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Determinants and Disparities in Profitability along the Potato Value Chain in South-Western Uganda

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Abstract

Potato farming, while meeting the demands of new food consumption patterns emanating from Uganda's urbanization and dietary diversification due to globalization, has potential to provide a steady and reliable stream of income to its value chain actors. However, challenges and disparities such as unequal distribution of profits exist among the various value chain actors (VCAs) and these include seed multipliers, producers, aggregators, traders, and processors. The study aims at assessing determinants of profitability along the PVC in South-Western (SW) Uganda, by examining factors that influence revenues, operational costs and profits. A cross-sectional research design was adopted to collect data from a sample population of 375 respondents from the districts of Kabale, Kisoro, Rubanda and Rukiga using a semi-structured questionnaire. Using the International Business Machine (IBM) Statistical Package for Social Sciences (SPSS), primary data was analysed to determine descriptive statistics. In addition, the Logistic Regression Model (LRM) was used to determine the factors associated with PVC actors' profitability. Study findings show that PVC actors' revenues, operational costs and profit varied along the value chain with processors, aggregators and traders reporting the highest profits in relation to their operational costs while farmers reported the lowest. Notably, results indicated that sales turnover, lack of access to new knowledge, and failure to realise effective collaboration significantly influenced profitability along the chain. Thus, it is concluded that farmers do not benefit as much as the other actors in the PVC due to factors of power imbalances, market structures and, knowledge access. It is, therefore, recommended that the government of Uganda should formulate strategies to increase producers' profitability. Such as the introduction and strengthening of farmers' cooperatives, undertaking focused capacity-building programs, and making policy reforms.

Keywords *– Potato Value Chain, Inequalities, Profit Margins, South-Western Uganda*

Introduction

Potato (*Solanum tuberosum* L.) is widely grown and consumed around the world. The Global Food Crises Report revealed that approximately 193 million people in 53 countries or territories experienced acute hunger in 2021 - an increase of nearly 40 million people compared with 2020 (FAO, 2022). Feeding the expanding human population nutritiously and sustainably requires substantial improvements in the global agri-food systems (FAO, 2024). As a result, agri-food systems have and continue to undergo rapid transformation as part of the agricultural

growth strategy that is driven by urbanization, globalization, diet diversification, concentration, and expansion of food markets and trade (FAO, 2017). Agricultural growth strategies can be effective in reducing hunger and malnutrition as part of the food security system because most of the extremely poor populations depend on agriculture for their livelihoods (Devaux et al., 2014; Haverkort & Struik, 2015). The potato is regarded as a reliable food-security crop that can ease future crises in world food supply and demand (FAO, 2024).

Potato farming in Uganda dates back to the 1880's when it was introduced to East Africa by the British as a food crop. It is mostly grown in the South-Western highlands Districts of Kisoro, Kabale, Rubanda and Rukiga and around the Mount Elgon area in Eastern Uganda (Africa 2000 Network, 2007). The potato crop forms a critical part of the players in its value chain since it is grown for both home consumption and as a source of income. In the 2010/11-2014/15 Government's Development Strategy and Investment Plan (DSIP), the potato crop was prioritized as one of the strategic commodities with the potential to make a remarkable contribution towards increased rural household incomes and improved nutrition and food security (Mbowa and Mwesigye 2016).

However, potato farmers in Uganda endure limited opportunities to scale up their production due to challenges such as access to affordable credit, poor infrastructure, high post-harvest operational costs, and market dynamics. They are also beset by unequal share of profits, exploitation by the potato traders and, their limited ability to venture into other levels of the value chain (Kyomugisha et al., 2017). On the other hand, traders and processors also complain of low volumes of potato produced by the farmers, the poor quality of their produce, and their inability to keep contractual agreements.

However, whereas research has been conducted on agricultural value chains in Uganda (Naluyima et al., 2017, Mbowa et al., 2016), these studies have not specifically looked into the profitability determinants of the PVC, thus revealing a knowledge and research gap. Therefore, the study on which the paper is based, attempts to assess the determinants of profitability along the PVC in SW Uganda through the following research questions: 1) How does profitability differ at different levels of the PVC? 2) How does revenue influence profitability on the PVC? 3) How do operational costs influence profitability on the PVC? 4) How does profit influence profitability on the PVC? The study is justified on the grounds that the findings contribute to the existing body of knowledge on agricultural value chains.

Secondly, the results inform the interventions that contribute to the achievement of the objective of Uganda's National Agriculture Policy (UNAP) on improving household incomes through coordinated interventions (MAAIF, 2016). Thirdly, the results contribute to the country's efforts towards commercialization of agriculture as stated in the National Development Plan III and the United Nations Sustainable Development Goal 1 (SDG 1) of 'ending poverty in all its forms everywhere' (UNDP, 2015).

