DETERMINANTS OF MARKET PARTICIPATION AND EFFECTS ON HOUSEHOLD INCOME AMONG SMALL-SCALE INDIGENOUS CHICKEN FARMERS IN KWENENG EAST DISTRICT, BOTSWANA

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DECLARATION AND RECOMMENDATION

Declaration:

This thesis is my original work and has not been presented in this University or any other for the award of a degree.

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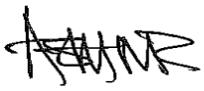
Signature:  Date: 10/09/2025

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DEDICATION

This work is dedicated to my late father, who believed in my potential from a young age. I also thank my mother, siblings and children for their unwavering support, prayers and encouragement.

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ABSTRACT

Poultry farming is pivotal to rural livelihoods and smallholder farming. Indigenous chickens, within poultry farming, are essential for boosting household income and food security even though farmers of these chickens remain impoverished. One possible reason for this is their limited participation in profitable markets. The aim of the study was to improve household income of small-scale indigenous chicken farmers by promoting their participation in profitable markets in Kweneng East District, Botswana. Specifically, this study aimed at identifying preferred indigenous chicken market outlets and their price differentials. It also determined the factors influencing market participation and the intensity of participation among small-scale indigenous chicken farmers, and the factors influencing the choice of market outlets among small-scale indigenous chicken farmers. Additionally, it examined the effects of market participation on household income among small-scale indigenous chicken farmers. A multi-stage sampling approach was applied to obtain a sample of 276 indigenous chicken farmers and the data was collected through a semi-structured questionnaire. Descriptive statistics was used to identify the preferred market outlets and their price differentials. Majority, about 30% indigenous chicken farmers, prefer a farm gate as a market outlet. Restaurants offer higher prices, BWP 103.24 (USD 7.39) and BWP 143.33 (USD 10.26) for hens and cocks, respectively, than other market outlets. The double hurdle model revealed that access to market information significantly influences the decision to participate by 1.062 at 1% and the intensity to participate. Multivariate Probit results revealed that off-farm income positively influenced the choice of farm gate market at 1% and market bargaining power had a positive statistical influence on the choice of all market outlets at a 1% significance level. The Average Treatment effect on the treated results of the endogenous switching regression model revealed that market participants would earn less (23 472 BWP) if they did not participate in the market and non-participants would earn 22 274 BWP if they had decided to participate and this shows the effect of market participation on the household income of farmers. The study recommends farmer collaboration to enhance collective marketing and access to diverse market outlets by indigenous chicken farmers. The study also suggests the improvement of access to public extension offices and road and transport networks to high value markets for upgrading the indigenous chicken farming industry.

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LIST OF ABBREVIATIONS AND ACRONYMS

AERC	African Economic Research Consortium
ATE	Average Treatment Effects
ATT	Average Treatment for the Treated
ATU	Average Treatment for the Untreated
BIDPA	Botswana Institute for Development Policy Analysis
BWP	Botswana Pula
CEDA	Citizen Entrepreneurial Development Agency
ESR	Endogenous Switching Regression model
FAO	Food and Agriculture Organization of the United Nations
FAP	Financial Assistance Policy
GDP	Gross Domestic Product
GPS	Global Positioning System
IC	Indigenous Chicken
IV	Instrumental Variables
LEA	Local Enterprise Authority
LIMID	Livestock Management and Infrastructure Development
MFDP	Ministry of Finance and Development Planning
MoA	Ministry of Agriculture
MNL	Multinomial Logit model
MVP	Multivariate Probit model
MYSC	Ministry of Youth, Sport and Culture
NCD	New Castle Disease
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
PSM	Propensity Score Margin
RUM	Random Utility Theory
SDGs	Sustainable Development Goals
SMME	Small Medium and Micro Enterprise
TCE	Transaction Cost Economics theory
TLU	Livestock Unit

USA	United States of America
USAID	United States Agency of International Development
USD	United States of America Dollar
YDF	Youth Development Fund

CHAPTER ONE
INTRODUCTION

1.1 Background information

Agriculture remains the major driver of economic growth in many developing countries worldwide. The sector contributes to job creation, poverty alleviation, food and resources, sectoral development, and foreign exchange earnings (Praburaj, 2018). Additionally, agriculture is the dominant source of employment in these countries in the early stages of economies (Mulanda & Punt, 2021). Poultry farming as a subsector of agriculture, plays an important role in rural economies, especially in developing regions where it supports small-scale producers (World Food Programme, 2020). Many small-scale producers view poultry as a supplementary enterprise that gives extra earnings and nutritious protein sources such as meat and eggs (Mekled *et al*., 2019).

Across various regions, especially in African and Asian developing nations, indigenous chickens play a key role in local agricultural practices. In many African countries, indigenous chickens dominate the poultry sector and their importance is also evident in Asia where they contribute over a third of total poultry products (Wells *et al*., 2024). These indigenous birds are an essential livestock asset of many households, especially in developing nations such as the low-income African countries (Gueye, 2007). Indigenous chickens are valued for their adaptability, hardiness, resistance to harsh climatic conditions and the ability to provide food and income for rural communities (Manyelo *et al*., 2020; Singh *et al*., 2023).

In Africa, farmers keep indigenous chickens on a subsistence scale, compared to hybrid chickens (Ouma, 2011). This is due to the inefficiency of the chain which results to low market participation. Indigenous chicken production across Africa generally consists of flock sizes managed in low-input free-range production system (Mathenge *et al*., 2010). Most indigenous chickens are raised through free-ranging without provision of proper food, therefore, they search for food at day time, while at night, they are only confined in temporary shelters. In some cases, the farmers supplement their diet with cereal grains and occasionally leftover food from the household. Aside from these feed supplements, little or no input, such as vaccines and antibiotics, is used, leading to low animal protein and egg output because of illness and malnutrition (Nguyen, 2011; Toomer *et al*., 2019).

In Botswana, the key agricultural activities in the country include agronomy (small grains like sorghum, maize, beans and millet), horticulture (vegetables and fruits) and animal (cattle,

goats, sheep, poultry) (Chikuta *et al*., 2023). Poultry production contributes to national development by enhancing livelihoods, reducing poverty, and generating employment opportunities (Government of Botswana, 2023). This argument is supported by (Moreki, 2013), who explains that poultry production boosts household food security in Botswana and is valued at BWP 1 billion (USD 300 million). Indigenous chicken is one of the poultries kept by Batswana, and its estimated population is approximately 1.02 million. The Kweneng East district is the leading district, with 81,159 chickens (Statistics Botswana, 2020). The fast-growing human population of the Kweneng East region and the high cost of beef have led to an increased need to rear indigenous chicken (Setlalekgomo, 2012).

According to Thutwa *et al*. (2012), households are estimated to own around 14 indigenous chickens on average and it is a common practice around the country. These chickens are prevalent in rural areas and peri-urban areas across the country. Indigenous chickens serve multiple purposes, such as religious and cultural purposes, income generation, social status and barter or gifting within communities (Aini, 1990; Gueye, 1998; Moreki, 2000) and egg and meat provision (Bekerie, 2015; Moreki *et al*., 2010). In most parts of Botswana, indigenous chickens are commonly raised under an extensive production system. They usually roam freely and rely on scavenging for food, with farmers providing only small amounts of supplements. Breeding is largely uncontrolled, as chickens mate naturally without close management from the farmers (Aganga *et al*., 2000; Badubi *et al*., 2006; Moreki, 2000).

Despite the much contribution to rural livelihoods, indigenous chicken farmers still face challenges in their industry. Oftentimes, the challenges include losses from predators and disease attacks. According to Wells et al. (2024), other constraints to rural indigenous chicken farming may include poor genetic performance, inadequate feed, and limited access to formal markets. Adding to this, Kena et al. (2002) states that limited access to market information, and seasonal price fluctuations make it difficult for better profitability in this industry. They cement Wells et al. (2024)'s point of limited access to formal markets, which means when farmers are further from reliable well-defined markets, they tend to lose out on better sales and profit, remaining in poverty. Other difficulties may generally include poor infrastructure, limited transport and storage facilities, and gaps in technical knowledge and management skills.

These issues increase marketing costs and force farmers to depend on traditional marketing methods (Ali *et al*., 2021). Although agriculture contributes less than 2% to Botswana's Gross

Domestic Product (GDP) (Statistics Botswana, 2023), the government is committed to developing a resilient and reliable agricultural sector to form a solid food security base. This is evidenced by the continued support to indigenous chicken farmers and other agricultural sectors in the form of subsidies, provision of inputs (chickens, feeds and nets), and enabling the environment for improved farmers' market participation and productivity of indigenous chickens across the country (Masole *et al*., 2015).

Botswana government has been supporting the poultry sector as part of its efforts to enhance national food security. According to Grynberg and Motswapong (2015) government support for poultry farming began in 1975 with the launch of a rural initiative called "Thuo ya Dikoko." The main objective of the Thuo ya Dikoko initiative was to boost egg production across Botswana. The 5 years long initiative began in key national centers, such as Gaborone, Lobatse, Mahalapye and Maun where poultry extension officers were sent to offer technical support. Managed by the Ministry of Agriculture (MoA) and funded Mennonites religious group, the project provided small-scale farmers, especially those from low-income households, with a relatively low-risk investment. The MoA purchased day-old chicks, raised them until they were 8 weeks old, then sold them to farmers once they reached maturity. The project was commended for cutting down imports and boosting household income. Towards the late 1970s and early 1980s, the government began introducing additional policies to further develop the poultry sector (Ministry of Agriculture (MoA), 1999).

