THE EFFECT OF CHILLI COMMERCIALIZATION ON THE INCOME OF SMALLHOLDER FARMERS IN KAMULI DISTRICT, UGANDA

MIRIAM NAMATA

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DECLARATION

I, Namata Miriam hereby declare that this is my original work, is not plagiarised and has not been submitted to any other institution for any award.

Miriam Namata

Signature: ..... Date: 31st/Dec/2025

APPROVAL

I have approved the submission of this thesis for the award of Master of Science in Agribusiness Management and Entrepreneurship at Uganda Christian University

Signature ……..…… Date 31st/ Dec/ 2025

Dr Elizabeth Kuteesa Balirwa

Academic supervisor

Faculty of Agricultural Sciences

ABSTRACT

Chilli (Capsicum annum L.), locally known as "Kamulali," is a vegetable spice with important nutritional, medical, and economic. The crop is mainly grown by smallholder farmers in Uganda. In Kamuli district, chilli provides a significant income source for mainly women and youths. Despite its importance and export potential, no literature exists on the commercialization of chilli production. This study addresses this gap. Using data collected from 220 smallholder chilli farmers in Butansi and Mbulamuti sub-counties in Kamuli district, the study examined the commercialization behaviour of chilli production using descriptive statistics. The determinants of the level of commercialization were analyzed using a Tobit regression model. The study further employed linear regression using OLS to analyze the effect of chilli commercialization on income of household farmers. Results show that chilli production is male dominated, mostly undertaken by married people and those having large households. The level of commercialization of chilli production was influenced by membership to farmer group, gender of the farmer, access to extension and financial services, household size. OLS results indicate that the commercialization level of chilli production has a positive and significant effect on the income level of smallholder farmers. The study recommends increasing the level of commercialization through increasing access to financial and extension services, providing an enabling environment for farmer group formation.

DEDICATION

I dedicate this thesis to my husband Mr. Isaac Kasoro and my parents Mr. Lule Charles and Mrs. Lule Loy. I am grateful for your support.

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List of acronyms and abbreviations

CABI - Centre for Agriculture and Bioscience International

CSRL - Centre for Sustainable Rural Livelihoods

FAO -Food and Agriculture Organization

FAOSTAT - Food and Agriculture Organization Statistics

HH -Households

IFAD -International Fund for Agricultural Development

MAAIF - Ministry of Agriculture, Animal Industry and Fisheries

UBOS -Uganda Bureau of Statistics

UGX - Uganda Shillings

UNEP -United Nations Environment Programme

USAID - United Nations Agency for International Development

VEDCO - Volunteer Efforts for Development Concern

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Chilli (*Capsicum annum L.*), locally known as "Kamulali" is a vegetable spice belonging to the Solanaceae family (Channa et al., 2020). The chilli plant is a bushy semi-perennial crop with a 60-80cm height. It has been said that people have been using chilli since the dawn of agriculture (Quresh et al., 2021). In the Western Hemisphere, it is one of the earliest cultivated crops. The native population used peppers for nourishment, as weapons in battle, and for religious rituals long before Columbus arrived in the Americas (Pandit et al., 2020). It originated in the tropical regions of Southern Latin America (New Mexico and Guatemala) around 7500 BC (Hussain & Abid, 2011). Chilli is produced for various economical, nutritional, and medicinal reasons. Its beneficial medicinal properties, export potential, and biological action potential make it suitable for use in a variety of pharmaceutical ointments and for colds, throat irritation, asthma, chest tightness, and pains (Pandit et al., 2020). In Uganda, chilli is mainly grown by smallholder farmers (typically owning smaller than two hectares), contributing significantly to household income (Acaye & Odongo, 2018).

Chilli grows well in warm and moist weather conditions with temperatures ranging from 22℃ to 35℃ (USAID, 2018). The soils should be well drained and aerated therefore sandy loam, loam, and clay loam are suitable for chilli production. High quality seeds should be used to produce crops resistant to diseases and pest attacks thus leading to better quality yields (CABI, 2017). Chilli yield varies depending on the cultivar and is estimated to be 4 tonnes per acre on average (Dijkxhoorn et al., 2019). Chilli is harvested at about 3 months after transplanting (Glodjinon et al., 2019). The crop for the export market is usually harvested when it is still green while that sold on the local market and for processing is harvested when fully ripe (red or yellow) in colour (Sinha & Joan, 2011). Chilli can take 6 to 7 months of harvesting after maturity at a recess of two weeks (Dijkxhoorn et al., 2019). In Africa, chilli is mainly grown during the rainy season, but can also be grown during the dry period in areas where irrigation is accessible (Oyewo et al., 2018).

Five cultivars of chilli are tamed; *Capsicum frutesens, Capsicum baccatum, Capsicum annum, Capsicum jchinense,* and *Capsicum pubescens* (Chabaane et al., 2021). Chilli uncovers widespread

commercial cultivation across different regions globally, serving various purposes such as a vegetable, spice, medicinal herb, and even as an ornamental plant. Those who eat chilli enjoy it in fresh, dried, and/or powdered form (Hussain & Abid, 2011). In Uganda, the most common varieties grown are bird's eye, scotch bonnet, hot pepper, and long cayenne (Lim & Lim, 2013; UNBS, 2013). Most farmers use seed that is saved from previous seasons, a production practice that makes it difficult to maintain a pure chilli cultivar (Lim, 2013). The development of chilli production from subsistence to commercial in Uganda dates back to the 1990s with specifications for export markets (Tusiime et al., 2010; Dijkxhoorn et al., 2019). Although most chilli harvests are for export, small portions are sold in urban markets, especially Kampala, and also processed into sauce and powder for local consumption (Dijkxhoorn et al., 2019).

In 2023, the total world production of dry chilli was 5,821,857.7 tonnes on 1,802,522 ha resulting in a yield of 3.2 tonnes/ha, while that of green chilli was 38,310,351 tonnes on 2,065,408 ha with a yield of 18.5 tonnes/ha. The highest world producer of chilli was China with 325,522 tonnes of dry chilli and 17,104,871 tonnes of green chilli in 2023 (FAOSTAT, 2023). Chilli is perceived to be a high value crop by many farmers in Uganda, which has proved it to be more profitable than competing crops such as okra and French beans (Lwasa et al., 2010; Kyomuhendo, 2019). In 2023, Uganda produced 3,178.9 tonnes of dry chilli over a corresponding area harvested of 3,145 ha (FAOSTAT, 2023).

In 2023, Uganda was the least chilli producing country in East Africa after Tanzania and Kenya. Tanzania produced 6,735.4 tonnes of dry chilli on 3,043 ha and 15,874 tonnes of green chilli on 590 ha. Kenya produced 2,989 tonnes of dry chilli on 2,463 ha and 10,745.7 tonnes on 1,270 ha (FAOSTAT, 2023). Uganda's dry chilli yield of 1.01 tonnes/ha was significantly lower than China's yield of 6.6 tonnes/ha by 84.68% compared that is over 6.5 times (FAOSTAT, 2023). In Kamuli district, chilli production has gained increasing importance among smallholder farmers. It is driven by its attractive economic returns and its potential to offer job opportunities, particularly to women and youth in the community (Buyinza & Mugagga, 2010).

In 2020, Kamuli's chilli farmers generated Uganda Shillings 100,602,450 (US$25,964) from the sale of 69,381 kilograms of green chilli (VEDCO, 2020). Chilli in Kamuli is mainly purchased by export companies such as KK Foods and Kehong Company (CSRL, 2021). This chilli is exported to China and some European countries like United Kingdom and Germany. There have been

various efforts by the government of Uganda to promote agricultural commercialization. This is through the implementation of policies like National Agricultural policy (NAP), Poverty Alleviation Action Plan (PEAP), National Agricultural Extension Policy (NEAP), and Plan for Modernization of Agriculture (PMA) (Kavuma & Kisaame, 2023). Despite these efforts, there is limited knowledge about the commercialization of chilli production in Uganda. This necessitates the need to examine the commercialization behaviour of chilli farmers, the determinants of chilli commercialization level, and how it affects the income of smallholder farmers in Kamuli district.

1.3 Problem statement

Chilli production is increasingly important in Uganda due to its financial contribution to smallholder farmers (Buyinza & Mugagga, 2010; Hodges, 2020). In Kamuli district, there is insufficient knowledge on the contribution of smallholder chilli farmers to the national export market for chilli. Although chilli export companies like KK Foods provide market for chilli in Kamuli, there is lack of evidence to show how the farmers are benefiting from the existing markets (Dijkxhoorn et al., 2019; VEDCO, 2020). In 2022, farmers in Kamuli contributed only 269 tonnes (21.9%) to the total 1,228 tonnes of green chilli exported by Uganda (VEDCO, 2022; FAOSTAT, 2023). Existing research on chilli production in Uganda has mainly concentrated on agronomic practices, postharvest handling practices, and its contribution to household income (Asiimwe et al., 2021 & Ssekkadde et al., 2021). However, limited focus has been put to understanding the commercialization of chilli production among smallholder farmers in Uganda.

Understanding commercialization of chilli production is important because it is a key income stream for several farmers (Buyinza & Mugagga, 2010). Nevertheless, these benefits cannot be fully realized without having clarity on the commercialization of chilli production among smallholder farmers. This research, therefore, sought to understand the commercialization behaviour of smallholder chilli farmers and unmask underlying factors determining the level of commercialization. The study also wanted to examine the effect of the level of commercialization of chilli production on the income of smallholder farmers in Kamuli district.

1.4 Objectives

To determine the effect of commercialization on the income of smallholder chilli farmers in Kamuli district.

1.5 Specific objectives

1. To analyze the commercialization behaviour of smallholder chilli farmers
2. To examine the factors that determine the level of commercialization of chilli production among smallholder farmers
3. To determine the effect of the level of commercialization of chilli production on the income of smallholder farmers

1.6 Research questions

1. Is there a relationship between the characteristics of smallholder chilli farmers and the level of commercialization?
2. What factors determine the level of commercialization of chilli production among smallholder farmers?
3. How does the level of commercialization in chilli production affect the income of smallholder farmers?

