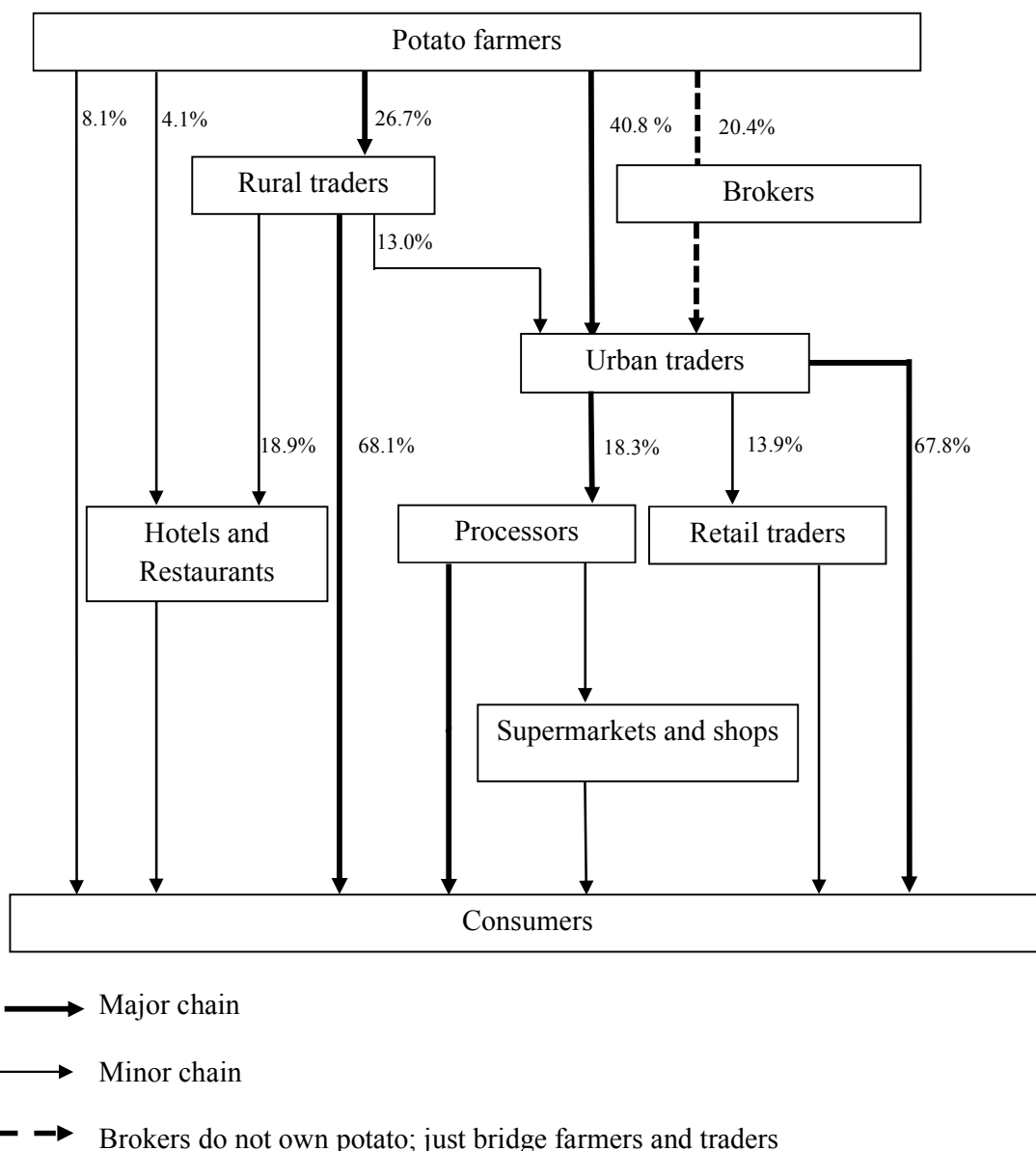
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The percentage figure against a chain arrow is the percent of chain actors (farmers and traders) involved in the chain node.

**Figure 1: Identified potato market chains in the study area**

**Table 1: Independent variables considered to influence profits at farmer node of the market chain**

<b>Variable label</b>	<b>Variable description</b>	<b>Expected sign of the relationship</b>
$X_1$	Duration of contractual agreement in months (0 if no contract existed)	Positive; actors in a longer contractual arrangement have better understanding of each other's expectations
$X_2$	Sex of the farmer (1 = male, 0 = female)	Positive or negative
$X_3$	Mode of potato marketing (1 = group marketing, 0 = individually)	Positive; group marketing is expected to reduce marketing and transaction costs per unit
$X_4$	Level of education (years of formal schooling)	Positive; farmers who are more educated are expected to engage the traders in price negotiations; they also understand the factors that favour and hinder the markets and make strategies accordingly
$X_5$	Farmer accesses marketing information (1= yes, 0 = no)	Positive; access to market information strengthens the farmers' bargaining power. It also enables them to check on the prices they receive vis-à-vis the prevailing market prices.
$X_6$	Farmer adds value to potato before selling it (1 = yes, 0 = no)	Positive or negative; potato with value added improves on its presentation and acceptability. On the other hand, the extra cost of value addition can

