

**COMMERCIALIZATION AND HOUSEHOLD WELFARE AMONG  
SMALLHOLDER GOAT FARMERS IN KWENENG EAST SUB-DISTRICT,  
BOTSWANA**

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**A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements  
for the Master of Science Degree in Agricultural and Applied Economics of Egerton  
University**


**EGERTON UNIVERSITY**

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## DECLARATION AND RECOMMENDATION

### Declaration

This thesis is my original work and has not been presented in any university and institution of higher learning for any award.

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## **DEDICATION**

This thesis is dedicated to my family and friends, especially my lovely father Kedibonye Ngwako and my mother Phalalo Ngwako, for their love, support and prayers.

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## **ABSTRACT**

Agriculture plays a major role in Botswana's economy and for the majority of the 2.3 million Batswana. Majority of Batswana are either directly or indirectly engaged in agriculture and derive their livelihood therein. Most smallholder farmers in Botswana rely on small stock specifically goats, for much of their livelihood. However, the level of commercialization is still very low and much of the production is majorly under traditional and subsistence systems, with a few who are commercialized. Subsistence farming system may not be a viable option to ensure food security and household welfare hence inadequate to support farmers' livelihood. Goat commercialization may enhance local production and possibly enable the country to export goat meat in addition to beef exports. This study aimed at analyzing commercialization and its effects on smallholder farmers' welfare as well as factors influencing the choice of marketing outlets. A multistage sampling technique was used to select 266 goat farmers who were interviewed using a semi-structured questionnaire. Fractional Response, Multivariate Probit and Endogenous Switching Regression models were used to achieve the set objectives. The results show that the level of commercialization was driven by contract arrangements and type of breed, among others. Results further show that most farmers (93%) preferred to sell their goats to individual consumers, with the least preferred being butcheries at 12%. The choice of marketing outlet was significantly influenced by farming experience, years of schooling, access to credit, distance to market, type of breed and access to a reliable market. Finally, the results of the Average Treatment Effects show a positive effect of commercialization on household income for both commercialized and non-commercialized farmers. The results underscore the importance of collective action and a reliable small stock market in enhancing commercialization. The development of a centralized market such as Botswana Meat Commission for small stock, especially in catchment areas with large number of goats could provide an assured market. Further, creating awareness and promoting contract farming and other relevant market coordination mechanisms for improved market access would be an added advantage.

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## **LIST OF ABBREVIATIONS AND ACRONYMS**

<b>ASSP</b>	Agriculture Services Support Project
<b>ATE</b>	Average Treatment Effects
<b>ATT</b>	Average Treatment Effect on the Treated
<b>ATU</b>	Average Treatment Effect on the Untreated
<b>BMC</b>	Botswana Meat Commission
<b>BWP</b>	Botswana Pula
<b>CEDA</b>	Citizen Entrepreneurial Development Agency
<b>DVS</b>	Department of Veterinary Services
<b>ESR</b>	Endogenous Switching Regression
<b>FAP</b>	Financial Assistance Policy
<b>FIML</b>	Full Information Maximum Likelihood
<b>FRM</b>	Fractional Response Model
<b>GDP</b>	Gross Domestic Product
<b>GoB</b>	Government of Botswana
<b>HCI</b>	Household Commercialization Index
<b>LEF</b>	Linear Exponential Family
<b>LIMID</b>	Livestock Management and Infrastructure Development
<b>MADFS</b>	Ministry of Agricultural Development and Food Security (formerly MoA)
<b>MNL</b>	Multinomial Logit
<b>MOA</b>	Ministry of Agriculture (Currently MADFS)
<b>MVP</b>	Multivariate Probit
<b>MYSC</b>	Ministry of Youth Sports and Culture (Currently known as Ministry of Youth Empowerment, Sports and Culture Development)
<b>OLS</b>	Ordinary Least Squares
<b>PSM</b>	Propensity Score Matching
<b>QML</b>	Quasi Maximum Likelihood
<b>SDGs</b>	Sustainable Development Goals
<b>SPSS</b>	Statistical Package for Social Sciences
<b>TLU</b>	Tropical Livestock Unit
<b>VIF</b>	Variance Inflation Factor
<b>YDF</b>	Youth Development Fund

## **CHAPTER ONE**

### **INTRODUCTION**

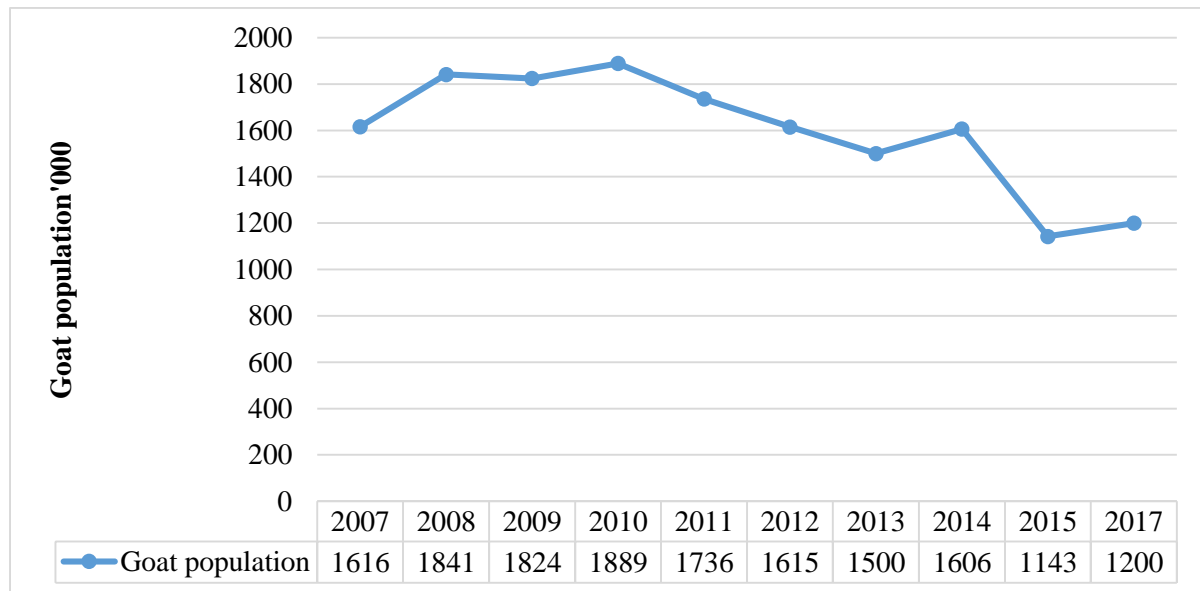
#### **1.1 Background of the Study**

Agriculture plays a major role in Botswana's economy and for the majority of the 2.3 million Batswana (Statistics Botswana, 2011). Majority of Batswana are either directly or indirectly engaged in agriculture and derive their livelihood therein. However, according to Botswana Investment and Business Guide (BIBG, 2016), the general agricultural sector's contribution to Gross Domestic Product (GDP) has experienced a steady decline from 40% at independence in 1966 to about 2.1% in 2017. The agricultural sector in Botswana consists of both livestock and crop production. The potential for crop production is mostly limited due to the Kalahari Desert effect and persistent droughts since most farmers are dependent on rain-fed agriculture (Masole, 2019). The climatic factors such as rainfall and its distribution, temperatures, and humidity, are some of the factors taken into consideration by farmers, while venturing in any agricultural enterprises. The climatic and socio-economic environment in Botswana makes communities vulnerable to food insecurity and unstable livelihoods, especially in rural areas (Ntseane, 2007). However, livestock particularly goats, performs better in drier areas due to their adaptability traits (Bahta *et al.*, 2013).

Livestock production forms the largest component of Botswana's agricultural sector since it contributes about 80% to the agricultural GDP, with cattle taking the lead. The country has opportunities for supplying beef to the European Union (EU) market, South Africa, China, and the Middle East countries (BIBG, 2016), among others. Among livestock, goat farming is considered to be a major livelihood activity with about 82,176 goat farmers (Statistics Botswana, 2014) and is the second largest after cattle in importance. Over 80% of small stock, (of which 70% are goats), are kept by smallholder farmers where they play a crucial role. Goats and other small stock are normally raised for milk, meat, quick income, insurance and social activities mainly at subsistence level (Aganga & Aganga, 2015; Baleseng *et al.*, 2016; Monau *et al.*, 2017). Rearing of goats can be handled by both women and children for household consumption in rural areas (Dipheko *et al.*, 2016).

It is noteworthy that goat production in Botswana has been declining overtime. The agricultural census report indicates that the 2015 (latest) agricultural season registered a decrease in goat population compared to the 2004 census year. The results show that goats' population dropped from 1.6 million to 1.2 million, while the birth rate dropped slightly from 48% to 43% in 2015

(Statistics Botswana, 2015). Figure 1 below shows the trend of goat population in Botswana between 2007 and 2017. As shown in the figure, there has been a general decline in goats' population between 2007 and 2017. The declining trend over the 10 years was as a result of increased death rates (Statistics Botswana, 2017).



**Figure 1: Goat population Trend, 2007-2017**

**Source: Statistics Botswana, 2017**

The decline in goat production has elicited a lot of concern and action, and several programs to support and improve goat production and other livestock were implemented by the Government of Botswana (GoB) (Monau *et al.*, 2017). Some of the key interventions implemented include the Livestock Management and Infrastructure Development (LIMID) program, Youth Development Fund (YDF) and Agriculture Services Support Project (ASSP)(Bahta *et al.*, 2018). These programs sought to enhance productivity in order to improve food security and the livelihoods of Botswana at large. The programs also aimed at encouraging new and diverse livelihood options and generating financial capital to eradicate poverty. The LIMID program which specifically focused on small stock (sheep and goats), started in 2006 with a view to promoting food security and reducing poverty through improved productivity and livestock management (Binge *et al.*, 2019; MoA, 2018). The GoB also invested in eradicating abject poverty through launching numerous poverty eradication programs such as *Nyeletso lehuma*.

Despite various efforts to support goat farming through different programs and free extension services, a shift towards a commercialized system is yet to be fully achieved. Most smallholder goat farmers engage in a traditional subsistence production system mainly for household consumption. Transforming goat farming from subsistence to commercial farming is one of the avenues to improve welfare through increased incomes, reduction of food insecurity and persistent rural poverty, and diversification of the rural economy (Nsoso *et al.*, 2004). In a National Agricultural Innovation System Assessment Report (2013), policy focus on research that addresses value chain approaches and robust public and private investment in the commercialization of small stock industry were some of the strategies that were recommended to accelerate agricultural innovation in Botswana. According to Mathenge *et al.* (2010), smallholder commercialization is vital for rural development and poverty reduction. This shows that the ultimate goal of commercialization is the alleviation of poverty and economic development through growth of incomes. In many developing countries such as Ethiopia, commercialization has remained key to policy makers in their effort to increase smallholder incomes and reduce poverty (Tufa *et al.*, 2014).

Markets are a critical part of commercialization as they define the channel through which farmers sell their surplus. For goats, there are different market outlets through which farmers sell their output. The most common outlets include other individual farmers, butcheries, individual consumers and various government programs, where most sales are done based on visual quality and estimated weight (Nsoso *et al.*, 2004). However, farmers can sell through more than one outlet based on different factors such as contracts and distance to markets. Pacillo (2016) noted that farmer's commercialization through market participation is believed to be effective in enhancing agricultural development and reducing poverty.

Besides, Babu *et al.* (2014) emphasized that commercialization, which is sometimes loosely referred to as market participation, has potential to raise income and consequently improve household welfare, food security and nutritional status. Thus, an increase in goat production may enhance commercialization since meat production and other by-products such as dairy and leather have the potential to grow substantially. The transformation needed is the market-led where farmers produce for the market. In improving productivity and market access, goat production and marketing is considered to be vital. Other value chain opportunities for enhancing efficiency in goat production would be selling other products such as milk and skins.

This study therefore, aimed at determining factors influencing commercialization among smallholder goat farmers. Since commercialization is not an end itself, this study was also geared towards exploring the different market outlets choices, as well as their determinants. Similarly, this study intended to determine how commercialization impacts smallholder farmers' incomes through evaluating the link between commercialization and household welfare in relation to goat farming.

## **1.2 Statement of the Problem**

Most smallholder farmers in Botswana rely on small stock specifically goats, for much of their livelihood. Despite the various government support programs for the improvement and transformation of goat farming in Botswana, the level of commercialization is still very low and much of the production is majorly under traditional and subsistence systems, with a few who are commercialized. Subsistence farming system may not be a viable option to ensure food security and household welfare hence inadequate to support farmers' livelihood. Consequently, commercial goat farming has not gained much response and investment from farmers. Shifting towards a more market-oriented farming system would be beneficial for income generation and sustainable livelihoods. Indeed, studies have shown that commercialization is one of the ways to improve welfare through increased incomes and reduction of persistent poverty. There is however little evidence of the link between commercialization and household welfare, specifically in Botswana. This study is therefore geared towards identifying the main factors influencing commercialization of goat farming and how this would, in turn, affect household welfare. Further, given the importance of markets in commercialization, this study also aimed at evaluating factors influencing the choice of marketing outlets among goat farmers and any challenges thereof.

## **1.3 Objectives of the Study**

### **1.3.1 General Objective**

To contribute towards smallholder goat farmers' household welfare through enhanced commercialization and better choice of marketing outlets in Kweneng East sub-district of Botswana.

### **1.3.2 Specific Objectives**

- i. To determine factors influencing commercialization among smallholder goat farmers in Kweneng East sub-district of Botswana.



- ii. To determine factors influencing the choice of marketing outlets among smallholder goat farmers in Kweneng East sub-district of Botswana.
- iii. To assess the effects of goat commercialization on household welfare among smallholder farmers in Kweneng East sub-district of Botswana.

#### **1.4 Research Questions**

- i. What factors influence goat commercialization in Kweneng East sub-district of Botswana?
- ii. What factors influence the choice of marketing outlets among smallholder goat farmers in Kweneng East sub-district of Botswana?
- iii. What is the effect of goat commercialization on household welfare among smallholder farmers in Kweneng East sub-district of Botswana?

#### **1.5 Justification of the Study**

Goat production has the potential to enhance diversification of the agricultural sector and the economy of Botswana at large (Bahta *et al.*, 2013). Increasing goat production may improve food security and rural unemployment in Botswana. Therefore, with the unexploited potential from commercialization and marketing, investigating the drivers of commercialization and its effects on household welfare would be important in identifying policies and programs for increased market orientation. Better policy measures may be key in contributing to improved production and development of marketing outlets for goat farmers. Also, goat commercialization may enhance local production and possibly enable the country to export goat meat in addition to beef exports. Commercialization of goat farming could allow farmers to gain maximum benefits which may improve their livelihoods, hence it needs to be considered (Bahta & Baker, 2015). Increased goat production may also contribute to the achievement of one of Botswana's vision 2036 pillars of sustainable economic development. This is in line with the Sustainable Development Goals (SDGs), to end hunger, achieve food security and improved nutrition and promote sustainable agriculture, which is a guide to most developing countries' economies. Therefore, the findings of this study would constitute an important source of information for policy and programs to promote market-oriented production of goats in Botswana.

## **1.6 Scope and Limitations of the Study**

This study focused on commercialization among smallholder goat farmers in Kweneng East sub-district. Due to poor record-keeping, farmers were expected to recall some of the required information, especially on income, expenditures and input prices. However, estimations of the quantities and prices with confirmation from relevant stakeholders were made. The period allocated for data collection was also short and hence enumerators were employed to cover the total sample size within a period of four weeks.

## **1.7 Operational Definition of Terms**

**Batswana-** citizens of Botswana.

**Commercialization-** involves a transition from subsistence farming to a market-driven production, i.e., the ability of a farmer to sell their outputs in the market.

**Cross sectional data-** data collected across different units at a particular point in time.

**Farming system-** is an arrangement on which livestock is kept and a household manages to sustain their livestock (extensive, semi-intensive or intensive).

**Household-** comprise of a group of people living together under the same roof usually answerable to a household head.

**Marketing outlets-** refer to arrangements or channels through which farmers sell their farm products.

**Marketing-** refers to activities undertaken by a farm to promote the buying or selling of its products.

**Pula (BWP)-** Botswana Currency.

**Smallholder-** goat farmer who owns a maximum of 150 goats.

**Welfare-** A social effort designed to promote the basic physical and material well-being of people in need of reasonably comfortable, healthy and secure living.

## CHAPTER TWO

### LITERATURE REVIEW

This chapter reviews the literature on commercialization, marketing outlets and farmers' welfare. The chapter also outlines the theoretical and conceptual framework for the study.

#### **2.1 Overview of Goat Production in Botswana**

The country has approximately 1.2 million goats (Statistics Botswana, 2017) that contribute significantly to the livelihoods of rural farmers under communal production systems. Communal production systems in Botswana are characterized by low input and productivity levels, lack of infrastructure and lack of properly defined breeding strategies. Evaluation of goat production systems through identification and prioritization of constraints is a prerequisite for planning and improving production (Monau *et al.*, 2017). Goats are suitable for hot, dry environments, sometimes with cold winter nights (Nsoso *et al.*, 2004). The majority of goats in Botswana keep the indigenous Tswana breed, characterized as multi-coloured, medium-sized goats with long lopping ears, short coarse hair and are often bearded and horned (Nsoso *et al.*, 2004).

The local (Tswana) breed is reported to have adapted to the semi-arid climatic conditions in Botswana, and is tolerant to parasites and diseases and hence performs better than exotic or mixed breeds. Goat production predominantly occurs in traditional systems (Baleseng *et al.*, 2016; Statistics Botswana, 2017). The most common type of production system employed is the communal grazing system where goats browse on tree forages in the communal rangelands. According to Aganga and Mosimanyana (2011), about 98% of farmers practice extensive farming whereas 59% feed crop residues to their animals when available. Farmers supplement feeds for their livestock especially during irregular fodder production triggered by bad weather conditions. Baleseng *et al.* (2016) found that farmers invest relatively less in supplementary feeding for their livestock mainly due to high feed costs as well as poor fodder production arising from unfavorable weather conditions. However, despite the large communal and subsistence nature, there are still several commercial farmers who invest in supplementary feeding to maintain the livestock. Lack of investment in supplement feeding probably hinders the productivity of the livestock sub-sector. Controlled breeding is generally not practiced in Botswana. Mixed crop-livestock farming system is also a common activity as farmers depend on rain-fed arable agriculture.

## 2.2 The Concept of Commercialization and its Determinants

The concept of agricultural commercialization has been expressed differently by various authors. Some studies regard it as increased production or productivity from subsistence level resulting in sales of marketable surplus (Bekele & Alemu, 2015), whereas other studies put more emphasis on access to markets and modern technology adoption in production as well as vertical integration. According to Bekele and Alemu (2015), goat commercialization is a complex and dynamic process involving different dimensions and degrees. The process involves a transition from low to a high degree of commercialization along different dimensions. The commercialization scale ranges from traditional or subsistence farming to modern commercialization or specialization farming (Mumba, 2019).

The management systems usually range from extensive farming, semi-intensive to intensive farming. Responding to the market signals, demand and consumer preferences, goat production is progressively shifting from an extensive farming system to the semi-intensive and intensive systems, respectively. These two dimensions of the level of commercialization and farming system determine the realization of the full potential of goat commercialization and the transition from low to a high level and have been considered as a crucial ingredient for economic development in developing countries (Carlletto *et al.*, 2016). Goat commercialization enhances trade and efficiency, leading to economic growth and welfare improvement at the national level. This is further expected to initiate a virtuous cycle that raises household income, thus improving consumption, food security and nutritional outcomes in rural households. In the context of this study, commercialization is defined as a transition from traditional farming to a more market-oriented system.

Numerous factors are believed to determine farmers' commercialization as well as their level of commercialization. These comprise of the socio-economic factors - age, gender, education level, household size and farming experience; institutional factors - farmer group participation, access to extension services, access to credit, contractual arrangements, access to information, access to trainings, and market factors such as assets owned, distance to the market, off-farm income and access to market. Tufa *et al.* (2014) conducted a study on determinants of the output side commercialization decision and the level of commercialization on horticultural crops in Ethiopia. The study revealed that gender, distance to the nearest market and cultivated land played a significant role in smallholder commercialization decisions whereas household education, household size, access to irrigation, cultivated land, livestock and distance to the

nearest market were the key determinants of the level of commercialization. The authors further noted that transforming subsistence-oriented production systems into a market-oriented production system as a way to increase smallholder farmers' income and reduce rural poverty has been in the policy spotlight of many developing countries including Ethiopia. The study also highlighted that there is a need to improve the smallholder commercialization decision as well as the level of commercialization to facilitate stable incomes and sustainable livelihoods.