The article is structured in form of sections. In the next section we review the genesis of the value chain and its context in the agricultural sector. This is followed by a review of the concept of profitability and the relative theories that underpin the study. The section on the methodology used to gather and analyse data includes the description of the area of study, the research design, sample size, sampling techniques, data collection and analysis. The results of

the study are summarized to show insights into profitability along the PVC and factors that influence it. The paper ends with the discussion, conclusions and recommendations.

Conceptualization of Key Concepts

Potatoes (*Solanum Tuberosum*)

The potato (*Solanum Tuberosum*) is considered one of the main food products worldwide. In 2013, its production exceeded 368 million tones according to the Food and Agriculture Organization (FAO) (FAOSTAT, 2013). In addition, these tubers represent a staple crop in many countries globally today (Alva *et al*., 2016). It is a versatile food highly popular worldwide, prepared and served in a variety of ways: cooked, fried, dehydrated, or as an ingredient in industrial prepared foods. About 60% to 80% of the potato dry matter is starch and its protein content is similar to that of cereals but higher than that of most roots and tubers. The potato is also rich in calcium, potassium, and vitamin C and has a good amino acid balance (Emana and Nigussie, 2011).

Value chain

Value chain refers to the full lifecycle of a product. Knez et al. (2022) define value chain as a series of stages in the generation of a product or service for the end user, whereby each stage adds value and the value of the end product is the sum of the value added in each stage. The existing global value chain (GVC) framework is analytically and empirically based on the idea that value is created in the production process and added to the value already present in the intermediate goods being used. The old value is only transferred to the new product, while the newly created value is added linearly to the transferred value (Knez et al., 2022). Value chain is a powerful tool which makes it possible to organize an enterprise into strategically important activities, resulting in the possibility of higher prices and lower costs (Strakova et al., 2021; Kharub & Sharma, 2017). Within the agricultural context, value chain is seen as the production, transportation, and marketing processes involved in ensuring that a basic agricultural product, like potato, is effectively and efficiently brought from the garden to the final consumer (Minten et al., 2013). It includes the sequence of interlinked agents, markets, inputs and services that transform a product into the kind that consumers can purchase at a marginal cost or resell at a reasonable profit (Devaux et al., 2018).

Profit

A profit is a positive gain that is generated from business operations and investments when the related total expenses have been deducted (Keil, 2017). It is an excess of revenue over all paid out operational costs, and a reward which an entrepreneur receives by integrating all factors of production within the constraints of the business environment (Baragar and Chernomas, 2013). Profit is further referred to as payment for taking an investment risk for which an entrepreneur receives a return for assuming final responsibility (Makadok, 2011).

Profitability

Profitability is described as to the degree to which a business or an activity yields profit (Kodua et al., 2018). It is the ability of a business or activity to generate revenue over and above its expenses. It is usually measured by the gross profit margin, that is, gross profit as a percentage of the revenue.

Determinants of Profitability

The nature of business and products or services engaged in, determines the factors of the firm's profitability. In the general business enterprises, determinants of profitability include price, quantity, variable operational costs, fixed costs, and sales (Margaretha and Supartika, 2016). Other determinants of profitability include the ability of stakeholders to add value to the product. For instance, value addition in the PVC may lead to increased profits for all the chain actors because of the customers' perception that the product on offer is a genuine improvement of the original (Schwepker and Good, 2004).

However, the determinants of profitability in a value chain tend to align to the actor in question. For instance, to producers, a financially profitable crop is one that will give them positive net incomes when all the total costs included in the production processes have been deducted (Naluyima, 2016). Thus, some farmers may not necessarily be bothered by the intricacies of incomes and costs related to overall yield of their harvest but the attachment they develop towards a particular crop. This may be because most farmers tend to adopt a stance of positive attitude to a particular crop because of their perception that it can bring in good profit. This can create a predisposition to respond in a favourable manner to that crop and put extra energy and willingness to cultivate, nurture and market it (Lukanu et al., 2009).

Furthermore, literature reveals that for a market to be efficient and profitable, there is need to appreciate economic, social, regulatory and environmental factors such as changes in production, markets, regulatory policies, availability of technology and collective action (Devaux et al., 2009). The availability or lack of credit and its accessibility and affordability will also determine a firm's profitability (Minten et al., 2013) as well as access to reliable, ample and appropriate information (Watabaji et al., 2016). Profitability for the actors in the PVC is specifically beset by factors such as lack of access to new knowledge, acceptable social environments, new opportunities, governance, managerial capabilities, changing policies and regulations from government and related regulatory bodies (Kopparthi, 2012; Miller, 2010).