		result into lower profits if the increase in price of the product does not offset this cost
$X_7$	Means used by farmer to transport potato to market (1=head portorage, 0= bicycle/motorized transport)	Negative or positive and; head portorage is limited to small volumes compared to motorised transport which exploits economies of scale. However, the cost of head portorage can be too low (insignificant share of the total marketing costs)
$X_8$	Farmer has access to extension services (1 = yes, 0= no)	Positive; extension services provide the farmer with information on how to produce (quality and quantity) for the market
$X_9$	Average size of land (hectares) allocated to potato production per season	Positive; there are possibilities of economies of scale with largescale production results into lower unit cost of production
$X_{10}$	Market availability in the farmer's area e.g. weekly market (1 = yes, 0= no)	Positive; farmers are assured of market for their produce, they can predict the demand and supply is demanded
$X_{11}$	Farmer accesses credit (1 = yes, 0 = no)	Positive; credit enables the farmer to meet costs of marketing
$X_{12}$	Marketing experience (time in months since the farmer started potato marketing business)	Positive; with time a farmer acquires what is the market demands and plans accordingly
$X_{13}$	Amount of income that the	Positive or negative; Income from other sources

	farmer gets from off farm activities in Uganda shillings	boosts is used to meet the potato marketing costs. On the other hand, a farmer getting more income from off farm activities may invest more resources in those activities and less in potato
$X_{14}$	Type of trader to whom potato is sold (1 = urban trader, 0 = otherwise)	Positive or negative; depending on , among others, the price bargaining power, the volumes bought at a time
$X_{15}$	Farmer location (1 = Kabale, 0 = Mbale)	Positive or negative

**Table 2: Independent variables considered to influence profits at trader node of the market chain**

<b>Variable label</b>	<b>Variable description</b>	<b>Expected sign of the relationship</b>
$X_1$	Trader buys potato under a contractual agreement from farmer (1 = yes, 0 = no)	Positive; under contractual arrangement, the trader incurs less transaction costs
$X_2$	Sex of the trader (1 = male, 0 = female)	Positive or negative
$X_3$	Level of education (years of formal schooling)	Positive; traders who are more educated are expected to understand the factors that favour and hinder the markets and make strategies accordingly
$X_4$	Distance (km) between	Negative; long distances are associated with high

	potato market and production areas from where trader buys the potato	transport costs
$X_5$	Marketing experience (time in months since trader started potato trading)	Positive; with time a traders acquires what is the market demands and plans accordingly
$X_6$	Mode of potato marketing (1 = group marketing, 0 = individually)	Positive; group marketing is expected to reduce marketing and transaction costs per unit
$X_7$	Type of trader (1 = urban trader, 0 = rural trader)	Positive or negative; depending on , among others, the price bargaining power, the volumes bought at a time
$X_8$	Trader stores potato before selling (1 = yes, 0 = no)	Positive or negative; higher process are expected when potato is sold longer after harvest. On the other hand, the extra cost of storage can be too high and rather reduce the price margin

**Table 3: Independent variables considered to influence profits at processor node of the market chain**

<b>Variable label</b>	<b>Variable description</b>	<b>Expected sign of the relationship</b>
$X_1$	Sex of the processor (1 = male, 0 = female)	Positive or negative

$X_2$	Level of education (years of formal schooling)	Positive; processors who are more educated are expected to understand the factors that favour and hinder the markets and make strategies accordingly
$X_3$	District from where the processor operates (1 = Kampala, 0 = others)	Positive; being a capital city there is increasing demand for processed potato (chips)
$X_4$	Processor considers specific potato variety for processing (1 = <i>rwangume</i> variety, 0 = no for others)	Positive; there is preference for <i>rwangume</i> variety for processing claiming that it has superior attributes in making chips
$X_5$	Processor ensures quality of his/her processed potato products (1 = yes, 0 = no)	Positive; quality products are associated with high prices
$X_6$	Amount of financial support received by processor for potato processing	Positive; financial support enables the processor to meet costs of processing and marketing end products