1.7 Significance

A clear insight of the factors determining the level of commercialization of chilli production among smallholder farmers may have substantial implications for eliminating poverty and improving livelihoods. By providing factual information on productive marketing approaches, the study can contribute to the promotion of approaches which focus on the market. This will enhance the income generating potential of smallholder farmers (FAOSTAT, 2023). This study could lead to an increase in market participation subsequently leading to increased profitability and enhanced living conditions for the farmers.

In the long run, this could create jobs and enhance the general Gross Domestic Product (GDP) of the nation (Endalew et al., 2020). Additionally, the study findings can provide crucial evidence in the development of policies that promote the commercialization of chilli production. This promotes targeted efforts to progress the income levels of smallholder farmers in Kamuli. Understanding the determinants of the level of commercialization offers valuable insights in providing solutions to the challenges that hinder the commercialization of farmers. The discoveries of this research also provide a foundation for further studies in the commercialization of smallholder farmers.

1.8 Justification

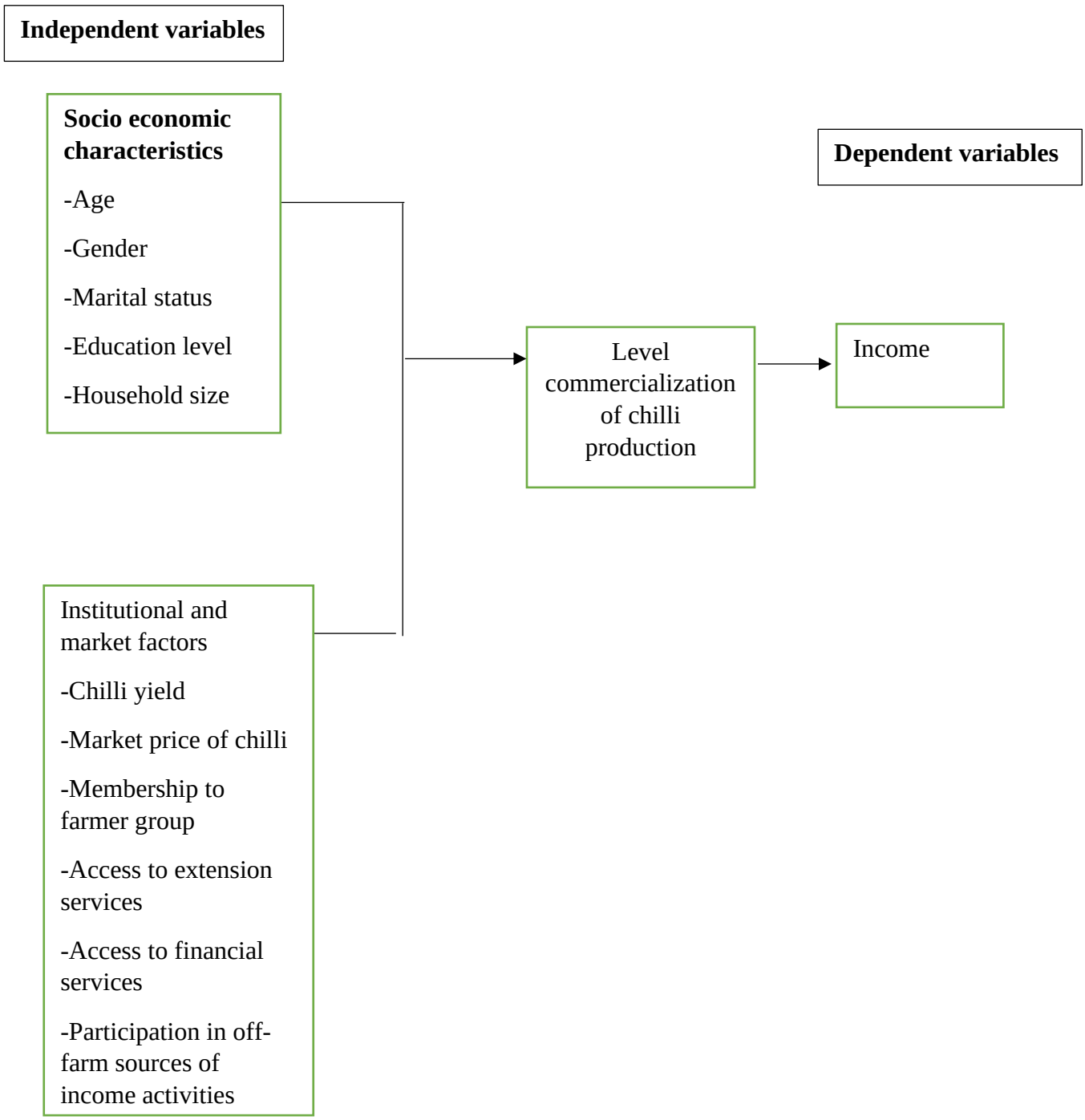
Chilli production is gaining importance in the agricultural sector due to its high profitability and increasing demand globally (Zohoungbogbo et al., 2024). It can enhance chilli production, sales, and farmer incomes. Chilli production has significant financial benefits and could provide an alternative source of income to farmers (Buyinza & Mugagga, 2010). In Kamuli district, there are efforts by development organizations such as Volunteer Efforts for Development Concerns and Iowa State University Uganda program to promote chilli production for income generation among smallholder farmers (VEDCO, 2020; CSRL, 2021).

Despite potential and effort towards chilli production, there is a substantial knowledge gap regarding its commercialization among smallholder farmers. Therefore, it is significant to investigate the determinants of the level of commercialization of chilli production. It is also crucial to understand the effect of commercialization levels on the income of smallholder farmers. This is largely because these areas have not been adequately addressed in previous studies. This study aimed to resolve these knowledge gaps and offer an understanding of the likely benefits of commercialization of chilli production in Kamuli. It also informs the process of decision making regarding future agricultural policies

1.9 Scope of the Study

This study focused on assessing the effect of the commercialization of chilli production on the income of smallholder chilli farmers. It was carried out among smallholder farmers growing chilli. The study was conducted in Uganda, Kamuli district specifically, Butansi and Mbulamuti sub-counties. This area was selected due to its high potential for chilli production in Uganda.

1.9 Conceptual framework



CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Agricultural Commercialization

Agricultural commercialization is the process of moving from an only consumption based system to an income generating system. It also involves increasing the quantity of produce that farmers sell (Nega et al., 2020). It is characterized by the intensive use of agricultural inputs such as fertilizers, pesticides, and high yielding seed varieties. This ensures increased output and marketable surplus (Godoy et al., 2014; Owusu & İşcan, 2021). Commercialization is necessitated by various factors like urbanization, globalization, population growth, government policies, and climate change (Abdullah et al., 2017). Agricultural commercialization is considered to drive development and reduce poverty in developing countries. Smallholder farmers should be supported to engage in commercialization to improve livelihoods in developing countries (George Rapsomanikis, 2015; Hagos et al., 2020)

Agricultural commercialization improves farmers' efficiency and productivity by employing improved technology, leading to the overall development of national economies (Ojong et al., 2022). Commercialization increases the income levels of farmers and improves food security by providing a range of foodstuffs through markets (Wakaba et al., 2022). Agricultural commercialization is a source of employment opportunities, facilitates infrastructural development, which leads to the development of rural communities (Etuk & Ayuk, 2021; Aida et al., 2022).

In Uganda, the commercialization of the agricultural sector is growing at a fast rate, as shown by an increase in the participation of smallholder farmers in both local and international markets (Nivievskyi et al., 2010; MAAIF, 2018). This is brought about by factors like an increase in the market for agricultural produce, government policies, and infrastructural development (Kavuma & Kisaame, 2023). As a result, most smallholder farmers have shifted from subsistence to commercial farming with emphasis on high value produce such as coffee, tea, cocoa, and horticultural crops (De Brauw & Bulte, 2021).

Commercialization of horticulture by smallholder farmers is usually recognized as a way of reducing poverty (Michelson, 2013; Muriithi & Matz, 2015, Abdullah et al., 2017). There is a strong relationship that has been observed between crop commercialization and income growth in Africa (Maertens & Swinnen, 2009). Other than the direct impact of chilli production on income, chilli has a short growth period which ensures a stable income flow. Its commercialization can provide extensive socioeconomic gains like employment opportunities and development of markets. However, regardless of these anticipated benefits, further research is required to completely understand the determinants of commercialization level of chilli production and its effect on the income of the smallholder farmers.

2.2 Level of commercialization

The systems for food production can be categorized as subsistence, semi-commercial, and commercial, based on the extent of market concentration (Tindiwensi et al., 2020). The levels of commercialization are dependent on the aims of the farmer in growing a particular crop, revenue sources, sources of input, and product mix (Abdullah et al., 2017). This shift from subsistence to money making arrangements shows the changing needs of farmers as the general economy expands and becomes more market oriented. With higher levels of commercialization, there is a greater adaptability of farm produce towards consumer demands. As a result, higher levels of commercialization play a key role of generating revenue and profit in the process of decision making (Cazzuffi et al., 2017).

Table 1: Features of food production systems that are becoming more commercialized

Market orientation level	Farmer's goal	Input sources	Product	Sources of income for the household
Subsistence systems	Food independence	Domestically produced (not traded)	Broad range	Primarily non agricultural
Semi-commercial systems	Excess production	A combination of non-traded and traded	Comparatively specific	Both farming and non-farming
Commercial systems	Maximizing Profit	Mostly exchanged inputs	Extremely specialized	Mostly non-agricultural

Source: Pingali & Rosegrant (1995)

Households in the subsistence system aim for food independence where they grow food which is sufficient for home consumption and not for sale. They depend on inputs that are produced domestically such as saved seeds, manure, and family labour. There is minimal use of traded inputs. The product mix is mostly a broad range of animals and crops that help to achieve the various household essentials. Income for the household in subsistence systems is primarily from agricultural activities. The main goal of the farmer in semi-commercial systems shifts to the production of surplus that includes produce for consumption and extra for sale. They use a combination of both traded and non-traded inputs. The product mix is comparatively specialized, focusing on fewer products and they obtain income from farming and non-farming activities. In the commercial systems, the farmers' major objective is profit maximization. Farmers mainly depend on the traded inputs like pesticides, improved seeds, and fertilizer. Production is very specialized, with emphasis on a few profitable crops. The household source of income is mainly from off-farm activities like employment.