As noted by Badubi (2017), in the early 1980s, the Botswana government introduced economic diversification policies by launching agricultural initiatives focused on pig farming, small livestock such as sheep and goats and poultry farming. At the time, Botswana' economy was relying much on diamond mining and beef production. Efforts to diversify the economy were mainly focused on creating employment opportunities for people living in rural areas (Ramosweu, 1999). During this time, the Financial Assistance Policy (FAP) was introduced to support small-scale poultry producers. Support was provided through grants, but recipients had to contribute a certain percentage as an initial down payment toward the funding they received (Ministry of Finance and Development Planning, 1995). The FAP policy was the second major initiative introduced in the 1980s to support poultry commercialization. The first policy was the introduction of a government-regulated marketing system which allowed Botswana to access the main poultry market. A third and arguably more influential measure was the implementation of trade restrictions

on imported eggs and poultry meat, which was designed to protect local producers (Grynberg & Motswapong, 2015).

The FAP began in 1982 to 2000. After the collapse of the FAP, the Citizens Entrepreneurial Development Agency (CEDA) was launched to assist local entrepreneurs. CEDA finances small-scale farmers who venture into different enterprises such as indigenous chicken farming, broiler production, cattle farming and horticulture farming. A large share of agricultural projects under the FAP focused on developing the poultry industry which stands as one of the enduring outcomes of the policy. Many of the poultry farms that received support through FAP are still active today. From start to finish, the poultry industry remained central to the government's agricultural support efforts under FAP (Grynberg & Motswapong, 2015).

The government also developed the Youth Development Fund (YDF) to support youth entrepreneurs aged 18 to 35 (Ngwako *et al.*, 2021). These youth entrepreneurs are involved in different enterprises, including indigenous chicken rearing, horticulture production, and more. Administered by the Ministry of Youth Empowerment, Sports and Culture Development, the program serves as a financial empowerment tool for aspiring youth. The program offers start-up capital to youth agribusinesses as loans granted at reduced interest rates (Ministry of Youth Sports and Culture (MYSC), 2019).

Local Enterprise Agency (LEA) is a governmental organization that aims to be the center of excellence for entrepreneurship and sustainable Small, Medium, and Micro Enterprise (SMME) development in Botswana. It facilitates access to finance and standards through competitive improvement programs of infrastructure and helps Batswana develop feasible business plans to apply for YDF and CEDA grants/loans. The government of Botswana also partnered with LEA through initiatives such as Nyeletso Lehuma, where LEA trains small-scale farmers on how to develop a feasible business plan and conducts workshops. After all these trainings and workshops, farmers are given inputs (Indigenous chicken, goats, seeds, etc.) to start their business, monitored by LEA, YDF, CEDA, and MoA until they are fully established (Matome, 2015). Despite continued government investment to promote commercialization, smallholder farmers in rural areas rely heavily on household market participation, resulting in restricted market involvement and low economic rewards, hence persistent poverty (Niankara & Traoret, 2019). Ngwako *et al*. (2021) state that markets determine the exchange through which farmers are engaging in selling their produce.

Locally, indigenous chickens are sold through formal and informal routes. Informally, sales in Botswana would happen between individual farmers and consumers. In most cases, prices of indigenous chickens are estimated through observation and weight assumption, rather than use of standard measures (Nsoso et al., 2004). Formal routes include government-supported programs such as Nyeletso Lehuma and the Livestock Management and Infrastructure Development (LIMID). The government uses the schemes to promote the shift of sales to formal markets. However, farmers may still have to adopt formal markets which are best suited to them. Reardon & Timmer (2007) supports by sharing that during the 1980s market interests shifted from government-intervention and informal markets to formal but self-regulating rural development market models.

Pacillo (2016) informs that great market participation encourages farmers to move from small-scale to large-scale production. Such a move is a powerful path to poverty reduction. In support, Babu et al. (2014) states that commercialising indigenous chicken farming increases farm household income and food security. Accordingly, this study sought to extend existing knowledge by identifying the main factors that influence market participation among small-scale indigenous chicken farmers in the Kweneng East District of Botswana, and to assess how such participation affects household income.

1.2 Statement of the problem

The chicken industry in Botswana is a key contributor to its economy and improved food security. However, the chicken production in Botswana doesn't meet domestic demand, despite the country's high potential. The indigenous chicken production can close this gap due to its hardiness, cultural importance and its contribution to household nutrition. The indigenous chickens continue to be valuable but underutilized resources in rural communities. Despite continued government support toward the indigenous chicken production, farmers are still slow to take part in the market because of the subsistence orientation of most indigenous chicken farmers, with only a few being commercial farmers.

Despite the pervasiveness and importance of indigenous chicken to household nutrition and livelihoods, there is low market participation and sales are usually made only when cash is needed. Limited market participation of smallholder farmers prevents farmers from earning incomes and improving their livelihoods may be a result of weak commercial linkages, no direct access to supermarkets and inconsistent or lack of market information**.** Transitioning towards a

market-oriented farming system may result in income generation, sustainable livelihoods and improved food security. Many studies have covered similar topics except the focus on indigenous chicken farming in Kweneng East or an inferable proximity. In addition, these studies assessed participation but not the intensity and choice of selling outlets. Innovatively, this study assessed indigenous chicken farmers' market outlet preferences, intensity of market participation and effect on household income in the Kweneng East district of Botswana. Market outlets reflect farmers' decisions over profitable markets and others. The intensity provides a deeper understanding which can inform policy on what influences a farmer to engage more in formal markets. Assessing the effect of participation on welfare helps to uncover the profitability difference of formal and informal markets and mirror such to farmers' choices.

1.3 Objectives

1.3.1 General objective

To contribute to improved household income of small-scale indigenous chicken farmers through market participation and access to profitable market outlets in the Kweneng East district of Botswana.

1.3.2 Specific objectives

i. To identify preferred small-scale indigenous chicken market outlets and their price differentials in the Kweneng East district of Botswana.

ii. To determine factors influencing market participation and the intensity of participation among small-scale indigenous chicken farmers in the Kweneng East district of Botswana.

iii. To determine factors influencing the choice of market outlets among small-scale indigenous chicken farmers in the Kweneng East district in Botswana.

iv. To determine the effects of market participation on household income among small-scale indigenous chicken farmers in the Kweneng East district of Botswana.

1.4 Research questions

i. What are the small-scale indigenous chicken market outlets found in Kweneng East and what are their price differentials?

ii. What factors influence market participation and the intensity of participation among small-scale indigenous chicken farmers in the Kweneng East district of Botswana?

iii. What factors influence the choice of market outlets among small-scale indigenous chicken farmers in the Kweneng East district in Botswana?

iv. What are the effects of market participation on household income among small-scale indigenous chicken farmers in the Kweneng East district of Botswana?

1.5 Justification of the study

Indigenous chickens are a vital part of the farming system in many regions as they contribute to poverty alleviation, income generation and improved standard of living of rural farmers. This study contributes to Botswana's national development objectives of social development, which aims to end rural poverty and improve food security. Increased participation in indigenous chicken market has the potential to strengthen local production. Much participation can also open opportunities for Botswana to export indigenous chicken meat. Moreover, this study aligns with the goals outlined in Botswana's vision 2036, especially those focused on promoting sustainable economic development. It also aligns with the goals of achieving an economically thriving Africa and global goals of sustainable development. Therefore, the study is informative to stakeholders addressing improved food security as well as improved livelihoods among small-scale indigenous chicken farmers. It also contributed to the existing knowledge by providing research findings on market participation and effects on household income among indigenous chicken farmers in Kweneng East district, Botswana.

1.6 Scope and limitations of the study

The research focused on small-scale indigenous chicken farmers in the Kweneng East district. Kweneng East has a climate well-suited for poultry farming, particularly the rearing of indigenous chickens, a practice widely adopted by smallholder farmers. The district's proximity to Gaborone, Botswana's capital city, offers farmers convenient access to broader and more varied

markets, making the region a strategic choice for examining market participation patterns. The study achieved objectives using primary data. The study concentrated on the determinants of market participation and the intensity of participation among smallholder indigenous chicken farmers, the factors that influence the choice of market outlets and the effects of market participation on household income among smallholder indigenous chicken farmers in Kweneng East district, Botswana. The study faced the following limitations: poor record-keeping by farmers as they had to provide information on income. To address the problem of poor record-keeping farmers were probed and made to recall/estimate their monthly incomes from crops, livestock and other activities.

Due to a lack of research knowledge, some farmers gave wrong information because they wanted to benefit from the government initiatives. There was a lack of cooperation from some farmers. To overcome this limitation, the village headmen was involved to enhance farmer collaboration and organizing awareness meetings to counter misinformation.

1.7 Definition of terms

Household income: it is the total income generated from on-farm income activities (sales of crops and livestock farm products) and off-farm income activities.