Dube and Guveya (2016) analyzed the level and determinants of commercialization of smallholder agriculture in two provinces of Zimbabwe (Manicaland & Masvingo). A Household Commercialization Index (HCI) was used to assess the level of commercialization. The study found that from these two provinces in Zimbabwe, farmers are highly subsistence with the mean HCI of 0.28. The findings of the study showed that the level of commercialization for female-headed households was similar to the male headed households. Further, the study revealed that the size of the household, availability of draft power, livestock ownership, access to irrigation, agricultural training, the distance of homestead to town and household income significantly and positively influenced commercialization. On the other hand, variables that significantly and negatively influenced commercialization include the number of household members with secondary education, communal tenure and location in the agro-ecological zone. According to Dube and Guveya (2016), promoting commercialization of smallholder agriculture is necessary with more emphasis on training farmers to view farming as a business and equipping them with marketing and negotiation skills.

In Zimbabwe, a study on commercialization and its determinants among smallholder farmers revealed that gender of the household head, access to draft power, access to extension, access to markets, access to finance as well as the number of crops positively influenced commercialization, (Rhubara & Mudhara, 2019). However, the age of the household head, number of cattle, off-farm income and communal lands were negatively associated with the level of commercialization. According to Rubhara and Mudhara (2019), even though subsistence farmers are likely to commercialize, there are still high levels of subsistence farming in sub-Saharan Africa. Similar to Dube and Guveya (2016), the study also used an HCI to capture the level of commercialization where the mean HCI was around 0.20. This implies that on average, farmers sell less than half of their produce.

An assessment of the determinants of adoption of improved rice varieties by Awotide *et al.* (2016) revealed that income from rice production, membership of farmer organizations and

distance to the nearest sources of seeds, cost of seed, yield as well as level of training positively and significantly influenced the intensity of improved rice varieties. Further, the gender of the household head, access to improved seeds, years of formal education and average rice yield were positive and statistically significant in increasing the probability that a farmer would participate in the market. According to Awotide *et al.* (2016), higher adoption of improved rice varieties would lead to an increase in rice yield and farmers could consequently have a marketable surplus which would lead to an increase in household income and also generate an improvement in household welfare.

Mathenge *et al.* (2010) examined factors influencing market participation of crop producers and their impact on income and poverty among the poor and marginalized groups in Kenya. The study found that female-headed households had higher bean market participation than male-headed households. The study found that land size, membership to a group and distance to a tarmac road had a positive and significant effect on bean market participation, while crop price had a negative and significant effect on the extent of bean market participation. The results of the study indicated that innovations that enhance the marginalized groups' access to land and credit could be instrumental in raising their ability to exploit market opportunities.

### **2.3 Government Efforts towards Goat Commercialisation in Botswana**

Botswana has for several decades implemented numerous programs towards the social and economic development of its people. The implicated outcomes of the formulated policies have majorly covered food security, technology adoption and transfer, infrastructure development, commercialization and an overall increase in welfare. Several programs have been introduced with the key focus to promote the economic participation of citizens and improve economic elements of employment, incomes, empowerment and entrepreneurial development (Magombeyi & Odhiambo, 2017). One of the programs implemented includes the Citizen Entrepreneurial Development Agency (CEDA) which began operations in 2001, replacing the Financial Assistance Policy (FAP) of 1982 (CEDA, 2019). The former was associated with high failure rates of supported programs, even though it was established with good intentions of providing business grants and promotion of employment creation and production. CEDA provides business loans for start-up or expansion of citizen-owned enterprises (agriculture included). Additional to that, the agency provides business advisory services towards all entrepreneurial development which spells out the commercialization of production to boost economic diversification and to empower citizens.

Youth Development Fund (YDF) was also set up specifically for the youth aged 18 to 35 years. The program, coordinated by the Ministry of Youth Empowerment, Sports and Culture Development was set up to promote youth participation, in economic development and to provide structures that take into account the needs of the youth. The program is an empowerment project that is mandated to finance young business people. It provides working capital to youth-owned agribusiness with subsidized interest rates (MYSC, 2019).

Lastly is the Livestock Management and Infrastructure Development (LIMID) program which was established in 2006 and is available to Botswana citizens. The objectives of the program are to promote food security through improved productivity of cattle and small stock (goats included) through the provision of resources to the poor and infrastructural development. The packages focused on agriculture and are targeted at; resource-poor households (small stock; Tswana chickens, and guinea fowl); infrastructural development (borehole/well drilling, equipping, reticulation, purchase, animal husbandry and fodder support, cooperative poultry abattoirs) (MADFS, 2019). An evaluation of the LIMID program by Moreki *et al.* (2012) noted that the program has beneficial effects and contributed towards improving food security and poverty reduction. LIMID beneficiaries are the buyers of young live animals from other farmers who may or not be the beneficiaries of the program, for their business start-ups. These then sell directly to butcheries in the local areas, individual customers and even other LIMID beneficiaries.

#### **2.4 Challenges Encountered in Goat Marketing**

The significance of goats to the subsistence of rural economies and developing nations where this form of livestock is mainstream cannot be understated (Hamza *et al.*, 2013; Musara *et al.*, 2013). However, the contribution continues to be undervalued mainly because of subsistence farming and the existence of limited formal marketing outlets. According to Carletto *et al.* (2016), market participation by African smallholder farmers remains low which impacts directly on the commercialization of their products. Interestingly, literature acknowledges that as a result of a more dynamic environment, smallholders are privileged with opportunities that can better their market participation (Zhou *et al.*, 2013). These include among others, climate change, population expansion, urbanization, technology, increasing value chains and enhanced trade relations.

Smallholders are deemed more vulnerable to marketing and farming challenges, than other value chain actors. This, in particular, points to their inability to keep up with current trends as per the market demands. Zhou *et al.* (2013) have explained this based on the nature of their part-time commitment to farming; high-cost demands associated, market information, technology, infrastructure, and resource skills. Marketing outlets through which farmers sell their goats are unorganized and unreliable (Musara *et al.*, 2013). Further noted is the inconsistent supply of chevon to the supermarkets' chains. Other major challenges faced by farmers include the insufficient promotion of goat meat, poor carcass grading and pricing systems, as well as the lack and inefficient transport bearing economic implications. High mortality rates, underdeveloped breed types, diseases, poor nutrition; rangeland, and housing tend to impede the goal to participate fully in the market.

According to Adefemi (2014), the structure and performance of goat markets are considered important. The key respondents of the study were goat traders who form part of the marketing system in the country. Traders faced challenges regarding the finances, price fluctuations, stock theft, seasonality, expensive veterinary services and drugs. Furthermore, Hamza *et al.* (2013) carried out a study on the system dynamics approach with a key interest in commercializing smallholder value chains for goats in Mozambique. The study also focused on traders in the locality who buy directly from farmers. The study intended to address issues such as limited information flows, production constraints of low supply. The potential to increase market participation lies in improving goat production, enhancing animal health practices and availing finances.

Moteiro *et al.* (2018), made a survey on advantages and disadvantages to the animal, environment and goat system productions. Noted was the limitation of goat's milk sales by productive data and seasonality, which affected the constant supply of milk to meet the market demands. As for production, lack of training programs, as well as modernized slaughter and processing facilities posed a major challenge toward increased market participation.

## **2.5 Empirical Reviews on Marketing Outlets**

Han (2011) defines marketing channels as the specific organizations that are interdependent and interrelated with products and their relevant services that can be transferred from producers to consumers. This institutional oriented perspective draws attention to channel actors (for example, wholesalers, distributors, retailers) comprising the distribution system and engaged in the delivery of goods and services from the point of conception to the point of consumption



(Han, 2011). A marketing channel ensures the flow of information, product and funds. It encompasses the activities surrounding where the product must be delivered and how and whether a producer directly delivers the product or if there are intermediaries. Several studies on choice of market channels have been carried out, revealing institutional, socio-economic and market factors influencing farmers' choice of marketing channels.

Wosene *et al.* (2018) conducted a study on factors affecting market outlets' choices of producers in Ethiopia. The findings of this study indicated that farmers were influenced by different factors to choose appropriate marketing outlets to sell their products. The MVP results indicated that the quantity produced, farming experience, extension contacts, years of schooling, bargaining power of the producer, post-harvest value addition, market distance, and livestock ownership had a statistically significant influence on choices of the market outlet. According to Wosene *et al.* (2018), since local collectors' market outlet was negatively and significantly affected by the frequency of extension services, strengthening efficient and area-specific extension education, thorough training would assist the farmers to choose the most profitable market outlets.

Ferto and Szabo (2002) conducted a study on the choice of supply channels in Hungary. The study aimed to investigate the choice of farmers among various supply channels employing the framework of transaction cost economics. The study highlighted that the farmers' decisions concerning supply channels are influenced differently by transaction costs. The results showed that the probability of the choice of marketing cooperatives was significantly and positively influenced by age of the farmers, having a mobile phone and negatively influenced by the bargaining power and the possibility of monitoring. However, the results also showed that physical assets do not have any significant influence on the farmers' decisions concerning wholesalers. Further, the probability of choosing to sell to a producer organization was positively influenced by the farmers' age and negatively by the bargaining power and the possibility of monitoring.

Martey *et al.* (2012) conducted a study on factors influencing the commercialization of smallholder agriculture in Ghana. The study analyzed the trends in production by farm households, estimated the levels of commercialization and quantified the magnitude and direction of factors influencing the level of commercialization. The observation drawn from the results was that output price, farm size, age and number of years of formal education of household heads are associated with a higher level of sales. On the other hand, output price,

farm size, number of adults that assist on the farm, quantity produced are associated with a higher level of commercialization. According to Martey *et al.* (2012), the majority of the farmers preferred the urban market channel because it offered the highest prices. The study highlighted that although farmers may be interested in selling to channels offering the highest prices, their socio-economic and institutional environment may not enable them to exploit the opportunity.

Another study was done by Asmare (2018) on the determinants of farmers' market outlet choice in Ethiopia. Asmare (2018) highlighted that access to the market in the form of different channels for farmers is crucial for exploiting the potential of coffee production to contribute to increased cash income of rural households. The main aim of the study was to investigate the determinants influencing the choices among farmers in general. The study found that the marketing channels that were existing in the area were marketing cooperatives, private traders, neighbouring cooperatives and informal traders. Delivering through the cooperative was the most utilized outlet in the study area.

## **2.6 Relationship between Commercialization and Household Welfare**

The perception that commercialization helps in reduction of poverty and improvement of welfare at the household level is supported by much of literature (Awotide *et al.*, 2016; Cazzuffi *et al.*, 2016; Ogutu *et al.*, 2019; Rabbi *et al.* 2017; Wasseja *et al.*, 2018). Commercialized farming is widely considered as the most effective means of addressing poverty in the developing world (Wasseja *et al.*, 2018). It is estimated that a one percent increase in agricultural productivity could reduce the percentage of poor people living on less than one dollar a day by a range of 0.6 percent to 2 percent (Asfaw *et al.*, 2012). From a theoretical point of view, commercialization is expected to generate welfare gains at both household and aggregate levels. These gains derive from static welfare effects of trade according to comparative advantage and translate into income and employment effects which are directly reflected in household welfare and into improvements of health and nutrition which are contingent on the level of income (Cazzuffi *et al.*, 2018). Access to markets and shifting from subsistence-oriented farming can bring changes in economic growth and eventually improved standards of living. A study by Zhou *et al.* (2013) shows that shifting from subsistence farming towards market commercialization increases income, welfare and contributes to economic prosperity. The authors also added that the substantial progress in agriculture and its shift from

largely subsistence to increasing commercialization have also played a great role in improving rural conditions.

According to Wasseja *et al.*, (2018), commercialization of smallholder farming lies in its potential to increase rural household economic growth and poverty reduction; improves on the welfare of most households directly through income effects. It is known for its comparative advantage over subsistence farming as it generates income for rural households, expansion in the use of hired labour than in subsistence farming (Von Braun *et al.*, 1994). Moreover, increased wages and employment from commercialization translates into a broad spectrum of development in the entire rural economy.

## **2.7 Factors Influencing Household Welfare**

Several factors have been identified to have either a positive or negative effect on household income. The main factors affecting household income include household size, age, education and gender of household members, market access, assets and employment, among others. There are also community factors that significantly determine household income such as weather, prices and infrastructure (Tuyen, 2015). Empirical evidence shows that off-farm employment is closely related with household income (Ding & Abdulai, 2018). Participation in off-farm employment is found to increase household income showing the importance of off-farm employment in the livelihoods of rural residents. The importance of employment and labor in helping the poor with regard to improving their livelihoods has been significant and tangible in many studies.

Among other factors, education is often found to have a positive effect on household income. This means that an additional year of formal schooling would increase household income. The role of education in improving household income was found positive in Vietnam's North Central region (Nguyen & Tuyen, 2018) and Northwest region (Tuyen *et al.*, 2018). However, the income effect of age and gender may be ambiguous (Tuyen, 2015). Households with younger working members are more likely to undertake non-farm jobs, which in turn might earn higher incomes. Nevertheless, household with older farmers tend to attain more work experience which might enable the household to earn higher income (Tuyen, 2015). The same applies to gender. Gender can affect income either positively or negatively. This is because males tend to work extra harder as the household heads in order to provide for the family.

Similarly, for female household heads where there is no any male person, females will also look for job opportunity in order to make extra money for the family.

Farm size and household size are also found to be the key drivers of household income. A bigger household that is composed of working adults will have better household income relative to a farm household composed of young, economically unproductive children Opondo and Owuor (2018). However, the positive coefficient of farm size supports the interpretation that large farm sizes encourage production of marketed surplus which can enhance commercialization. Also, smallholder farmers with large farm sizes can improve their household income through a variety of agricultural activities (Tuyen, 2015). In terms of access to market, findings by Wasseja *et al.*, (2018) have shown a positive relationship between access to market and household welfare. The study highlighted that if the government wants to improve commercialization, emphasis should be put on markets and farmers' accessibility to these markets.

Some other characteristics such as access to credit, assets ownership and farming experience are also positively linked with household income. Access of rural households to both formal and informal credit has improved the living standards in some developing countries (Cuong, 2008). Further, empirical evidence confirms that land has a positive effect on household income. Other evidence shows that employment status, especially non-farm employment, plays an increasingly important role in rural household income(Tran, 2015).

## **2.8 Theoretical and Conceptual Framework**

### **2.8.1 Theoretical Framework**

The analytical framework used in this study is based on sustainable livelihood theory which is built on the ideas of capability, equity and sustainability. According to Chambers and Conway (1992), a livelihood comprises of people, their capabilities and their means of living which include income and assets. This concept of sustainable livelihoods was put in the report of an Advisory Panel of the World Commission on Environment and Development for new analysis where sustainable security was proposed as an integrating concept securing ownership and access to resources and income-earning activities. Livelihood considers adequate stocks and flows of food and cash to meet basic needs whereas sustainability reflects the ability to maintain or enhances resource productivity on a long term basis. Therefore, a household may be able to

gain sustainable livelihood through ownership of land, livestock, right to grazing, fishing, hunting and gathering or through stable employment with adequate remuneration.

Particular to the study, commercialization of goat farming may enhance farmers' livelihoods through increased household incomes and employment. Commercialization may also improve household health and nutrition depending on the level of farmers' income. Using best marketing outlets by farmers could probably enhance production, maximize profits and enhance their incomes. The sustainable livelihood framework gives an overview where farmers operate in a context of vulnerability through subsistence farming systems, within which they have access to support and services such as funding and free extension services. The services are normally provided by the government through prevailing social, institutional and organizational environment such as policies, institutions and processes. The context is supposed to improve and encourage farmers into better farming systems that will enhance their livelihood through improved food security and increased well-being (Kollmair & Gamper, 2002).

### **2.8.2 Conceptual Framework**

The framework in Figure 2 explains the relationship of relevant variables that the study investigated towards commercialization, marketing outlets and household welfare. This is based on the idea that socio-economic, institutional and farm factors influence farmers' decision to commercialize or not. Once a farmer decides to commercialize, they are further faced with a decision of which marketing outlet they prefer based on several factors such as farm, institutional as well as socio-economic. Further, access to lucrative markets could also provide incentives to commercialize. The expected outcome is to maximize profits which enhances household incomes ultimately, increases food security and leads to poverty reduction.

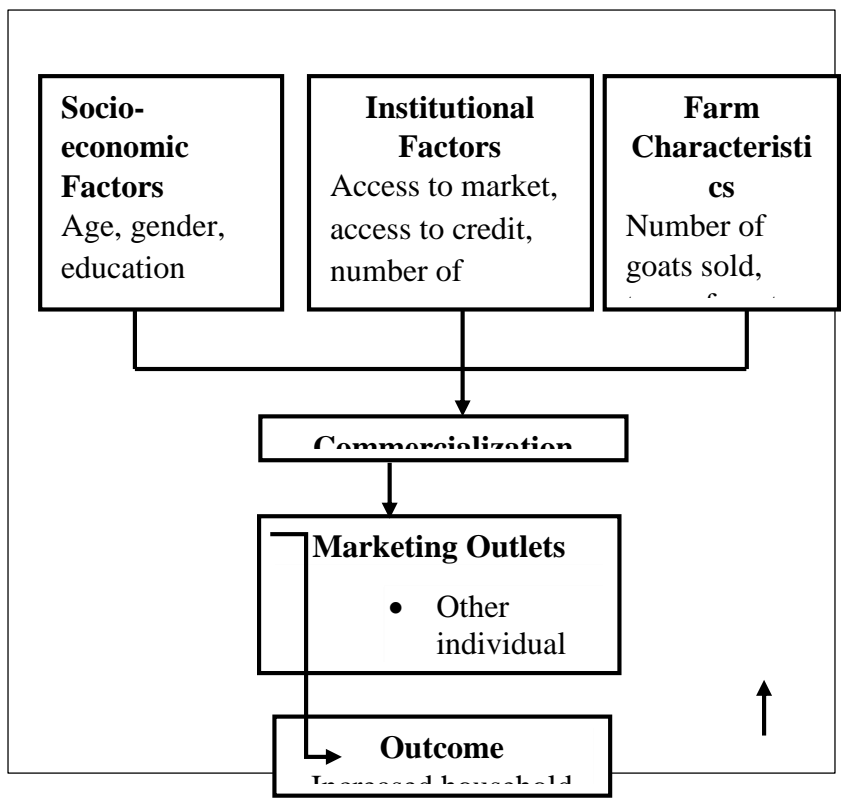


Figure 2: Conceptual framework

## CHAPTER THREE

### METHODOLOGY

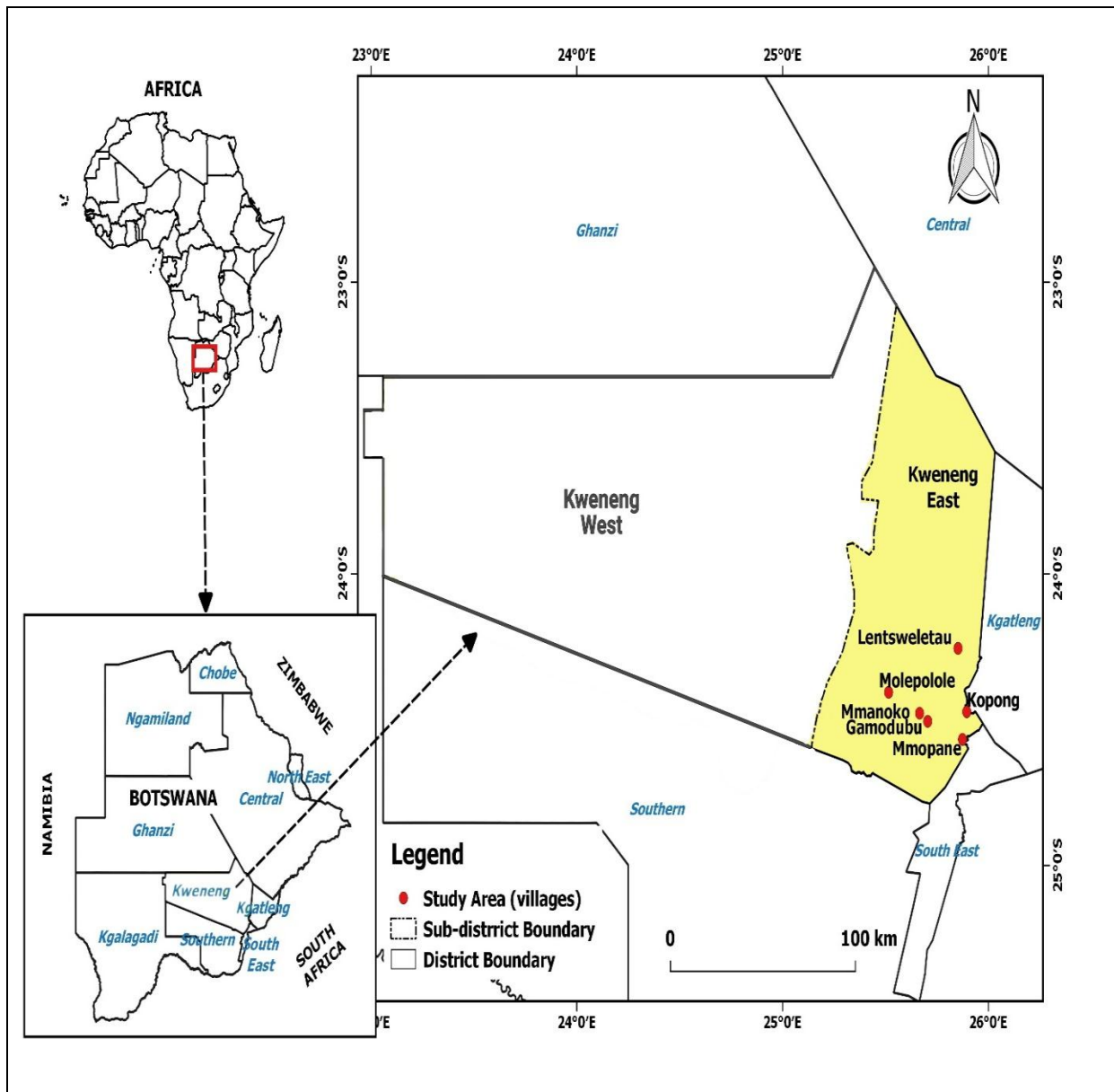
This chapter discusses the data and methods of the study. It gives an insight into the study area, the sampling procedures, data collection, and the analytical framework employed.