2.3 Measuring the level of commercialization

Govereh & Jayne (1999) and Kahenge et al. (2019) proposed a continuum-based approach to measure commercialization in agricultural systems, ranging from total subsistence production (zero commercialization) to complete market focused production (100% commercialization). To assess this continuum, they introduced the Household Commercialization Index (HCI), expressed in percentage form. This is determined by multiplying the overall value of all crops produced by the overall value of all crops sold, and then multiplying the result by 100 (Thandeka et al., 2022). Asuming-Brempong (2013) and Falola et al. (2022) categorized commercialization into three groups: Low (HCI ≤30%), Medium (HCI 30.1–75%), and High (HCI >75%). Greater levels of commercialization correlate with higher welfare levels, and equally lower levels of commercialization correlate with lower welfare levels (Liverpool et al., 2023). Using the HCI can avoid simple classifications of farms as completely or partially commercialized. Instead, it gives a more refined understanding of the level of commercialization for each farm (Ochieng et al., 2019). Nevertheless, the HCI has some limitations for example if a farmer harvests one kilogram of a crop and sells it all, the HCI would indicate 100% level of commercialization. On the contrary, if a farmer harvests a hundred kilograms of a crop, then sells only twenty kilograms, the HCI would be 20%. This implies low level of commercialization which might not exactly represent the actual situation. Although the interpretation of the HCI might not be practical and unclear, the HCI can still be helpful despite this drawback. This is mainly in developing countries where it is unusual to find large farms not selling any of their produce or smallholder farms selling their produce entirely. It lays a foundation for measuring the level of market focus for different farms. By putting additional factors and context into consideration, there will be a more extensive understanding of agricultural commercialization (Katerega et al., 2018; Kahenge et al., 2019).

Tafesse et al. (2020) applied four methods to measure the level of commercialization of households in agricultural production. The ratio of total sales of produce to total agricultural produce was calculated to obtain the sales to output ratio. The net profit margin was computed as the ratio of gross sales to proceeds from agricultural produce only. The market position was also obtained by calculating the proportion of the quantity sold and procured to the total stock of produce this classified the status of the home into three: net supplier, net purchaser, or independent. The level of specialization of the farmer was obtained by calculating the specialization index. Altogether, these approaches provided a comprehensive estimate of the level of household commercialization.

This provided a deeper understanding of market orientation, income diversification, and specialization level (Ochieng et al., 2019).

2.4 The commercialization behaviour of smallholder farmers

Commercialization behaviour are the attributes that farmers exhibit at the different levels of commercialization (Mutea et al., 2025). The commercialization behaviour of smallholder farmers is determined by various factors both internally and externally. These include availability of production land, need for household food security, farmer's attitude towards risk, education level, access to financial and extension services. These are instrumental in influencing the commercialization decisions of small scale farmers (Getahun, 2020; Kissoly et al., 2020)

At different commercialization levels, farmers usually display different characteristics. Farmers with high commercialization levels often have improved access to financial services, better education, larger land sizes, and more income. The reverse is true for farmers in the lower levels of commercialization (Balirwa & Waholi, 2019; Abate et al., 2022; Hlatshwayo et al., 2022). The gender of the farmer varies at different levels of commercialization. Male farmers tend to have higher levels of commercialization than female farmers due to better access to resources like land (Thandeka et al., 2022). The age of the farmer varies at the different levels of commercialization, with young farmers expected to achieve higher levels than their older counterparts (Mihretie, 2020).

2.5 Determinants of the level of commercialization among smallholder farmers

2.5.1 Socioeconomic factors

i. **Age:** Age of smallholder farmers has a major influence on the level of commercialization. Farmers who are older tend to fall in the low level of commercialization (Kyaw et al., 2018). This could be attributed to physical challenges due to age, which hinder their market participation and the commercialization of their produce. Additionally, older farmers are resistant to technological changes (Goemans, 2014). In contrast, Worku et al. (2022) established that the farmer's age had a significantly positive effect on the level of commercialization of chickpea production.

ii. **Household size:** The household size of the farmer is a negative determinant of the level of commercialization. Farmers with larger households tend to attain low level of

commercialization. (Haile et al., 2022). This could be brought about by high demand for food and reduced saleable surplus. Due to the large size of the household, the priority of the farmer is to provide food for the family and sales are made in case there is surplus produce (Wakaba et al., 2022).

iii. **Gender:** The gender of the farmer significantly determines of the level of commercialization. Male farmers tend to attain a high commercialization level. This is attributed to the ease with which male farmers access resources like land and finances (Ayele et al., 2021). However, female farmers mostly attain low levels of commercialization due to challenges like social roles and restricted access to production resources (Otekunrin & Idris, 2019; Gebre et al., 2021). The gender of the farmer had an important effect on the choice and amount of potatoes to offer for sale (Sebatta et al., 2014). Most of the decision making concerning agricultural production and trade is done by the male family members (Ayele et al., 2021).

iv. **Marital status:** The farmer's marital status significantly affects the level of commercialization. Married farmers were associated with higher levels of commercialization among smallholder maize farmers (Hlongwane et al., 2014). This is brought about by increased labour and joint decision making, which enhance commercialization (Zamasiya et al., 2014; Egbetokun et al., 2017).

v. **Education level:** The education level accomplished by the farmer positively affects the commercialization of milk by smallholder farmers in Uganda (Balirwa & Waholi, 2019). Higher levels of education enable farmers to negotiate better when selling their produce (Lubungu et al., 2012; Kyaw et al., 2018). However, Haile et al. (2022) found education level to have a significant but negative effect on commercialization level among smallholder farmers. This suggests that obtaining education could open additional job opportunities, hence reducing the level of commercialization.

vi. **Farm land size:** Farmers with larger cultivable land are usually more engaged in the market due to their capacity to produce higher quantities, which in turn, ensures the availability of surplus produce for marketing (Gebremedhin & Hoekstra, 2011). Balirwa & Waholi (2019), found the land size owned by market participants in terms of acreage to be higher than that owned by farmers with smaller land sizes.

2.5.2 Market and institutional factors

a) **Market price:** Farmers who receive higher market prices tend to increase their agricultural output, resulting in an increased market surplus (Kyaw et al., 2018). The level of commercialization among Ugandan banana growers together with those growing maize and kale in peri-urban Kenya are positively impacted by output pricing (Omiti et al., 2009; Jagwe, 2011; Ouma et al., 2010). Consequently, market prices play a significant role in positively influencing the level of rice commercialization (Chikuni & Kilima, 2019).

b) **Yield:** The yield of produce positively influences the level of commercialization. The higher the yield obtained, the higher the level of commercialization attained by the farmer (Hailua et al., 2015). With high yields, farmers obtain more marketable surplus and are motivated to participate in commercialization (Haile et al., 2022)

c) **Membership to farmer group:** Households that are members of farmers' groups experience increased level of commercialization due to the enhanced capabilities in both agricultural production and marketing (Ingabire et al., 2017). Farmer groups boost the level of commercialization by providing access to production and marketing information. Additionally, farmers obtain high prices for their produce because of the high bargaining power when they sell their produce collectively (Otekunrin et al., 2022). According to Hlatshwayo et al. (2022), participation in farmer groups can successfully increase the level of commercialization among smallholder farmers.

d) **Access to extension services:** It has a positive and significant effect on the level of commercialization among smallholder farmers (Mamo & Beguije, 2022). Extension offers key services to smallholder farmers like providing knowledge on proper agronomic practices, market information, and input use (Gachuri et al., 2021). This enables the farmers who access extension services to increase their yield and surplus for the market. This increases the level of commercialization of the farmers (Kyaw et al., 2018).

e) **Access to financial services:** This is a positive determinant of the level of commercialization among smallholder farmers (Mmari & Kapaya, 2022). Financial

services provide capital for farmers to invest in production of agricultural produce. It also enables the use of improved postharvest technologies, which reduce losses and increase the level of commercialization (Ayele et al., 2021).

f) **Participation in off-farm income activities:** This negatively affects the level of commercialization (Deshmukh et al., 2023). Farmers who earn income from other activities are not motivated to participate intensively in agriculture (Getahun, 2019). Farmers also have limited time to engage in agricultural commercialization due to commitments related to non-farm activities (Apind, 2015; Abdullah et al., 2017)

2.6 Smallholder farmers

Smallholder farmers are farmers working on smaller pieces of land, usually less than two hectares (Wiggins, 2009; Hazell, 2015). Smallholders produce both food and non-food goods on a limited scale with minimal outside resources, growing a variety of crops, trees, livestock, fish, and other aquatic species (Reardon, 2015). Smallholders are notable for their emphasis on family needs and the preservation of the homestead farm structure. They also predominantly depend on family members for labour in farming activities, and assign a ration of the agricultural yield for personal consumption within the family (FAO, 2012). Small-scale farmers contribute to approximately 70% overall food needs in Africa, and they are responsible for roughly 80% of the food consumed in Sub-Saharan Africa and Asia. The primary producers of major agricultural exports in many developing countries are smallholder farmers (IFAD & UNEP, 2013; United Nations, 2015).

2.7 Effect of commercialization on the incomes of smallholder farmers

Commercialization is generally associated with an increase in household income since it encourages market participation. Farmers obtain income from sales by increasing the share of their produce which is sold on the market (Opondo & Owuor, 2018). Therefore, increasing the level of commercialization is considered a significant way of reducing poverty in developing countries.

Numerous studies in Africa show that there is a positive relationship between commercialization and income. As farm production resources are transferred from traditional to marketable crops, household income rises (Von Braun, 1995; Euler et al., 2017; Ogutu & Qaim, 2019). Empirical evidence shows that households that implemented a commercial specialization strategy had much

higher annual net incomes than those that did not (Jaleta et al., 2007; Dorsey, 2014). In commercialized systems, farmers usually receive more revenue from cash crops in bulk payments.

However, commercialization has some negative effects on the income of farmers. The bulky payments from sales are mostly spent fast and generally on non-food items, differing from the smaller but more reliable income from semi-subsistence production systems (Von Braun, 1995). The absence of organized banking systems that encourage savings from cash crop sales exacerbates this issue.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study area description

Kamuli district is situated in South Eastern Uganda, Busoga sub-region. It is nearly 72 kilometers north after Jinja, the biggest urban area in the Busoga region, on the main road. The coordinates of Kamuli are 0°56'42.0"N, 33°07'30.0"E (Latitude: 0.9450; Longitude: 33.1250). Kamuli has a total land area of 1,557 km^2. It borders the districts of Buyende, Luuka, Jinja, and Kayunga towards the north, east, south, and west, respectively (UBOS, 2017).