Indigenous chicken: refers to tswana/local chickens that are bred and raised specifically for both meat and egg production, they are well adapted to specific local environments and conditions over generations.

Intensity of participation: refers to the volume/number of indigenous chickens and other by-products sold to market outlets by indigenous chicken farmers.

Market participation: refers to involvement in market-oriented production as opposed to traditional subsistence production by indigenous chicken farmers.

Smallholder farmers/small-scale farmers: For this study, these two terms will be used interchangeably, and they refer to indigenous chicken farmers who keep a maximum of 100 birds.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

The chapter explores the empirical and theoretical perspectives on poultry farming, with a particular focus on indigenous chicken production. It first outlined the status of Botswana's poultry industry, followed by examining approaches of the government to strengthen the system. Moreover, the concept of market participation including the key factors that determine whether and how farmers engage with markets. The elements that influence farmers' decisions when selecting market outlets for their products were discussed. This chapter also highlighted the constraints of raising indigenous chicken, and the knowledge gap. Lastly, the study's theoretical and conceptual frameworks were presented and explained.

2.1 Overview of the poultry industry in Botswana

Botswana's poultry industry is structured into three: layer, broiler, and indigenous chicken farming (eggs and meat) (Badubi, 2004). Among these, broiler farming stands out due to its short production cycle, enabling farmers to see quick profits. On the other hand, indigenous chickens are mainly kept to produce eggs and meat under free-range. Commercial broiler production in Botswana is still growing despite an increasing demand for broilers. Before the 1970s, indigenous chickens were the main source of meat in Botswana despite their slow growth and inefficient feed conversion (Mushi *et al*., 2000). This behavior leads to low productivity. Initially, Botswana relied solely on diamond mining and beef production. In the early 1980's, the government focused on economic diversification and begun to introduce a series of agricultural policies. The policies helped to promote pig farming development, small livestock (sheep and goats), dairy development, and poultry industry. The objective was to enhance food security and rural livelihoods (Badubi, 2004).

To strengthen Botswana's poultry sector, the government introduced the Financial Assistance Policy (FAP) in 1982. This funding initiative aimed to boost local chicken production of small poultry business. Following, the Livestock Management and Infrastructure Development (LIMID) program was then launched in 2006. LIMID focused on the provision of infrastructure, training, and access to resources to livestock farmers (Transtec & Botswana Institute for Development Policy Analysis, 2010). Botswana poultry production has significantly increased despite its inability to local demand. According to Transtec and BIDPA (2010), many factors

played a role in this growth of poultry production. One of the factors was import restrictions on poultry produce except for value-added products and inputs such as hatching eggs and point-of-lay heifers (Seleka, 2004). The FAP also contributed to the development of existing enterprises.

Unlike other breeds, indigenous chickens are adaptable, durable, can withstand harsh weather and diseases, and can survive under less care. Indigenous chickens perform well in free-range systems. This natural hardiness makes them an important focus for sustainable poultry studies. Botswana is defined by these agroecological factors which the indigenous chickens survive under. Their adaptability and low input requirements make them ideal for resource-constrained households (Tadelle & Ogle, 1996). These birds are mostly managed by women and can be kept on small land sizes, hence their importance to women's standards of living (Pederson *et al*., 2001).

For a resource limited nation such as Botswana, indigenous chickens are ideal to rear as they can survive under minimal inputs and cope with local conditions. Local markets highly prefer their meat and eggs for the sweet flavour and perceived health benefits. The favourable perceptions makes indigenous chickens a valuable focus area for research.

2.3 Concept of market participation and its determinants

Market participation is engaging in the buying and selling processes within the indigenous chicken production industry. Not far-fetched, Mugonola *et al.* (2017) describe market participation as the extent to which farmers engage in the demand and supply chain (includes input and output markets). This active involvement is necessary for scaling production from lower to higher levels. Smallholder farms gain better income and general poverty alleviation when they engage in profitable markets. (Akrong *et al.,* 2021; Manda *et al.,* 2020).

Many studies appreciated the market participation definition. According to Andareige *et al*. (2021) market participation is a farmer's ability to efficiently and effectively engage in the market. On another hand, Marenya et al. (2017) considers market participation as an extension of the specialiation principle. Specialization promotes labour division, higher economic efficiency and better income generation. Jari (2009) and Pingali et al. (2005) also circle around the same definiton, They state that market participation implies that farmers are focused on profit maximising and higher income generating channels rather than operating on subsistence markets alone.

Kyaw *et al.,* 2018; Manda *et al.,* 2020 view market participation as a path to improving income levels and strengthen food security. Which means that when a smallholder indigenous

chicken farmer has access to profitable markets, they often see higher earnings and better economic opportunities within the agricultural sector. Mohamed *et al.* (2016) also suggests that the majority of rural households keep indigenous chicken for income generation purposes. Despite these praised benefits of market participation, Carletto *et al.* (2017) observed that agricultural commercialization remains low across many African countries, largely because smallholder farmers participate less in formal markets. Indeed, smallholder farmers can choose to keep indigenous chickens both for household consumption and selling purposes. This dual purpose highlights the key role of indigenous chickens in improving food security and financial stability of the smallholder farmers in rural areas.

A farmer's decision to participate in the market can be driven by several factors which can be classified into socio-economic, institutional and market-related. The socio-economic determinants of market participation could potentially include age, gender, education, family size, leadership positions, engagement in off-farm income generating activities, and access to transport. Suggestively, the institutional determinants include farmer group membership, access to credit, extension services and road, and infrastructure quality. Then, market factors could include market price, quantity of sales, access to the market and market information, and experience in indigenous chicken production and trading. Various studies have carried out this subject and found some factors to influence market participation among indigenous chicken farmers.

Sekele *et al.* (2020) in South Africa confirms that indeed gender, age, education, and years of farm experience and production, adding flock and land sizes to the list. The study found out that women are more likely to engage in indigenous chicken farm markets than men as they are usually the main caretakers of the chickens which mean they lead most of production and marketing decisions. Additionally, the study states that the older, and more educated the farmer gets the more likely to engage in the market they are. According to their study, majority of market participants operate on small sizes of land.

Abeykoon *et al.* (2013) suggests that age, gender, religion are the major determinants of engaging in indigenous chicken market. In their discussion, age and household income declines the likelihood of market participation. Younger farmers are likely great market participants than older farms. According to their findings, the extent of engaging the market is affected by income, village location, access to transport and market, and flock size. Unlike Sekele *et al.* (2020)'s findings, male farmers in Sri Lanka are likely to participate in the market than females. From the differences in

the two findings of age and gender, it is reasonable to assume that either old or young, and either women or men might be higher market participants.

In Uganda, Miremba (2018) found out that gender, family size, access to markets, and veterinary services, income, education, farmer group membership, access to communication mediums, flock sizes, market prices and investment in disease control are major drivers and barriers of market participation. According to their study, male-headed households are less likely to participate in the market, revealing what Sekele *et al.* (2020) stated. Women assume main roles in the production and marketing of indigenous chickens. Larger households are also less likely to engage in the market. According to this study farmers with limited access to markets and veterinary offices are also less likely to engage in the market. The study also suggests that a farmer who has larger off-farm income, higher education levels, a mobile phone and more indigenous chickens is more likely to be a market participant. Additionally, higher selling market prices encourages farmers to engage in the market. Farmers who spend on disease control and prevention measures are more likely to be interested in the market.

Still in Uganda, Akidi *et al.* (2018) shares that the determinants of market participation include age and income. According to their study older farmers are less likely to engage in the market. Farmers with more household income are likely to engage much in the market. The extent of market participation which was determined by income from indigenous chicken sales improves with the flock size, bird prices, access to the market and market information among farmers, and reduces with the farmers' age and sub-county location. This means that the degree of market participation is indeed shaped by socio-economic descriptions and availability of resources to the farmer.

Simon et al. (2015) examined the determinants of farmers' market participation decision and the extent of involvement in Western Kenya. They found out that age and off-farm income improve the likelihood of farmers engaging market. This implies that older farmers tend to be more engaged in indigenous poultry marketing. Indigenous farmers who are engaged in off-farm income generation activities are more likely to engage in the market. This could imply that the income gained from those activities is reinvested in the production and marketing activities hence the motivation to keep engaging in the market. According to the study, less market participation is promoted by large land sizes and higher education levels. This means that farmers who own large plots of land are less interested in joining the market. Why?

In Botswana, Kgosikoma and Malope (2016) were curious about the determinants of general market participation of livestock farmers and the barriers they face. According to their study, age, farm income, engagement in crop production, access to marketing information and cattle mortality influence the decision and extent to participate in the market. The researchers determined that market participation is reduced by aging of the livestock farmer. This implies than market participation might be common among young farmers.

Following the reviewed literature, this study has employed different classes of independent factors to assess the determinants of market participation and the extent of participation. These are the socio-economic, institutional and market-related factors. The socio-economic factors include but not limited to age and gender, institutional factors include access to extension services, while market-related ones include access to markets. This holistic approach to analysing the effect of various factors helped provide a more deeper understanding of what and how market participation is influenced. Unlike most previous studies, this research introduced several less-examined, such as household dependency ratio, Tropical Livestock Units (TLU), trust in chicken traders, length of residence in the village, and type of main road connecting the households to the markets.