Theoretical Framework

The study was guided by four theories i.e., the Dynamic Theory of profit (DTP), Innovation Theory of Profit (ITP), Risk-bearing Theory of Profit (RTP), and the Marginal Productivity Theory (MPT). From an economic perspective, the DTP points out that profit arises from dynamic changes in the economy, for instance, changes in technology, consumer preferences, and value chain actors (Mas-Colell et al., 1995). Furthermore, the DTP postulates that profitability is gained when entrepreneurs take advantage of changes in the economy. However, the theory has been criticised for neglecting the effects of business skills and individual expertise. Others argue that it is not the dynamic changes that lead to profitability but other factors that are normally unpredictable.

Secondly, the Innovation Theory of Profits (ITP) explains the role of innovations such as introduction of novel products, new production methods, cost-cutting interventions and exploration of untapped markets to make profits. The theory further expounds that, by reshaping the market landscape with inventions, firms can create new consumer needs and value, which help businesses gain competitive advantage and profits (Carrera, 2016).Yet, opposition to the ITP argues that the theory disregards risk and uncertainty and the aspects of entrepreneurship such as planning, coordinating and risk-taking.

Thirdly, the Risk-bearing Theory of Profit (RTP) regards profit as a reward for entrepreneurs in bearing risks and uncertainties in a business. Within the PVC, actors bear risks such as crop perishability, pest infestation and disease outbreaks (for farmers), and storage and market volatility for the other actors. The theory asserts that the ability of these value chain actors to bear risks is rewarded with the profits they receive in return (Cencini, 2005). However, the RTP has been criticised for failing to account for different risk preferences and levels of risk aversion among entrepreneurs.

Lastly, the Marginal Productivity Theory (MPT) argues that profit is determined by the equilibrium of the forces of demand and supply in the market. It is based on the premise that when the supply of a particular product is less than its demand, excess profits are generated, and vice versa (Romer, 2001). The theory brings to the fore the ability of actors in the PVC to scan the market and make the right decision on the allocation of resources and on the timing to procure or dispose of their products (Keil, 2017). However, the major criticism of the MPT is that it assumes that consumers are rational and makes other unrealistic assumptions that may be hard to achieve in a realistic business environment.

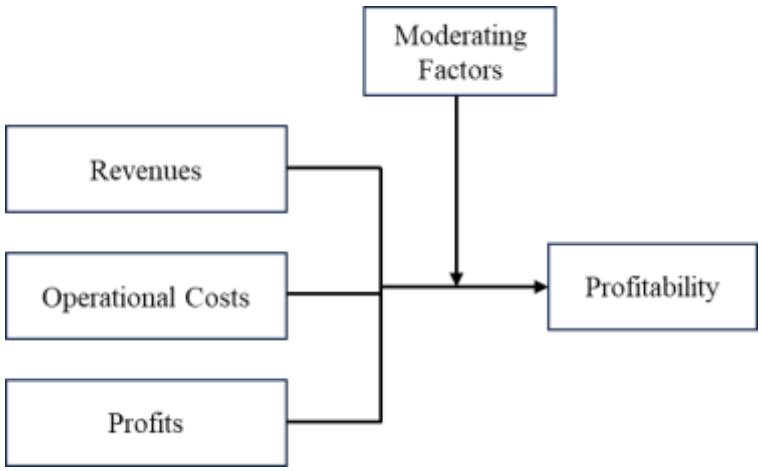

Figure 1: Conceptual Framework

Methodology

Description of the Study area

The study was conducted in Kabale, Kisoro, Rubanda and Rukiga districts in south western Uganda. The districts had a combined population of 863,000 (UBOS, 2022) of which 604,000 (70%) engaged in potato farming (UBOS 2014). Kabale District (-1° 14' 60.00" S and 30° 00' 0.00" E) has a mountainous landscape with a population of 285,097 people (UBOS, 2024). It is bordered by the Districts of Rukungiri to the North, Rukiga to the North-East, Rubanda to the West, Kanungu to the North-Nest and the Republic of Rwanda to the East and South (ACODE, 2020). The increasing demand for farmland over the past several decades led to fragmented landholdings on the hillsides and conversion of wetlands into agricultural lands. Approximately 6% (111 km^2) of the total land area of the district are wetlands, all of which are located in valleys. The district is largely agrarian with crops grown including potatoes, cereals, beans, coffee, vegetables and matooke (ACODE, 2020).

Kisoro district (-1°17'06.0"S and 29°41'06.0"E) also has a mountainous landscape with a population of 431,175 inhabitants (UBOS, 2024). It is located in SW Uganda and shares part of Bwindi National Park which is a habitat for the African mountain gorilla. Kisoro is bordered by the districts of Kanungu to the North, Kabale to the East, the Republic of Rwanda to the South, and the Democratic Republic of Congo to the West. The local economy is private sector-led and dominated by enterprises in tourism and trade in agricultural produce (ACODE, 2020).