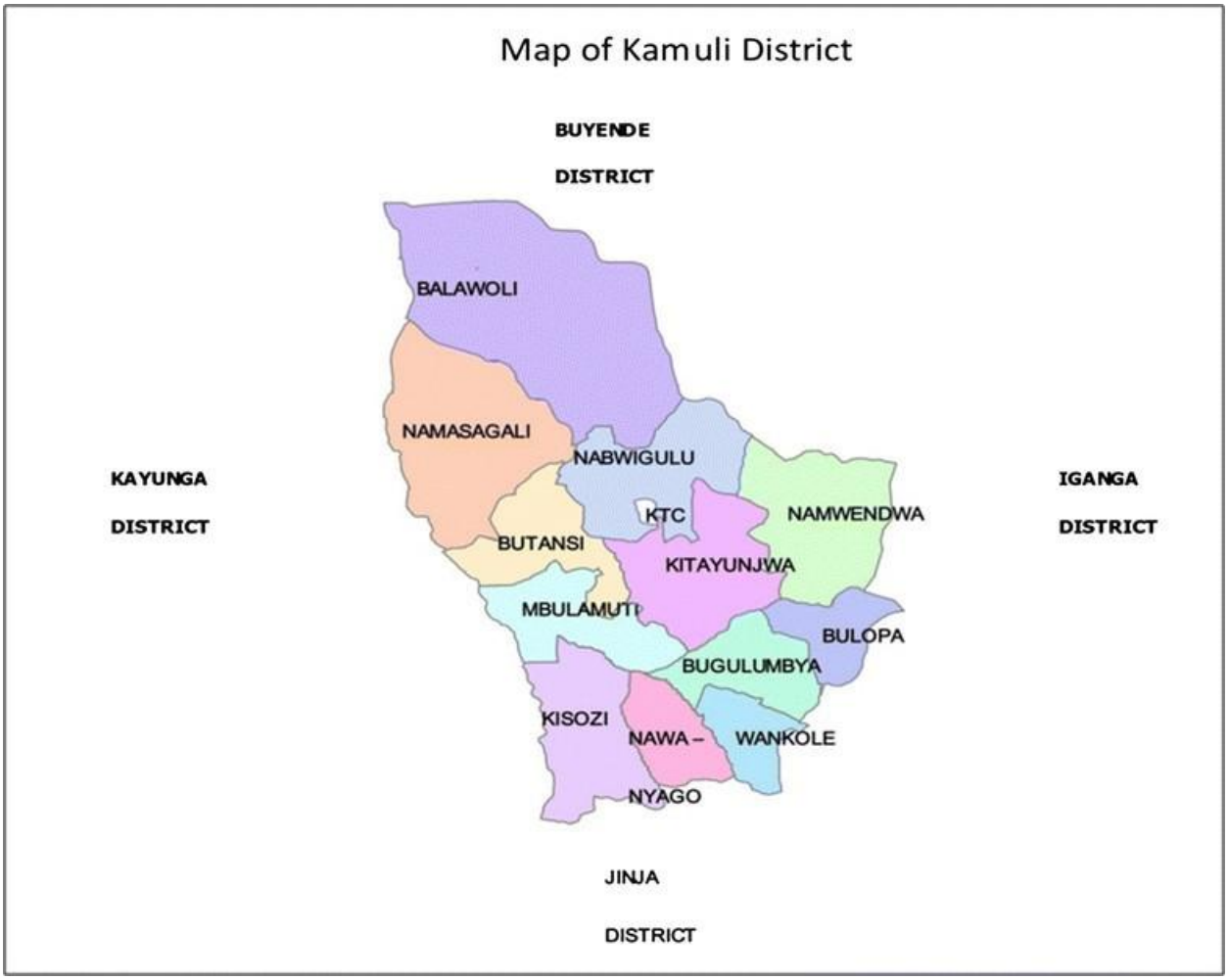


Figure 1: A map of Kamuli district. Source: (Bawate et al., 2016)

Kamuli has an overall population size of 539,699 people (UBOS, 2024b). Approximately 78.5% of households in Kamuli rely primarily on subsistence farming as their major source of living. The district has multiple cultures with Basoga being the predominant one, which makes up 76% of the total population. The main economic activities include; fishing, agriculture, retail trade, and quarrying (Government of Uganda, 2020).

Kamuli has a bi-modal type of rainfall which ranges between 75mm to 100mm per year. It has two peaks, one from March to May and the other from August to October. The area experiences moderate temperatures ranging from 19^0C to 36^0C (Gipea Africa Limited, 2022). The district has mainly lowland areas which are covered in swamps and surrounded by Nile. Nevertheless, some areas are hilly, especially in the northern parts of the district. Most of the soils are sandy loams and they support the growing of various food crops such as beans, groundnuts, maize, and sweet potatoes. In its initial phases, Kamuli was primarily characterized by forest and savannah landscapes. At present, the forest and savannah vegetation has been replaced with secondary vegetation of simple woodlands, bushes, and grass thickets due to farming, harvesting firewood, and charcoal (Gipea Africa Limited, 2022).

3.2 Research design

This study used a cross-sectional study for research design. This research design involves collecting data from various individuals at one point in time (Zangirolami-Raimundo et al., 2018).

3.3 Sampling

The Yamane formula was used for calculating sample size. The sample determination formula proposed by Yamane (1967) is as follows: $n=N/[1+N(e)^2]$ where e is the margin of error at 0.05, N is the population size, and n is the sample size. The population size was 489 chilli farmers according to the Kamuli district agricultural office. The sample size was;

$n=489/ [1+489 (0.05)^2]$ …….. 1

n = 220 farmers

In each subcounty, the villages in which chilli was mainly grown were purposively selected. The study employed a multi-stage sampling approach to select a sample size of 220 farmers. Kamuli district was purposively selected for being among the important chilli producing districts in Eastern

Uganda. Butansi and Mbulamuti sub-counties were then selected because they are the leading chilli producing sub counties in Kamuli district. Random selection of 220 farmers was carried out from the lists provided by the subcounty agricultural officers. From each subcounty, 110 farmers were selected for the study

3.4 Data tools and procedures for data collection

The data was obtained using a standardized questionnaire, and it comprised both closed and open-ended questions. Pilot testing was done for the questionnaire with 10 sample farmers in Naluwoli Parish, Butansi sub-county. This was done to correct any mistakes and ensure that high quality data was collected. The questionnaires were issued to the selected farmers over face to face interviews. Research assistants were selected and trained to administer the questionnaires to the interviewees. The data was kept safe to maintain the confidentiality of participants. A total of 220 questionnaires were distributed to the respondents and were all filled out and returned, yielding a response rate of 100%. After data collection, the questionnaires were carefully reviewed to ensure accuracy. The data was cleaned to identify and handle missing values as well as correct discrepancies. All the data collected was coded and entered into STATA for analysis.

3.5 Validity and reliability of the data collection tool

Validity and reliability are important in ensuring that high quality results are obtained from the study. Validity is the extent to which the study measures its intended purpose. It ensures that the study results are valid and applicable. Validity in this study was ensured by having the tool thoroughly reviewed by the academic supervisor and pretesting the instrument. Reliability is the ability of the instrument to consistently produce stable results. It ensures that the results obtained are trustworthy. To ensure reliability, the research assistants were trained before data collection, and the pilot testing was done with a few farmers.

3.6 Ethical considerations

The questionnaire for data collection was reviewed and approved by the supervisor to ensure compliance. Ethical clearance was obtained from the University Research Ethics Committee before data collection. Informed consent was obtained from the respondents to ensure they understood the aim of the study and voluntarily participated in the study.

3.7 Methods of analysis of data

STATA (Version 14) was used for both descriptive and quantitative data analyses.

3.7.1 Objective 1: To analyze the commercialization behaviour of smallholder chilli farmers

Descriptive data analysis techniques such as percentages, means, t-tests, and chi-square tests were used to analyze this objective. These statistics assessed and differentiated the characteristics of smallholder farmers who participated in chilli production. To compare the means of continuous variables such as chilli yield at different levels of commercialization, T-tests were used. to compare means, such as chilli yield and income from chilli among the distinct levels of commercialization. The Chi-square tests were used to evaluate the level of association between categorical variables and the three commercialization levels.

3.7.2 Objective 2: To examine the factors that determine the level of commercialization of chilli production among smallholder farmers

Commercialization level among smallholder farmers indicates the extent to which farming is intended for the market in place of home consumption (Von Braun, 1995). In this study, commercialization is conceived as a spectrum showing the quantity of the total output that is sold. Therefore, chilli commercialization is the proportion of chilli sold to that produced by each farmer. The Household Crop Commercialization Index was used to calculate the level of commercialization of chilli production among smallholder farmers

$$[HCI]_i = \frac{(\text{Gross value of chilli sales HHi year j})}{(\text{Gross value of all chilli produced HHi year j})} \times 100 \quad \ldots\ldots (2)$$

Where $[HCI]_i$ is the household crop commercialization index of household i in year j.

Application of the Tobit Regression model

To examine the determinants of the level of commercialization of chilli production among smallholder farmers, the Tobit Regression model was used.

The Tobit model is mainly used in studies when the dependent variable is censored (Tobin, 1958). The model was suitable for analyzing data in which the dependent variable has lower and upper limits and provides consistent estimates of the parameter vector (Maddala, 1983; Mazengia, 2016;

Guye et al., 2025). Therefore, the logit model was selected for this study because of the nature of the dependent variable. The commercialization level ranges from 0 to 1 and the Tobit model is the most suitable econometric model for analysis.

According to Maddala (1983), the model can be expressed as follows;

$CCL^{*}_{i} = \beta' X_i + \varepsilon_i, \varepsilon_i \sim N(0, \sigma^2)$ …….. 3

Where; MCL^{*}_{i} denotes the unobserved (latent) variable, X is the independent variable vector, β' are the estimated parameters; and ε is an error term assumed to be independent and normally distributed with zero mean and constant variance σ and i = 1, 2….n (n is the number of observations).