#### 3.1 Study Area

The study was conducted in Kweneng East sub-district which is the biggest sub-district in Kweneng district of Botswana. The district has a population of about 304, 549 (Statistics Botswana, 2011) and covers an area of 35, 890 square kilometers. In terms of goat population, the district recorded an estimated 286,605 goats (Statistics Botswana, 2017). By itself, Kweneng East sub-district has a population of 229, 647 goats (Statistics Botswana, 2017) with average rainfall between 450 and 500 mm annually, most of which is received during summer seasons. The place is dominated by *Acacia* and *combretum* tree savannah given the dry climatic conditions in the country. Few farmers especially those who keep goats for commercial purposes are involved in intensive and semi-intensive farming systems. Other livestock kept in the region include cattle, pigs and chickens. Mixed farming is a common practice in this area where farmers combine their main livestock activity with some crop farming (Monau et al., 2017). As shown in Figure 3, the area boarder's Central district, Kgatleng district, South-East district, Southern district, Kgalagadi district, and Ghanzi district.

#### 3.2 Sampling Technique

A multi-stage sampling technique was used to select respondents to be interviewed. Firstly, Kweneng district was purposively selected because it has the highest number of commercial goat farmers and also is the second-highest goat population of about 286, 605 herds (Statistics Botswana, 2017) in the country. Kweneng district has two sub-districts. In the second stage, Kweneng East sub-district was purposively selected because it is the largest sub-district with the highest number of goats in the district. Thirdly, out of the 31 villages in the sub-district seven villages were randomly selected. Lastly, in each village a list of farmers was generated and a systematic random sampling method was used to select the respondents proportionate to the population of each village.



**Figure 3: Map of the study area**

Source: Egerton University, Department of Geography, 2019

### 3.3 Sample Size Determination

A sample of 266 farmers was obtained using Yamane (1967) formula;

$$n = \frac{N}{1 + N(e)^2} \quad (1)$$

where:

n = desired sample size,

N= population size (Statistics Botswana, 2017) and

e = acceptable error (0.06).



An allowable error of 0.06 was used implying that the study is willing to tolerate an error of 6% in the sample estimates. The study assumes that the estimated sample size is within plus or minus 6% of the population value.

$$n = \frac{6623}{1+6623(0.06)^2} = 266 \quad (2)$$

To calculate the distribution of the sample size across villages, the number of farmers per village was multiplied by the total sample size and then divided by the total number of farmers in all the seven villages;

$$n \text{ (per village)} = \frac{\text{No of farmers (per village)} \times 266}{\text{Total number of farmers}} \quad (3)$$

**Table 1: Distribution of sample size across the villages**

<b>Village</b>	<b>Number of Farmers</b>	<b>Sample size</b>
Molepolole	480	96
Gakuto	151	30
Mmopane	281	56
Lentsweletau	177	36
Kopong	74	15
Mmanoko	103	21
Gamodubu	58	12
<b>Total</b>	<b>1024</b>	<b>266</b>

**Source: Department of Veterinary Services, Botswana (2019)**

### **3.4 Target Population of the Study and Respondents**

The targeted population of the study was the smallholder goat farmers in Kweneng East sub-district. This consisted of both commercialized and non-commercialized farmers in the last 12 months. Both farmers were necessary for the study to make a comparison when determining the effect of commercialization on household incomes.

### **3.5 Data Collection and Research Design**

Cross-sectional survey research design was used in order to establish a relationship between different variables. A semi-structured questionnaire was administered to selected goat farmers to gather information on farm, socio-economic and institutional characteristics; marketing outlets, production systems, incomes, returns to goat farming, as well as challenges faced in goat farming. Before data collection, the questionnaire was pretested to check its validity with the assistance of trained enumerators. Finally, STATA and Statistical Package for Social

Sciences were used for data entry, cleaning and analysis. The study committed and insured that all the data collected will be treated with confidentiality and presented as a collective analysis without mention of any individual. Therefore, research participants were not subject to any harm in any way whatsoever.

### 3.6 Analytical Framework

#### **Objective One: To determine factors influencing commercialization among smallholder goat farmers in Kweneng East sub-district of Botswana**

Under this objective, commercialization was measured using the Household Commercialization Index (HCI). It considers the proportion of total agricultural production that is marketed (Strasberg et al., 1999). HCI was used as the dependent variable in determining the factors influencing the level of commercialization. The index reflects a proportion of the total value of goats sold in the market out of the total value of goats kept by a farmer. The total value of goats kept by a farmer took into consideration the value of goats a farmer had in addition to any sales and/or deaths they experienced in a period of one year and expressed as:

$$HCI = \frac{\text{Total Value of goats sold}}{\text{Total value of goats kept}} \times 100 \quad (4)$$

According to Dube and Guveya (2016) and Muhammad-Lawal *et al.*, (2014), the index assumes values between 0 and 100. An index value of zero implies fully subsistence-oriented farming while an index of 100 would signify a higher level of commercialization. This means that farmers who have high level of commercialization are intensively engaged in the market. In this study, non-commercialized farmers were expected to have a zero HCI because they did not sell any of their goats during the past 12 months. On the other hand, commercialized farmers were expected to have an HCI greater than zero because of participating in the market. The study did not anticipate an HCI value of 100 as most farmers would always retain some stock for breeding and household utilization, implying that selling an entire production may not be practical for goat farmers.

To further analyze factors influencing the level of goat commercialization, the Fractional Response Model (FRM) was used. According to Williams (2015), FRM is more applicable in cases where the dependent variable is measured as a proportion, percentages or ratios. The FRM takes into account the continuous and bounded nature of the dependent variable from both above and below, predicts response values within the interval limits of the dependent variable; and captures the nonlinearity of the data thereby yielding efficient estimates compared

to linear estimation models (Chegere, 2017). Bounded variables include proportions and probabilities which cannot take values outside the interval of [0, 1] or [0, 100]. Although occasionally used for such analysis, censored and truncated models such as Tobit are more applicable where the dependent variable is only bounded either from below or above (but not both)(Martey *et al.*, 2012). Logit and Probit models are also not appropriate because they estimate the probability of the occurrence of an event that takes a value of one if the event occurs and a value of zero, if otherwise.

Chegere (2017) and Papke and Wooldridge (1996) considered the following model for the conditional expectation of the fractional response variable:

$$E(y_i | x_i) = G(x_i\phi) , i = 1, 2, \dots, N \quad (5)$$

where:

$0 \leq y_i \leq 1$  denotes the dependent variable

$x_i$  represents the explanatory variables for the observation  $i$ .

$G(\cdot)$  is a known function satisfying  $0 \leq G(\cdot) \leq 1$ .

A typical choice of  $G(\cdot)$  is a cumulative distribution function, most popularly a logistic distribution  $G(z) \equiv \exp(z)/(1 + \exp(z))$  directly estimated using nonlinear techniques. The estimation procedure proposed by the author is a particular quasi- maximum likelihood (QML) method based on a Bernoulli log-likelihood function, given by:

$$LL_i(\phi) = y_i \text{Log}[G(x_i\phi)] + (1 - y_i)[1 - G(x_i\phi)] \quad (6)$$

Since the Bernoulli distribution is a member of the linear exponential family (LEF), the QML estimator of  $\phi$  defined by:

$$\phi = \arg \max_{\phi} \sum_{n=1}^N LL_i(\phi) \quad (7)$$

is consistent and asymptotically normal, regardless of the true distribution of  $y_i$  conditional on  $x_i$ ; and  $y_i$  could be a continuous variable, a discrete variable or have both continuous and discrete characteristics. This method generates consistent and robust methods for estimation and inference of the model's parameters under general linear model conditions (Papke & Wooldridge, 1996).

The FRM regression equation was therefore specified as:

$$y^* = b + f(x) + u \quad (8)$$

where:

$u$  = unobserved latent variable

$x$  = set of explanatory variables

$f$  = defines the relationship between  $x$  and  $y^*$

$y^*$  = bounded dependent variable of interest (HCI in our case)

$b$  = vector of parameters to be estimated

### **Explanatory variables included in the FRM model**

Variables included in the FRM model (Table 2) were adopted from previous studies (Agwu *et al.*, 2013; Kyaw *et al.*, 2018; Mbitsemunda & Karangwa, 2017; Morrison *et al.*, 2007; Omiti *et al.*, 2009; Olwande & Mathenge, 2012; Rabbi *et al.*, 2017; Sigei *et al.*, 2015; Seyoum *et al.*, 2011; Tarekegn & Yosefe, 2017; Tufa *et al.*, 2014) as well as from economic theories and own conceptualization. Gender was a binary variable expected to influence the level of commercialization either positively or negatively. Yameogo *et al.* (2018) revealed that male farmers had a higher chance of participating in the market than females because the latter produces mainly for self-consumption and to satisfy household demand rather than for financial purposes. Age was another variable considered important in influencing the level of commercialization positively. According to Rabbi *et al.* (2017), the age of farmers was attributed to farming experience because older farmers have more experience than younger farmers and are well aware of farming practices and production technologies.

Distance to the market was expected to have a negative effect on the level of commercialization consistent with findings by Agwu *et al.* (2013), where the distance to market was found to be significant but with a negative effect. Ideally, as the distance to the market increases, the probability of farmers' orientation towards commercialization reduces. This is because farmers located far away from the market would have to bear transaction costs associated with transport and exchange (Yameogo *et al.*, 2018). Contract agreements were expected to positively influence commercialization because they assure farmers of reliable markets. Sigei *et al.* (2014) found that contract marketing was significant and positive because farmers who were operating under contract arrangements had a higher probability of increasing the proportion of sales.

Land size allocated for livestock production was expected to increase the level of commercialization. Findings by Tufa *et al.* (2014) showed that farm size increased the value of sales of horticultural products. Additionally, based on Kyaw *et al.* (2018) findings, the number of goats sold was expected to increase the level of commercialization given that higher production could drive market participation. The study explained that farmers with high productivity are likely to have a surplus to sell to the market. The type of breed kept by farmers was also expected to have either a positive or negative influence on the level of goat commercialization. Results obtained by Tarekegn and Yosefe (2017), revealed that the type of breed owned by farmers significantly and positively influenced household's market participation. The study highlighted that better breed types encourage smallholder farmers to start production and market their produce. Lastly, farming in peri-urban areas was expected to positively or negatively influence the level of commercialization. This was based on observations by Omiti *et al.* (2009), who showed that peri-urban villages were more commercialized than rural villages.

**Table 2: Description of variables for estimating determinants of commercialization**

<b>Variables</b>	<b>Variables Description and Type</b>	<b>Exp. sign</b>
<b>Dependent</b>		
HCI	Household Commercialization Index (value of goat sales/value of goats kept by a farmer) (Continuous)	
<b>Independent</b>		
Age	Age of a farmer in years (Continuous)	+
Gender	Gender of a farmer (Binary; 1=Male and 0 otherwise)	+/-
Education	Number of years of schooling by a farmer (Continuous)	+
Experience	Farmers' years of experience in goat farming(Continuous)	+
Extension	Farmers' contacts with extension officers per year (Continuous)	+
Training	Number of training sessions a farmer attended in goat farming (Continuous)	+
Active mem.	Number of household members involved in goat farming (Continuous)	+
Access info.	Access to information on available markets (Binary; 1=Accessed and 0 otherwise)	+
Credit	Farmers' access to credit (Binary; 1=Accessed and 0 otherwise)	+
Farmer group	Farmer participation in a group (Binary;1=Participated and 0 otherwise)	+
Distance	Distance to the market in kilometers (Continuous)	-
Land prop.	Proportion of land allocated for livestock in hectares (Continuous)	+
Breed	Type of goat breed kept by a farmer (Binary; 1=Improved and 0=Tswana)	+/-
Beneficiary	Government program beneficiary (Binary; 1=Beneficiary and 0 otherwise)	+
Goats sold	Number of goats sold in the past 12 months (Continuous)	+
Assets	Value of assets owned by a household in Pula (Continuous)	+
Contract	Contract arrangements (Binary; 1=Have Contract and 0	+

	otherwise)	
Region	Location of farming activities (Binary; 1 = Peri urban and 0 if	+/-
Dummy	rural)	

**Objective Two: To determine factors influencing the choice of different market outlets among smallholder goat farmers in Kweneng East sub-district**

Farmers sell their goats through different market outlets such as other individual farmers, butcheries, individual consumers and government programs. Farmers could either sell to only one or more than one outlet. Multivariate Probit (MVP) model was used to analyze factors influencing farmers' choice of marketing outlets. The MVP was appropriate for this study given the nature of the outcome variable which has more than one outlet choices (Greene, 2012). Since the outlets are not mutually exclusive, the model accounts for the simultaneous choice of multiple outlets and the potential correlations among the outlets (Timu *et al.*, 2014). Such characteristics allow the MVP to give more efficient estimates than would a Multinomial Logit (MNL) model.

Following Timu *et al.* (2014), the model is specified as:

$$Y_{ik}^* = \beta_k X_{ik} + \varepsilon_{ik} \tag{9}$$

where:  $Y_{ik}^*$  ( $k = 1, \dots, k$ ) represent the unobserved latent of marketing outlet chosen by the  $i^{th}$  farmer ( $i = 1, \dots, n$ ). The study focused on four mainly used goat outlets; other individual farmers, butcheries, individual consumers and government programs, denoted by letter k.  $X_{ik}$  is a  $1 \times k$  vector of observed variables that affect the choice of marketing outlets. These include the socio-economic, institutional and market factors influencing the choice of outlets.  $\beta_k$  is a  $k \times 1$  vector of unknown parameters to be estimated.  $\varepsilon_{ik}$  is the error term that jointly follows a multivariate normal distribution (MVN) with a mean of zero and the variance normalized to one. The variance-covariance matrix (M) below has values of 1 on the leading diagonal and correlations (Teklewold *et al.*, 2013).

$$M = \begin{bmatrix} 1 & \rho_{PQ} & \rho_{PR} & \rho_{PS} \\ \rho_{QP} & 1 & \rho_{QR} & \rho_{QS} \\ \rho_{RP} & \rho_{RQ} & 1 & \rho_{RS} \\ \rho_{SP} & \rho_{SQ} & \rho_{SR} & 1 \end{bmatrix} \tag{10}$$

Equation 9, is a system of  $k$  equations that can be shown as:

$$\left. \begin{aligned} Y_1^* &= X_1\beta_1 + \varepsilon_1 Y_1 = 1 \cdot \text{if} \cdot Y_1^* \succ 0, Y_1 = 0 \cdot \text{otherwise} \\ Y_2^* &= X_2\beta_2 + \varepsilon_2 Y_2 = 1 \cdot \text{if} \cdot Y_2^* \succ 0, Y_2 = 0 \cdot \text{otherwise} \\ Y_3^* &= X_3\beta_3 + \varepsilon_3 Y_3 = 1 \cdot \text{if} \cdot Y_3^* \succ 0, Y_3 = 0 \cdot \text{otherwise} \\ Y_4^* &= X_4\beta_4 + \varepsilon_4 Y_4 = 1 \cdot \text{if} \cdot Y_4^* \succ 0, Y_4 = 0 \cdot \text{otherwise} \end{aligned} \right\} \quad (11)$$

### **Explanatory variables included in the MVP model**

Explanatory variables in Table 3 were included in the MVP model. The variables were chosen based on findings and discussions from previous studies (Abayneh & Tefera, 2013; Abera *et al.*, 2016; Assefa, 2008; Edossa *et al.*, 2019; Hailu & Fana, 2017; Montshwe, 2006; Wosene *et al.*, 2018) as well as from economic theory and own conceptualization. The number of household members who are actively involved in goat farming activities was expected to positively influence the choice of marketing outlet. This is because a household member who is involved in goat farming activities is likely to be actively involved in marketing activities as well. Since most of the individual farmers are relatives, neighbors, friends and colleagues, a bigger household size would result in an enlarged network by each member which can affect the marketing of goats to other farmers who need goats to increase stock. Montshwe (2006) also added that in the absence of income, additional members will force smallholder farmers to market more goats to sustain current livelihoods.

The education level of farmers was measured in terms of their years of schooling. The study expected a positive relationship between education level and the choice of marketing outlets. The reason is that farmers who have acquired formal education may have better business skills. Educated farmers are more empowered in decision making and they can negotiate for better prices. A farmer will therefore have a choice of better outlets to exercise their bargaining powers. Edossa *et al.* (2019) added that education helps farmers to select relatively better market outlets for their produce they usually have access to various marketing information.

Farming experience also plays an important role in the choice of marketing outlets for goats. The expected result of this variable was either positive or negative. A positive influence would imply that more years of farming increases the likelihood of choosing a market outlet whereas a negative influence would suggest that an increase in years of farming reduces the choice of an outlet. This is because farmers who have been farming for many years have established relationships with certain outlets which they will prefer. Wosene *et al.* (2018) emphasized that



experienced farmers have a better knowledge of cost and benefits associated with various outlets. Similarly, the expected impact of the type of breed on the choice of marketing outlets was both positive and negative because keeping a breed that is preferred by a certain outlet will automatically enhance farmers to choose such an outlet over other outlets.

Access to credit was expected to positively influence the choice of marketing outlets. This is because being able to acquire credit helps in terms of purchasing initial stock and could be used to cover production and marketing costs as well. Farmers would therefore choose to maximize their profits which will help to repay the loan. Based on the results obtained by Richard (2017), access to credit services increased the probability of a farmer selling to the producer-brokers. On the other hand, distance to the market was expected to negatively influence the choice of marketing outlets because generally, longer distances are associated with high transport costs incurred to make deliveries. Therefore, in such instances, farmers would opt to sell to outlets that are nearer or provide transport for themselves to minimize costs. Abera *et al.* (2016) also found that distance to market influenced farmers to sell their produce to rural assemblers due to low transportation costs incurred in taking the farm produce to major market places.

Reliable markets are always preferred. Therefore, access to reliable markets was expected to influence the choice of marketing outlets either positively or negatively. This means that access to reliable market positively influence the choice of reliable markets but negatively influence those that are not reliable. The findings by Hailu and Fana (2017) showed that access to reliable markets negatively influenced farmers to choose the wholesale market compared to retail markets. The study highlighted that the more households have access to the market area, the more they diversify their production and supply to retailers.