Rubanda district is bordered by the Districts of Kisoro to the West, Rukungiri and Kanungu to the North, Kabale to the East and the Republic of Rwanda to the South. It has interlocking and heavily cultivated hills and valleys supporting a population of 245,684 people. The district has a land area of 660.2 square kilometers with altitudes between 1,219-2,347 meters above sea level (https://www. Rubanda.go.ug). The district is largely agrarian with crops that include potatoes, cereals, and beans (ACODE, 2020).

Rukiga district is bordered by the districts of Ntungamo to the East, Kabale to the South-West, Rubanda to the North-West, Rukungiri to the North and the Republic of Rwanda to the South-East, (https://www. Rukiga.go.ug). With a population of 132,029 (UBOS, 2024), Rukiga is largely agrarian with the growing of potatoes, cereals, matooke and beans (ACODE, 2020).

Research design and data collection tool

The study adopted cross-sectional research design whereby data was collected once and this involved administration of a semi-structured questionnaire to collect the data. The design was appropriate as it allows data collected to be used to determine association between variables (Bazeley, 2018). It allowed comparison of different variables concurrently (Hesse-Biber and Johnson, 2015). The structured questionnaire had a total of 109 questions divided into sections. Section One had 5 questions focusing on the identities of the enumerator and supervisor, and interview location. Section Two included 18 questions that covered farmer location details and the socio-economic characteristics of the respondents. Section Three consisted of 21 questions on potato production and operational costs. Section Four contained 10 questions on post-harvest handling. Section Five comprised 29 questions, which focused on potato markets and market access, trends and governance. Section Six involved 16 questions that solicited information on competitiveness and inclusiveness. Section Seven had 6 questions focusing on services such as financial, information flow, and inputs suppliers while Section Eight contained 4 questions on the enabling environment.

Sample and sampling techniques

The four districts had a combined population of 863,000 (UBOS 2022) out of which 604,000 (70%) were engaged in potato farming (UBOS 2014) and constituted the sampling frame for the study. A sample size of 384 was computed using the Krejcie and Morgan's formula for a finite population (Krejcie and Morgan, 1970) expressed as:

$s = X^2NP\ (1-P) \div d^2\ (N-1) + X^2\ P(1-P)$
where s = required sample
X^2 = the table value of chi-square for 1 degree of freedom at the desired confidence level
N = the population size
P = the population proportion (assumed to be .50)

d = the degree of accuracy expressed as a proportion (.05)

However, only 375 respondents participated in the study for various reasons.

A stratified random sampling technique was applied to ensure representation of each subgroup of potato actors within the study population (Bryman and Bell, 2015). The four districts were purposefully selected since they produced about 74% of the potato in the country (UBOS, 2014). Within the study districts, the most active sub-counties in the potato production and trade were also purposively selected. Relevant authorities and leaders in the selected sub-counties were asked for guidance in the process of preparing the sampling frames for the different categories of respondents that informed this study. For the potato farmer level, the sampling frame was a list of households and their heads obtained from the sub-country headquarters. While for the rest of the other actors, the sampling frame was generated from common knowledge of the authorities and leaders of the sub-county as well as from the Ministry of Agriculture. All items on the sampling frame were assigned unique identifiers, which were used in the final random process of selecting the individual respondents of this study.

The study population included value chain actors, service providers and regulatory authorities along the potato value chain. The value chain actors were sub-stratified into producers, aggregators/traders, processors, and retailers. The substrata under the service providers included agro-inputs dealers, seed multipliers, financial services, market information, and umbrella organizations. Under the regulatory authorities and development partners, the substrata included extension workers, NGOs, policy makers, and relevant government departments and ministries.

Data Collection and Analysis

The study adopted a quantitative approach where primary data from the PVC actors were collected through a semi-structured questionnaire that allowed the collection of large amounts of data from a relatively large sample size (Bryman and Bell, 2015). Quantitative data collected through the questionnaire was analysed using IBM-SPSS whereby descriptive statistics (means, frequencies and percentages) were determined. In addition, inferential statistics were determined through regression analysis. The Logistic Regression Model (LRM) was used to determine association between various variables and the dependent variable (profitability). The profitability (Y) was predicted by multiple explanatory variables (X_1 to X_3) (Pallant, 2013; Elliot and Elliot, 2002) expressed as:.

$$Y = a + (B_1X_1) + (B_2X_2) + (B_3X_3)$$

Logistic regression was used instead of other models because the dependent variable was binary (0/1) it a natural choice. In addition, the relationship between the independent variables and the dependent variable was non-linear and, the researcher was more interested in predicting the probability of the outcome, rather than just the outcome itself. The researcher also wanted to classify observations into one of the two categories based on the predicted probabilities. The model assessed the determinants of profitability within the constructs of revenue, operational cost, and profit by providing coefficients and standard errors for each variable (Table 3).