Denoting Y_i as the censored variable;

$$Y_i = \begin{cases} 1 if y_i * \geq 1 \\ y_i * f 0 < y_i * < 1 \\ 0 if y_i * < 0 \end{cases} \quad \ldots\ldots\ldots\ldots 4$$

where, y_i* is the latent variable and Y_i is the observed dependent variable that is the commercialization index of chilli production of the farmer and unobserved for values that are greater than 1 but less than 0. The equation for this study is derived as follows:

$CCL_i = \beta_0 + \beta_1 age + \beta_2 gen + \beta_3 maritals + \beta_4 hhsize + \beta_5 educ + \beta_6 landsize + \beta_7 chilliyield + \beta_8 group + \beta_9 chilliprice + \beta_{10} finsvs + \beta_{11} offinc + \beta_{12} extsvs + \varepsilon_i$ ……5

Where CCL_i is the commercialization level for chilli of farmer i. The model uses maximum likelihood estimation and marginal effects to measure the factors determining the level of commercialization.

The likelihood function of this model is as follows;

$$L(\beta,\sigma) = \prod_{yi=0} = \Phi\left(\frac{Xi\beta}{\sigma}\right) \prod_{0<yi<1} \frac{1}{\sigma} \phi\left(\frac{yi - Xi\beta}{\sigma}\right) \prod_{yi=1} \left[1 - \Phi\left(\frac{1 - Xi\beta}{\sigma}\right)\right] \quad \ldots\ldots\ldots\ldots 6$$

Where yi = 0 (lower limit) and yi = 1 (upper limit) and are normal standard density functions.

Most commercialization studies use the two step Heckman's model involving participation then, level (intensity) of commercialization to analyze determinants of commercialization. However, this study used the Tobit model because chilli is only grown for commercial purposes in Uganda.

This model focuses on analyzing the determinants of the level of commercialization of chilli production.

Table 2: Description of the variables included in the empirical models

Variable Name	**Description**	**Variable Type**	**Variable measurement**	**Expected sign.**
Dependent Variables				
Level of commercialization	Level of commercialization of chilli production	Continuous	Household crop commercialization index	N/A
Explanatory/independent variables				
Age	Age of farmer	Continuous	Number of years	+/_
Gender	Gender of farmer	Dummy	1 if farmer is male and 0 otherwise	+/_
Marital	Marital status of the farmers	Categorical	1= Single, 2 = Married, 3 = Widowed, 4 = Divorced/ separated	
Household size	Number of people in a HH	Continuous	Number of people in a HH	+/_
Education level	Number of years of schooling/Education level of farmer	Continuous	Number of years spent in school	+/_
Land size	Total land size	Continuous	Acreage	+
Chilli yield	Yield of chili per HH	Continuous	Kilograms per acre	+

Membership to farmer group	Membership to chilli farmer group	Dummy	1 if chilli group member, 0 otherwise	+/_
Market price	Market price of chilli	Continuous	Shillings per kilogram	+
Access to financial services	Access to credit for chilli production	Dummy	1 if farmer had access to financial services for chilli production, 0 otherwise	+/_
Off-farm income sources	Farmer earning income from other sources	Dummy	1 if the household had other sources of income, 0 otherwise	+/_
Extension services	Access to extension services	Dummy	1 if household accessed extension services, 0 otherwise	+/_

3.7.3 Objective 3: To determine the effect of the level of commercialization of chilli production on the income of smallholder farmers

To determine the effect of the level of commercialization of chilli production on the income of smallholder farmers in Kamuli district, the Ordinary Least Squares (OLS) was utilized to capture the connection between commercialization and income. The outcome variable is the income of the smallholder farmer from chilli production, and the explanatory variable is the commercialization of chilli production for the farmer.

The income of the farmers was measured as;

$GM = TR - TVC$ …….. 7

Where GM is Gross Margin, TR is Total Revenue, and TVC is Total Variable Costs

It is anticipated that market and socio-economic factors will either positively or negatively affect household income.

$Y = \beta_0 + \beta_i X_i + \varepsilon_i$ …….8

Where Y is the gross margins, Xi is a trajectory of socio-economic and institutional variables that affect margins in including commercialization level, and ε_i is the error term likely to be independent and have a normal distribution with constant variance and zero mean.

Table 3: Description of the variables in the Ordinary Least Squares model

Variable	Description	Measurement	Expected sign
Dependent variable			
Y	Household income per capita for chilli producing households	Continuous	
Independent variables			
Commercialization category	Commercialization category (1= Low, 2= Medium, 3= High)	Categorical	±
Age	Age of the farmer (years)	Continuous	±
Gen	Gender of the farmer (1=male, 0=female)	Binary	±
Marital	Marital status (1 = Married, 0 = Not married)	Binary	±
Educ	Education level of the farmer (years in school)	Continuous	±
Hh size	Household size	Continuous	±
Land	Size of farm land (acres)	Continuous	±
Yield	Chilli yield (kgs)	Continuous	±
Org	Membership to a farmer group (1=yes, 0=no)	Binary	±
Price	Market price of chilli (Uganda shillings)	Continuous	±
Income	Off farm sources of income	Continuous	±
Finance	Access to financial services (1 = yes, 0 = no)	Binary	±

Ext	Access to extension services (1=yes, 0=no)	Binary	±

3.8 Verifying for normality and log variable transformations

The normality of continuous variables was visually inspected using histograms to ensure accurate and unbiased estimates. According to Gujarati (1995), applying a log transformation to numerical data can address issues of skewness and kurtosis. In this study, any variables that failed to meet the normality criteria were adjusted to follow a normal distribution.

3.9 Testing for multicollinearity

Multicollinearity arises when explanatory variables exhibit minimal variation or are highly correlated. The Variance Inflation Factor (VIF) is a metric used to measure multicollinearity (Kozak, 1997). If the VIF is more than 10, there is significant multicollinearity. Before carrying out the multinomial logistic regression, the VIF was calculated to ensure that multicollinearity did not exist among the variables.

3.10 Testing for heteroscedasticity

The Breusch-Pagan test was employed to examine heteroscedasticity among the explanatory factors. Heteroskedasticity is a situation where the errors of the variables are inconsistent at all levels of the explanatory variables. Where heteroscedasticity is detected, the study can employ robust standard errors using the Huber/White/sandwich variance estimators. This approach, as suggested by White (1980) and Vella (2014), corrects for potential heteroscedasticity, ensuring that regression errors remain homogeneous (Raza et al., 2023).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 RESULTS

4.1.1 Commercialization behaviour of smallholder chilli farmers

Tables 4 and 5 present the results of commercialization behaviour of chilli farmers. The descriptive results of the continuous and categorical variables are presented in Tables 4 and 5, respectively.

Results in Table 4 show that the average age of the farmers was 40 years, with a standard deviation of 11.896 years. The youngest farmer was 19 years old and the eldest was 65 years old.

On average, the farmers had spent 7.7 years, with the least educated farmer having zero years and the most educated having 20 years in school.

On average, the household size was 7.1 members, ranging from 1 to 22 members. The standard deviation of the household size was 3.79 members.

The average farming experience of chilli in Kamuli was just 2.2 years, with a standard deviation of 1.625 years. The farming experienced ranged from months to 11 years.

Overall, the mean quantity of chilli harvested and sold was 1,167.1 kgs and 787.1 kgs, respectively. The least quantity of chilli harvested was 74 kgs, while the highest quantity harvested was 14,400 kgs.

The findings indicate that the average yield of chilli was 1,695 kgs per acre, with a standard deviation of 934.35 kgs per acre. The farmer with the lowest yield had 148 kgs per acre and the highest yield was 7,680 kgs per acre. There were wide disparities in the yield obtained by various chilli farmers.

Generally, the farmers owned a total land size of 2.8 acres and allocated 28.87% of their land to chilli production. This suggests that most farmers grow chilli on small land holdings.

Table 4: Continuous variables of smallholder chilli farmers in Kamuli District.

	Min	Max	Mean	Std. Dev.
Age	19	65	40.027	11.896
Years in school	0	20	7.741	3.806
Household size	1	22	7.064	3.79
Years in chilli production	0	11	2.209	1.625

Quantity of chilli harvested	74	14400	1167.045	1493.881
Quantity of chilli sold	0	8000	787.109	883.747
Chilli yield	148	7680	1695.033	934.354
Land size owned	0	32	2.778	3.481
Land size under chilli production	.25	4	0.639	.429
Land size under chilli production over total land (%)	1.538	100	28.865	23.694

Table 5 provides insights into the commercialization behaviour of smallholder chilli farmers in Kamuli district. About 61.36% of the sampled farmers were male, while 38.64% were female. In terms of marital status,70.91% were married, while the remaining 29.09 were not married. Regarding farmer group membership, 69.55% of the farmers belonged to farmer groups, while the rest did not. The results show that 89.09% of the farmers had access to extension services, while only 10.91 lacked access. The farmers who had participated in off-farm income activities were 45.91%, while most of the farmers (54.09%) only participated farming activities.

Table 5: Descriptive characteristics of categorical variables for smallholder chilli farmers in Kamuli District.

Variable	**Description**	**Frequency**	**Percentage**
Gender	Male	135	61.36
Marital status	Married	156	70.91
Farmer group	Yes	153	69.55
Access to financial services	Yes	185	84.09
Access to extension services	Yes	196	89.09
Off-farm income activities	Yes	101	45.91

4.1.3 Testing for normality and multicollinearity

The continuous variables were tested for normality and the results are presented in Table 4 of the appendix. Land under chilli production was highly skewed because a few farmers grew chilli on larger pieces of land. This variable was adjusted by applying the log transformation to it to reduce the skewness and normalize the distribution before including it into the regression analysis.

Variance Inflation Factor (VIF) was used to determine the existence of multicollinearity among variables. Multicollinearity is the existence of high associations among explanatory variables in a regression model. The results presented in Table 5 of the Appendix exhibited that the values of the VIF ranged from 1.07 to 1.89 and had an average of 1.35. Therefore, conclusions were made that there was no collinearity among the independent variables because the VIF values were all below 5 (Shrestha, 2020; Ozgur & Dexter, 2021; Kyriazos & Poga, 2023).