Farming in peri-urban areas was hypothesized to positively and negatively affect the choice of marketing outlet. Goat farmers located in peri-urban areas have higher choices of goat markets than rural farmers. Therefore, farming in peri-urban areas positively affects the choice of selling to other outlets and at the same time reduces the choice of selling to other outlets.

**Table 3: Description of variables for factors influencing farmers' outlet choices**

<b>Variables</b>	<b>Variable Description and Type</b>	<b>Exp. Sign</b>
<b>Dependent</b>		
Outlet choice	If the farmer sold goats through various marketing outlets (1=other individual farmers, 2=Butcheries, 3=individual consumers, 4=government programs)	
<b>Independent</b>		
Age	Age of a farmer in years (Continuous)	+/-
Gender	Gender of a farmer (Binary; 1=Male and 0 otherwise)	+/-
Education	Number of years of schooling by a farmer (Continuous)	+
Experience	Farmers' years of experience in goat farming (Continuous)	+/-
Active mem.	Number of household members involved in goat farming (Continuous)	+
Credit	Farmers' access to credit (Binary; 1=Accessed and 0 otherwise)	+
Farmer group	Farmer participation in a group (Binary; 1=Participated and 0 otherwise)	+
Distance	Distance to the market in kilometers (Continuous)	-
Breed	Type of goat breed kept by a farmer (Binary; 1=Improved and 0=Tswana)	+/-
Goats sold	Number of goats sold in the past 12 months (Continuous)	+
Assets	Value of assets owned by the household in Pula (Continuous)	+
Market access	Farmer's access to reliable market (Binary; 1=Access and 0 otherwise)	+/-
Other livestock	Other livestock owned by the household in Tropical Livestock Units (Continuous)	+
Region dummy	Location of farming activities (Binary; 1=Peri Urban and 0 if rural)	+/-

**Objective Three: To determine the effect of goat commercialization on household welfare among smallholder farmers in Kweneng East sub-district of Botswana**

Household income was used as the indicator of household welfare. Household income is considered to be one of the common indicators to measure welfare (OECD, 2011). Relative to other indicators such as consumption, income is generally easier to report and is available for much larger samples, providing greater power to test hypotheses (Meyer & Sullivan, 2003). Income allows people to satisfy their needs and achieve many other goals that they consider important to their lives and sustain their choices over time. Thus, households that have a high income are expected to have a higher standard of living. Collecting data on expenditure may not be very accurate since some people may purchase food every day, while others go to the market once a week or even less frequently which may bring some fluctuations in the data (Falkingham & Namazie, 2002).

Endogenous Switching Regression (ESR) model was used to determine the effect of goat commercialization on household income. The model was more applicable as it corrects for potential endogeneity (Lapple *et al.*, 2013). According to Asfaw *et al.* (2012), ESR takes into account both the observed and unobserved attributes in estimating the treatment effects. The model accounts for endogeneity by estimating a simultaneous equation model with endogenous switching by full information maximum likelihood (Tesfaye & Trivayi, 2016). Since commercialization was highly endogenous in the model, Propensity Score Matching (PSM), which is commonly used for impact evaluation studies, was not appropriate as it fails to correct for the endogeneity problem. This is because PSM does not account for unobservable variables that may affect both the outcome variables and the level of commercialization (Asfaw *et al.*, 2012; Olwande & Smale 2014). Moreover, even though both ESR and Instrumental Variables (IV) methods rely on normality assumptions, the ESR approach is generally more efficient than instrumental variables techniques (Muricho *et al.*, 2017).

ESR model can follow a two-step procedure. The first step involves the estimation of a binary selection model of commercialization decision. The second step involves the estimation of two regression models using Ordinary Least Squares (OLS) to describe the outcome variable of each group of farmers in the two treatment regimes. The study employed the Full Information Maximum Likelihood (FIML) method which jointly estimates the selection and regression equations. The FIML is an efficient method to estimate ESR as it simultaneously estimates the

selection equation and the regression equations to yield consistent standard errors (Lee & Trost, 1978).

The study adopted the approach used by Asfaw and Shiferaw (2010) to measure commercialization. This was a binary variable equal to one if a farmer has commercialized and zero if a farmer was non-commercialized in the last 12 months. In this case, farmers who commercialized were considered as the treatment group whereas those who did not commercialize were the control group. The ESR model considers some instrumental variables which are correlated with the endogenous variable (commercialization) but does not directly influence the dependent variable (household income) in the model. Variables such as mode of payment, distance to market and beneficiary of government programs were used in the selection model when running the regression.

Following Asfaw and Shiferaw (2010), the selection equation for commercialization was specified as:

$$C^* = \beta X + u \quad \text{with} \quad C = \begin{cases} 1 & \text{if } C^* > 1 \\ 0 & \text{Otherwise} \end{cases} \quad (12)$$

where;

$C^*$  = unobservable variable for commercialization

$\beta$  = vector of parameters to be estimated

$C$  = observable counterpart (the dependent variable where goat commercialization equals 1 if the farmer has commercialized and 0 otherwise).

$X$  = vectors of observable instrumental variables

$u$  = error term

In the welfare outcome (Income) model farmers face two regimes. Regime1 (commercialized) and Regime 2 (non-commercialized) were defined as:

$$\text{Regime 1: } Y_1 = \beta_1 X_1 + \varepsilon_1 \quad \text{if } C = 1 \quad (13)$$

$$\text{Regime 2: } Y_0 = \beta_0 X_0 + \varepsilon_0 \quad \text{if } C = 0 \quad (14)$$

where;

$Y_1$  = income for commercialized farmers

$Y_0$  = income for non-commercialized farmers

$X_1$  = Observed explanatory variables determining the income for commercialized farmers

$X_0$  = Observed explanatory variables determining the income for non-commercialized farmers

$\beta_1$  and  $\beta_0$  = vectors of parameters to be estimated

$\varepsilon_1$  and  $\varepsilon_0$  = error terms for commercialized and non-commercialized farmers respectively.

Given the assumption of a trivariate normal distribution for the error terms, the logarithmic likelihood function for the system of equations 12, 13 and 14 can be given as:

$$LnL = \sum_{i=1}^N CL \left[ \ln \phi \left( \frac{\varepsilon_1}{\sigma_{\varepsilon 1}} \right) - \ln \sigma_{\varepsilon 1} + \ln \Phi(\varphi_1) \right] + (1-C) \left[ \ln \phi \left( \frac{\varepsilon_0}{\sigma_{\varepsilon 0}} \right) - \ln \sigma_{\varepsilon 0} + \ln(1 - \Phi(\varphi_0)) \right] \quad (15)$$

where:

$$\varphi_{ji} = \frac{\beta_j X + \gamma_j \varepsilon_j / \sigma_j}{\sqrt{1 - \gamma_j^2}}, \quad j_i = 1, 2, \text{ with } \gamma_i \text{ denoting the correlation coefficient between the}$$

error term  $u$ , of the selection equation (12) and the error term  $\varepsilon$  of equation (13) and (14).

The ESR was used to compare the expected household incomes of commercialized farmers for non-commercialized farmers and explore the expected income in the counterfactual hypothetical cases that the commercial farmers did not commercialize, and that the non-commercialized farmers have commercialized. The actual and counterfactual household incomes for commercialized and non-commercialized farmers are computed as follows:

**Actual Scenarios:**

$$\text{Commercialized: } E(Y_1 / C = 1) = \beta_1 X_1 + \sigma_{\varepsilon 1u} \lambda_1 \quad (16)$$

$$\text{Non-commercialized: } E(Y_0 / C = 0) = \beta_0 X_0 + \sigma_{\varepsilon 0u} \lambda_0 \quad (17)$$

**Counterfactual scenarios:**

For commercialized farmers, if they did not commercialize:

$$E(Y_0 / C = 1) = \beta_0 X_1 + \sigma_{\varepsilon 0u} \lambda_1 \quad (18)$$

For non-commercialized farmers, if commercialized:

$$E(Y_1 / C = 0) = \beta_1 X_0 + \sigma_{\varepsilon 1u} \lambda_0 \quad (19)$$

Applying these conditional expectations using commercialization as a treatment variable, the treatment effects among the sampled farmers were computed following Muricho et al. (2017). The effect of the Average Treatment on the Treated (ATT) was calculated as the difference between (16) and (18).

$$ATT = E(Y_1 / C = 1) - E(Y_0 / C = 1) = X_1(\beta_1 - \beta_0) + \lambda_1(\sigma_{\varepsilon_{1u}} - \sigma_{\varepsilon_{0u}}) \quad (20)$$

which represents the effect of commercialization on household income for farmers who commercialized. Similarly, the effect of the treatment (commercialization) on the untreated (ATU), for farmers who did not commercialize was calculated as the difference between (17) and (19):

$$ATU = E(Y_1 / C = 0) - E(Y_0 / C = 0) = X_0(\beta_1 - \beta_0) + \lambda_0(\sigma_{\varepsilon_{1u}} - \sigma_{\varepsilon_{0u}}) \quad (21)$$

Following Olwande and Smale (2014), the study also computed the heterogeneity effects for both commercialized and non-commercialized farmers as follows:

$$BH_1 = E(Y_1 / C = 1) - E(Y_1 / C = 0) = \beta_1(X_1 - X_0) + \sigma_{\varepsilon_{1u}}(\lambda_1 - \lambda_0) \quad (22)$$

$$BH_2 = E(Y_0 / C = 1) - E(Y_0 / C = 0) = \beta_0(X_1 - X_0) + \sigma_{\varepsilon_{1u}}(\lambda_1 - \lambda_0) \quad (23)$$

$$TH = ATT - ATU = [E(Y_1 / C = 1) - E(Y_0 / C = 1)] - [E(Y_1 / C = 0) - E(Y_0 / C = 0)] \quad (24)$$

where;  $BH_1$  and  $BH_2$  gives the effect of base heterogeneity for commercialized farmers and non-commercialized farmers, respectively. TH is the transitional heterogeneity which gives the difference between ATT and ATU. A positive value of  $BH_1$  would mean that actual commercialized farmers would have better incomes than non-commercialized farmers even if the latter decided to commercialize. Similarly, a positive value of  $BH_2$  would imply that the counterfactual of commercialized farmers would have better incomes than the actual non-commercialized farmers. These measures are important in understanding whether or not there is some heterogeneity between the two groups that may make them different irrespective of their commercialization of goat farming

**Table 4: Treatment and heterogeneity effects**

Sub sample	Decision stage		Treatment effects
	Commercialized	Non-Commercialized	
Commercialized	a) $E(Y_1/C=1)$	c) $E(Y_0/C=1)$	ATT
Non-commercialized	b) $E(Y_1/C=0)$	d) $E(Y_0/C=0)$	ATU
Heterogeneity			
Effects	BH <sub>1</sub>	BH <sub>2</sub>	TH

Outcomes (a) and (d) in Table 4 represent the observed income for commercialized and non-commercialized farmers, respectively, while (c) and (b) represent their respective counterfactual expected incomes. Further,  $C=1$  if farmers have commercialized and  $C=0$  if farmers did not commercialize.  $Y_1$  represents income for commercialized farmers whereas  $Y_0$  denotes income for non-commercialized farmers. ATT is the treatment effect of the treatment (commercialization) on the treated (commercialized farmers) and ATU is the treatment effect of the treatment on the untreated (non-commercialized farmers).

#### **Explanatory variables included in the ESR model**

Table 5 shows the variables included in the ESR model. Variables were chosen based on findings by other studies (Anang, 2017; Assefa, 2008; Filmer & Pritchett, 2001; Lhing et al., 2013; Rabbi et al., 2017; Richard, 2017) as well as from economic theory and own conceptualization. The study expected the age of farmers to influence household income either positively or negatively. Age would positively influence income in the sense that older farmers have accumulated resources through investments and savings over the years, unlike young farmers. Additionally, older farmers have more farming experience than young farmers and due to social networks that they have established over a while, older farmers tend to increase their incomes through increased levels of commercialization. The effects of the age of a farmer on household income could be ambiguous and not possible to make an a priori determination. Lhing *et al.* (2013) found the age of farmers to be negatively associated with household income.

Education level was captured in terms of years of schooling. This study hypothesized a positive relationship between the education level of farmers and their household income. This is because educated farmers are likely to have higher income earning potentials and more alternative opportunities to diversify their income generation activities. Off-farm participation was also

expected to increase household income because studies show that households that participate in off-farm employment have higher incomes than households that did not participate in off-farm employment (Anang, 2017). Farmers who participate in off-farm employment source extra income besides on-farm income. Similarly, higher household income was expected for farmers who owned many assets since assets reflect accumulated investments and savings over time. According to Filmer and Pritchett (2001), assets are a good indicator of long term or permanent income.

The type of breed kept by farmers was expected to either positively or negatively influence household income. This is because farmers that keep improved breed of goats are expected to earn higher returns than those who keep local breeds due to a higher value attached to improved breeds. Assefa (2008) found that large-sized, white coloured goats with thick and straight horns have better market value and are fast marketed than other coloured goats. Similarly, access to extension services was expected to positively influence household commercialization and hence income. This is because market information on prices, demand, buyers, and other relevant information could contribute to farmers' marketing decisions which could significantly raise the probability of market participation among households (Richard, 2017). Further, information disseminated by extension service providers on veterinary services and diseases raises awareness for farmers to take precaution measures and reduce mortality rates.



**Table 5: Description of variables for the effect of commercialization on household income**

<b>Variables</b>	<b>Variable Description and Type</b>	<b>Exp. Sign</b>
<b>Dependent</b>		
Income	Total annual household income in US\$ (Continuous)	
<b>Independent</b>		
Age	Age of a farmer in years (Continuous)	+/-
Gender	Gender of a farmer (Binary; 1=Male and 0 otherwise)	+/-
Education	Number of years of schooling by a farmer (Continuous)	+
Training	Number of training sessions a farmer attended in goat farming	
	Farmers' contacts with extension officers per year (Continuous)	+
Active mem.	Number of household members involved in goat farming (Continuous)	+/-
Off-farm	Off-farm participation by a farmer (Binary, 1=Participated and 0 otherwise)	+
	Farmers' participation in a group (Binary; 1=Participated and 0 otherwise)	+
Distance	Distance to the market in kilometers (Continuous)	-
Assets	Assets owned by a household using an asset index (Continuous)	+
Breed	Type of goat breed kept by a farmer (Binary; 1=Improved and 0=Tswana)	+/-
	Average goat selling price in Pula (Continuous)	+/-
By-products	Other by-products sold (Binary; 1= Sold and 0 otherwise)	+
Payment	Mode of payment (Binary; 1=Cash, 0=Cheque)	+/-
Beneficiary	Government program beneficiary (Binary; 1=Beneficiary and 0 otherwise)	+/-



## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

This chapter presents the results of the study and discussion of key findings with respect to the objectives as stated. The first section (4.1) gives the results of the descriptive analysis on farm, socio-economic and institutional characteristics. Section 4.2 and 4.3 provides the findings of the FRM and the MVP models, respectively. Lastly, section 4.4 discusses the results of the ESR model on the effect of goat commercialization on household income and thus welfare.

#### **4.1 Results for the Descriptive Analysis**

##### **4.1.1 Socio-Economic and Farm Characteristics by Commercialization**

Results in Table 6 show that the majority (63%) of respondents were male whereas 37% were female. The overall results show that over half of the male respondents (61%) commercialized whereas 39% of females commercialized in the past 12 months. Similar findings were obtained by Nsoso et al. (2004), where the majority of males were farming with small stock. This indicates that goat farming in the study area is male-dominated. In agreement with Umunna et al. (2014), most of the goats and sheep farmers (90%) were males. However, the study shows reasonably good participation of females in goat production which indicates a good contribution of females in economic empowerment especially livestock farming.

About 56% of farmers kept goats under an extensive farming system where goats are allowed to browse on tree forages in the rangelands. The results could be attributed to free access to communal grazing land. Seleka (2005) noted that livestock production in Botswana is dominated by the communal farming system which is characterized by lower off take rates and high mortality rates. Bahta *et al.* (2018) also revealed that the majority of smallholder farmers in Botswana are extensive grazers depending mainly on rain-fed vegetation. Relatively few farmers (3%) kept goats under an intensive farming system. Results of the chi square show that the production system was statistically significant at 1% level indicating that the distribution of systems was statistically different between commercialized and non-commercialized.

**Table 6: Socio-economic and farm characteristics by commercialization**

Variables	Response	Commercial	Non-	Overall	χ <sup>2</sup>
		ized (n=206)	commercialized (n=60)	(n=266)	
		Percentage (%)	Percentage (%)	Percentage (%)	
Gender	Female	38.8	30	36.8	
	Male	61.2	70	63.2	1.559
Production system	Intensive farming	3.9	1.7	3.5	
	Semi-Intensive farming	45.1	23.3	40.2	
	Extensive farming	51	75	56.3	10.929 ***
Type of breed kept	Local	65.5	76.7	68.1	
	Improved	34.5	23.3	31.9	2.649
Supplementary feeding	Yes	31.6	51.7	64.7	
	No	68.4	48.3	35.3	5.726* *
Govt. program Beneficiary	Yes	29.6	20	27.4	
	No	70.4	80	72.6	2.156

Note: \*\*\*, \*\*= significance at 1% and 5% level respectively

The chi square results on supplement feeding show a statistical significance of 5% level between commercialized and non-commercialized. On average, approximately 65% of the farmers provide feed supplements for their goats to avoid the effects of drought such as premature births and deaths. Supplement feeds such as salt, molasses, lablab, and lucerne and crop residues help maintain goats during dry seasons. According to Baleseng *et al.* (2016), farmers invested relatively less in supplementary feeding for their livestock mainly due to high feed costs. However, in the current study, contrary observations were made since most farmers were supplementing feeds because feed prices were affordable. This could be because of the government subsidy programs whereby when a drought year is declared the government subsidizes animal feeds and supplements.

In terms of type of breed, the local (Tswana) breed is kept by 68% of farmers in the study area. Aganga and Aganga (2015) noted that in Botswana's climatic conditions, the survival and production of the Tswana breed are better than the exotic breeds such as Boer goats. However, 32% of farmers do keep improved breeds mainly for commercial purposes. About 27% of farmers benefited from government programs whereas 73% of farmers used their income from salaries, social groups, family, savings and personal bank loans to purchase stock. Farmers reported that they could not attain funding from government programs due to long processes of assessment to benefit from such support services.

#### **4.1.2 Institutional Characteristics by Commercialization**

Table 7 shows results on the descriptive analysis of commercialization by farmers' institutional factors. Results show a statistically significant difference between commercialized and non-commercialized farmers concerning access to a reliable market. This is because a relatively high number of farmers reported that there is a lack of access to reliable markets whereas relatively few farmers had access to reliable markets. Relatively few (18%) of both commercialized and non-commercialized farmers have reported access to reliable and organized markets for small stock specifically goats. About 85% of commercialized farmers were faced with the challenge of accessing a reliable market. For non-commercialized, approximately 28% had access to reliable markets. Lack of access to reliable market can be attributed to the distance to market outlets as well as lack of reliable transport (Chipasha *et al.*, 2017). Kocho *et al.* (2007) highlighted that a lack of market information and formal credit sources are some of the major constraints that affect the efficiency of livestock marketing.

Overall results on access to credit show that 5% of the farmers did access some credit services, on average.

**Table 7: Institutional characteristics by commercialization**

Variables	Commercialized	Non-commercialized	Overall	$\chi^2$
	(n=206)	(n=60)	(n=266)	
	(%)	(%)	(%)	
Access to reliable Market	15	28.3	18.1	5.45**
Access to credit	3.9	6.7	4.5	0.836
Access to training	23.8	15	21.8	2.104
Contract arrangements with the buyer	2.4	0	2.4	1.484
Farmer group participation	15.5	5	13.2	4.512**

Note: \*\*= significance at 5% level

Among commercialized farmers, only 4% acquired some amount of credit whereas 7% of non-commercialized had access to credit. Obtaining credit services is very minimal since farmers seem to have resources to purchase stock and support their production whereas some seek government assistance. The results show that relatively few farmers acquire loans to boost their production or use as their start-up capital. Similar findings were obtained by Chipasha *et al.* (2017), where 87% of the smallholder goat farmers had no access to credit. Bakala and Tedesse (2019) also reported that only 5% of the respondent had access to credit. According to Honja *et al.* (2017), access to credit enables farmers to endow economic resources in order to be involved in formal marketing.