Results

Socio-economic characteristics

It was observed that seed potato multipliers had more males (60%) than females. However, under ware potato only 43.6% of the respondents were male. This showed more male farmers preferred seed potato farming to ware potato farming, probably because seed potato farming tended to be more commercial, with 100% grown for sale in some cases. Women probably tend to be more concerned with food security in homes. Moreover, more than 50% of the respondents under seed potato were between the ages of 25 and 45, whereas almost the same percentage under the ware potato respondents were above 46 years. This probably indicated the tendency of the younger generation preferring seed potato farming to ware potato farming. This could be related to the higher proceeds from the seed potato, and the older generation being more mindful of food security in the home than the commercial benefits from the crop.

The findings further showed that 56.8% of the seed potato respondents had achieved primary education or higher, whereas 67.8% for ware potato respondents had either no formal education or only up to primary education. This indicated that in seed potato multiplication those with no formal education probably found challenges in coping with the trainings. But it was also mentioned that the seed multiplier trainers sometimes purposely left out those with no formal education. Additionally, seed potato was found to have a higher percentage (61.6%) of new entrants (less than 10 years) compared to the 44.3% of new entrants for ware potato. A smaller percentage of 1.6% had above 20 years' experience in seed potato production compared to 12.5% with more than 20 years' experience in ware potato production. In general, however, the majority of the respondents had been in potato farming for less than 20 years. This catered for 66% of the total respondents, which indicates reasonable current fresh entry into the sector. Also important to note is that 97.6% of the seed potato respondents said they were involved in ware potato farming as well. And that both the seed and ware potato respondents said they each belonged to at least one farmer group.

At trader level 73.1% were between 25-45 years of age. Indicating the task at this needed someone still energetic but also reasonably independent. It is also important to note that this level was male dominated (61.3% male). Education at trader level, 53.9% had attained more than primary level education. Indicating the level lucrative enough to attract the more educated. On experience, 53.8% of the traders had less than 10 years in the business, indicating reasonable fresh entry in the business. The majority (60.7 %) of processors were above 35 years of age. Indicating maturity and financial stability. The level is also male dominated (52.2% male), and the women in processing are mainly in cottage processing. 60.9% of the processor have at least tertiary education, much higher than all the other levels, some indicating the need for more complex skills at this level but the lucrativeness. The majority of processors had less than 10 years of experience, accounting for 73.9%. Also indicating some recent changes in the economy that could have encouraged value addition.

Profitability

Study findings (Table 1) show that the average profit along the PVC was UGX 14 million whereby the average revenues was [1]UGX40.3 million with a standard deviation of UGX128

[1] 1USD (United State Dollar) = 3,667 UGX (Uganda Shillings) in July 2024

million. The fact that some actors in the PVC can receive revenues as low as UGX280, 000 and others as high as UGX1.99 billion is indicative of the effect of value addition. On the other hand, results reveal that actors incur average operational costs of UGX22.4 million and the standard deviation was UGX97.8 million. The minimum operational costs of UGX53,100 and maximum of UGX1.78 billion are indicative of the diverse nature of operational costs incurred by different players in the value chain. The results further indicate that some actors in the PVC receive as much as UGX457 million against averages of UGX14 million as profit. The rather high standard deviation of UGX37 million is indicative of the discrepancies in profit sharing along the potato value chain in SW Uganda.

Table 1: Determinants of profitability on the PVC

Variable	N	Mean	SD	Minimum	Maximum
Revenue	375	4.030e+07	1.280e+08	280000	1.990e+09
Operational costs	375	2.240e+07	9.780e+07	53100	1.780e+09
Profit	375	1.400e+07	3.700e+07	49350	4.570e+08

Profitability along the PVC

Study findings showed that Seed and Ware Potato farmers had the lowest percentage of profits on the potato value chain, 10% and 3% respectively (Table 2). While, the Traders and processors enjoyed the biggest percentage of profits at 25.6% and 42% respectively. The findings are in line with what has been reported in literature in relation to the shrewd nature of the PVC actors as influenced by marketing and distribution capabilities of Traders (Doyle, 2000). Moreover, profitability variations across the PVC have been reported by other researchers whereby glaring discrepancies between the potato farmers and other actors existed (Mbowa and Mwesigye, 2016; Emana and Nigussie, 2011). The potato traders' and WP farmers' percentage of the total lowered considerably when it came to profit, observed to be an issue of efficiency in the operations at these two levels of the PVC.