4.1.4 The level of chilli commercialization

The level of commercialization of chilli production was expressed as the Household Crop Commercialization index, ranging from 0 to 1. In Figure 2, the average commercialization level of the sampled farmers was 0.6889. This implies that the farmers sold 68.89% of the harvested chilli. These results support the classification of chilli as a cash crop in Uganda since it is primarily grown for sale purposes (Acaye & Odongo, 2018).

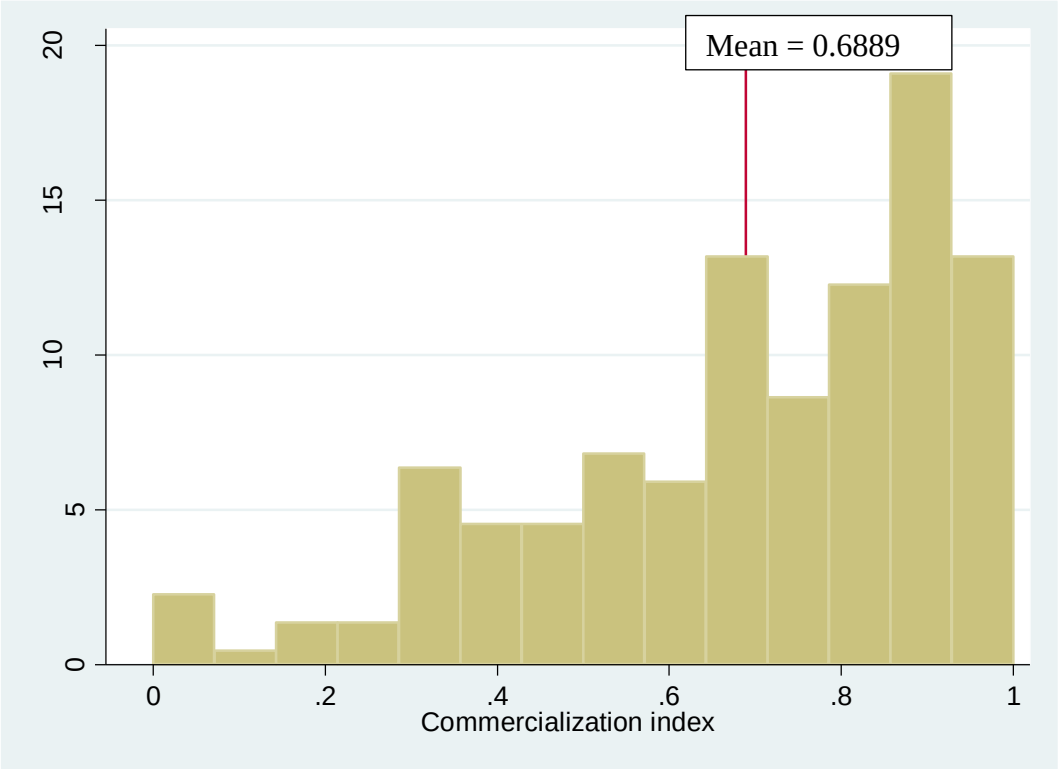


Figure 2: Frequency distribution of the commercialization level of chilli farmers

4.1.5 Use of unsold chilli

The results in table 6 show the various ways the farmers utilize the unsold chilli. Out of the 211 farmers who did not fully sell their chilli, 0.47% used the unsold chilli for home consumption, 21.80% gifted it to neighbours, 59.24% preserved it as seed, 7.11% discarded it, and 11.37% used it as a pesticide for other crops

Table 6: Use of unsold chilli

Uses of unsold chilli	Frequency.	Percentage
Home consumption	1	0.47
Gift to neighbours	46	21.80
Seed preservation	125	59.24
Discarding	15	7.11
Use as pesticides	24	11.37
Total	211	100.00

4.1.6 Determinants of the level of commercialization of chilli production

The significant factors determining the level of commercialization of chilli production were access to extension services, followed by access to financial services, membership to a farmer group, and the gender of the farmer. Access to financial services has a positive and significant effect on the level of commercialization. The marginal effect of 0.136 indicates that an increase in access to financial services from 0 to 1 increases the commercialization level of chilli by 13.6%. Access to financial services was found to be a positive and significant determinant of the level of commercialization. The marginal effect of 0.108 shows that an increase in access to financial services from 0 to 1 increases the level of chilli commercialization by 10.8%. Another positive and significant determinant of chilli commercialization level was membership to farmer group, with marginal effects of 0.084. This signifies that an increase in membership to farmer group from 0 to 1 increases the level of commercialization by 8.4%. The gender of the farmer was also a positive and significant determinant of the level of commercialization.

Table 7: Marginal effects of the Tobit model estimates for the determinants of the level of commercialization of chilli production among smallholder farmers in Kamuli district.

Variable	Chilli commercialization level			
	Marginal effects	Std. Error	z	P>z
Age	-0.001	0.002	-0.440	0.659
Gender	0.078	0.034	2.300	0.022**
Marital status	0.034	0.027	1.260	0.207
Household size	0.006	0.005	1.290	0.199
Years in school	0.004	0.005	0.920	0.356
Log of land size	-0.005	0.039	-0.140	0.888
Chilli yield	-0.000	0.000	-0.410	0.682
Membership to farmer group	0.084	0.036	2.370	0.018**
Unit price of chilli sold	-0.000	0.000	-0.300	0.765
Access to financial services	0.108	0.044	2.440	0.015**
Access to extension services	0.136	0.052	2.600	0.009***
Off farm income activities	-0.022	0.035	-0.620	0.538

Note: ***, **, and * represent significance at 1%, 5%, and 10% respectively.

Number of observations = 220

Chi-square = 34.957

Prob > chi2 = 0.000

Pseudo R2 = 1.147

4.1.7 Effect of the level of commercialization of chilli production on income of smallholder farmers

Table 7 presents the gross margins of chilli farmers in Kamuli district. Results indicate that the total cost of production by the chilli farmers was UGX 62,958,505 and their total revenue UGX 187,700,000. The average cost of production per farmer was UGX 286,175, while the average revenue from chilli sales was UGX 853,152 per farmer. The mean gross margin obtained by the chilli farmers was UGX 566,977.25. The standard deviation was UGX 823,078.76, showing a significant variation in the income obtained by the smallholder farmers participating in chilli production. The minimum income for all the farmers was UGX -871,000, while their maximum income was UGX 5,758,000. This shows that some farmers registered losses in chilli production. The average cost of production per acre for each farmer was UGX 449,658. The minimum cost of production per acre for all the farmers was UGX 79,000, and their maximum cost of production per acre was UGX 2,142,000.

Table 8: Gross margins for the chilli farmers

Variables	Total (UGX)	Average (UGX)	Std. Dev. (UGX)	Min (UGX)	Max (UGX)
Total cost of production	62,958,505	286,175	285,011	20,000	2,628,000
Total revenue from chilli	187,700,000	853,152	961,558	-	8,000,000
Gross margins	124,700,000	566,977	823,079	-871,000	5,758,000
Cost of production per acre	98,924,672	449,658	285,114	79,000	2,142,000

Effect of commercialization level on the income of smallholder farmers

The linear regression results for the effect of commercialization level on the income of farmers are presented in Table 8. The regression model has an R-squared of 0.736, signifying that the model

accounts for 73.6% of the variation in farmer income. The F-test is statistically significant ($F = 73.391$, $p < 0.001$), signifying that the overall model is strong and fits the data well.

Results of the study indicate that overall, the commercialization level of chilli production significantly affects the income level of the smallholder farmers. The commercialization index had a p value of 0.000, which was significant at the 1% level. A unit increase in the commercialization index of the farmer increases their income by UGX 896,600.66. Besides commercialization, the unit price of chilli, chilli yield, and the log of land size also have a positive and significant effect on the income of smallholder farmers at 1% level. A unit increase in the unit price of chilli increases the farmer's income by UGX 293.41. Additionally, a unit increase in the chilli yield also increases the income of the farmer by UGX 531.87. The results also show that a 1% increase in land size increases the income of the farmer by UGX 915.4, holding other factors constant.

Table 9: Regression analysis results for the effect of the level of commercialization of chilli production on the income of smallholder farmers

Income	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Commercialization index	896600.66	131685.48	6.81	0.000	637012.94	1156188.4	***
Age of the farmer	-1341.592	2979.917	-0.45	0.653	-7215.815	4532.631	
Years in school	-11458.638	8371.969	-1.37	0.173	-27962.056	5044.779	
Household size	-5100.606	8862.995	-0.58	0.566	-22571.967	12370.755	
Years in chilli production	-21980.272	20504.332	-1.07	0.285	-62399.861	18439.316	
Unit price of chilli	293.405	45.069	6.51	0.000	204.562	382.248	***
Chilli yield	531.87	34.176	15.56	0.000	464.499	599.24	***
Log of land size	915359.73	73026.378	12.53	0.000	771404.97	1059314.5	***
Constant	-544423.57	174551.74	-3.12	0.002	-888512.28	-200334.85	***

Mean dependent var	566977.250	SD dependent var	823078.758
R-squared	0.736	Number of obs	220
F-test	73.391	Prob > F	0.000
Akaike crit. (AIC)	6341.796	Bayesian crit. (BIC)	6372.339

*** *p<.01, ** p<.05, * p<.1*

4.2 DISCUSSIONS

4.2.1 Commercialization behaviour of smallholder chilli farmers in Kamuli District

The average age of the farmers was 40 years. This implies that the farmers are of productive age basing on the national statistics (UBOS, 2024). Farmers in this age group are most likely to grow high value horticultural crops like chilli. These findings align with Wakaba et al. (2022) who reported similar findings in the production of Irish potatoes.

Most of the chilli farmers attained primary education, while a few had tertiary education. A small number of the chilli farmers did not attain any formal education. Education enables farmers to perform improved farming and marketing activities (Gachuhi et al., 2021).

The household size of 7.1 members among chilli farmers is above the national average of 4.4 members in Uganda (UBOS, 2024). The chilli farmers had large families. This implies that large family sizes support commercialization by providing labour for chilli production and marketing activities (Thandeka et al., 2022).

The average farming experience suggests that farmers lacked sufficient experience in chilli production. Farmers with more experience are expected to implement improved agricultural practices and become more knowledgeable about markets. According to Nwafor & van der Westhuizen (2020), farming experience enhances production efficiency and boosts the confidence of farmers to invest in producing saleable crops.