**Table 4: Selected characteristics of farmers in the potato market chain**

Characteristics	Farmers with contracts (n =35)		Farmers with no contracts (n =145)		t-value	P-value
	Mean	Std.Dev	Mean	Std.Dev		
Farmer age (years)	39.51	11.96	40.97	12.50	0.62	0.53
Education (years of formal schooling)	7.09	2.91	6.46	3.22	-1.05	0.30
Total land owned by farmer	1.55	2.72	1.35	1.42	-0.58	0.56

(ha)						
Land under potato per season	0.40	0.28	0.31	0.24	-1.68	0.09
(ha)						
Average potato output (kg) per season	2626.43	2705.60	1249.69	1322.59	-4.36	0.00
Distance to market (km)	4.00	5.26	7.46	7.57	2.64	0.01
Potato marketing experience (years)	11.89	7.40	10.59	8.88	-0.80	0.43
Ware potato sold (kg) per season	1775.71	2500.32	843.54	1010.18	-3.48	0.00
Seed potato sold (kg) per season	244.00	405.25	97.93	503.44	-1.60	0.11
Income from ware potato per season ('000 Ush)	935.91	471.73	448.36	591.20	-3.26	0.00
Off farm monthly income ( Ush)	72110	105270	49820	101780	-1.16	0.25

**Table 5: Selected characteristics of traders in the potato market chain**

Characteristics	Urban trader		Rural trader		t-value	P-value
	(n = 44)		(n= 16)			
	Mean	Std. Dev	Mean	Std. Dev		
Years of formal education	6.68	3.72	6.00	3.20	-0.65	0.52
Potato marketing	6.23	5.96	9.56	5.98	1.92	0.06

experience (years)						
Distance to market (km)	105.56	193.38	50.81	107.10	-1.07	0.29
Potato quantity (kg) handled per trip	3181.36	4133.22	2191.25	3851.64	-0.83	0.41
Total costs incurred by trader per season in marketing potato('000Ush)	625.58	743.69	759.41	1035.11	0.55	0.58
Potato income per season (million Ush)	36.80	67.20	38.80	76.70	0.09	0.92
Transportation costs per season ('000Ush)	526.34	658.39	654.00	971.22	0.58	0.56
Market fees ('000Ush) per month	23.78	49.06	11.75	15.53	-0.96	0.34
Damage costs incurred per season in form of potato that rots ('000Ush)	46.82	73.07	72.05	106.87	1.04	0.30

**Table 6: Costs incurred and profits realised by farmers in the three major potato market chains**

Variable	Chain one (n = 41)		Chain two (n = 36)		Chain three (n =71)	
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev
Output of potato in a season (kg)	1545.12	2130.42	1667.50	1621.40	3462.18	1,041.66
Cost of transporting potato	37.29	23.83	40.28	29.32	28.66	13.55

to market (USh/kg)						
Storage cost (USh/kg )	13.15	14.58	8.64	7.44	7.20	4.10
Communication cost per season (‘000USh)	8.70	1.44	2.18	1.59	4.29	3.04
Packaging cost (USh/kg)	6.10	9.08	6.17	8.97	8.86	15.25
Income earned from potato sales per season (‘000USh)	400.65	626.21	353.58	467.65	753.85	1,01.87
Value added /profits earned (‘000USh per season )	344.50	573.07	303.99	418.58	434.62	273.15

NB: Storage costs were those that were incurred during the trading period and depended on the volume of potato stored but not the period of storage since potato is not stored for long. It included only the storage space rent.

Chain one: Farmers sell to rural traders who sell to final consumers.

Chain two: Farmers sell directly to urban traders who sell to final consumers.

Chain three: Farmers sell to urban traders but through brokers; the traders then sell to small/medium scale processors who sell either chips or crisps to final consumers.

**Table 7: Costs incurred and profits realised by traders in the three major potato market chains**

Variable	Rural trader –Final consumer (Chain one) (n =37)		Urban trader – consumer (Chain two) (n = 32)		Urban trader – Processor (Chain three) (n = 32)	
	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev
Price at which the trader bought potato (Ush/kg)	671.10	206.90	942.91	236.28	943.02	237.33
Potato (kg) bought by the	2,661.49	4,196.54	4,210.09	4,500.53	3,183.13	4,254.96

trader per trip						
Cost of transporting potato to market (USh/ kg)	47.77	50.85	42.41	73.54	41.92	56.03
Packaging cost (USh/ kg)	11.98	4.62	10.92	2.12	12.47	3.11
Potato storage cost (USh/ kg)	14.95	17.35	3.41	7.82	6.74	11.57
Communication cost per trip (USh)	1,242.00	1,981.25	1,6875.00	5,938.67	10,391.75	11,599.09
Revenue earned from potato sales per season (million Ush)	38.40	80.20	27.60	26.60	22.60	19.70
Profits earned from potato sales per season (million USh)	15.10	33.85	17.30	10.61	10.70	5.22

NB: Storage costs were those that were incurred during the trading period and depended on the volume of potato stored but not the period of storage since potato is not stored for long. It also included only the storage space rent.