Table 2: Determinants of profitability at different levels of the PVC

	Aggregators	**Processors**	**SP farmers**	**WP farmers**	**Traders**	**Total**
Revenue	127,990,779	145,195,130	18,769,689	138,109,029	260,480,519	690,545,146
Operational cost	104,960,492	59,400,141	6,011,791	5,412,761	196,096,177	371,881,362
Profit	26,574,108	58,921,989	14,622,638	4,176,018	35,910,276	140,205,029

Profitability determinants on the PVC

Profitability is considered the best measure for the for-profit organisations. Whereas the tenet of profitability conceptualises other factors such as the business impact on its immediate environment or stakeholders, factors related to money, in terms of how much is received from the business and spent to facilitate operations, remain at the forefront (Carrera, and Rossi,

2015). The study examined the profitability of the PVC in SW Uganda through the financial factors of revenue, operational costs and profit using the LRM by providing coefficients and standard errors for each variable. Generally, the overall results from the LRM showed that 26.8%, 22.0% and 20.4% of the variability in revenues, operational costs and profit respectively could be explained by the influencing factors of profitability (Table 3).

Revenue

The results of the regression analysis showed that sales' turnover (coeff. = 871,261, $p<0.01$) had a positive and statistically significant influence on revenue. The factors of collaboration (coeff = -4.713e+07, $p<0.01$) and access to new knowledge (coeff = -6.323e+07, $p<0.05$) were statistically significant and positively related to revenue as a measure of profitability. Access to information, length of time in business, capability, good value chain governance, access to finance, and research and extension services were positively related but not statistically significant to the measure of revenue. Social and environmental acceptability, flexibility, open opportunities, information flow, human capital, value chain actor policies, infrastructure constraints and hindrance by government policies and regulations were neither positively related nor statistically significant to revenue and profitability (Table 3).

Operational Cost

The results of operational cost as a measure of profitability indicated that the factor of sales' turnover (coeff = 677,218, $p<0.01$) had a positive and statistically significant influence on cost. Access to new knowledge (coeff = -6.074e+07, $p<0.01$) and collaboration (coeff = -2.630e+07, $p<0.01$) were statistically significant but not positively relate to operational cost. Conversely, access to information, length in business, capability, good value chain governance, access to finance, and infrastructural constraints are positively related but not statistically significant to measure of operational cost. Social and environmental acceptability, collaboration, open opportunities, human capital, information flow, value chain actor governance, research and extension services and hindrance by government policies are neither positively related nor statistically significant to the measure of operational cost and profitability (Table 3).

Profit

Results on the measure of profits reveal that Sales' turnover (coeff = 174,103, $p<0.01$) and research and extension services have positive and statistically significant influence on profit. However, collaboration (coeff = -1.420e+07, $p<0.01$), value chain actor policies (coeff = -1.350e+07, $p<0.01$), infrastructural constraints (coeff = -1.413e+07, $p<0.05$), social and environmental acceptability (coeff = -8.320e+06, $p<0.10$) and, information flow (coeff = -8.805e+06, $p<0.10$ are statistically significant but not positively related to profit. Open opportunities, length in business and hindrance by government policies are positively related but not statistically significant to the measure of profits. Access to information, access to knowledge, flexibility, capability, human capital, value chain governance, and access to finance are neither positively related nor statistically significant to profit as a measure of profitability (Table 3).

Table 3: LRM model of determinants of profitability in the potato value chain. Values in UGX

Variable	Revenue	Operational Cost	Profit
Sales' turnover	871,261***	677,218***	174,103***
	(156,678)	(123,344)	(46,638)
Access to information	8.218e+06	7.180e+06	-3.972e+06
	(1.293e+07)	(9.947e+06)	(3.761e+06)
Access to new knowledge	-6.323e+07**	-6.074e+07***	-8.087e+06
	(2.514e+07)	(1.958e+07)	(7.403e+06)
Social & environmentally acceptable	-1.428e+07	-6.290e+06	-8.320e+06*
	(1.592e+07)	(1.201e+07)	(4.541e+06)
No Collaboration	-4.713e+07***	-2.630e+07**	-1.420e+07***
	(1.607e+07)	(1.219e+07)	(4.610e+06)
Flexibility present	-2.114e+07	-6.450e+06	-3.350e+06
	(1.511e+07)	(1.165e+07)	(4.406e+06)
Open opportunities present	-1.269e+07	-1.560e+07	1.917e+06
	(1.393e+07)	(1.074e+07)	(4.059e+06)
Length in business	804,777	448,791	227,882
	(737,767)	(575,034)	(217,430)
Capable	6.801e+06	1.247e+07	-1.557e+06
	(1.602e+07)	(1.237e+07)	(4.679e+06)
Adequate human capital	-7.828e+06	-3.480e+06	-1.970e+06
	(1.478e+07)	(1.139e+07)	(4.306e+06)
Good value chain governance	1.302e+06	2.753e+06	-3.574e+06
	(1.387e+07)	(1.065e+07)	(4.026e+06)
Access to finance	2.491e+07*	1.699e+07	-4.321e+06
	(1.456e+07)	(1.125e+07)	(4.254e+06)
Proper information flow	-2.005e+07	-772,895	-8.805e+06*
	(1.579e+07)	(1.227e+07)	(4.639e+06)
Value chain actors have no policies and regulations	-1.967e+07	-7.083e+06	-1.350e+07***
	(1.633e+07)	(1.263e+07)	(4.775e+06)
Infrastructure constrains	-174,230	3.103e+06	-1.413e+07**
	(1.980e+07)	(1.529e+07)	(5.780e+06)
Receive research and extension services	1.113e+06	-5.504e+06	9.708e+06***
	(1.260e+07)	(9.871e+06)	(3.732e+06)
Not hindered by Government policies and regulations	-1.319e+07	-6.603e+06	1.242e+06
	(8.615e+06)	(6.588e+06)	(2.491e+06)
Male	1.923e+07	1.354e+07	1.105e+07***
	(1.357e+07)	(1.046e+07)	(3.957e+06)
Respondent age	-842,029	-450,419	-26,790
	(571,454)	(443,127)	(167,554)
Actor was married	4.847e+06	-3.026e+06	4.181e+06
	(1.881e+07)	(1.445e+07)	(5.464e+06)
Actor has secondary level education and above	-1.106e+07	-1.656e+07	-836,140
	(1.346e+07)	(1.039e+07)	(3.928e+06)