Findings on training show that 22% of farmers were trained on goat farming and marketing related issues. About 24% of commercialized farmers received training. Similarly, a small proportion (15%) of non-commercialized farmers received some form of training on goat production. Relatively few farmers had access to training probably because most farmers had reliable experience in goat farming from their families who have been keeping goats for years. Chipasha *et al.* (2017) have also found that the majority of the goat farmers (68%) did not receive any form of training on goat production. They highlighted that according to those who

received some trainings, most of the training sessions were on goat production with minimal marketing and entrepreneurial skills.

In terms of contract arrangements, the statistics between commercialized and non-commercialized were almost the same. Results show that most farmers (98%) do not have any contractual arrangements to supply goats. About 2% of farmers indicated to have contracts probably with butcheries and the government to supply goats to newly funded beneficiaries. These results contradict findings by Sigei *et al.* (2014) who found that more than half (53%) of the market participants were under market contracts. According to Sigei *et al.* (2014), marketing under contract has been perceived to increase market participation because farmers are assured of the ready market for their produce.

The chi square results on farmer group participation show a statistically significant difference between commercialized and non-commercialized farmers because quite a high number of farmers did not participate in any farmers' groups. The overall proportion of farmers who belong to farmer groups was found to be 13%. About (16%) commercialized and non-commercialized (5%) farmers belong to a farmer group. This implies that farmer group participation is still not recognized in the study area. This is likely due to a lack of understanding of the importance and benefits of participating in farmer groups. Similar to Sigei *et al.* (2014), majority of farmers were not in farmer groups. Marketing in a group is essential because it facilitates information exchange among members which reduces transaction costs hence increases the level of commercialization (Sigei *et al.*, 2014). Additionally, belonging to a farmer group empowers farmers to bargain and negotiate for better market prices and conditions.

#### **4.1.3 Farm, Socio-economic and Institutional Characteristics by commercialization**

Table 8 shows the mean values of farm, socio-economic and institutional characteristics between commercialized and non-commercialized farmers. The mean age for both commercialized and non-commercialized farmers was about 49 years. Farmers in the study area can, therefore, be described as middle-aged farmers who are vibrant and actively involved in goat farming. Based on the findings by Umunna *et al.* (2014), the mean age of goat farmers has increased from 41 to 49 years with time, implying a possibility of much older farmers engaging in this activity. However, Rabbi *et al.* (2017) noted that farmers with a range of 50 years and above are still in their productive age. Age was correlated to farming experience

because older farmers are more experienced in goat farming. More experienced farmers accumulate resources to generate surpluses for sales hence commercialize (Rubhara & Mudhara, 2019).

**Table 8: Farm, socio-economic and institutional characteristics by commercialization**

Variables	Commercialized (n=206)		Non-commercialized (n=60)		Overall (n=266)		t-test
	Mean	SD	Mean	SD	Mean	SD	
Age of a farmer	49.17	16.36	48.53	15.2	49.02	16.08	-0.27
Household members	3.01	1.74	2.9	1.6	2.99	1.71	-0.46
Years of schooling	8.90	4.67	7.92	5.76	8.68	4.94	-1.36
Farming Experience (years)	12.75	11.04	12.35	12.45	12.66	11.35	-0.24
Off farm income (US\$)	1,500.31	2,737.87	6	4,220.99	1,691.98	3,145.17	1.85*
Total household income(US\$)	6,660.17	49,458.15	7	4,684.37	5,897.97	43,579.35	-0.53
Value of assets owned (US\$)	15,516.68	55,018.96	2	7,933.17	12,885.43	48,781.02	-1.64
Number of other livestock (TLU)	7.67	14.22	4.82	6.70	7.02	12.95	-1.50
Number of goats sold	10.60	9.27	0.00	0.00	8.18	9.37	-8.70***
Land allocated for livestock(ha)	0.3000	0.34	0.3400	0.33	0.31	0.34	0.69
Distance to market(km)	40.91	36.27	30.82	21.62	38.64	33.76	-2.05**
Number of extension services acquired	1.42	1.20	0.98	1.49	1.32	1.90	-1.56

Note: \*\*\*, \*\*, \*= significance at 1%, 5% and 10% level respectively; USD=United States Dollar; TLU= Tropical Livestock Unit; ha=hectares; km=kilometres; SD= Standard Deviation; Exchange rate during time of study: 1Pula= US\$ 0.091

On average, farmers have been farming for 12 years. Ajal and Adesehiwa (2007), have also found that the respondents have been operating for more than 10 years. According to Rabbi *et al.* (2017), farmers who have been farming for a long time tend to make well-informed decisions.



The average number of household members was approximately 3 members for both commercialized and non-commercialized goat farmers. The results are slightly different from Emanu *et al.* (2015) who found that the mean household size was 5.90 members ranging from 2 to 13. This study considered family members who were actively involved in goat farming without considering the entire household size. An average of 3 members may ensure an adequate supply of family labour for goat farming; therefore, most of the farmers did not hire herd boys.

Further, the findings show that the majority of farmers in the region had formal education. The average years of schooling for commercialized farmers was 8.90 whereas for non-commercialized was 7.92. This indicates that commercialized farmers have a higher level of education as compared to non-commercialized. The study found that education level has an effect on commercialization since most farmers who had formal education were commercialized. The effect of higher levels of education on commercialization is probably due to the adoption of better production methods, access to information on available markets which enable farmers to maximize profits. A higher level of education could also provide a network for information flow between farmers, extension officers and researchers. According to Umunna *et al.* (2014) education is an important factor to adopt new technologies. The chi square results show that education level was statistically significant at 5% level indicating that the distribution of education levels was statistically different between commercialized and non-commercialized farmers.

Off-farm income may have a direct and indirect effect on agricultural production. The t-test results showed a statistically significant relationship of off-farm income between commercialized and non-commercialized. The average annual off-farm income was US\$ 1,691.98 as the average off-farm income for commercialized farmers amounted to US\$ 1,500.31 and US\$ 2,350.06 for non-commercialized. The results indicate that the off-farm income is higher for non-commercialized. Farmers who are not intensively engaged in goat farming are generating extra income from off-farm employment besides goat sales. Farmers could engage in other economic activities to secure their income. Nevertheless, the average total household income for commercialized farmers is more (US\$ 6,660.17) than for non-commercialized farmers (US\$ 3,281.07) because of the income acquired from goat sales.

The total mean value of assets owned by farmers was US\$ 12,885.43 with an average value of US\$ 15,526.68 for commercialized farmers and US\$ 3,851.82 for non-commercialized farmers. Assets ownership serves as a good source of future investments to finance goat farming in terms of any challenges. In such times, farmers can sell some of their assets to sustain the business. Other livestock such as cattle, pigs, sheep and chicken are considered to be important productive assets. Farmers owned an average of 7 Tropical Livestock Unit (TLU) where commercialized farmers had 8 TLU and non-commercialized had 5 TLU. This implies that commercialized farmers had more livestock units. A study by Abebe (2014), shows that productivity can be affected by the number of livestock owned by a farmer. Besides their use in different agricultural activities, income from selling such livestock may supplement farm income in case of failure in goat production. Hence, farmers owning more livestock may be more efficient.

Land size also plays an important role in agricultural production. The majority of farmers had an average of 0.31 hectares of land allocated for livestock production where commercialized and non-commercialized farmers had an average of 0.31 hectares and 0.34 hectares respectively. Further, there was a statistically significant difference between commercialized and non-commercialized farmers in terms of the number of goats sold. Results show an overall average of 8 goats sold per farmer. However, commercialized farmers sold an average of 11 goats and non-commercialized did not engage in the market in the past 12 months.

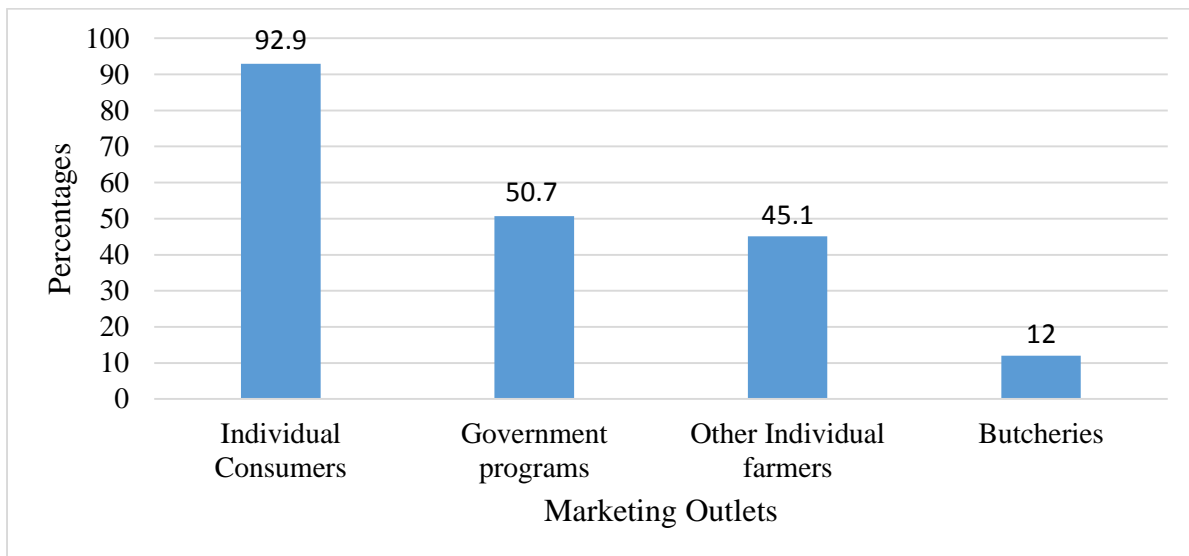
Distance to the market was measured in kilometers. Results show a statistically significant difference in distance to market between commercialized and non-commercialized farmers. Findings indicate that farmers are located about 39 km away from the market on average. For commercialized and non-commercialized, farmers traveled 41 km and 31 km to reach the market, respectively. Commercialized farmers would not mind making an extra effort to travel long distances in search of the market. Martey *et al.* (2012) revealed that distance to market reduces commercialization since long distances are associated with high transportation and marketing costs and marketing costs that hinder farmers' commercialization.

Farmers' overall mean contacts with extension service providers were done once per year. The number of contacts is similar for both commercialized and non-commercialized farmers. Farmers reported that they contacted extension service providers mainly to seek help on disease control measures since they faced a problem of *sekwape* (peeling off of the skin) disease in the

region. Similarly, Muricho *et al.* (2017) also found that about 50% of households that participated in the market had contacts with extension service providers.

#### 4.1.4 Preference of Marketing Outlets by Farmers

The descriptive analysis of goat marketing outlets through which farmers sell goats is presented in Figure 4. The four outlets were preferred differently; Individual Consumers; 93% government programs (51%), while other individual farmers and Butcheries were 45% and 12%, respectively.



**Figure 4: Preferred Marketing Outlets**

Most farmers (about 93%) sell goats to individual consumers who purchase mainly for family consumption and other functions such as weddings and funerals. Farmers have reported that lack of a reliable market for goats in the region makes them to have minimal choices but to sell to consumers who buy goats in times of need. Nsoso *et al.* (2004) also found that selling of goats among small stock farmers was largely through individual sales, recording about 92% of farmers selling to individual consumers.

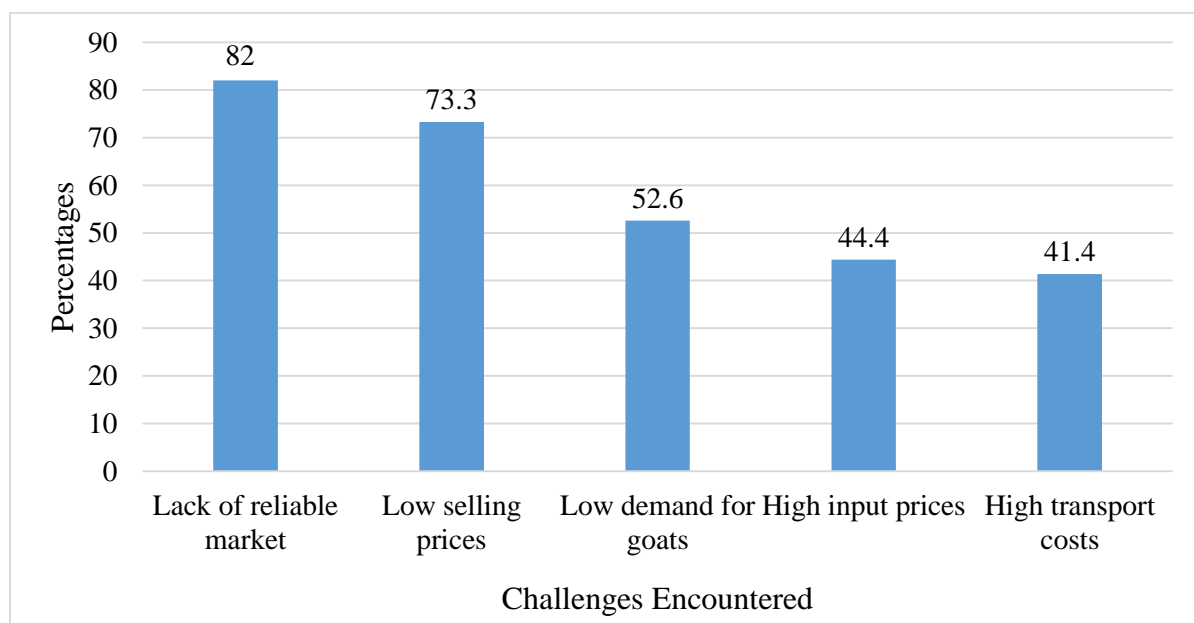
Government programs were the second preferred marketing outlet. The government is somewhat considered to be a reliable market because they purchase goats in large numbers to supply beneficiaries who are funded by various programs such as LIMID, YDF and *Nyeletso Lehuma*. These programs are related to youth empowerment, poverty alleviation, as well as regional development and, are mainly focused on small stock (Bahta *et al.*, 2013). From the results, about 51% of farmers were recorded to be selling to government programs.

About 12% of farmers sell goats to butcheries. Butcheries were the least preferred outlets probably because they base their prices on goat body weight hence considered to buy at higher prices. The results are consistent with findings by Zuwarimwe and Mbaai (2015) where most respondents preferred private sales marketing options followed by auctions whereas butcheries were the least preferred option. Bahta *et al.* (2013) found that butcheries are one of the major market outlets for cattle rather than small stock.

Lastly, farmers also sell goats to other individual farmers. These are farmers who normally buy bucks and female goats to increase their stock. Farmers reported that most of these individual farmers are friends, neighbors, relatives and/or colleagues. Results show that slightly less than half (45%) of farmers interviewed prefers to sell to other individual farmers.

#### 4.1.5 Challenges Encountered by Goat Farmers

Farmers face several production and marketing constraints in goat farming (Figure 5). Reported challenges include lack of reliable market for goats, low selling prices, high transport costs, and low demand for goats, among others. Similar to Binge *et al.* (2019), lack of reliable market appears to be the major challenge to the majority of the farmers. Farmers (73%) also reported that they receive unfair prices from buyers.



**Figure 5: Major challenges encountered by goat farmers**

#### 4.2 Factors Influencing Goat Commercialization

Prior to running the models, econometric tests of multicollinearity were performed (see appendices) to check whether there is a correlation between the explanatory variables. A

Breusch-Pagan test was also conducted to check if the data portrays homoscedastic traits which make the variance to be normal. The mean Variance Inflation factor (VIF) indicated that there is no correlation between the explanatory variables. This shows that the regression model estimates for the coefficients are more stable and the standard errors for the coefficient are not wildly inflated (Williams, 2015). Similarly, in testing for heteroskedasticity, *ap*-value greater than 10% is not significant implying that we fail to reject the null hypothesis, so the data exhibit homoscedastic traits. A normal variance makes the data to be fit for analysis.

The Wald Chi-square of 162.28 was significant at 1% level, implying that the explanatory power of the factors included in the model was satisfactory. The pseudo  $R^2$  of 0.079 suggests that the variables included in the model explained about 8% of the variation in the level of commercialization which is a bit low but not entirely unexpected with cross-sectional data. The results indicate that explanatory variables age, contract agreement, distance to market, number of goats sold, type of breed, years of schooling and proportion of land allocated for livestock farming significantly and positively influenced the level of commercialization. However, gender and the peri-urban dummy had a negative significant effect on the level of commercialization. The marginal effects ( $dy/dx$ ) were used to interpret the determinants of commercialization.

The level of commercialization was measured using a Household Commercialization Index (HCI) where the mean HCI was 20%, with a minimum of zero and a maximum of 61%. According to Demeke and Haji (2014), an HCI less than 25% implies a probability that farmers are less commercialized. Besides, farmers who have an HCI value between 25% and 50% are considered to be moderately commercialized whereas those with an HCI above 50% are considered fully commercial. Therefore, the results of this study show that farmers are less commercial. An HCI of zero implies that farmers did not commercialize. Results of the FRM on factors influencing the level of commercialization are shown in Table 9.

The level of commercialization was negatively and significantly influenced by gender at 5% level. The negative sign means that being male reduces the level of goat commercialization by 3.66%. This implies that male farmers are less likely to be market market-oriented than their female counterparts; hence does not participate more in goat marketing. This is because goats

are small stock which can easily be handled by women (Dipheko *et al.*, 2016). Moreover, male tend to have resources to purchase and maintain large ruminants such as cattle.

**Table 9: Results of the Fractional Response Model on determinants of commercialization**

HCI	dy/dx	Coef.	SE	z	P> z
Gender of farmer	-0.0360	-0.1709	0.0670	-2.55	0.011**
Age of farmer	0.0012	0.0055	0.0027	2.06	0.040**
Years of schooling	0.0026	0.0124	0.0072	1.74	0.082*
Farming experience(years)	-0.0000	-0.0000	0.0043	-0.01	0.993
Household members	0.0001	0.0007	0.0200	0.03	0.973
Number of extension contacts	-0.0101	-0.0478	0.0664	-0.72	0.472
Number of training sessions	-0.0093	-0.0444	0.0240	-1.85	0.273
Farmer group participation	-0.0136	-0.0645	0.0703	-0.92	0.358
Access to credit	-0.0344	-0.1634	0.1217	-1.34	0.179
Contracts arrangements	0.0660	0.3138	0.1475	2.13	0.033**
Distance to market(km)	0.0004	0.0017	0.0008	2.29	0.022**
Type of breed kept	0.0426	0.2025	0.0675	3.00	0.003***
Government program beneficiary	0.0204	0.0971	0.0652	1.49	0.137
Number of goats sold	0.0075	0.0356	0.0043	8.37	0.000***
Access to information on available market	0.0158	0.0752	0.1426	0.53	0.598
Proportion of land allocated for livestock	0.0502	0.2385	0.1003	2.38	0.017**
Log value of assets owned(BWP)	-0.0045	-0.0213	0.0177	-1.21	0.228
Peri-Urban Dummy	-0.0338	-0.1609	0.0708	-2.27	0.023**
Constant		-1.8348	0.2492	-7.36	0.000***
Number of observations	266				
Wald chi2(17)	162.28				
Prob > chi <sup>2</sup>	0.0000				
	-				
Log pseudo-likelihood	102.203				
Pseudo R <sup>2</sup>	0.0782				

Note: \*\*\*, \*\*, \*= Significance at 1%, 5% and 10% level respectively; BWP=Botswana Pula; TLU= Tropical Livestock Unit; ha=Hectares; km=Kilometers; SE= Standard Error; Coef. = Coefficient; Exchange rate during time of study: 1Pula= US\$ 0.091.

The findings of this study are similar to Kahenge *et al.* (2019), Okemute *et al.* (2014) and Zamasiya *et al.* (2015) who concluded that gender negatively affects the participation of male headed households in the market, especially in Africa where some of the agricultural activities are culturally viewed as women's activities.

Farmers' age significantly and positively influenced the level of commercialization at 5% level. An increase in the age of a farmer increased the level of farmers' commercialization by 0.1%. Based on the descriptive statistics, the study found that the age of farmers was correlated with farming experience. Older farmers are likely to be more experienced and are well informed about better production technologies and adoption of high yielding practices and such as controlled and cross-breeding. Elderly farmers are possibly more passionate in farming compared to the younger generation who are less likely to be engaged in goat farming and prefer seeking employment in urban areas especially in the service sectors (Rabbi *et al.*, 2017). Further, they tend to have large households who are contributing positively to levels of commercialization through participation in goat marketing activities compared to younger farmers who possibly have smaller households. Similar findings by Rabbi *et al.* (2017) also revealed that farmers' age had a positive and statistically significant effect on commercialization.