2.4 Factors that influence the choice of market outlets

When a farmer decides to sell in the market, one of the first challenges is finding a place that offers both convenience and profitability. The choice of marketing channel therefore becomes a key element of a farmer's overall marketing strategy. According to USAID (2010), different marketing channels provide varying price incentives and support services, which in turn influence farmers' decisions on where and how to sell their produce.

Informal markets are characterized by unofficial sales, which are often conducted directly to other farmers and consumers. Such markets would involve participants such as middlemen, fellow farmers and personal networks such as friends and family. Comparing, formal markets engage clear procedures of grading, quality control and safety regulations. Farmers tend to be driven by some factors when they are faced with choice of market outlet decisions. According to Jari and Fraser (2009) indigenous chicken farmers are faced with limited access to formal markets due to higher transport costs, higher risks and the complexities of market participation.

Farmers' choices of a market outlet are not random, normally such a decision is influenced by income linked to the market outlet(s) (Abera, 2016). Farmers are mostly faced with various market channels to choice from and these include selling at the farm-gate, to rural and urban

markets, and through cooperatives and middlemen (brokers and wholesalers) (Sigei *et al.,* 2014; Kumar *et al.,* 2013; Arumgum *et al.*, 2022; Dessie et al., 2018). In Botswana, a typical indigenous chicken farmer would choose to sell through informal routes such as to fellow farmers and individual consumers. Formal markets would then encompass government programs and other commercial buyers such as restaurants and hotels. The profitability of an indigenous chicken farm depends on the choice of a market outlet. Various studies have determined what causes a farmer to prefer a certain channel compared to another.

According to Kuma *et al.* (2013) in Kenya, the drivers of a market channel preference are farmer group membership, and education. This means that when a farmer belongs to a certain farmers' organization, club or community, he or she may have a significant preference of a market outlet. The significant effectiveness of education was also noted by Barrett's (2008) as a positive driver of a farmer's market outlet choice.

Kiprop *et al.* (2020) also shares that access to transport, the market, and market information, size of farm land, and bargaining power. This means that when the costs of travelling to one market outlet is less compared to other outlets, a farmer is more likely to prefer the cheaper channel. When farmer have knowledge on what happens in the market, they should be expected to be more likely to wisely choose an indigenous market channel that best suite them. Farmers who hold a large bargaining power in the value chain are likely to choose the market outlet which favours them negotiations and profitability.

Similarly, Sigei *et al.* (2014) is also informative about the determinants of a farmer's market outlet choice. According to their study, production volume, access to price information, contract-based marketing arrangements, and ownership of transport significantly determine market outlet choice. In their discussion which aligns with Jari and Fraser (2009), participation in groups improves access to more distant markets by facilitating the sharing of information and leveraging social networks hence informed market outlet choice. Chalwe (2011) further emphasizes on transportation and states that having farm transport increases the likelihood of farmers preferring private traders as their main marketing channel over other market outlets.

In Ethiopia, Dessie *et al.* (2018) found out that farmers who were faced with choice of market outlet were influenced by age, education, access to credit, livestock ownership, off-farm income, and farm size. Facing a choice between four main outlets (consumers, assemblers, retailers, and wholesalers), the study found out that older farmers are less likely to consumers or retailers,

whereas more educated farmers tended to prefer direct outlets, likely reflecting their enhanced managerial skills. The study also shared that access to credit and larger farm sizes encouraged sales to assemblers and wholesalers, while higher livestock holdings and off-farm income increased the likelihood of selling directly to consumers and retailers.

Still in Ethiopia, Wosene *et al.* (2018) examined the factors influencing market outlet choices among pepper producers. They identified the quantity of production, bargaining power, post-harvest value addition, and access to farm training, extension services, formal education, and market. Most of these factors had a positive effect helping farmers access more profitable marketing channels. In contrast, longer distance to the market negatively influenced outlet choice, indicating that farmers located farther from markets were less likely to sell their produce through high-value channels.

In Nigeria, Anthony *et al.* (2021) examined the factors influencing rice output and the selection of marketing outlets among smallholder farming households. A multinomial logit model identified gender, level of education, access to credit, extension services, price and market information as well as marketing experience as significant determinants of outlet choice. The farmers' likelihood to choose formal and profitable market channels increased with the level of education, credit access, extension support, access to reliable markets and price information. Similarly, marketing experience enhanced farmers' ability to navigate structured markets. However, the study also revealed that being male was a barrier to accessing profitable outlets, suggesting that gender dynamics play a role in market participation outcomes.

The study provided a comprehensive and innovative method for comprehending the elements affecting smallholder farmers' selection of market outlets. It introduced less frequently studied factors in addition to the commonly used ones, such as gender, years of education, group participation, market access, trading experience, land size, and off-farm income. Less researched variables (behavioural, informational, and social capital layers) were included in the analysis and these are ownership of a television, leadership position, reliance on support, market negotiating power, and trust in local traders. This study provided a more nuanced and context-specific understanding of market outlet decisions among indigenous chicken farmers in Botswana.

2.5 Challenges faced by small-scale indigenous chicken farmers

Indigenous chicken production, like other agricultural investments, faces several constraints that limit productivity and contribute to low income levels among smallholder farmers.

One of the major challenges is the outbreak of diseases such as Newcastle disease, which significantly affects flock health and survival (Okwor & Eze, 2011). Diseases weakens an animal's immune status and can lead to death losses. (Justus *et al.,* 2013) adds that majority of mortality losses are due to attack by diseases, especially within the first year of hatching. Other constraints which could hinder the progression of indigenous chicken production include poor management practices and theft. Mutua (2018) suggests that these challenges are prominent in the free-range production system and Botswana is widely known for this type of production which could hint the challenges they face in production. Ondwasy *et al.* (2006) shares that indigenous chickens face numerous risks that negatively affect their survival and overall productivity. Harrison and Alders (2010) and Moges *et al.* (2010) also picked that disease-associated losses within indigenous chicekn production is a serious threat.

Poor management seems to be a common challenge. In their study, Zindove *et al.* (2022) uncovered that poor management practices, predation and feed shortages are dominating challenges of indigenous chicken production. Other challenges in this industry include lack of capital, price instability, lack of infrastructure and limited access to farm production training. While highlighting these, studies seem to repeat predator losses, and feed insufficiency (Dana *et al.,* 2010; Magothe *et al.,* 2012; Mekonnen *et al.,* 2010; Okeno *et al.,* 2012). This could mean that theft of indigenous chickens is common and leaves a dent in the productivity and income of the farm.

Similarly, this research also explored the challenges of indigenous chicken production in Botswana through a qualitative analysis of farmers' experiences. While comparable studies exist in other countries, Botswana's distinctive social, economic, and environmental conditions make a local investigation particularly important. Understanding these challenges provides insight into the main barriers to productivity and market participation, which can inform more effective support strategies and boost food security and income of indigenous chicken farmers.

2.6 Gaps in the literature

Generally, previous studies focused mainly on the broader drivers of market participation in agriculture, with minimal attention towards indigenous chickens. The reviewed studies that inadequate participation in output market was linked the low level of income by smallholder farmers. However, information on determinants of market participation among small-scale indigenous chicken farmers is still inadequate. None of these studies provided empirical evidence

on market participation of indigenous chicken farmers and their effects on the household income of small-scale farmers, particularly in Botswana.

In summary, the reviewed literature emphasized the crucial role of market participation on the economic development of emerging and developing economies. The literature presents a range of benefits associated with agricultural market participation, which include increased per capita income, enhanced food security and improved living standards of the farming households. Therefore, the study raises awareness about the potential of market participation and the intensity of participation among smallholder indigenous chicken farmers. It also adds to the existing literature, as effects of indigenous chicken market participation on household income have not been fully explored in Botswana.

2.7 Theoretical and conceptual framework

2.7.1 Theoretical framework

The research was grounded in the concept of utility maximization theory.

2.7.1.1 Utility maximization theory

Utility maximization theory has a historical background dating to Bernoulli's attempt to resolve the St. Petersburg Paradox (Vardoyan & Wehner, 2022). The theory of utility maximization is a concept that focuses on maximizing overall happiness or satisfaction through the allocation of resources. The decision-making behavior of individuals is often modeled under the assumption of rationality, where choices are guided by the maximization of utility. Greene (2012) explains that unordered choice models such as the multinomial logit are grounded in the Random Utility Model (RUM), which is derived from utility theory. This framework suggests that when a small-scale indigenous chicken farmer is faced with multiple options such as whether to participate in the market and at what level of intensity the decision will be based on the alternative that offers the highest expected utility (Sigei *et al*., 2014). Similarly, the selection of a specific market outlet is influenced by the perceived utility or profit associated with each available option. Given that most smallholder indigenous chicken farmers are primarily driven by income generation, they are likely to prefer market channels that maximizes profits and contribute to improved household livelihoods.

Following the utility maximization theory, a farmer is more likely to choose a decision with more net benefits or that maximizes utility subject to a budget. In this study, budgets are

proxied by aggregate barriers of choosing a profitable market outlet. Such constraints include lack of financial access, resource availability, and production function (Otekunrin *et al*., 2019).