Constant	1.917e+08***	1.100e+08***	5.343e+07***
	(4.430e+07)	(3.459e+07)	(1.308e+07)
Observations	375	375	375
R-square	0.268	0.220	0.204

Discussion

Sales turnover

The regression analysis results showed that the profitability determinant of Sales' turnover had a significant positive influence on the measure of revenue and profit. This suggested that PVC actors strongly associated higher sales' turnovers with better operational and financial performance in terms of revenue, operational costs and profit. Moreover, the high level of significance indicated that sales' turnover was a critical driver of profitability in the PVC (Kyomugisha et al., 2017). The observation aligns to what has been reported by Mbowa and Mwesigye, 2016, that profit was a major catalyst for value chain actors not only to engage in the potato business but, also invest more resources for its sustainability.

Mutual benefits

Generally, value chains tend to survive where there is mutual respect, collaborative engagement and trust. Study findings show that the PVC actors in addition to pursuing profits, equally considered reaping of mutual benefits to be critical to their sustained profitability. Moreover, the LRM results show that the variable of mutual benefits was significant to revenues ($p \leq 0.001$) and profits ($p \leq 0.05$) and operational costs ($p \leq 0.001$) (Table 3). The results echo what has been reported in literature (Emana, and Nigussie, 2011; Hassan et al., 2021) that equity, mutualism and collaborative engagement were strong pillars for ensuring an effective and efficient value chain development.

Access to new knowledge

Regression analysis results (Table 3) showed that lack of access to new technologies by actors in the PVC significantly reduced their revenues ($p \leq 0.05$) and increased operational costs ($p \leq 0.001$) but had less profound effect on profit. The observation reflected the current complex and dynamic nature of the business environment. Therefore, requiring astute entrepreneurs whose need and access to knowledge should not be limited to their business environment (Carrera and Rossi, 2015). Generally, access to timely, appropriate and adequate new knowledge for PVC actors is critical as this enhanced their ability to innovate and pursue value addition that can enable them increase revenues, reduce operational costs and reap bigger profits (Devaux et al. 2018). This highlighted the importance of continuous learning and knowledge acquisition for maintaining competitiveness and efficiency.

Access to information

The variable of access to information revealed positive influences to the profitability factors of revenue and operational costs but was negatively related to profits and not statistically significant to any other factors (Table 3). This interpreted that while access to information by the PVC actors helped them to improve their revenues and reduced operational costs, there were other factors that were crucial in translating these gains into actual profit. Literature is awash with research that showed the extent to which lack of sufficient information and failure

to trust other chain actors, notably the brokers and traders, led to reduced revenues, high operational costs and low profits (Devaux et al. 2009). Yet, information sharing was helpful to value chain actors to align their strategic and operational plans (Holweg et al. 2005), improve value chain performance through collaborations and risk-sharing (Munyua and Stilwell, 2013), and help in coordinating activities across the value chain (Hassan et al. 2021). It was also critical in improving PVC actors' access to new knowledge and efficient management of business resources (Watabaji et al. 2016).

Knowledge on Policies and regulations

Table 3 shows that lack of knowledge on value chain policies and regulations was significantly ($p \leq 0.001$) associated with PVC actors' profits/profit. However; the association with the actors' revenue and operational costs was insignificant. The observation suggested that lack of knowledge on value chain policies and regulations for PVC actors might be affecting their profit because of external regulations. Since most of the actors in the PVC might not be conversant with applicable government policies and regulations for good practice in business (Ferris, et al., 2002), there was a possibility of them paying high taxes or penalties for failure to comply.