The effect of years of schooling on the level of commercialization was also evident. An increase in education level by one year increases the level of commercialization by 0.26%. Higher level of education is important in enhancing farmers' access to market information and improves their ability to make meaningful decisions on how and when to sell their produce. This puts them in a better position to know different market outlets where their goats can be sold at a better price to increase income. Further, educated farmers are well knowledgeable to the use of technology and better husbandry practices to increase their production, hence participate more in the market. Gebremedhin and Jeleta (2010) has stated that the level of education raises human capital and increases the level of managerial abilities, which is an incentive for commercialization. The results are consistent findings by Akinlade *et al.* (2016) and Obsesan (2017), who found that education increases the level of commercialization in Nigeria.

The effect of contract marketing was found to be significant at 5% level. Having contract agreements increases the level of goat commercialization by 7.37%. This denotes that farmers who are marketing under contract arrangements had 7.37% chances of selling more goats due



to the availability of a ready market than those who do not have any contract agreements. Contracts act as an instrument to promote value chain efficiencies and smallholder market linkages and may also help farmers to increase their bargaining power. Normally, contract marketing guarantees farmers a ready market. Ready markets reduce farmers' costs that are associated with marketing as well as transport (Sigei *et al.*, 2015). Similar findings were obtained by Sigei *et al.* (2014), who indicated that contract marketing positively influenced the level of market participation because farmers who were operating under contract arrangements had a higher probability of increasing the proportion of sales.

Distance to market had a positive effect on the level of commercialization at 5% significance level. The marginal effects indicate that an increase in distance to the market increases the level of goat commercialization by 0.04%. On average, farmers travel for about 38km to reach the market. Most farmers keep goats in the cattle posts which are located far from the villages and towns. The results are not as expected because generally, as distance to the market increases, the probability of farmers' orientation towards commercialization reduces given transaction costs associated with transport and exchange (Agwu *et al.*, 2013; Yameogo *et al.*, 2018). However, longer distances coupled with good road infrastructure, reliable markets and better price offers could result in increased profits. Further, farmers who have reliable market located far from their farms would be prompt to increase their sales to avoid multiple trips they could travel if they were to sell in small numbers. Similar results by Ruhangawebare (2010) found that selling in large numbers may reduce the unit cost of transportation that producers incur due to longer distances. The aspect is subject to further research.

The level of commercialization was positively and significantly influenced by the type of breed of goats at 1% level. Despite the high preference for Tswana breed due to its adaptability traits to harsh climatic conditions, keeping improved breed led to a 4.5% increase in the level of commercialization because improved breeds attract higher prices from buyers as compared to local breeds. Since improved breeds are mainly raised for commercial purposes and are less adaptable to dry conditions, farmers invest relatively high in supplementing their feeds and in buying drugs. Therefore, farmers would intensively engage in market participation to earn profits, hence increases their level of commercialization. Similar findings by Tarekegn and Yosefe (2017) indicated that type of breed owned significantly and positively influenced household's market participation. They further stated that access and utilization of improved breed enhance the productivity and participation decision in marketing.

Regarding the number of goats sold, the variable had a significant and positive influence on the level of commercialization at 1% level. This means that the more the number of goats taken to the market, the higher the level of commercialization by 0.75%. In essence, farmers who sold more goats to the market had increased levels of commercialization. Due to the measurement of the level of commercialization which considered the proportion of the total value of goats sold in the market out of the total value of goats kept by a farmer, larger goat sales would imply a 0.75% increase in the proportion of commercialization. According to Kyaw *et al.* (2018), higher production could drive market participation since market participation is a function of productivity; farmers with high productivity have a surplus to sell in the market. Olwande and Mathenge (2012) also observed an increase in the extent of market participation for maize, vegetables, fruits and milk due to the proportion of products taken to the market.

Total land allocated for livestock farming had a significant effect on the level of commercialization at 5% level. Results suggest that more land allocated for livestock enhances the level of commercialization by 5.20%. A bigger land size allows farmers to engage intensively in goat commercialization and rear more goats. In addition, farmers could also preserve a greater portion of their land for grazing purposes, especially during the dry season. This may enhance their production since goats would not move for long distances looking for food hence maintain their body weight. The results are consistent with findings by Tufa *et al.* (2014) where farm size increased the level of commercialization at 1%. The study highlighted that an additional hectare of the land allocated for production would increase the values of output sold since land is a critical production asset having a direct bearing on the production of surplus due to economies of scale.

Farming in peri-urban areas reduced the level of commercialization compared to farming in rural areas. Most farmers who stay in peri-urban areas are either full time employed, part-time employed or self-employed. This means that they participate in other off-farm activities to source extra income outside the farm. Therefore, farmers who had other off-farm income activities tend not to be fully dependent on goat farming. Moreover, peri-urban farmers are more based in towns where farming is less common and a part-time activity. Contrary, the observations by Omiti *et al.* (2009) revealed that in Kenya, peri-urban villages were more commercialized than rural villages. The study found that rural households consume about most

of their products and sell the remaining in retail open-air markets whereas peri-urban households sell two-third of their produce mostly in wholesale markets. They further stated that rural farmers incur higher transport costs compared to their peri-urban counterparts in search of market channels which could be the potential constraints, particularly for the rural farmers.

### 4.3 Factors Influencing the Choice of Marketing Outlets among Smallholder Farmers

The correlation coefficients of the marketing outlets were obtained to evaluate the relevance of the MVP model. According to Young et al. (2009), MVP allows for a correlation between the dependent variables. The correlations of the marketing outlets in Table 10 show that the MVP model was suitable to analyze the data on the choice of marketing outlets since the outlets are not mutually exclusive.

**Table 10: Correlation coefficients of marketing outlets**

	<b>Other Farmers</b>	<b>Butcheries</b>	<b>Individual Consumers</b>	<b>Government Programs.</b>
Other Individual Farmers	1			
Butcheries	0.1524**	1		
Individual Consumers	0.1048*	-0.1218**	1	
Government Programs	0.0921	-0.0749	-0.1564**	1

**Note:** \*, \*\*=Significance at 10% and 5% level, respectively

Table 11 provides MVP results on factors influencing the choice of marketing outlets. The Wald Chi<sup>2</sup> value of 915.73 and prob>chi<sup>2</sup>=0.000 indicate a significant model, implying that the variables included in the model fit the MVP model well. The Log pseudo-likelihood statistics was also significant.

Household members actively involved in goat farming positively influenced the likelihood of selling to other individual farmers at 5% significance level. The results indicate that an increase in household members by one member increases the choice of selling to other individual farmers by 31.39%. A household member who is involved in goat farming activities is likely to be actively involved in goat marketing as well.

**Table 11: Results of the Multivariate Probit model on the choice of marketing outlets**

Variables	Other							
	Individual farmers		Butcheries		Individual Consumers		Government Programs	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Gender of a farmer	0.1148	0.1739	0.2152	0.2268	-0.2833	0.2513	0.2388	0.1765
Age of a farmer	0.0007	0.0067	0.0090	0.0095	0.0103	0.0075	0.0058	0.0071
SD Household members	0.3139**	0.1445	0.0164	0.1872	-0.0869	0.1969	0.0007	0.1502
Years of schooling	-0.0205	0.0207	-0.0358	0.0246	0.0446*	0.0264	0.0239	0.0224
Farming experience	-0.0187**	0.0092	-0.0195*	0.0117	-0.0082	0.0127	-	0.0092
Farmer group participation	-0.0321	0.2293	-0.6695	0.5093	0.4426	0.4009	0.1680	0.2332
SD-Access to credit	0.1399	0.0861	0.2156**	0.0960	0.3127*	0.1865	-	0.0997
Number of goats sold	-0.0094	0.0105	-0.0112	0.0120	-0.0190*	0.0100	0.0617***	0.0125
Distance to market (km)	0.0026	0.0024	0.0074***	0.0025	0.0160***	0.0061	0.0029	0.0029
Type of breed kept	0.0537	0.1890	0.0034	0.2214	-0.1667	0.2655	0.3956**	0.2000
Access to reliable market	0.0826	0.2137	0.1227	0.2665	-0.6198	0.3963	-	0.2153
Log value of assets owned(US\$)	0.0652	0.0516	0.0135	0.0743	-0.0178	0.0785	-	0.0555
Number of other livestock(TLU)	-0.0059	0.0069	0.4516	0.2347	-0.4601	0.2527	-	0.1784
Peri Urban dummy	-0.1050	0.1681	0.0001*	0.0113	0.0059*	0.0075	0.0075	0.0080
Constant	-0.8190	0.5969	-1.9840	0.8176	1.9323	0.8801	-	0.6360
Number of observations	266							
Wald chi <sup>2</sup> (56)	178.05							
Log pseudo-likelihood	-459.96							
Prob > chi <sup>2</sup>	0.0000							

Note: \*, \*\*, \*\*\*=significance at 10%, 5% and 1% level, respectively; SD= Standardized; km=kilometer, BWP = Botswana Pula; TLU=Tropical Livestock Unit; SE= Standard Error; Coef. = Coefficient; Govt. = Government; Exchange rate during time of study: 1Pula= US\$ 0.091.

This is because unlike other outlets, other individual farmers purchase goats for production, of which they mostly purchase through connections or from farmers they know based on the goat characteristics they prefer. Since most of these individual farmers are relatives, neighbors, friends and colleagues, a bigger household possibly means a bigger network by each member which could affect the marketing of goats to other individual farmers who need stock. Bigger households could also contribute to farmers' decisions and strategies to choose the best outlet which can benefit the entire household especially other individual farmers. Additional household members could play a vital role in linking farmers to the market through information dissemination from their friends and other sources of information. Results by Montshwe (2006) found that larger households are more inclined to increase their production and marketing to a more economically viable extent and participate in mainstream markets.

Farmers' level of education positively influenced their decisions to sell to individual consumers at 10% significance level. As the number of schooling increases by one year, the probability of selling to individual consumers increases by 4.46%. This is possibly because farmers who have acquired formal education and training have better business skills and knowledge. Such knowledge helps to minimize unnecessary costs of production and marketing and increase their earnings. Therefore, individual consumers appear to be the best marketing outlet where farmers would make sales with fewer transaction costs resulting in good returns. This is because individual consumers buy at the farm gate and their buying prices are flexible. Further, educated farmers are more empowered on price decision making and selling to individual consumers would enable them to negotiate for better prices. According to Edossa *et al.* (2019), education helps farmers to select the best marketing outlets for their produce. It may have a major impact on transforming and creating many marketing avenues for goat farmers. Edossa *et al.* (2019) further revealed that oriented farmers usually have access to various marketing information and market outlet choices.

An increase in the years of farming had a significant negative effect on farmers' choice of other individual farmers and butcheries outlets at 5% and 10% levels respectively. Results suggest that as farmers become more experienced in goat farming, the likelihood of selling to other individual farmers reduces by 1.87% and to butcheries reduces by 1.97%. Since experienced farmers have been engaged in farming for long, they have a better understanding of the goat industry which makes them have greater contacts that allow trading opportunities to be discovered at a lower cost. Experienced farmers have good marketing strategies and make well-

informed decisions in choosing marketing outlets. Wosene *et al.* (2018) also discovered that experienced farmers have a better knowledge of cost and benefits associated with various goat marketing outlets. Due to their lower fixed prices, butcheries were the least preferred outlet in the entire region due to its lower prices and this makes experienced farmers not to be an exception mainly because of their business skills to negotiate for better prices. More experienced farmers have a higher likelihood of acquiring information on available markets which makes them to always have better alternatives. Likewise, other individual farmers were not the best market because they tend to offer lower prices as they purchase goats for stock and production as well. Similar to Nsoso (2004), most farmers believed that individual consumers were offering reasonable prices even though purchases were made in small numbers.

Access to credit had a significant and positive effect on the choice of butcheries and individual consumers at 5% and 10% levels respectively. The positive sign means that the ability of farmers to access credit increased the likelihood of selling to butcheries by 21.56%. Similarly, farmers' access to credit enhanced farmers' preference to sell to individual consumers by 32.27%. The preference to sell to butcheries is because credit invested in farm technology and input purchases extends to production enabling farmers to rear more and increase their flock size and eventually their level of commercialization. Therefore, since butcheries buy goats in bulk and regularly, farmers would prefer to maximize their profits to repay the loans. Further, individual consumers could be the best alternative outlet to provide instant cash needed because they are the principal goat market in the study area. Similar results were obtained by Richard (2017), where access to credit services increased the probability of selling to the brokers. The study highlighted that the use of credit on inputs boost yield and lead to a more marketable surplus to be supplied to brokers. According to Abayneh and Tefera (2013), access to credit helps the farmers to buy different inputs for production, to cover labour costs, transportation costs as well as other costs related to their operation hence contributing positively to their decision to participate in the market.

The probability of selling to government programs increased by 6.17% as the number of goats taken to the market increases. Likewise, an increase in the number of goats sold reduced the likelihood of selling to individual consumers by 1.90%. More goat sales imply an increased level of commercialization, therefore, farmers with large herds of goats will prefer to sell to government programs who purchase in bulk to supply beneficiaries rather than individual consumers who buy in small quantities. Further, farmers who could afford to supply

government programs with stock tend to be market-oriented and would not mind being paid using a cheque, which is the common mode of payment used by the government. Results are consistent with findings by Emanu *et al.* (2015) who found that quantity sold reduced the likelihood of farmers selling to collectors because households with large volumes prefer to use market outlets that would bring higher earnings. The study further stated that a large volume of sales motivates households to prioritize the channels and decide to use the best alternative.

The distance to market was measured in kilometres. The variable significantly and positively influenced the choice of butcheries and individual consumers at 1% level each. An increase in the distance to reach the market place increases the likelihood of farmers selling to both butcheries by 0.74% and to individual consumers by 6.17%. Generally, longer distances are associated with high transport costs to make deliveries. Therefore, in such instances, farmers prefer selling to butcheries and individual consumers because they provide their transport as they buy at the farm gate. Farmers could also negotiate for better prices with individual consumers who mainly purchase for consumption. Moreover, farmers who had established agreements to supply goats to butcheries will sell to such outlets to secure reliable markets despite being distant away. Butcheries were also preferred for buying in bulk even though their prices seem to be lower than those offered by individual consumers. The results are comparable with findings by Abera *et al.* (2016) who revealed that distance to market makes farmers sell their produce to rural assemblers due to low transportation costs incurred in taking the farm produce to major market places.

The type of breed of goats kept by farmers was important in influencing the choice of government programs outlet. Results indicate that keeping local breed of goats enhanced the likelihood of farmers selecting government programs by 39.56%. The government usually purchase female goats (of which are local breeds) and buck (mainly improved breed) to supply initial stock for newly funded beneficiaries. Therefore, farmers who keep the desired breed by the government are likely to sell to the government more especially because they purchase the stock in bulk. Further, farmers especially those who were funded by the government tend to sell back to government programs because of the agreement established. According to Richard (2017), breed type take into consideration some inbreeding and reproduction matters, therefore preference based on breed attributes affects farmers' choice of marketing channels. For example, Assefa (2008) found that large-sized, white coloured goats with thick and straight horns have better market value and are fast marketed than other coloured goats in Ethiopia.

Access to reliable markets negatively influenced the choice to sell to government programs at 5% significance level. The negative sign implies that access to reliable markets decreases the choice of government programs by 43.55%. The possible reason is that government programs offer low fixed prices and also make payments using cheque which may not be the preferred method for most of the farmers. Therefore, such may hinder farmers to sell to the government provided there are ready and reliable markets offering better prices and most preferred payment methods like cash. Further, farmers who keep improved breeds may not consider government programs as the best outlets since the government mostly purchase local breeds for their beneficiaries. The findings are consistent with Hailu and Fana (2017) who revealed that access to market negatively influenced farmers to choose wholesale markets compared to retail markets. The study highlighted that, as households had more access to the market area; the more they diversified their production and supply to retailers.

Farming in peri-urban areas influenced both butchereries and individual consumers in different directions. First, farming in peri-urban areas reduced the likelihood of choosing butchereries at 10% significance level. Secondly, farmers located in peri-urban areas had lower chances of selling to individual consumers by 0.59%. Farming location is important in enhancing farmers' ability to access and choose the best-marketing outlets alternatives available for them. Due to peri-urban and population sizes, many butchereries sell goat meat. This, therefore, makes butchereries' demand for goats to be higher in peri-urban areas compared to rural areas. Additionally, there is a likelihood that farmers in peri-urban areas have agreements to supply goats to butchereries, hence the choice of such an outlet. Further, farmers who are in peri-urban areas would also choose to sell to butchereries since they purchase regularly to supply meat, unlike individual consumers.

#### **4.4 Effects of Goat Commercialization on Household Income**

Table 12 presents the results of the factors influencing household income. The results indicate that variables age, years of schooling, type of breed kept by farmers and assets owned had a significant and positive influence on the household income of both commercialized and non-commercialized farmers. Other variables such as off-farm participation and the number of household members involved in goat farming negatively influenced household income.



**Table 12: ESR Results on the factors influencing household income**

Household Income	Selection model		Commercialized		Non-commercialized	
	B	SE	$\beta$	SE	$\beta$	SE
Age of a farmer	-0.0672***	0.0218	0.013 0***	0.0048	0.0046	0.0086
Gender of a farmer	-0.0719	0.5988	0.0843	0.1426	-0.1892	0.2426
Household members	-0.4936	0.3030	-0.0143	0.0401	-0.0547	0.0618
Years of schooling	0.1550*	0.0828	0.0466***	0.0176	0.0423*	0.0249
Access to extension services	0.6607**	0.3221	-0.0300	0.1470	0.4831*	0.2566
Number of training sessions	-0.3513	0.5787	0.1532	0.1722	-0.4967	0.3510
SD Average goat price (US\$)	-1.3525**	0.0902	0.0581	0.0671	0.1936	0.1350
Off-farm participation	-0.1142	0.2842	- 0.2877***	0.0618	-0.2145**	0.0833
Type of breed kept	0.5564**	1.1448	0.4273***	0.1436	0.2711	0.3015
Farmer group participation	-0.9430	0.3007	- 0.117 1	0.1872	0.2276	0.4637
Number of assets owned	0.2128	0.5065	0.1947***	0.0686	0.0303	0.1117
SD By-products sold	-0.2282	0.4208	0.0831	0.0628	0.1978	0.1853
Constant	7.5481***	0.0255	9.2039**	0.4751	9.7316** *	0.6462
Mode of payment	0.0786***	0.0255				
Distance to market(km)	0.0195	0.0146				
Beneficiary of government programs	-0.6411	0.5199				
Number of observations	266					
Wald chi <sup>2</sup> (12)	80.33					
Log-likelihood	-354.59					
Prob> chi <sup>2</sup>	0.0000					

Note: \*\*\*, \*\*, \* = Significance at 1%, 5% and 10% levels; km=Kilometres; Coef. = Coefficient; SE = Standard Error; SD = Standardised; Exchange rate during time of study: 1Pula= US\$ 0.091.

An increase in the age of a farmer by one year increased the household income of commercialized income by 1.30%. Elderly farmers are likely to be more experienced and well

informed in better marketing and production practices such as controlled breeding which could enhance production. They tend to have a high level of goat commercialization and earn more profits and increase their income. Moreover, their household income could also be attributed to the accumulation of resources and wealth through investments and savings over time. Similarly, due to social networks established over time, older farmers are likely to have better marketing strategies as well as access to information on available markets which could positively influence their level of commercialization. Lhing *et al.* (2013) found that age negatively influenced household income of farmers. This could probably be because farmers' energy and ability to work and produce more tend to diminish with time.

Education level is a common significant variable influencing household income. Results indicate that an increase in the number of years of schooling increases commercialized farmers' household income by 4.66%. Besides, education level reduced the income of non-commercialized farmers by 4.23%. Educated farmers are expected to have higher incomes than those who did not have any formal education. This is because they are likely to have higher income earning potentials and more alternative opportunities to diversify their income generation activities. However, education level for non-commercialized farmers negatively influenced their household income probably because; though they attained formal education, they acquired low qualifications such as primary education which could not allow them to get high paying jobs. Results for non-commercialized are similar to findings obtained by Rabbi *et al.* (2017) who revealed that education level negatively influenced household income. The study discovered that the reason might be because farmers started formal education and leave after a few years of schooling to join farming as a full-time occupation.