Utility is not directly measured (latent variable U_{ij}), hence it is proxied by the level of participation a farmer selects. For the i^{th} household faced with *J* choices, the utility choice *j* is:

$$Uij = z'ij\Theta + \varepsilon ij \quad \text{(1)}$$

Where

U_{ij} = Utility, z'_{ij} = observable component, this include household characteristics and their attributes of choices, ε_{ij} = random component.

The assumption is that if a household chooses j in particular, U_{ij} is the maximum among the *J* utilities. The probability that choice *j* is made then is:

$$Prob(Uij > Uik) \text{ for all other } k \neq j \quad \text{(2)}$$

2.7.1.2 Transaction costs theory

Transaction cost economics (TCE) theory was created by Oliver Williamson who uncovered that economic agents are not only motivated by utility or price but also costs associated with conducting transactions. Key components of transaction costs were identified as information costs, search costs, bargaining and negotiation costs (Williamson, 1985). TCE theory assumes that individuals are rational decision-makers who act under conditions of uncertainty and possible opportunism. Following the idea, this research supposes that farmers are ration-beings and they will choose a market outlet with lower transaction costs, even if the channel offers lower selling prices than others.

Kiprop *et al*. (2020) found that factors such as transport costs, market distance, the cost of information, and bargaining expenses significantly influence farmers' choice of market channels. These results align with the Transaction Cost Economics (TCE) framework. The idea is that farmers tend to favour market channels that minimize transaction costs, even when prices are slightly lower than those offered in formal markets. For example, informal channels such as brokers or neighbours often involve lower negotiation costs, immediate cash payments, and less stringent quality control, making them attractive to farmers. In contrast, formal markets typically entail higher transaction costs due to contractual obligations, grading standards, and delayed payments, despite potentially offering higher prices. This distinction is sufficient to assume that

farmers may be biased towards informal channels than formal ones, due to associated transaction costs.

Based on this theory, this study assumes that indigenous chicken farmers' decisions are not driven solely by the profit maximization goal. Other costs of selling chicken would include the associated risks, time and effort. These can be reflected by variables such as the bargaining power, and access to transport, market, and market information. The likelihood of selecting a particular market outlet can be estimated using a multivariate probit model, with the probability of choice increasing as transaction costs decline. In this way, TCE complements the theory of utility maximization by offering a more comprehensive understanding of smallholder farmers' economic behavior under real-world constraints.

2.8 Conceptual framework

The conceptual framework in Figure 1, illustrates how the main variables of the study relate. It highlights key factors that influence both the decision to participate in market activities and the level of participation among smallholder indigenous farmers in Botswana. These factors, grouped into socio-economic, market, and institutional categories, affect farmers' choices of market outlets. The framework also examines how market participation affects household income, emphasizing the interconnected nature of these variables. Socio-economic factors include gender, age, household size, education, number of schooling years, off-farm income, dependency ratio, farming experience, years stayed in the village, active members, inactive members, land size, support from relatives, support from friends, marital status and leadership position of relative/friends. Market-related factors include distance to the output market, number of local chicken traders, distance to the main road, market bargaining power, Tropical Livestock Units, trust in indigenous chicken traders, own transport means, vaccination, type of road, television ownership and market information. Institutional factors include access to credit, access to extension services, distance to the extension officers, number of extension visits made, receiving government assistance and group membership. Some of these factors consequently influence the choice of market outlets for the farmers who participate in the market. Once the farmer has identified the preferred market outlet, it leads to intensity of participation as well as improved income and other household welfare indicators, leading to poverty reduction and food security.

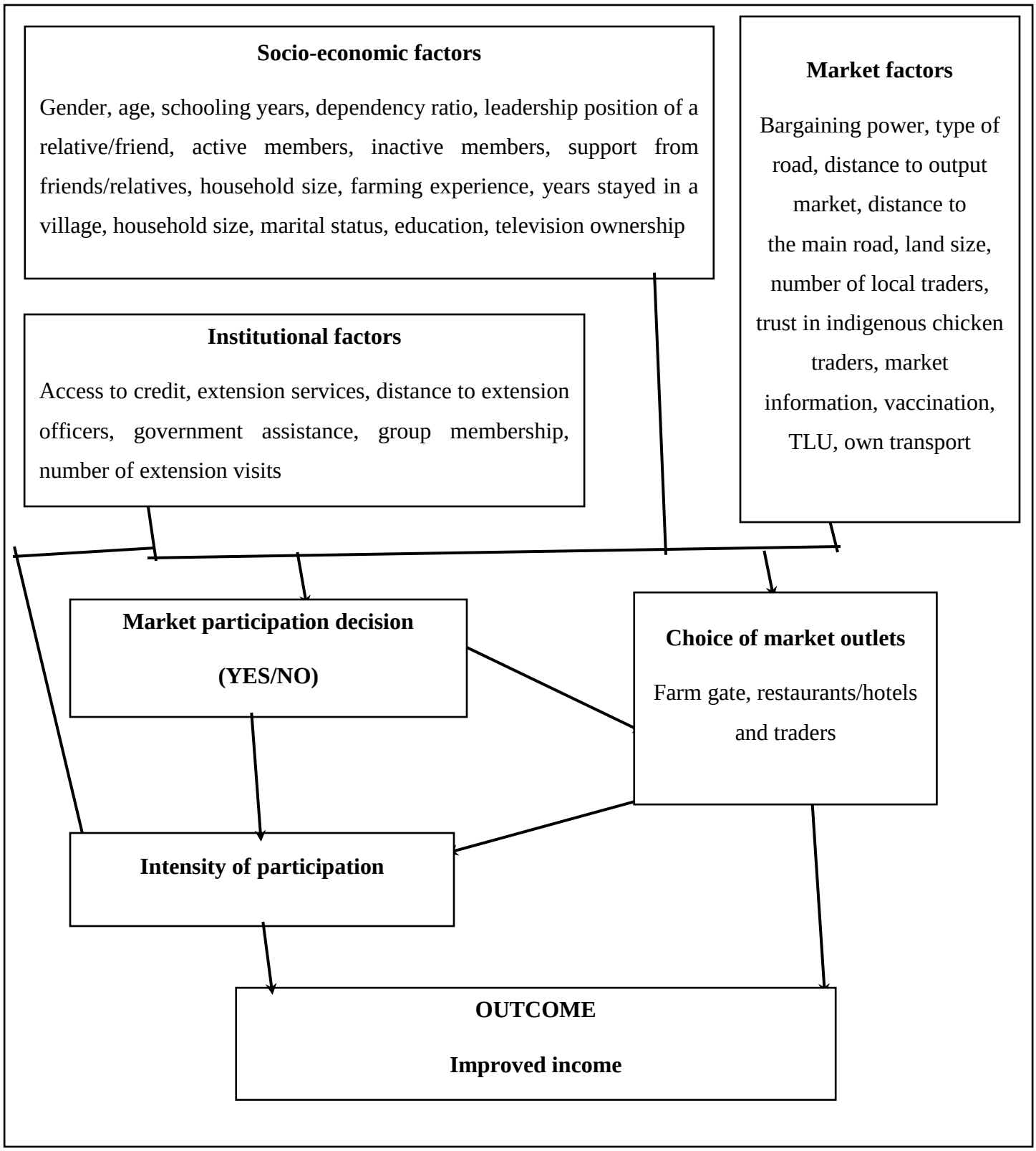

Figure 1: Conceptual framework

CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction

The chapter provides insights into this study's data collection and analytical framework. It also discussed the area of the study, the sampling approach, sample size determination, and methods used to collect data.

3.1 Study area

As illustrated in Figure 2, the research was carried out in Botswana's Kweneng East district, located at approximately 24°0′ South and 26°0′ East. This area represents the largest sub-region within the broader Kweneng district. According to Statistics Botswana (2022), Kweneng East is home to an estimated 330,225 residents and spans roughly 35,890 square kilometers. In 2019, the district reported a poultry population of around 81,159 chickens (Statistics Botswana, 2019). The region experiences average annual rainfall ranging from 450 to 500 millimeters, with the bulk of precipitation occurring during the summer months. However, because of climate change, the country has been experiencing many heat waves. More indigenous chicken farmers characterize this region because it is closer to the capital city, so farmers take advantage of this closeness and get involved in more profitable enterprises. Indigenous chicken farmers are mostly involved in extensive farming systems because they lack the resources and capital to build housing structures for their chickens. Other livestock kept by small-scale farmers in this region include cattle, pigs, sheep, and goats. They often practice mixed farming, growing crops alongside raising animals to feed their families and earn extra income (Monau *et al*., 2017).