Research and extension services

Study findings (Table 3) indicated that lack or poor access to research and extension services by PVC actors significantly ($p \leq 0.001$) affected the profit and were positively related to revenues. Generally, access to research findings and extension services was crucial to increasing profitability along agricultural value chains. Access to extension services enabled farmers and other value chain actors to adopt new technologies and innovations on how to improve their operations for profit maximization (Fuglie, 2007). According to Webber (2007) innovations did not only enable value chain actors to master and implement the design and production of goods and services that were new to them but, could help them increase their revenues and profits.

Length of time in business

The regression analysis results (Table 3) revealed that an actor's experience in the PVC was positively associated with their revenues, reduction operational costs and profit. However, the association was not statistically significant. Literature showed that new business ventures in developing economies tended to fail within the first year of their establishment. Therefore, the length of time of a business in operations could relate to sustainability that was similarly associated to good business and management practice (Baloyi, 2010). Generally, PVC actors faced many and diverse challenges that they had to endure to remain competitive. Thus, the longer they remained in business the more likely they would understand the risks and challenges hence, their ability to design strategies to mitigate them.

Capability

The capability of leaders to design strategies and managers to implement them was considered critical to a firm's performance, growth and sustainability. Table 3 showed that PVC actors' capabilities were positively associated with their revenues and operational costs but not with the profit. The observation was in line with expectation that PVC actors' capabilities were critical when it came to revenue generation and management of operational costs but not

necessarily profits (Webber, 1996). The results also echoed available literature on competences, which suggested that capabilities of a firm's stakeholders were essential to ensuring good performance (Porter, 1996).

Access to finance

Generally, availability and access to finance by investors was deemed a major determinant of an enterprise's profitability. Regression analysis results (Table 3) showed that access to finance by the PVC players was positively related to their ability to generate revenues and reduce operational costs. However, the relationship was not statistically significant. Nonetheless, access to finance was not positively related to the PVC actors' profit. It is possible that access to finance may result into increased revenues and reduced costs, but not necessarily increased profits due increase in others cost like renting larger premises, hiring more staff or investing into novel innovations (Margaretha and Supartika, 2016).

Whereas failure to access reliable and affordable finance was a country-wide challenge for most business, its effect within the potato value chain might be more critical because of the nature of the product (Miller, 2010). Potatoes are perishable goods which need timely attention at all levels of the chain as failure to achieve this can lead to colossal losses (Kopparthi, 2012). The current efforts to open an agricultural-based bank in the country would be a relief and possible mitigation for the risks associated with lack of access to timely, affordable and reliable finance.

Conclusions and recommendations

The study aimed at assessing determinants of profitability along South-Western Uganda's PVC. Based on the study's findings it is concluded that PVC actors' revenue, operational costs and profit varied along the value chain with processors, aggregators and traders reporting the highest profit in comparison to seed and ware potato farmers. It is also concluded that since farmers' profit was the lowest in the whole PVC, as price takers, they were not benefiting as much as the other PVC actors. It is further concluded that many factors influence PVC actors' profitability whereby sales turnover and access to research and extension services were positively and significantly associated with PVC actors' profitability. Conversely, lack of mutual benefits and lack of clear policies & regulations for the PVC actors were negatively and significantly associated with profitability.

It is further concluded that the study findings were in line with the arguments of the theories that guided it. For example, it aligns to the Risk-bearing Theory of Profitability (RTP) as PVC actors have been observed to be entrepreneurs who take risks to invest in the value chain and are ultimately rewarded for their efforts. Similarly, study findings showed that lack of access to new knowledge; information and research were impediments to profitability which aligns to the Innovation Theory of Profitability (ITP). In addition, the findings have shown that PVC actors work in a complex and dynamic environment which necessitates adoption of new innovations/technologies in pursuit of profit maximization; this observation is in alignment with the Dynamic Theory of Profitability (ITP).

Based on the study findings and conclusions the following are recommended first, the government of Uganda should come up with strategies to increase farmers' profitability on the PVC through facilitating better access to markets and farmer cooperatives, subsequently

increasing their incomes and improving their livelihoods. Secondly, there is a need for the Ministry of Agriculture and other relevant stakeholders to come up with clear policies and regulations for the PVC actors. This would especially be to address taxes on agricultural products, price stabilization mechanisms and access to finance for agriculture. Doing so will also ensure that PVC actors abide by the same hence, avoiding unnecessary penalties that may reduce their profitability. Lastly, there is need for further research on other factors that might impact on the profitability of PVC actors in SW Uganda. Examining the role of gender dynamics, climate resilience strategies, and digital technologies in PVC profitability could also provide valuable insights.

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