Off-farm participation negatively influenced household income for both commercialized and non-commercialized farmers at 1% and 5% significance levels, respectively. Results imply that an increase in off-farm participation reduces the household income of commercialized farmers by 28.77%. Similarly, as non-commercialized farmers participate more in off-farm activities, their household income reduces by 21.45%. Studies show that households that participate in off-farm employment have higher incomes (Anang, 2017) as they source extra income besides income from the farm. However, a possible explanation is that farmers who venture in off farm activities do it out of distress and a push hence engages in petty trade and business just to meet basic needs. The results are consistent with findings by Rakotoarisoa and Kaitibie (2019) who revealed that participation in off-farm activities has no effect on overall agricultural income.

The number of assets owned by a farmer positively influenced commercialized farmers' income at 1% significance level. The results imply that the more assets owned by a farmer, the more the likelihood of an income increase by 19.47%. Assets such as land, livestock and other productive assets could be leased, sold and be used productively to earn more income. According to OECD (2011), households who have assets can utilize them to generate income and attain a higher standard of living. Further, assets are considered more stable over time and give a reflection of accumulated investments and savings; and are a good indicator for long-run household economic status and permanent income (Dzanku, 2015; Filmer & Pritchett, 2001).

The effect of type of breed of goats on household income was significantly positive at 1% level. Results indicate that keeping improved breeds increases household income for commercialized farmers by 42.73%. This is because improved breeds are expected to earn higher returns due to higher values attached to them. Further, goat by-products such as milk sales are expected to be relatively higher for improved breeds because they are likely to produce more litres of milk compared to local breeds. Farmers who keep improved breeds tend to practice some controlled breeding which enhances high birth rates hence increase production. The results are consistent with findings by Assefa (2008) who revealed that large-sized, white coloured goats with thick and straight horns have better market value and are fast marketed than other coloured goats.

Regarding access to extension services, the variable was significant at 10% level. Access to extension services positively influenced household income by 48.31% for non-commercialized farmers. Farmers who have contact with extension agents are more likely to acquire knowledge about production, input and output prices, information on markets as well as veterinary services. Information on veterinary services and diseases raises awareness for farmers to take necessary precaution measures and reduce mortality rates as well as maintain the good health and desired weight of the goats. According to Richard (2017), market information on prices, demand, buyers, and other relevant information could contribute to farmers' marketing decisions which could significantly raise the probability of commercialization among households. Anang *et al.* (2020) also observed that participation in agricultural extension enhances farm income of farmers, hence the need to increase access to extension services especially for smallholder farmers.

#### 4.4.1 The Treatments Effects of Household Income

To determine the effect of commercialization on household income, ESR model was used. The income model was estimated jointly with the selection model that explains farmers' commercialization. Diagnostic tests were performed before running the model to test whether commercialization is endogenous in the model or not. The Durbin (score)  $\chi^2$  and the Wu-Hausman F (1,254) tests were significant implying that we reject the null hypothesis that commercialization was exogenous in the model. Further, the estimated coefficients of the three instrumental variables (payment mode, distance to market and beneficiary of government support programs) were jointly significant [F (3,253),  $p < 0.001$ ]) and the minimum Eigen statistics (62.15) appeared to be greater than the critical values. Therefore, the null hypothesis: instruments were weak, was rejected implying that the instrumental variables used in the model were valid. This then supported their usage in identifying the selection model since they do not directly affect household income. The Wald test  $\chi^2$  also indicates that the model was significant at the 1% level. In determining the mean treatment effects of commercialization, commercialized farmers were considered as the treatment group whereas non-commercialized farmers were the control group, and the hypothetical counterfactual estimation of the two groups was also made. The estimated results of the treatment effects are presented in Table 13.

The diagonal values on (a) and (d) represent the actual mean values of household income for commercialized and non-commercialized farmers, respectively. The values on (b) provide the counterfactual expected estimates for non-commercialized farmers and (c) give the counterfactual expected estimates for commercialized farmers. The ATT results show that commercialized farmers would earn US\$ 0.66 less, had they decided not to commercialize.

In the same way, non-commercialized farmers would earn an extra US\$1.08 if they have decided to commercialize. This indicates that goat commercialization has a positive and significant effect on household income for both groups. Therefore, farmers who commercialize are better off than those who do not commercialize. According to literature (Olwande & Smale, 2014), the base heterogeneity effects ( $BH_1$ ) imply that, had they commercialized, non-commercialized farmers would perform better than commercialized farmers. On the other hand,  $BH_2$  shows that commercialized farmers would perform better than non-commercialized farmers even if they did not commercialize. The results indicate that for each decision stage, the counterfactuals are higher than the actual incomes for the two groups.

**Table 13: Mean Treatment effects on household income**

Sub sample	Decision stage		
	Commercialized	Non-commercialized	ATE
Commercialized	a) 9.90	c) 9.23	0.66***
Non-commercialized	b) 10.12	d) 9.03	1.08***
<b>Heterogeneity effects</b>	<b>BH<sub>1</sub> = -0.22</b>	<b>BH<sub>2</sub> = 0.20</b>	<b>TH = -0.42</b>

Note: \*\*\*= significance at 1% level

Similar results were obtained by Opondo and Owuor (2018) and Muricho *et al.* (2017) where the commercialized counterfactual performed better than the actual non-commercialized. The table also provides a negative TH results which show that the effect of commercialization was significantly higher for non-commercialized farmers than for commercialized farmers. This implies that the non-commercialized would earn US\$ 0.42 higher than commercialized farmers. Overall results of the study are in line with literature that supports positive income effects of goat commercialization at the household level (Justus *et al.*, 2015; Tatwangire, 2011; Wasseja *et al.*, 2018). According to Wasseja *et al.* (2018), goat commercialization is a means to improve household livelihoods through raising income thereby a means of reducing the incidence of poverty.

## **CHAPTER FIVE**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Conclusions**

Although the level of commercialization was generally low in the region, high proportions of farmers were selling goats. This implies that most goat farmers already have an experience with the market and may not require much push to increase their engagement through commercialization. This by itself presents an opportunity and entry point for government and other stakeholders in their support to improve the welfare of goat farmers and increased market orientation. The regression analysis results indicate that having contractual arrangements to supply goats and type of breed were some of the key drivers of the level of goat commercialization. Contractual arrangements assure farmers of a ready and reliable market hence acting as an incentive to commercialize. Further, improved breed of goats plays a major role in commercialization since improved breeds are mainly kept for commercial purposes.

The study further evaluated factors influencing the choice of marketing outlets among smallholder goat farmers. The results show that most farmers preferred to sell goats to individual consumers, with the least preferred being butcheries. Econometric results revealed that the choice of a market outlet was majorly affected by farmers' years of schooling, access to credit, farming experience as well as the type of breed of goats.

Finally, the study determined the effects of commercialization on the household income of smallholder farmers. Results of the Average Treatment Effects (ATE) model showed a positive and significant effect of commercialization on household income for both commercialized and non-commercialized farmers. The results imply that goat commercialization enhances household income and transitioning to market-oriented farming will improve farmers' livelihoods as well as diversify the economy of the country. Other drivers of household income include age of farmers, type of breed, number of assets owned, access to extension services as well as years of schooling.

#### **5.2 Recommendations**

Given the significance of contractual farming on the level of commercialization, government support in encouraging and facilitating contract farming is important. Creating awareness and promoting contract farming and other relevant market coordination mechanisms for improved market access would be an added advantage. Moreover, support and investment in contract

farming could provide farmers with access to a range of managerial and technical services that may not be easily obtained. The study recommends farmers to utilize contract farming as it could facilitate access to credit with commercial banks for funding to boost their production. Further, other commercialization determinants such as access to extension services, credit and training need strengthening.

The study also recommends the development of a decentralized market such as BMC for small stock, especially in catchment areas with large number of goats such as Kweneng and Kgalagadi districts. Well-functioning and designed markets may contribute to household welfare and overall economic growth.

Further, given the impact of commercialization on household welfare, policies that enhance commercialization and encourage market-oriented farming should be prioritized. This includes farmer support programs, improved extension services and farmer training which may encourage a profitable farming business and contribute to improved household welfare.

### **5.3 Further Research**

Further research on the demand for goat meat and other by-products could provide better understanding of the availability and nature for goats in the country. The current study was limited to the production side without exploring on goat consumption. However, end-users are also important players in the value chain. Further study on the description of existing outlets in terms of their preferences, standards and prices would better inform policies on the side of buyers as well.

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## APPENDICES

### Appendix 1: Questionnaire

My name is Gomolemo Ngwako and I am a student at Egerton University. You have been selected as one of the respondents whom I believe can provide valuable information and support towards achieving the objectives of this research project. I commit and promise that all the information you provide will be treated with strict confidentiality. The results will be published as a collective analysis without mention of any single individual or organization. Your participation in answering these questions is highly appreciated.

Please indicate whether you agree or disagree with the following statements by placing a tick (✓) next to the statement in the column with a score corresponding to your correct response. Provide an answer where necessary.

### IDENTIFICATION

Questionnaire No \_\_\_\_\_ Date (dd/mm/yy) \_\_\_\_\_ Sub-district \_\_\_\_\_ Village \_\_\_\_\_ Ward \_\_\_\_\_ Plot number \_\_\_\_\_  
Enumerator name \_\_\_\_\_

### PART A: DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENT

- 1) Name of the farmer \_\_\_\_\_
- 2) Telephone Number \_\_\_\_\_
- 3) Are you a household head? Yes [  ] No [  ]
- 4) Gender of the farmer (*Tick as appropriate*) Female [  ] Male [  ]
- 5) Age of the farmer (*Years*) \_\_\_\_\_
- 6) Age of the household head (*Years*) \_\_\_\_\_
- 7) Number of family members who are actively engaged in goat farming \_\_\_\_\_
- 8) What are the ages of your household members?  
1. [  ] 2. [  ] 3. [  ] 4. [  ] 5. [  ] 6. [  ] 7. [  ]  
8. Others, (*specify*) \_\_\_\_\_
- 9) What is the gender of your household members?  
1. [  ] 2. [  ] 3. [  ] 4. [  ] 5. [  ] 6. [  ] 7. [  ]  
8. Others, (*specify*) \_\_\_\_\_
- 10) Education level of the farmer (*years of schooling*)? \_\_\_\_\_
- 11) Goat farming experience of the farmer (*years*)? \_\_\_\_\_

## **PART B: SOCIO ECONOMIC AND INSTITUTIONAL FACTORS**

1) Did you have contact with extension officers in the last 12 months?

Yes [ ] No [ ]

2) If yes, how many times did you contacts extension service providers? \_\_\_\_\_

3) What kind of extension services did you access?

1. Veterinary services [ ] 2. Marketing Information [ ] 3. Govt subsidies [ ] 4. Others, (specify) \_\_\_\_\_

4) Did you receive any trainings related to goats in the last 12 months? Yes [ ] No [ ]

5) If yes, how many trainings sessions? \_\_\_\_\_

6) Have you ever done any marketing course for the past 5 years? Yes [ ] No [ ]

7) Do you have access to information on available market? Yes [ ] No [ ]

8) Where do you often get information on available market? (*Tick on all that apply*)

1. I do not have access to it [ ] 2. Media [ ] 3. Extension Officers [ ] 4. Friends [ ]  
5. Other farmers [ ] 6. Buyers [ ] 7. Government [ ] 8. Others, (specify)

9) Do you have access to grazing areas? Yes [ ] NO [ ]

10) Where do you access drinking water for your goats from?

1. Own a borehole [ ] 2. Rent a borehole [ ] 3. Buy water [ ] 4. . Others, (specify)  
\_\_\_\_\_

11) If buy or rent, how much do you pay per month? \_\_\_\_\_

12) Do you belong to any farmer group? Yes [ ] No [ ]

13) Are you a member of any social group? Yes [ ] No [ ]

14) If yes, which group? \_\_\_\_\_

15) Have you accessed any credit to boost your production? Yes [ ] No [ ]

16) If yes, what is the total amount last accessed in the past 5 years \_\_\_\_\_

## **PARTC: GOAT COMMERCIALIZATION**

1) Why do you primarily keep goats?

1. For selling [ ] 2. For Household consumption [ ] 3. Income supplement [ ] 4. Others, (specify) \_\_\_\_\_

2) If you are selling, do you also buy from other farmers or neighbors to sell? Yes [ ] No [ ]

3) How many goats have you slaughtered for household consumption in the last 12 months? \_\_\_\_\_

4) How many goats were given out as a gift in the last 2 months?

1. Neighbors [        ]    2. Family members [        ]    3. Friends [        ]    4. Others  
(specify) \_\_\_\_\_

5) What other goats by products do you sell apart from goats?

1. Leathers [        ]    2. Milk [        ]    3. Kraal manure [        ]    4. Others, (*specify*)  
\_\_\_\_\_

6) If you sell them for how much do you sell per month?

1. Leathers \_\_\_\_\_ 2. Milk \_\_\_\_\_ 3. Kraal manure \_\_\_\_\_ 4. Others, (*specify*)  
\_\_\_\_\_

7) Goat sales (in the last 12 months)

	Number of goats sold	Unit Price (Pula/goat)	Total Revenue (Pula)	Payment mode(Cheque, cash,Credit, Multiple, specify)
Uncastrated Bucks 1 year and above				
Castrated males 1 year and above				
Females 1 year and above				
Males under 1 year				
Females under 1 year				

8) Have you benefited from any government program/project? Yes [    ] No [    ]

9) If yes, which program (s)?

1. LIMID [    ]    2. Nyeletso lehuma [    ]    3.CEDA [    ]    4.YDF [    ]    5. YFF [    ]    6. Others  
(*specify*) \_\_\_\_\_

10) If No, what was your source of your funding? \_\_\_\_\_

11) What is the nature of your livestock production system?

1. Intensive [    ]    2. Semi intensive [    ]    3. Extensive [    ]

12) Which farming system do you maintain your goats under?

1. Communal [    ]    2. Private [    ]    3. Others, (*specify*) \_\_\_\_\_

13) Do you supplement feeds for your goats? Yes [    ]    NO [    ]

14) If yes, how much do you buy for your feeds per month (specify the quantity)?

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15) Do you have a herdboys (s)? Yes [ ] No [ ]

16) If yes, how many? \_\_\_\_\_

17) If yes, how much do you pay them (each)? \_\_\_\_\_

**PART D: MARKETING OUTLETS**

1) Do you have any contract agreement to supply goats? 1. YES [ ] 2. NO [ ]

2) Where do you normally sell your goats?

1. Do not sell [ ] 2. Individuals customers [ ] 3. Individual farmers [ ] 4. Butcheries [ ] 5. BMC [ ] 6. Government programs [ ] 7. Others, (*specify*): \_\_\_\_\_

3) How many goats did you sell through these outlets in the last 12 months?

1. Did not sell [ ] 2. Individuals customers [ ] 3. Individual farmers [ ] 4. Butcheries [ ] 5. BMC [ ] 6. Government programs [ ] 7. Others, (*specify*): \_\_\_\_\_

4) How often did you sell to the following marketing outlets in the last 12 months (*weekly, monthly, twice a month*)?

1. Did not sell [ ] 2. Individuals customers [ ] 3. Individual farmers [ ] 4. Butcheries [ ] 5. BMC [ ] 6. Government programs [ ] 7. Others, (*specify*): \_\_\_\_\_

5) For how long do you travel to reach your nearest market? (*distance in km*) \_\_\_\_\_

6) How do you transport your goats to the market?

1. Own a truck [ ] 2. Hire a truck [ ] 3. Customers transport for themselves [ ] 4. Others, (*specify*) \_\_\_\_\_

7) How much on average did it cost to transport your goats in the last 12 months?

\_\_\_\_\_

**PART E: ASSETS OWNERSHIP**

1) How many goats do you own and state the per unit market value for the following?

	Bu ck(Uncast rated)	Cas trated Males 1yea r and over	F emales 1year and over	F emales under 1 year	F emales under 1 year	To tal number of goats owned	T otal value of goats owned
Ts wana(#)							
<i>Un it Value</i>							
Cr osses(#)							
<i>Un it value</i>							
Ex otic(#)							
<i>Un it Value</i>							

2) Number and estimate of the current value of other livestock and assets owned by the farmer.

Livestock	Number	Value per unit (P)
1. Cattle		
2. Sheep		
3. Chicken		
4. Others, ( <i>specify</i> )		

Items	Number	Value per unit(P)
5. Farm implements		
6. Ear tags		
7. Buddizzo		
8. Kraal		
9. Syringe		
10. Troughs		
11. Water tank		
12. Borehole		
13. Vehicle		
14. Donkey cart		
15. Mobile phone		
16. Radio		
17. TV		
18. Refrigerator		
19. Others, ( <i>specify</i> )		
20.		

3) How many hectares of land do you own for agricultural activities? \_\_\_\_\_

4) How much land is allocated for; 1.Livestock \_\_\_\_\_ 2. Crops \_\_\_\_\_

5) What type of land do you own?

1. Private [ ] 2. Rented [ ] 3. Freehold [ ] 4. Tribal [ ] 5. Communal [ ]

6.Others, (*specify*) \_\_\_\_\_

6) What is your main source of your drinking water?

1 Tap [ ] 2 Borehole [ ] 3.River [ ] 4.Well [ ] 5. Rain water [ ] 8. Other

(*specify*) \_\_\_\_\_

7) What kind of toilet facility does your household have? \_\_\_\_\_

1. Flush toilet [ ] 2.Traditional pit latrine [ ] 3.None/Bush/Field [ ] 5. Other (*specify*)

\_\_\_\_\_

8) What types of materials make the walls, roof and floor of your house?

Walls	Roof	Floor
1. Mud	1. Grass	1.Mud
2. Wood	2.Iron sheets	2.Cement
3. Iron sheets	3.Tiles	3.Tiles
4. Bricks	4. Others <i>specify</i>	4. Others, <i>specify</i>
5.Stones		
6.Others <i>specify</i>		

## PART F: HOUSEHOLD INCOMES AND EXPENDITURES

1) Employment status of a farmer?

1. Working full time [ ] 2.Working part-time [ ] 3.Self-employed [ ] Not working [ ]

Others, (*specify*) \_\_\_\_\_

2) Sources of Household Income in the last 12 months

Source of Income	Amount in Pula
1. Cattle	
2. Goats	
3. Sheep	
4. Chicken	
5. Pigs	
6. Sorghum	
7. Sales of milk	
8. Maize	
9. Beans	
10. Watermelon	
11. Off farm employment	
12. Pension	
13. Others, ( <i>Specify</i> )	
14.	

3) How much do you spend on the following items per month



Items	Amount spent
1. Food	
2. Housing(Rent)	
3. Clothing	
4. School fees	
5. Health services	
6. Fuel	
7. Water bills	
8. Others,(specify)	
9.	

**PART G: CONSTRAINTS FACED BY FARMERS**

1) What challenges do you face in selling your goats?

1. Lack of market/buyers Yes [ ] NO [ ] 2. Low prices Yes [ ] NO [ ] 3. High transport costs Yes [ ] NO [ ] 4. High input prices Yes [ ] NO [ ] 5. Low demand of goats Yes [ ] NO [ ] 6. Others, (*specify*) \_\_\_\_\_

2) How many goats did you lose due to?