The average quantity of chilli harvested indicates moderate levels of production among farmers. The study also shows wide disparities in the quantity of chilli produced by different farmers. These differences could be attributed to the size of the garden, agronomic practices, and use of inputs (Abate et al., 2022).

The quantity of chilli sold is less than the quantity harvested. This suggests that not all the chilli harvested by the farmers is sold. This could be due to poor post-harvest handling and limited market opportunities. In commercialization, sales are crucial rather than just production (Owusu & İşcan, 2021).

The average yield of chilli was significantly lower than the estimated yield of 4,000 kgs per acre. This could be attributed to the use of poor quality inputs and implementing bad farming practices (Deshmukh et al., 2023).

The farmers allocated a sizeable portion of their land to chilli production. There were wide differences in the size allocated by different farmers. Some farmers consider chilli production as a

priority, while others have competing uses for their land. This pattern is widespread in smallholder farming systems (Muoni et al., 2022).

The majority of the chilli farmers are male. This indicates that there is a higher chance for male farmers to participate in chilli commercialization. Male farmers have more access to production resources such as land than their female counterparts. Most of the decisions concerning production are made by the male household members (Taiy et al., 2017).

Most of the farmers are married. These results align with Jonathan & Idowu (2021) who found that most of the commercialized farmers were married. This is attributed to a large labour force provided by the family members.

A big number of the chill farmers belonged to a farmer group. Farmers who participated in farmer groups were more likely to participate in chilli commercialization (Gebre et al., 2021). This is attributed to the benefits associated with farmer groups such as knowledge sharing and collective marketing, which increases the bargaining power of the members.

A large proportion of the chilli farmers had access to financial services. Financial services provide funds for investing in farm inputs, which increases productivity and marketable surplus (Joshi & Piya, 2021). This enables the farmers to participate in the commercialization of chilli.

Most of the farmers in chilli production had access to extension services. Farmers with access to extension services were most likely to attain high levels of commercialization in chilli production. Extension services equip farmers with knowledge on proper agronomic practices, which increases productivity and increases the level of commercialization (Hlatshwayo et al., 2022; Nambafu et al., 2024)

The majority of the farmers did not participate in off-farm income activities. This implies that most of the chilli farmers depend on farming for their livelihoods. This could be attributed to limited employment opportunities, limited skills by the farmers. Farmers allocate most of their time and skills in production of various crops (Nkegbe et al., 2024).

4.2.2 Determinants of the level of commercialization of chilli production

The positive effect of access to extension services on the level of commercialization highlights the key role played by extension services in increasing the volume of chilli that is sold. Extension services enable farmers to improve their agronomic practices, access good quality inputs and have

proper market knowledge. These findings align with Endalew et al. (2020) and Woreda et al. (2024), who also found that access to extension services increases the level of commercialization among smallholder farmers. Expanding the reach and quality of extension services can increase chilli productivity and market participation.

Access to financial services was a positive and significant determinant of the level of commercialization. Access to financial services empowers farmers to invest in agricultural inputs like improved seed and fertilizers, thereby enhancing the quality of produce (Mmari & Kapaya, 2022). These align with the findings of Pierre et al. (2017) and Mamo & Beguije (2022), who found that access to financial services had a significant effect on the level of commercialization among smallholder bean farmers in the Southern Province of Rwanda. Policies should aim at strengthening rural financial services through Village Savings and Loans Associations (VSLAs), microfinance institutions, mobile banking, and savings and credit cooperatives (SACCOs).

Membership to farmer group was found to be a significant determinant of the level of commercialization of chilli production. This indicates that farmers who are members of farmer groups have improved access to markets and higher bargaining power in the market. It also enables farmers to collectively purchase inputs and share production knowledge. Membership to farmer groups is beneficial by providing farmers with production and marketing knowledge, as well as increasing their bargaining power. This boosts the level of commercialization among the smallholder farmers (Kehinde et al., 2021). These results align with those of Agwu et al. (2013), who found that farmers having membership in farmer groups were expected to attain a high level of commercialization. There is need to support the formation of farmer groups by reducing on the formal procedures for group registration.

The gender of the farmer emerged as a key determinant of the level of commercialization. Male farmers were more likely to attain higher levels of commercialization than their female counterparts. This could be associated with better access to production resources, including finances and land, and more time to participate in agricultural activities than female farmers. Gebre et al. (2021) and Deshmukh et al. (2023) also found that male farmers tended to attain a higher level of commercialization compared to female farmers. Policies that increase female farmers' access to production resources such as land and credit should be put in place.

4.2.3 Effect of commercialization level on the income of smallholder farmers

The positive and significant effect of commercialization on income suggests that commercialization level plays a key role in determining the income of the farmers. This implies that farmers who sell larger proportions of their chilli are more likely to obtain higher income levels. Operating at higher levels enables farmers to access improved markets, benefit from scale economies, and hence boost productivity (Opondo & Owuor, 2018; Rabbi et al., 2019). The findings of Ojong et al. (2022) and Kavuma & Kisaame (2023) also found that the commercialization level significantly affected farmer income. There is a need to support farmers to increase the quantity of produce they sell by connecting them to markets. This will increase their income levels.

The unit price of chilli has a significant and positive effect on the income, which suggests that farmers who receive a high price for chilli obtain higher income levels. Farmers who sold their chilli for higher prices made substantially more income than farmers who sold their chilli cheaply. Market efficiency and price negotiation are important in improving the profitability of smallholder farmers (Tetiana, 2023). This emphasizes the necessity for farmers to participate in organized markets and value addition programs to secure improved prices (Kyomugisha et al., 2018).

The yield of chilli was found to significantly affect income, suggesting that enhancing productivity improves farmer income. With higher yields, there is increased efficiency, which reduces the unit cost of production and increases profitability. These findings align with Vliet et al. (2021) and Rahman & Connor (2022), who highlighted that enhanced agricultural productivity is important in increasing the income of farmers. There is need to implement policies that increase productivity such as subsidizing high quality inputs.

The significant effect of log of the land size on income highlights the key role played by the size of the farm in determining a farmer's income. Farmers who allocate larger land sizes to chilli production are likely to produce more chilli and sell larger quantities. They also tend to enjoy economies of scale hence reduced costs of production and increased income (Muyanga & Jayne, 2021). These results were similar to those of Vliet et al. (2021), who found a positive and significant effect of land size on the income of cocoa farmers in Côte d'Ivoire and Ghana. This implies that allocating more land to chilli production is an effective way of increasing the income of the farmers in Kamuli.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the findings of the study, draws conclusions from the research, and provides actionable recommendations aimed at enhancing the level of commercialization of chilli production among smallholder farmers in Kamuli District.

5.1 Conclusions

i. Chilli production among smallholder farmers in Kamuli district is characteristically male dominated, mostly undertaken by married people and those having large households as it may require labour.

ii. Members who had access to extension and financial services, were members in farmer groups, and were male by gender attained higher levels of commercialization.

iii. The level of commercialization of chilli production had a positive and significant effect on the income of smallholder farmers. Income of the farmers increases with increase in the level of commercialization. Additionally, land size, chilli yield, and the unit price of chilli were positive and significant determinants of income.

5.2 Policy recommendations

i. The study recommends policies that support block farming. The consolidation of land will enable farmers to increase mechanization by using tractors and machinery in production. This will support the efficient use of land and labour.

ii. Farmers should be supported to access financial services through government programs like the Parish Development Model (PDM). The programs provide credit to farmers at low interest rates, which enables the farmers to invest in high quality inputs.

iii. Policies that strengthen the market participation of farmers should be implemented. These include programs that support the construction of agro-processing facilities to reduce post-harvest losses and linking chilli farmers to lucrative markets.

5.3 Limitations of the study

This study provides key insights even though it has some limitations. Firstly, the study used cross-sectional data was used which obtains data at one point in time and hence may not entirely justify

seasonal disparities and commercialization trends. The study focused on Kamuli district and these findings may not be generalized to geographical areas with differing climatic and socio-demographic characteristics. In addition, data collection depended on self-declared information from farmers, which may have errors due to bias and misreporting. Lastly, whereas the study examined determinants of commercialization level, other external variables like climate variations, policy changes, and international market trends were not widely examined

5.4 Areas for further research

Future studies ought to improve on the findings of this study by examining additional external factors determining the commercialization level of chilli farming. Longitudinal studies are suggested to evaluate the prolonged effects of commercialization on household welfare in general including income stability, asset acquisition, and food security. Comparative studies should be done across different regions and different crops within the same area to assist policymakers in developing comprehensive policies for improving commercialization in various agricultural structures.

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APPENDIX

Appendix I: Tables for normality and multicollinearity tests

Table 10: Table showing skewness and kurtosis test results

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
Age	220	40.027	11.896	19	65	19	64	.138	2.122
Years in school	220	7.741	3.806	0	20	0	18	.381	3.529
Household size	220	7.064	3.79	1	22	1	20	1.162	4.979
Years in chilli production	220	2.209	1.625	0	11	1	9	2.162	9.691
Land under chilli production	220	.639	.429	.25	4	.25	2	4.997	36.39
Commercialization index	220	.689	.238	0	1	.01	1	-.899	3.047
Chilli yield	220	1695.033	934.354	148	7680	160	4666.667	2.155	13.273
Margins	220	567000	823000	-871000	5758000	-409000	4370000	3.177	16.491

Table 11: Results of diagnosis of multicollinearity for variables in the multinomial regression model

Variable	Variance Inflation Factor (VIF)
Natural log of land size under chilli production	1.885
Source of market information - traders	1.718
Source of market information - neighbours	1.684
Total cost of pesticides	1.552
Total cost of seeds	1.532
Participation in off-farm income activities	1.308
Total cost of fertilizers	1.298

Number of years in school	1.289
Total cost of manure	1.27
Source of market information – Extensionists	1.238
Chilli marketing channel - traders	1.218
Access to credit facilities	1.217
Membership to farmer group	1.204
Household size	1.198
Gender	1.164
Chilli marketing channel - middlemen	1.087
Unit price of chilli	1.071
Mean VIF	**1.349**

Appendix II: Copy of Informed Consent Form for respondents.