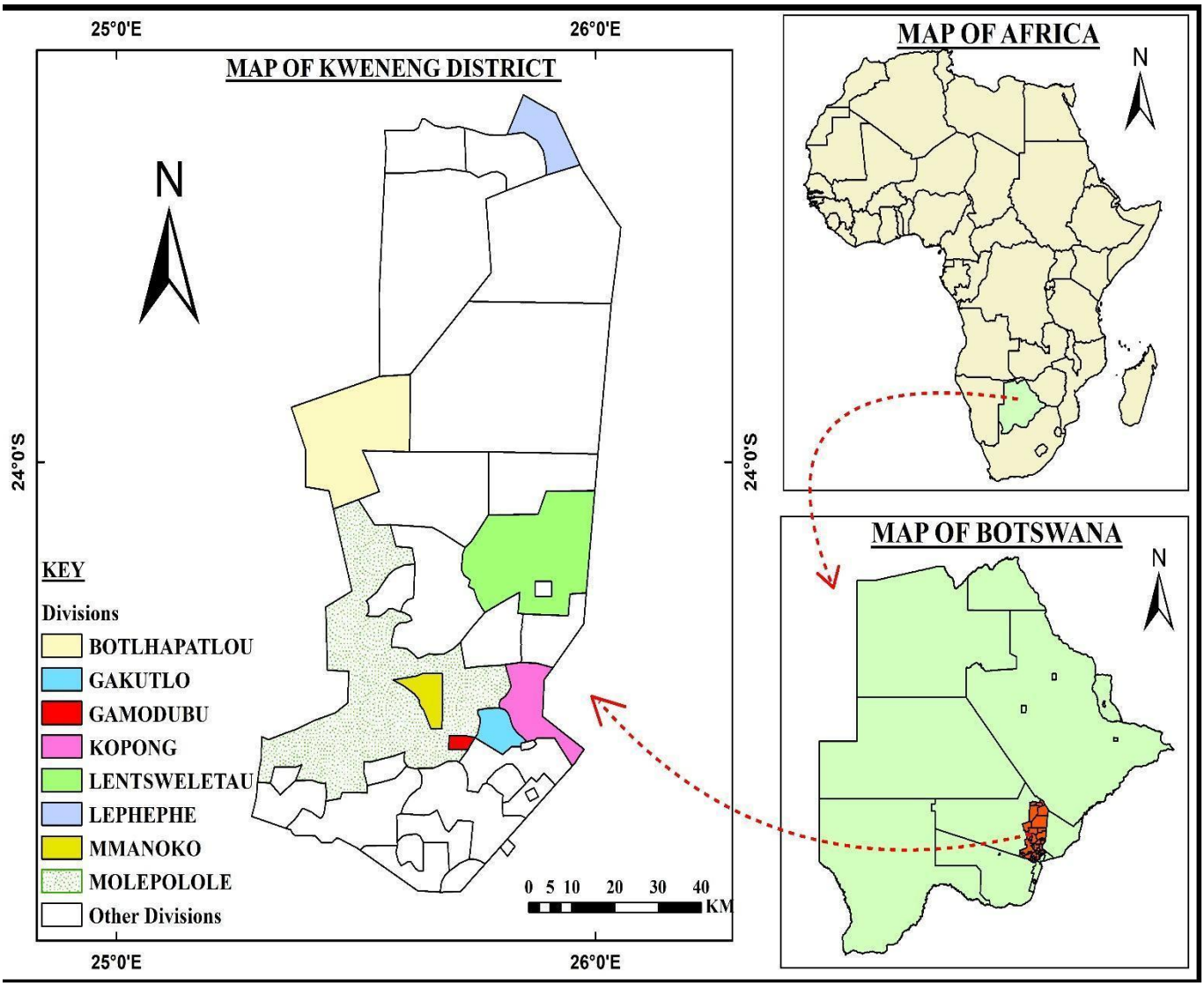

Figure 2: Map of Kweneng East District, Botswana

Source: Egerton University, Geography Department, 2024

3.2 Research design

This research employed a survey design to obtain both qualitative and quantitative information while preserving the natural setting of the research environment. It also entails the descriptions of the attributes the target population exhibits, and hence its application is justifiable. The survey design is flexible and allows for examining different aspects of the problem being studied (Creswell, 2003).

3.3 Sampling design

3.3.1 Target population

The research used a sample size of 276 small-scale indigenous chicken farmers residing in Botswana's Kweneng East district. These are the ones who registered as beneficiaries and non-beneficiaries of government programs. To determine the impact of market participation on household income, the study sampled both market participants and non-participants. This made it possible to compare the different groups.

3.3.2 Sampling procedure

The study targeted small-scale indigenous chicken farmers in Kweneng East District, which served as the primary sampling unit. A multi-stage sampling approach was employed to select participants. In the first stage, the broader Kweneng District was purposively chosen due to its high agricultural potential. The district is divided into two parts: Kweneng East and Kweneng West. On the subsequent stage, Kweneng East which is the largest sub-district was specifically chosen. This area is well known for having high concentration of small-scale indigenous chicken farmers and has the highest chicken population. Its close proximity to Botswana's capital also contributes to its role as a key economic zone. In the third stage, the 8 villages across the district were randomly selected. The study chose these villages randomly to represent farmers with a small number of chickens, a large number of chickens, as well as farmers from remote areas and those closer to the capital city to avoid bias. This is because these small-scale indigenous chicken farmers are affected by different factors in their production, so they are all necessary to make a good representative of the study. Lastly, the snowballing sampling method was employed to identify respondents from the selected villages (Molepolole, Gakutlo, Gamodubu, Botlhapatlou, Lephepe, Mmanoko, Kopong and Lentsweletau) in the sub-district. Even though the researcher had a list of farmers from the Ministry of Agriculture, not all indigenous chicken small-scale farmers were registered, therefore using snowballing during data collection was the best from other alternatives.

The sampling was conducted at the district population level rather than directly targeting individual farmers, based on the understanding that indigenous chicken farmers are embedded within households across the district. Smallholder farming is practiced at the household level, hence drawing a sample size out of the entire district allowed for a representative and inclusive approach. The sampling method ensured that all farming households, whether they benefited from

government programs or not, were included in the study. It also reflects the rural structure of Botswana, where farming is mostly done at the household level and spread throughout the district.

3.3.3 Sample size determination

A total of 276 farmers were selected from the district population using the formula proposed by Yamane (1967):

$$n = \frac{N}{1 + N(e)^2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

To improve precision, the study used a 0.06 margin of error which indicates that the study accepts a potential deviation of up to 6% in its sample estimates. This means the calculated sample size is expected to fall within ±6% of the actual population parameter, ensuring a reasonable level of precision in the findings

$$n = \frac{38500}{1 + 38500(0.06)^2} = 275.7879 \sim 276$$

Next, the study determined the sample size for each village. Each sample size was determined by multiplying village farmer population by the overall district sample size, from there dividing by the total district farmer population:

$$n(per\ village) = \frac{no\ of\ farmers\ (per\ village) x\ 276}{total\ numbers\ of\ farmers} \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Table 1: Sample size distribution

Kweneng East sub-district villages	Total population of farmers	Sample
Molepolole	430	123
Lentsweletau	102	29
Kopong	60	17
Gakutlo	50	14
Gamodubu	131	38
Lephepe	80	23
Mmanoko	50	14
Botlhapatlou	58	17
Total	**961**	**276**

Source: Statistics Botswana, 2022

3.4 Data collection and data analysis

Data used in this study was collected from primary and secondary sources using semi-structured questionnaire, and published materials from the Ministry of Agriculture, respectively. The semi-structured questionnaires were crafted using closed and open-ended questions (to capture qualitative depth), and the responses were obtained through face-to-face interviews. Secondary data included government handbooks, policy documents, statistical reports, planning frameworks, and records. The data were entered, cleaned, and analyzed using the Stata (version 17) statistical software. Before collecting the main dataset, pilot study was conducted assess validity and reliability. The pilot study was conducted in Kgatleng district, rather than Kweneng, to prevent any overlap or influence on the main study.

3.5 Analytical framework

3.5.1 Objective 1: To identify preferred small-scale indigenous chicken market outlets and their price differentials in the Kweneng East sub-district

Descriptive statistics was used to address this objective. Mean, frequencies, and bar charts were used determine the preferred market outlets. The same tools were used to assess price variations across the different market outlets.

3.5.2 Objective 2: To determine factors influencing market participation and the intensity of participation among small-scale indigenous chicken farmers in the Kweneng East sub-district

This objective was analyzed using the Double Hurdle (DH) model. Following Craig (1971), the first stage of the DH model involved assessing the farmers' market participation decision. The next stage, involved measuring the intensity of market participation. Comparatively, the Heckman model assumes that participation and intensity of participation are influenced by different variables and it is appropriate in cases of incidental truncation (Wooldridge, 2002). On another side, the Tobit regression assumes a single analysis process (that is, participation and participation intensity are analyzed in a one-step decision); therefore, it is restrictive in nature.

The Double Hurdle (DH) model is preferred because it is more flexible, allowing these two decisions to be analyzed separately. Unlike the Heckman model, the DH model assumes that the factors influencing a farmer's decision to participate in the market (a yes/no choice) may differ from those affecting the intensity of participation (how many chickens are sold). In the first stage DH model was estimated using Probit regression, which identified factors affecting the decision to participate in markets by using all sample households in the first stage. Market participation is defined by yes or no responses, while the level of participating in the market is defined by the number of chickens sold. The model takes values of 1 and 0 that are assigned to represent the choice of whether a producer decides to participate or not. The standard Probit model for participation decision is represented by Eq (4):

$$Di = \alpha Zi,k + \varepsilon i \dots\dots\dots\dots\dots (5)$$

$$D_i = 1 \text{ if } D^*_i > 0 \qquad D_i = 0, \text{ if } D^* i \leq 0$$

Where:

Di is a dummy variable that takes the value 1 if the producer participates in marketing the output and 0 otherwise.