1. Drought\_\_\_\_\_ 2.Wildlife\_\_\_\_\_ 3.Pests and Diseases\_\_\_\_\_ 4. Theft \_\_\_\_\_  
 5. Other, (*specify*) \_\_\_\_\_

3) What other major challenges are you experiencing in goat farming (*in order of importance, starting with the most important one*)

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**THANK YOU FOR YOUR PARTICIPATION!**

## Appendix 2: Objective One Output

### a) Fractional Response Model results

```
. fracreg probit HCI gender age education experience family_members extn_access training_sessions farmer_group credit_access contract distance breed beneficiary goats_sold access_info LandPr
> op ASSETS Peri_Urban
```

```
Iteration 0: log pseudolikelihood = -205.22481
Iteration 1: log pseudolikelihood = -103.74973
Iteration 2: log pseudolikelihood = -102.20567
Iteration 3: log pseudolikelihood = -102.2034
Iteration 4: log pseudolikelihood = -102.2034
```

```
Fractional probit regression      Number of obs      =      266
                                Wald chi2(18)       =     162.28
                                Prob > chi2            =      0.0000
Log pseudolikelihood = -102.2034 Pseudo R2           =      0.0782
```

HCI	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
gender	-.1709105	.0670431	-2.55	0.011	-.3023125	-.0395085
age	.005469	.0026608	2.06	0.040	.000254	.0106841
education	.0124298	.0071512	1.74	0.082	-.0015863	.0264458
experience	-.000038	.0042964	-0.01	0.993	-.0084587	.0083827
family_members	.0006668	.0200277	0.03	0.973	-.0385869	.0399204
extn_access	-.0478076	.0664443	-0.72	0.472	-.178036	.0824208
training_sessions	-.0443707	.023973	-1.85	0.064	-.091357	.0026155
farmer_group	-.0645427	.070261	-0.92	0.358	-.2022518	.0731663
credit_access	-.1634246	.1217214	-1.34	0.179	-.4019943	.075145
contract	.3137844	.1474662	2.13	0.033	.0247559	.6028129
distance	.0017298	.0007552	2.29	0.022	.0002496	.0032099
breed	.2024675	.0675199	3.00	0.003	.0701309	.334804
beneficiary	.0971011	.0652305	1.49	0.137	-.0307483	.2249506
goats_sold	.035614	.0042533	8.37	0.000	.0272777	.0439502
access_info	.0752063	.1425863	0.53	0.598	-.2042577	.3546703
LandProp	.2385265	.1002849	2.38	0.017	.0419717	.4350812
ASSETS	-.0213338	.0176897	-1.21	0.228	-.056005	.0133373
Peri_Urban	-.1608605	.070761	-2.27	0.023	-.2995496	-.0221715
_cons	-1.83479	.2491547	-7.36	0.000	-2.323124	-1.346455

### b) Marginal effects output of the Fractional Response Model

```
. margins, dydx(*)
```

```
Average marginal effects      Number of obs      =      266
Model VCE      : Robust
```

```
Expression      : Conditional mean of HCI, predict()
dy/dx w.r.t.    : gender age education experience family_members extn_access training_sessions farmer_group credit_access contract distance breed beneficiary goats_sold access_info LandProp
ASSETS Peri_Urban
```

	Delta-method					[95% Conf. Interval]
	dy/dx	Std. Err.	z	P> z		
gender	-.0359574	.0142602	-2.52	0.012	-.063907	-.0080079
age	.0011506	.0005583	2.06	0.039	.0000563	.0022449
education	.0026151	.0014997	1.74	0.081	-.0003243	.0055545
experience	-8.00e-06	.0009039	-0.01	0.993	-.0017795	.0017635
family_members	.0001403	.0042135	0.03	0.973	-.0081181	.0083986
extn_access	-.0100581	.0140091	-0.72	0.473	-.0375155	.0173993
training_sessions	-.009335	.0050443	-1.85	0.064	-.0192217	.0005516
farmer_group	-.013579	.0148811	-0.91	0.362	-.0427455	.0155875
credit_access	-.0343825	.0256237	-1.34	0.180	-.084604	.0158391
contract	.0660163	.0309486	2.13	0.033	.0053582	.1266744
distance	.0003639	.0001594	2.28	0.022	.0000515	.0006764
breed	.0425966	.0141772	3.00	0.003	.0148098	.0703834
beneficiary	.0204289	.013694	1.49	0.136	-.0064108	.0472685
goats_sold	.0074927	.0008454	8.86	0.000	.0058357	.0091497
access_info	.0158225	.030018	0.53	0.598	-.0430117	.0746566
LandProp	.050183	.0215027	2.33	0.020	.0080384	.0923275
ASSETS	-.0044884	.0037067	-1.21	0.226	-.0117534	.0027767
Peri_Urban	-.033843	.0147994	-2.29	0.022	-.0628493	-.0048368

### c) Diagnostic Tests

. vif

Variable	VIF	1/VIF
age	1.89	0.528888
experience	1.77	0.565621
education	1.66	0.602290
ASSETS	1.37	0.728664
breed	1.30	0.771606
goats_sold	1.30	0.771776
extension_~t	1.19	0.842900
Peri_Urban	1.15	0.868532
LandProp	1.13	0.882605
gender	1.13	0.883160
credit_access	1.13	0.886241
family_mem~s	1.13	0.888715
contract	1.11	0.901052
distance	1.10	0.906695
access_info	1.08	0.923462
frequency	1.08	0.926599
farmer_group	1.07	0.934315
Mean VIF	1.27	

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of HCl

chi2(1) = 12.34

Prob > chi2 = 0.0004

## Appendix 3: Objective Two Output

### a) Multivariate Probit Model results

```
. mvprobit( Other_farmers= gender age Logfamily_members education experience farmer_group SDcredit_acces goats_sold distance breed lack_market ASSETS PeriUrban_Dummy LIVESTOCK_UNIT ) ( butche
> ries =gender age Logfamily_members education experience farmer_group SDcredit_acces goats_sold distance breed lack_market ASSETS PeriUrban_Dummy LIVESTOCK_UNIT) ( consumers =gender age Log
> family_members education experience farmer_group SDcredit_acces goats_sold distance breed lack_market ASSETS PeriUrban_Dummy LIVESTOCK_UNIT) ( govt_programs =gender age Logfamily_members e
> ducation experience farmer_group SDcredit_acces goats_sold distance breed lack_market ASSETS PeriUrban_Dummy LIVESTOCK_UNIT), robust
```

```
Multivariate probit (SML, # draws = 5)           Number of obs   =           266
Log pseudolikelihood = -459.96069                 Wald chi2(56)   =           178.05
                                                    Prob > chi2     =           0.0000
```

	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
<b>Other_farmers</b>						
gender	.1147913	.1739141	0.66	0.509	-.226074	.4556567
age	.0006876	.0066878	0.10	0.918	-.0124203	.0137954
Logfamily_members	.3138817	.1444825	2.17	0.030	.0307013	.5970622
education	-.0204619	.0206553	-0.99	0.322	-.0609456	.0200218
experience	-.0186555	.009235	-2.02	0.043	-.0367557	-.0005553
farmer_group	-.0321158	.2293206	-0.14	0.889	-.481576	.4173443
SDcredit_acces	.1399022	.0860864	1.63	0.104	-.0288241	.3086286
goats_sold	-.0093831	.0104935	-0.89	0.371	-.0299499	.0111837
distance	.0025572	.0024215	1.06	0.291	-.0021888	.0073032
breed	.0536528	.1890416	0.28	0.777	-.3168618	.4241675
lack_market	.0825797	.21365	0.39	0.699	-.3361666	.501326
ASSETS	.0651537	.0516286	1.26	0.207	-.0360365	.1663439
PeriUrban_Dummy	-.104954	.1680563	-0.62	0.532	-.4343384	.2244304
LIVESTOCK_UNIT	-.0058587	.006906	-0.85	0.396	-.0193942	.0076769
_cons	-.8190182	.5968622	-1.37	0.170	-1.988846	.3508102
<b>govt_programs</b>						
gender	.2388054	.1764822	1.35	0.176	-.1070934	.5847042
age	.0057878	.0071048	0.81	0.415	-.0081375	.019713
Logfamily_members	.0006774	.150178	0.00	0.996	-.2936661	.295021
education	.0239012	.0223918	1.07	0.286	-.0199859	.0677883
experience	-.0090093	.0092191	-0.98	0.328	-.0270785	.0090599
farmer_group	.1680177	.2331601	0.72	0.471	-.2889676	.6250031
SDcredit_acces	-.0776367	.0997196	-0.78	0.436	-.2730836	.1178102
goats_sold	.0616667	.0124775	4.94	0.000	.0372112	.0861222
distance	.0029119	.0029419	0.99	0.322	-.0028542	.0086779
breed	.3956202	.199982	1.98	0.048	.0036626	.7875778
lack_market	-.4355243	.2152668	-2.02	0.043	-.8574394	-.0136092
ASSETS	-.0592051	.0554519	-1.07	0.286	-.1678888	.0494787
PeriUrban_Dummy	-.0633043	.1783657	-0.35	0.723	-.4128947	.2862862
LIVESTOCK_UNIT	.007545	.0079998	0.94	0.346	-.0081344	.0232243
_cons	-.6740187	.6360132	-1.06	0.289	-1.920582	.5725444

<b>butcheries</b>						
gender	.2152381	.2267631	0.95	0.343	-.2292094	.6596855
age	.0089744	.0095475	0.94	0.347	-.0097383	.027687
Logfamily_members	.0164074	.1871987	0.09	0.930	-.3504953	.3833101
education	-.0357778	.0246302	-1.45	0.146	-.0840522	.0124966
experience	-.0194853	.0117356	-1.66	0.097	-.0424867	.0035161
farmer_group	-.6695462	.50926	-1.31	0.189	-1.667677	.328585
SDcredit_acess	.2155877	.0959881	2.25	0.025	.0274545	.4037208
goats_sold	-.0112334	.0120051	-0.94	0.349	-.034763	.0122961
distance	.0073596	.0024843	2.96	0.003	.0024905	.0122288
breed	.0033918	.2214467	0.02	0.988	-.4306357	.4374194
lack_market	.1226995	.2664737	0.46	0.645	-.3995794	.6449785
ASSETS	.0135426	.0743383	0.18	0.855	-.1321578	.1592431
PeriUrban_Dummy	.4516459	.2346648	1.92	0.054	-.0082887	.9115804
LIVESTOCK_UNIT	.000112	.0113138	0.01	0.992	-.0220625	.0222866
_cons	-1.98399	.8175536	-2.43	0.015	-3.586366	-.3816149
<b>consumers</b>						
gender	-.2832628	.2513235	-1.13	0.260	-.7758479	.2093223
age	.0103236	.007545	1.37	0.171	-.0044644	.0251116
Logfamily_members	-.0869379	.19694	-0.44	0.659	-.4729333	.2990574
education	.0445504	.0264062	1.69	0.092	-.0072048	.0963056
experience	-.0082248	.0127105	-0.65	0.518	-.033137	.0166873
farmer_group	.4425544	.4008657	1.10	0.270	-.343128	1.228237
SDcredit_acess	.3127148	.1864905	1.68	0.094	-.0527998	.6782294
goats_sold	-.0189964	.0100225	-1.90	0.058	-.0386402	.0006474
distance	.0159758	.0061241	2.61	0.009	.0039727	.0279788
breed	-.1667132	.2655317	-0.63	0.530	-.6871458	.3537194
lack_market	-.6198291	.3962562	-1.56	0.118	-1.396477	.1568188
ASSETS	-.0177944	.0785033	-0.23	0.821	-.1716581	.1360693
PeriUrban_Dummy	-.4601044	.2526806	-1.82	0.069	-.9553493	.0351405
LIVESTOCK_UNIT	-.005886	.0074549	-0.79	0.430	-.0204973	.0087253
_cons	1.932317	.8800999	2.20	0.028	.2073532	3.657281

## b) Diagnostic Tests

```
. vif
```

Variable	VIF	1/VIF
age	1.89	0.529623
experience	1.76	0.566908
education	1.58	0.632318
ASSETS	1.43	0.697457
LIVESTOCK_~T	1.30	0.768825
goats_sold	1.26	0.792063
breed	1.26	0.795920
PeriUrban_~y	1.14	0.876996
SDcredit_a~s	1.11	0.899060
gender	1.10	0.908013
distance	1.09	0.913402
family_mem~s	1.09	0.919213
lack_market	1.08	0.924297
farmer_group	1.04	0.965929
Mean VIF	1.30	

```
. estat hettest
```

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of Other\_farmers

chi2(1) = 0.19

Prob > chi2 = 0.6633

## Appendix 4: Objective Three Output

### a) Endogenous Switching Regression Model results

```
. ivregress 2sls LogIncome age gender family_members education extn_access employment_status feed_costs Landprop LogAssets ( sold_or_not= payment_mode distance beneficiary )
```

```
Instrumental variables (2SLS) regression          Number of obs   =       266
                                                Wald chi2(10)   =      157.34
                                                Prob > chi2     =       0.0000
                                                R-squared       =       0.3165
                                                Root MSE       =       .91739
```

LogIncome	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
sold_or_not	.7268479	.2111305	3.44	0.001	.3130398 1.140656
age	.0037405	.0041826	0.89	0.371	-.0044572 .0119382
gender	.0047291	.1219196	0.04	0.969	-.2342289 .2436872
family_members	-.0277198	.0341018	-0.81	0.416	-.094558 .0391185
education	.0164081	.014455	1.14	0.256	-.0119233 .0447394
extn_access	-.0555027	.120863	-0.46	0.646	-.2923899 .1813845
employment_status	-.3562725	.0503093	-7.08	0.000	-.454877 -.257668
feed_costs	.0000756	.0000727	1.04	0.299	-.0000669 .000218
Landprop	-.1428114	.1751471	-0.82	0.415	-.4860935 .2004706
LogAssets	.1932788	.0355668	5.43	0.000	.1235692 .2629884
_cons	8.282163	.4752071	17.43	0.000	7.350774 9.213552

Instrumented: sold\_or\_not

Instruments: age gender family\_members education extn\_access employment\_status feed\_costs Landprop LogAssets payment\_mode distance beneficiary

```
. estat endog
```

Tests of endogeneity  
Ho: variables are exogenous

Durbin (score) chi2(1) = 20.3414 (p = 0.0000)  
Wu-Hausman F(1,254) = 21.0321 (p = 0.0000)

```
. estat firststage
```

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(3,253)	Prob > F
sold_or_not	0.5096	0.4864	0.4531	69.8795	0.0000



Minimum eigenvalue statistic = 69.8795

Critical Values # of endogenous regressors: 1  
 Ho: Instruments are weak # of excluded instruments: 3

	5%	10%	20%	30%
2SLS relative bias	13.91	9.08	6.46	5.39
2SLS Size of nominal 5% Wald test	22.30	12.83	9.54	7.80
LIML Size of nominal 5% Wald test	6.46	4.36	3.69	3.32

. movestay LogINCOME age gender family\_members education extn\_access training SDAverage\_Price employment\_status breed farmer\_group ASSET\_INDEX SDOther\_byproducts , select( sold\_or\_not= paym  
 > ent\_mode distance beneficiary )

Endogenous switching regression model Number of obs = 266  
 Wald chi2(12) = 80.33  
 Log likelihood = -354.58934 Prob > chi2 = 0.0000

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
<b>LogINCOME_1</b>						
age	.0129774	.004782	2.71	0.007	.0036049	.0223499
gender	.0843416	.1426113	0.59	0.554	-.1951713	.3638545
family_members	-.0143027	.0400823	-0.36	0.721	-.0928625	.0642571
education	.0465586	.0175968	2.65	0.008	.0120695	.0810477
extn_access	-.0300367	.1470164	-0.20	0.838	-.3181837	.2581102
training	.153231	.1721768	0.89	0.373	-.1842294	.4906914
SDAverage_Price	.0580918	.0671047	0.87	0.387	-.073431	.1896146
employment_status	-.2877284	.0618466	-4.65	0.000	-.4089455	-.1665114
breed	.4272579	.1435882	2.98	0.003	.1458301	.7086856
farmer_group	-.1171304	.1871585	-0.63	0.531	-.4839543	.2496936
ASSET_INDEX	.1947331	.0686324	2.84	0.005	.0602161	.3292501
SDOther_byproducts	.0830767	.0628032	1.32	0.186	-.0400153	.2061688
_cons	9.203949	.4750944	19.37	0.000	8.272781	10.13512
<b>LogINCOME_0</b>						
age	.0045727	.0086057	0.53	0.595	-.0122942	.0214396
gender	-.1892043	.2425775	-0.78	0.435	-.6646474	.2862388
family_members	-.0547301	.0618248	-0.89	0.376	-.1759044	.0664442
education	-.0422878	.024858	-1.70	0.089	-.0910086	.0064329
extn_access	.4830766	.2565766	1.88	0.060	-.0198043	.9859574
training	-.4967217	.3509734	-1.42	0.157	-1.184617	.1911735
SDAverage_Price	.1936465	.1350069	1.43	0.151	-.0709622	.4582551
employment_status	-.2145398	.083335	-2.57	0.010	-.3778734	-.0512062
breed	.2711014	.3015247	0.90	0.369	-.3198761	.8620789
farmer_group	.227613	.4637287	0.49	0.624	-.6812786	1.136505
ASSET_INDEX	.0302962	.1116785	0.27	0.786	-.1885896	.249182
SDOther_byproducts	.197775	.1853374	1.07	0.286	-.1654796	.5610295
_cons	9.731597	.646242	15.06	0.000	8.464986	10.99821



Variable	Coef.	Std. Err.	t-Stat	P >  t	95% Conf. Interval	95% Conf. Interval
sold_or_not						
age	-.0671901	.0218027	-3.08	0.002	-.1099226	-.0244575
gender	-.0719071	.598783	-0.12	0.904	-1.2455	1.101686
family_members	-.4936399	.3030078	-1.63	0.103	-1.087524	.1002445
education	.1550402	.0828074	1.87	0.061	-.0072592	.3173396
extn_access	.6606813	.3221046	2.05	0.040	.0293679	1.291995
SDAverage_Price	-1.352455	.5787228	-2.34	0.019	-2.486731	-.2181794
employment_status	-.1141787	.0901692	-1.27	0.205	-.2909071	.0625497
breed	.5564221	.2842364	1.96	0.050	-.000671	1.113515
farmer_group	-.9430216	1.144801	-0.82	0.410	-3.186791	1.300748
ASSET_INDEX	.2127496	.3007387	0.71	0.479	-.3766874	.8021867
SDOther_byproducts	-.2281638	.5065445	-0.45	0.652	-1.220973	.7646451
training	-.3512974	.4207767	-0.83	0.404	-1.176005	.4734098
payment_mode	.078626	.0255399	3.08	0.002	.0285688	.1286832
distance	.0195435	.0145727	1.34	0.180	-.0090184	.0481054
beneficiary	-.6411053	.5199139	-1.23	0.218	-1.660118	.3779072
_cons	7.54805	2.42002	3.12	0.002	2.804897	12.2912

## b) Diagnostic Tests

. vif

Variable	VIF	1/VIF
payment_mode	2.13	0.470336
sold_or_not	2.02	0.495781
education	1.49	0.672219
age	1.43	0.701552
employment~s	1.19	0.843050
beneficiary	1.15	0.870001
gender	1.11	0.898696
breed	1.10	0.908280
farmer_group	1.09	0.918950
SDAverage~e	1.07	0.933663
family_mem~s	1.06	0.940806
SDOther_bu~s	1.05	0.948746
distance	1.05	0.953031
ASSET_INDEX	1.05	0.956160
Mean VIF	1.28	

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity  
Ho: Constant variance  
Variables: fitted values of LogINCOME

chi2(1) = 0.26  
Prob > chi2 = 0.6126

## Appendix 5: Research Permit

P.O. Box 31  
Molepolole  
REFERENCE:



Republic Of Botswana

Telephone: 5921313  
Fax No: 5910322  
Internet: [www.moa.gov.bw](http://www.moa.gov.bw)

21<sup>st</sup> August 2020

The Director  
Board of Post Graduate  
Egerton University  
P O Box 536-20115  
Egerton, Njoro  
Kenya

Dear Sir/Madam

### CONFIRMATION OF ASSESSMENT: MS GOMOLEMO NGWAKO

This serves to confirm that Ms. Gomolemo Ngwako of National Identify number 424 421 619 was accepted and allowed to collect her Master Degree Research data on "Assessment of Goat Commercialization among smallstock holders farmers in Kweneng district, Botswana." The research was conducted during the month of August 2019.

Thank you.

Yours faithfully

A handwritten signature in blue ink, appearing to read 'L.E Telekelo', written over a horizontal line.

L.E Telekelo  
District Agricultural Coordinator, Kweneng

OUR VISION: Attain national food security and global competitiveness in agricultural products  
OUR MISSION: To improve agricultural productivity through technology development and transfer, diversification and commercialization, in order to promote food security in partnership with our stakeholders.

## Appendix 6: Publication

[jard] Editor Decision  Inbox 



Małgorzata Kołodz... Mar 22

 to me 



Dear Gomolemo Ngwako:

We are pleased to inform that the paper "The Effects of commercialization on household welfare among smallholder goat farmers in Botswana" submitted to the Journal of Agribusiness and Rural Development has been accepted for publication.

Sincerely,

Małgorzata Kołodziejczak  
[malgorzata.kolodziejczak@up.poznan.pl](mailto:malgorzata.kolodziejczak@up.poznan.pl)

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Journal of Agribusiness and Rural Development