Chain one: Farmers sell to rural traders who sell to final consumers.

Chain two: Farmers sell directly to urban traders who sell to final consumers.

Chain three: Farmers sell to urban traders but through brokers; the traders then sell to processors who sell either chips or crisps to final consumers.

**Table 8: Profits earned and marketing efficiency at farmer level of the marketing chain**

Farmer node	Mean market efficiency (%)	Std. dev	Mean profit (million Ush)	Rank
Farmer - rural trader (chain one) ( <i>n</i> = 41)	159	278	0.35	1
Farmer –urban trader (chain two)	117	277	0.30	3

<i>(n = 36)</i>				
Farmer – broker – urban trader	128	228	0.34	2
<i>(chain three) (n = 71)</i>				
Chain one:	Farmers sell to rural traders who sell to final consumers.			
Chain two:	Farmers sell directly to urban traders who sell to final consumers.			
Chain three:	Farmers sell to urban traders but through brokers; the traders then sell to processors who sell either chips or crisps to final consumers.			

**Table 9: Profits earned and marketing efficiency at trader level of the marketing chain**

Trader node	Mean market efficiency (%)	Std. dev	Mean profit (million Ush)	Rank
Rural trader - consumer (chain one) <i>(n = 37)</i>	78	55	15.10	2
Urban trader – consumer(chain two) <i>(n = 32)</i>	81	35	17.30	1
Urban trader - processor (chain three) <i>(n = 32)</i>	56	38	10.70	3

**Table 10: Factors influencing profits earned by potato farmers**

Variables	Coefficient	Std. Error	t-value	P> t
Duration of contractual agreement with trader (months)	0.01	0.00	2.41	0.02
Sex of farmer (1= male, 0= female)	0.20	0.12	1.65	0.10

Farmer markets potato in a group	0.40	0.11	3.56	0.00
Ln years of formal education	-0.01	0.08	-0.13	0.90
Farmer accesses market information	-0.76	0.11	-0.68	0.50
Farmer adds value to potato before selling	0.14	0.19	0.71	0.48
Transport means to the market (1 = head portorage)	-0.13	0.12	-1.13	0.26
Number of extension visits (squared)	0.00	0.00	1.42	0.16
Amount of land allocated to potato (squared)	1.05	0.19	5.52	0.00
Market availability in the farmer's area e.g. weekly market (1 = yes, 0= No)	-0.08	0.12	-0.68	0.50
Farmer accesses credit	0.21	0.11	1.92	0.06
Experience in potato marketing (months)	0.01	0.01	2.1	0.03
Off farm income (US\$)	2.41	0.50	4.83	0.00
Type of buyer (1 = urban trader)	-0.09	0.11	-0.87	0.39
Farmer location (1 = Kabale district 1)	-0.03	0.14	-0.20	0.84
Constant	-0.27	0.28	-0.99	0.33

No. of Obs = 180, Prob> F = 0.0000, R-squared = 0.4141, Adj R-squared = 0.3526

**Table 11: Factors influencing profits earned by potato traders**

Variable	Coefficient	Std. Error	t-value	P> t
Trader has a contract with farmers	53.10	31.00	1.71	0.09
Sex of trader (1 =male)	30.60	18.00	1.70	0.09
Years of formal education	2.74	2.32	1.18	0.24
Distance to market (km)	0.19	0.069	3.14	0.00

Potato trading experience (years)	2.24	1.33	1.68	0.09
Trader markets potato as an individual	12.50	37.70	0.33	0.74
Trader type (1= urban trader)	-16.10	20.60	-0.78	0.44
Trader stores potato before selling	-23.80	18.40	-1.29	0.20
Constant	-102.00	71.60	-1.42	0.16

Number of Obs = 58, Prob> F = 0.0007, R-squared = 0.4309, Adj R-squared = 0.3242

**Table 12: Factors influencing profits earned by potato processors in the studied potato market chain**

Variable	Coefficient	Std. Error	t-test	P> t
Sex (1 = female processor)	-10.10	3.77	-2.69	0.01
Ln years of formal education	2.36	5.179	0.46	0.65
District from where the processor operates (1= Kampala)	10.90	2.76	3.94	0.00
Processor considers a specific variety of potato (1= <i>rwangume</i> variety)	-0.48	4.97	-0.10	0.92
Processor ensures good quality potato for processing	6.74	3.91	1.73	0.09
Amount of financial support	15.02	12.72	1.18	0.25
Constant	-22.30	10.60	-2.09	0.05

Number of Obs = 30, Prob> F = 0.0050, R-squared = 0.5667, Adj R-squared = 0.4288