Zi is a vector of independent variables hypothesized to influence participation decisions.

k is the regressor.

α is a vector of parameters to be estimated.

εi error term.

In the second stage, a truncated regression which omits part of the sampled observations based on the value of the dependent variable is applied (Wooldridge, 2010). At this stage, the focus

is on the market participants (farmers who were assigned the value of 1 in the first step). Since non-market participants represent zero sales, the model incorporates a lower-bound truncation at zero, this allows for determination of factors influencing the level of market involvement among participating farmers. The truncated regression model for factors affecting the intensity of participation is described as:

$$yi = \beta i\chi i + i + \varepsilon i$$

$$y * i = \beta i\chi i + \nu \ldots\ldots\ldots\ldots\ldots (6)$$

$$y_i = \{y^*_i \ if \ y^*_i > 0 \qquad and \ D_i = 1; 0 \ otherwise\}$$

where:

y^*_i and y_i are latent and the observed intensity of participation, respectively.

xi is a vector of variables influencing the intensity of participation.

β is a vector of parameters to be estimated.

In this model, the error terms are assumed to be independent and normally distributed, reflecting that the two decisions made by each producer, whether to participate and the level of participation are made independently: $u_i \sim N(0, 1)$ and $v_i \sim N(0, \sigma^2)$.

The log-likelihood function for the double-hurdle model that nests the Probit model and a truncated regression model is given following (Christoph *et al*., 2014):

$$log\ log\ L = \sum \quad ln[1 - \Phi](Z'i\alpha)(\frac{x_{i\beta}^{'}}{\sigma})] + \sum_{+} \quad ln\ [\Phi(z_i'\alpha)\frac{1}{\sigma}\Phi(\frac{y_i - x_i'}{\sigma}\beta) \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where:

Φ and φ refer to the standard normal probability and density functions, respectively.

Zi and Xi represent independent variables for the Probit model and the Truncated model, respectively.

α, σ, and β are parameters to be estimated for each model.

Table 2: Variables included in the Double Hurdle regression model

Variables	Variable Description and Measurement	Exp Sign
Dependent		
Mkt participation	The decision of a farmer to participate (1=Yes 0=No) Dummy	
Intensity of participation	Quantity of indigenous chickens sold (Continuous)	
Independent		
Gender	Gender of the household head (Dummy) 1=Male 2=Female	+/-
Schooling years	Number of schooling years of the household head (Continuous)	+
Dependency ratio	Ratio of the non-working household members compared with working group (continuous)	+
TLU	Tropical Livestock Unit of the farmer's other livestock in units (continuous)	+
Extension services	Access to extension services (dummy) 1=Yes, 0=No	+/-
Market access	Access to a reliable market by farmers (Dummy) 1=Yes 0=No	+/-
Leadership position	Having a friend or relative in leadership position (Dummy) 1=Yes, 0=No	+
Trust in indigenous chicken traders	Farmers having trust on indigenous chicken traders (Dummy)1=Yes,0=No	+/-
Distance	Distance of the farm to the market (Continuous) Kilometers	-
Land size	Land size allocated for indigenous chicken farming (Continuous)	
Marital status	Marital status of the household head (Dummy) 1=married, 2=single	+/-
Rely on support	Relying on family, friends and relatives support in production (dummy) 1= Yes, 0=No	+/-

Trade experience	Number of years in indigenous chicken trading (continuous)	+/-
Vaccination	Vaccination of indigenous chickens by farmers (Dummy) 1=Yes 0=No	+/-
Years stayed in a village	Number of years stayed in a village by indigenous chicken farmers (continuous)	+
Type of main road	Type of main road used by the farmer (gravel, tarred road), continuous	+

3.5.3 Objective 3: To determine factors that influence the choice of market outlets by small-scale indigenous chicken farmers in the Kweneng East district of Botswana

Post the decision to participate, farmers have to choose a suitable indigenous chicken market outlet. There are multiple marketing outlets that farmers can choose from. The study then employed a Multivariate Probit (MVP). The MVP framework is grounded in the random utility theory of decision-making, which posits that individuals select the combination of market channels that maximizes their perceived utility (McFadden, 1981). When presented with a full set of possible outlet combinations, the chosen bundle reflects the highest utility among the available alternatives. The market outlets included restaurants/hotels, farm gate and traders. Since the outlets are not mutually exclusive, the MVP model accounted for the simultaneous selection of multiple outlets and the possible interdependency among the outlets (Timu *et al*., 2014).

Alternative models include the Multinomial Logit (MNL), and the ordered logit model, as the dependent variables have more than two outcomes or categories. Unlike the MVP, the MNL assumes that a farmer can only choose one market outlet at a time from a set of different choices that are mutually exclusive (Arumugan *et al*., 2022: Tse, 1987). The model is also used when the nominal outcome variable to be predicted is unordered and this model can also be applied to any number of continuous or categorical independent variables. However, that is not applicable since for this study farmers can choose more than one alternative. The ordered logit is similar to the MNL model, except that it is a regression model for an ordinal response variable; therefore, small-scale indigenous chicken farmers cannot choose ordered outlet markets as a response, henceforth making this model inappropriate for this study.

The Multivariate Probit (MVP) model was suitable as it accounts for the possibility of simultaneous and correlated decisions across multiple marketing channels. An MVP is suitable for modelling farmers' decisions as it increases estimation efficiency (Jenkins *et al*., 2011). Following this, the study adopts the MVP approach to analyze how smallholder farmers choose among different market outlets. The specification of the MVP model is presented below:

$$Y_{it}^{*} = \beta_{it} X_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where:

Y_{it} is a set of dependent variables (market outlets).

t= (1,2,3) represents the choice of indigenous chicken market outlets including restaurants/hotels, farm gate and traders denoted by the letter k.

X_{it} is a 1 x k vector of all factors that influence the choice of market outlet, including socio-economic, institutional and market-related factors.

B_{it} represents a k x 1vector of the parameter to be estimated.

i^{th} farmer is given i(1, 2…, n) to choose a market outlet.

ε_{it} (t=1, …, m) represents error terms.

The observed outcome for choosing the indigenous chicken market outlet will be modeled as follows:

Y_{it} $\{1\ if\ Y * it > 0\ 0\ otherwise$ t= 1,2,3: 0 otherwise

For this study, small-scale indigenous chicken farmers choose market outlets based on the derived utility. Whereas the decision of market outlet implies multiple-choice such as restaurants/hotels, farm gate and traders. Consequently, the systems of equations for each market outlet will be given as:

$$Y_{1i}^{*} = \beta_1 X_1 + \varepsilon_{1i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

$$Y_{2i}^{*} = \beta_2 X_2 + \varepsilon_{2i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

$$Y_{3i}^{*} = \beta_3 X_3 + \varepsilon_{3i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Where:

Y_1^{*} = restaurants/hotels

Y^{*}_2 = farm gate

Y^{*}_{3} = traders

Even though MVP is considered the best model to analyze the objective, econometric tests multicollinearity and heteroscedasticity will be carried out before running the regression model.

Table 3: Description and measurement of variables used in the Multivariate Probit Model

Variables	Variable Description and Measurement	Exp Sign
Dependent		
Mkt Outlets	The market outlets of IC (1=restaurants/hotels, 2=farm gate, 3=traders)	
Independent		
Gender	Gender of the household head (Dummy) 1=Male 0=Female	+/-
Schooling years	Number of schooling years of a household head (continuous)	+
HH Size	Number of individuals in the household participating in IC farming (Discrete) Number	+/-
Off-farm income	Income from other activities apart from indigenous chicken farming(continuous)	+
TLU	Tropical Livestock Units of the farmer's other livestock in units (continuous)	+
Trade_exp	Number of years a farmer has been involved in indigenous chicken trading (continuous)	+
Group membership	If a farmer is a member of any farmer groups(dummy) 1= Yes 0=No	+/-
Market access	Access to a reliable market by farmers (dummy) 1=Yes 0=No	+/-
Leadership position	Having a friend or relative in leadership position(dummy) 1=Yes 0=No	+/-
Trust in indigenous traders	Farmers having trust on indigenous chicken traders(dummy) 1=Yes 0=No	+/-
Distance to Ext office	Distance to the nearest extension agent office in kilometers (continuous)	+

Distance to main road	Distance from the farmers' home to the main road in kilometers(continuous)	+
Distance to output market	Distance from the farmers' home to the indigenous chicken output market (continuous)	+
Own television	Ownership of a television as a source of market information by the farmer (dummy) 1=Yes 0=No	+/-
Rely on support	Rely on support from friends/ relatives during critical times(dummy) 1=Yes, 0=No	+/-
Land size	Land size allocated for IC farming (Continuous) Square meters	+
Market bargaining power	Ability of a farmer to negotiate on the set prices (dummy) 1=Yes 0=No	+/-

3.5.4 Objective 4: To determine the effects of market participation on household income among small-scale indigenous chicken farmers in the Kweneng East district of Botswana

Household income is one of the most commonly used measures of living standard (OECD, 2011). In comparison proxies like consumption, income is straightforward for respondents to report and is often available across bigger sample sizes. Since income is easy to report, it provides the statistical power to test robust hypothesis. Income is necessary for daily survival and economic well-being. Income data allows for a deeper comprehension of the socio-economic disparities and opportunities (Olvera *et al*., 2008).