My name is Namata Miriam, pursuing a Master of Science in Agribusiness Management and Entrepreneurship at Uganda Christian University, Mukono. I am conducting research on the study to assess the determinants of commercialization of chilli production among smallholder farmers in Kamuli district. The study findings will provide evidence to guide policy planning and implementation of interventions aimed at enhancing chilli commercialization among smallholder farmers. This research is crucial for understanding the factors influencing chilli commercialization, which can significantly boost farmers' income and livelihoods, thereby contributing to poverty eradication and rural development. By addressing specific constraints and offering evidence-based marketing strategies, the study aims to foster increased market participation and profitability, promoting socio-economic advancements in Kamuli and beyond.

I will present you with information encouraging you to participate in this research. You can discuss the findings with anybody you feel comfortable with before making a decision. There may be terms on this consent form that you might not comprehend. As we go over the material, feel free to ask me to stop at any moment, and I will provide a sufficient explanation. You are welcome to ask me or any other team member researcher questions at a later time.

Interview process: I will ask you to tell me your age, gender, farm size, other occupations, the quantity of chilli produced, the quantity of chilli sold, income from chilli sales and other questions. You can indicate if you do not wish to respond to any of the questions asked, and the interviewer will go on to the next question.

Risks of study participation: I do not foresee any risks for you to participate in this study because the highest degree of confidentiality will be upheld throughout the research process.

Benefits of study participation: There will not be direct benefits to the interviewees for their participation in this study. However, the results will contribute to a broader understanding of chilli commercialization factors. This will help in the development of better informed policies and interventions. This can potentially benefit the wider farming community by enhancing support, resources, and socio-economic advancements in the region.

Study costs: There are no costs associated with taking part in this study other than the 25 minutes you will need spend respond to the questions.

Confidentiality: Confidentiality concerns will be addressed by ensuring that all collected data is securely stored and only accessible to authorized research personnel, with no identifying information being shared in reports or publications.

Voluntary Participation: Participating in this research is entirely voluntary. The decision to take part in this study will not have any effect on your relationships with the community now or in the future. If you choose to take part, you are free to stop at any moment, with no repercussions and no impact on those relationships. For any inquiries or worries regarding this research, kindly reach out to Namata Miriam, the lead investigator, at 0702 742131.

Potential respondent's record of consent: I was presented with the material mentioned above and given the chance to ask any questions I had about the study. I received satisfactory answers. I provide my free consent to take part in the research. Signature……..…..Date……/……./2024

Or Thumb print Date……/……./2024

Statement by the Research Assistant:

I have done my best to ensure that the participant is aware of the goal and fundamentals of the interview by accurately reading the data sheet to them and making sure they understand it. I certify

that the participant had a chance to ask questions concerning the study, and that I did my best to accurately and completely respond to all of their inquiries. I confirm that the subject provided free and informed consent that was not forced upon them and that they are free to withdraw their consent at any point before or during the study. Signature……Date……/……./2024

Appendix III: Questionnaire for assessing the determinants of commercialization of chilli production among smallholder farmers in Kamuli District

IDENTIFICATION PARTICULARS.

i) Date of interview (DD/MM/Year) …….

ii) Name of the interviewer ……

iii) Questionnaire number …….

iv) Subcounty…….

v) Village ……

A. SOCIO-DEMOGRAPHIC AND PRELIMINARY INFORMATION

1. Age: …… / Date of birth: DD…… MM…..... YY……
2. Are you the household head? 1.☐ Yes 0. ☐ No
3. Gender of household head 1. ☐ Male 0. ☐ Female
4. Number of years spent in school by the household head: ……
5. Marital status.

   ☐ Single ☐ Married ☐ Widowed ☐ Divorced/ separated.
6. Other occupations of the household head: 1. Casual laborer ☐ 2. Salaried employee 3.☐ Other farming activities ☐. Trader public ☐ 5. Others 6. None ☐
7. What is the number of household members? ……
8. What is the total land size owned? ……..
9. What is the number and the value of livestock owned in the last year?

No.	Livestock species	No. owned in past one year	Value (Uganda shillings)
1.	Cattle		
2.	Goats		
3.	Sheep		
4.	Pigs		
5.	Rabbits		
6.	Poultry		
7.	Others		

Do you belong to any farmer group/ organization?

1. Yes ☐ 0. No ☐

10. If yes, for how long? (years)……

11. What benefits do you enjoy from the group?

1) Friendship ☐
2) Knowledge ☐
3) Loan ☐
4) Training ☐
5) Marketing ☐
6) Others (specify)……

12. How did you get capital for chilli production?

1. Personal savings ☐
2. Loans ☐
3. Others (specify) ……

13. Do you have access to credit facilities?

1. Yes ☐ 0. No ☐

14. If yes (13), from where?

1. Financial institutions e.g., banks, microfinance ☐
2. Money lenders ☐
3. Friends and family ☐
4. Farmer groups/ organizations ☐

5. Others (specify) …….

15. Have you ever borrowed money to use for chilli production in the last 6 months?

1.Yes ☐ 0. No ☐

16. If yes (13), state the amount borrowed? ……and how much allocated for farming? ……

17. Have you paid off your loan in whole or in part?

1. Yes, paid all ☐
2. Yes, paid out partially ☐
3. No, not paid at all ☐

18. Did you save money in the last 6 months?

1. Yes ☐ 0. No ☐

19. If yes (15), how much did you save in the last 6 months?.....

20. Did you receive any extension services in the past 6 months?

1. Yes ☐ 0. No ☐

21. If yes, who was the provider of the extension services?

1. Government ☐
2. Non-Governmental Organizations (NGOs) ☐
3. Other farmers ☐
4. Others (specify)…….

22. What was the extension service provided about?

1. Crop production ☐
2. Livestock production ☐
3. Marketing ☐
4. Others (Specify) …….

23. What was the number of times visited by the extension provider in the past 6 months?

……..

24. What was the level of satisfaction of the extension service visit?

1. Very satisfied ☐
2. Satisfied ☐
3. Not sure ☐

4. Unsatisfied ☐
5. Very Unsatisfied ☐

25. How do you typically obtain market information when it comes to output prices?

1. Radio ☐
2.Television ☐
3. Mobile telephone ☐
4. Neighbours ☐
5. Extension agents ☐
6. Traders ☐
7.Others (specify)…….

B. PRODUCTION CHARACTERISTICS

25. Which variety of chilli do you produce? ……..

1. bird's eye 2. scotch bonnet 3. hot pepper 4. long cayenne

26. How long have you been growing chilli? .....

27. What are the factors limiting chilli production?

Constraint	Do you face the following constraints	Rank from most important
High initial cost of production		
Inadequate land		
Limited access to credit		
Pests and diseases		
High input prices		
Inadequate extension services		
Inadequate market		
Unfavorable weather conditions		

28. What is the size of land under chilli production in acres?

Total Acres of land	Amount occupied by Chilli	Cost of land hire (if applicable)

29. What crops do you grow on your farm other than chilli?

Crop	Land size (Acres)	Output	Unit price	Amount
Sugarcane				
Maize				
Beans				
Bananas				
Sweet potatoes				
Cassava				
Soybean				
Groundnuts				
Others (specify)				

INPUT USE

30. Did you use any inputs for chilli production the previous season?

1. Yes ☐ 0. No ☐

31. If yes (27), specify the cost and quantity of inputs used in chilli production for a season?

Input type	Unit of measure	Quantity	Unit cost	Total cost
Seed				
Manure				
Fertilizer				
Pesticides				
Fungicides				

Herbicides				
Others (specify)				

32. Please specify any other additional costs of inputs purchased used in chilli production.

Input type	Mode of delivery to the farm	Price of transportation
Seed		
Manure		
Fertilizer		
Pesticides		
Fungicides		
Herbicides		
Others (specify)		

33. What is the amount of money spent on labour for the different activities?

Activity	Labour type	Number of workers	Days worked	Price per workday	Total cost
First tillage	Family				
	Hired				
Second tillage	Family				
	Hired				
Planting	Family				
	Hired				
Weeding	Family				
	Hired				
Pesticide application	Family				
	Hired				
Fungicide application	Family				
	Hired				

Application of herbicides	Family				
	Hired				
Harvesting	Family				
	Hired				
Storage and post-harvest activities	Family				
	Hired				
Others (specify)	Family				
	Hired				

CHILLI OUTPUT AND MARKETING

34. What is the amount of chilli produced and sold in the past season?

Unit of measure	Quantity harvested	Quantity sold	Unit price	Total revenue	Quantity unsold

35. How do you dispose off the chilli that is not sold?
    1. Home consumption ☐
    2. Gift to neighbours ☐
    3. Seed preservation ☐
    4. Discard ☐
    5. Others (specify) ……..

36. Who do you sell your chilli to
    1. Non market participation ☐
    2. Middlemen ☐
    3. Consumers ☐
    4. Market traders ☐
    5. Cooperatives ☐
    6. Others (specify) ……

37. What is the quantity of other crops grown and harvested in the past season?

Crop	Unit of measure	Quantity harvested	Quantity sold	Unit price	Total revenue
Sugarcane					
Maize					
Beans					
Bananas					
Sweet potatoes					
Cassava					
Soybean					
Groundnuts					
Others (specify)					

38. Do you participate in off farm income generating activities?

1. Yes ☐ 0. No ☐

39. If yes, how much income was earned from these activities?

No.	Activity	Total income earned in the past 6 months
1.		
2.		
3.		
4.		

40. Suggest ways on how you can increase the amount of chilli produced

……

……

……

……

……

41. Suggest ways on how you can increase the amount of chilli sold

……

……

……

……

……

Thank you for your information.

Appendix IV: Workplan for the proposed research

	2024												2025	
Activity	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Development of the research proposal and proposal defense														
Research ethics committee approval														
Procurement of research materials and supplies														
Recruiting and training research assistants														
Collecting data and quality checks														
Data entry, analysis, writing, and submission of draft thesis														
Write the final copy of the thesis, submit, defend and disseminate the findings														

Appendix V: Proposed budget for the research

Category	**No. of people**	**Rate per day**	**No. of days**	**Amount (UGX)**
Research Assistants (RAs)	4	50,000	5	1,000,000
Transport for RAS	4	15,000	5	300,000
Data collection questionnaires				500,000
Air time	4	15,000	5	300,000
Compensation for participants	220	3,000	1	660,000
Final report and dissemination of results				700,000
Total				**3,460,000**