An Endogenous Switching Regression (ESR) model was used analyze this objective. The model deals with the possible endogeneity problem (Lapple *et al*., 2013). Comparative models include the Ordinary Least Squares (OLS), Instrumental variables (IV), Propensity Square Matching (PSM) and Heckman (Ojo *et al*., 2022). These models may yield inconsistent estimates unlike the ESR which overcomes this weakness by correcting for selection bias. Although the Heckman also corrects for selection bias Heckman (1979), the model provides unreliable standard errors Lokshin and Sajaia (2004). A PSM neglects selection bias; also, it assumes that farmers' decisions are influenced by observed factors only, not accounting for the inherent unobserved factors. Meaning, farmers can supply more indigenous chickens not because they are participating in the market but due to other factors such as managerial skills, motivation, and more (Asfaw *et*

al., 2012; Olwande & Smale, 2014). This is captured by the ESR, it considers both observable and unobservable factors in the analysis. To account for self-selection, the ESR uses a full information maximum likelihood to estimate a simultaneous equation model (Tesfaye & Trivayi, 2016). Although ESR and IV methods follow the normality assumption, the ESR model is broadly regarded as more efficient in estimation as it extracts more information as compared to IV (Muricho *et al*., 2017).

Hence, this study adopted the ESR model to examine the effects of market participation on the welfare of smallholders. The ESR model has two-stage estimation procedures which are done simultaneously. In the first stage, the estimation of an equation (12) called the selection equation is usually done to determine the factors affecting market participation.

A probit model will be used to determine factors influencing market participation and specified as follows:

$$M_i^* = \alpha_i X_I + u_i \quad \text{with } M_i = \sum(0\ otherwise 1\ if\ mi > 1.) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(13)}$$

Where:

M_i* is the unobservable or latent variable for market participation.

M_i is the observable counterpart (i.e. equals 1, indigenous chicken farmers have sold any quantity of indigenous chickens (proxied by monetary value) produced by him/her in the market and zero otherwise).

X_i is a vector of observed farm and non-farm characteristics influencing market participation.

α is the coefficient estimate.

u_i is random disturbances associated with market participation.

In the second stage, the model is specified for two regimes of participants and non-participants of the market as: Regime 1 (participants): y_{ip} and y_{in} are outcomes (income) variables for market participants respectively; *W* is a vector of exogenous variables of household I, expected to influence household income, B is the coefficient vector to be estimated; μ is the error term and p is a dummy for market participation.

The study assessed the influence of market participation by analyzing expected outcomes relative to counterfactual scenarios in which farmers did not take part in the market. Equations (14a) and (14b) illustrate the expected values of the outcome y for cases of both market participation and non-participation:

Regime 1: (Participants): $E(y_{ip}|p=1)) = w,\beta_{ip} - \sigma_{p\varepsilon}\lambda p$ ……. (14a)

Regime 2: (Non-participants): $E(y_{in}|p=1)) = w'\beta_{in} - \sigma_{n\varepsilon}\lambda p$ …… (14b)

A change in the outcome as a result of participation referred to as the average treatment effect on the treated (ATT), is expressed in equation (15) as the difference in the expected outcomes from equations (14a) and (14b) (Lokshi & Sajaia. 2004).

$$ATT = E(p=1) - E(p)=1) - W(\beta_{ip} - \beta_{in} + \lambda_p(\sigma_{p\varepsilon} - \sigma_{n\varepsilon}) \ldots\ldots\ldots (15)$$

Similarly, the effect of treatment (market participation) on the untreated (ATU), for farmers who did not participate in the market will be calculated as:

$$ATU = E(p=0) - E(p) = 0 - W(\beta_{ip} - \beta_{in} + \lambda_p(\sigma_{p\varepsilon} - \sigma_{n\varepsilon}) \ldots\ldots\ldots (16)$$

Table 4: Variables included in the Endo-switching regression (ESR) Model

Variables	Variable description and measurement	Exp sign
Dependent		
Household income	Total annual household income from off-farm and on-farm activities (Continuous: Pula)	
Independent		
Gender	Gender of the household head (Dummy 1= male, 0=female)	+/-
Schooling years	Number of years of schooling by a farmer (Discrete; Years)	+
Inactive members	Number of members who are not actively involved in indigenous chicken farming (continuous)	+
Active members	Number of household members actively involved in indigenous chicken farming (continuous)	+
TLU	Tropical Livestock Unit of the farmers other livestock in units (continuous)	+
Extension visits	Number of visits made to the extension officers by a farmer (continuous)	+

Group membership	If a farmer is a member of any farmer groups(dummy) 1=Yes 0=No	+/-
Market access	Access to a reliable market by farmers(dummy) 1=Yes 0=No	+/-
Leadership position	Having a friend or relative in leadership position(dummy) 1=Yes 0=No	+/-
Local chicken traders	The number of indigenous chicken traders in the village(continuous)	+
Trust- ic traders	Farmers having trust in indigenous chicken traders(dummy) 1=Yes 0=No	+/-
Distance to output market	Distance from the farmers's home to output market (continuous)kilometers	+
Distance to main road	Distance from the farmers home to the main road(continuous)kilometers	+
Land size	Land size allocated for indigenous chicken farming(continuous) square meters	+
Marital status	Marital status of the indigenous chicken farmer(dummy) 1=married 0=single	+/-
Own transport	Ownership of any transport means by the farmer(dummy) 1=Yes 0=No	+/-
Vaccination	Vaccination of chickens by an indigenous chicken farmer(dummy) 1=Yes 0=No	+/-
Government assistance	A farmer receiving assistance from the government(dummy) 1=Yes 0=No	+/-
Relatives support	Support from relatives during critical times (dummy)1=Yes 0=No	+/-

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.0 Introduction

This chapter shares the research findings and examines the key factors influencing market participation, as well as how these factors affect household income for small-scale indigenous chicken farmers in Botswana's Kweneng East district. The study considered 276 farmers who responded to the questionnaires. The results in Section 4.1 provide a descriptive overview of the socio-economic, market, and institutional characteristics of small-scale indigenous chicken farmers. The preferred indigenous chicken market outlets and their price differentials are also discussed in descriptive statistics in Section 4.2. The findings from the Double Hurdle are reported in Section 4.3, focusing on factors influencing market participation and the intensity of participation in the first and second stages, respectively. The findings of the Multivariate Probit on the factors influencing the choice of market outlets among small-scale indigenous chicken farmers are presented in Section 4.4. Section 4.5 then evaluates how market participation affects household income, drawing on results from the Endogenous Switching Regression model.

4.1 Descriptive analysis

4.1.1 Socio-economic, market and institutional characteristics of market participants and non-market participants.

Table 5 presents the t-test analysis of small-scale indigenous chicken farmers' socio-economic, market, and institutional characteristics.

Table 5: Socioeconomic, market and institutional characteristics by market participation (continuous variables)

Variables	Non-market participants n=138	Market Participants n=138	Pooled n=276	t-test
Age	51.89	51.43	51.66	0.27
	(1.25)	(1.19)	(0.85)	
Number of schooling years	7.51	7.74	7.62	-0.41
	(0.40)	(0.40)	(0.29)	
Trade experience	2.54	8.66	5.60	**-6.13*** **
	(0.49)	(0.87)	(0.53)	
Experience in indigenous chicken farming	19.82	21.17	20.50	**0.75**
	(1.37)	(1.40)	(0.98)	
Household size	6.41	6.35	6.38	0.10
	(0.36)	(0.43)	(0.28)	
Dependency Ratio	0.71	0.63	0.67	0.82
	(0.07)	(0.07)	(0.05)	
Land-owned square meters	1.38	0.80	1.09	1.01
	(0.53)	(0.24)	(0.29)	
Tropical Livestock Unit (TLU)	2.58	2.68	2.62	-0.12
	(0.58)	(0.57)	(0.40)	
Extension Visits	0.25	0.51	0.38	**-2.09** **
	(0.07)	(0.11)	(0.060	
Years stayed in Village	34.20	34.80	34.50	-0.24
	(1.76)	(1.80)	(1.26)	
Number of Local chicken traders in the village	0.71	1.05	0.88	**-1.68** **
	(0.14)	(0.14)	(0.10)	
Distance to nearest Main Road (KM)	2.20	1.66	1.93	**2.00** **
	(0.22)	(0.16)	(0.14)	
Distance to nearest extension agent office (KM)	7.90	6.78	7.34	**1.44***
	(0.56)	(0.53)	(0.39)	

Distance to nearest Output Market (KM)	1.78	0.47	1.31	0.98
	(1.31)	(0.19)	(1.32)	
Support from relatives	1.25	1.76	1.51	**-1.68****
	(0.16)	(0.26)	(0.15)	
Support from friends	0.91	1.26	1.09	**-1.29***
	(0.16)	(0.22)	(0.14)	

Note: Figures in parentheses represent standard deviations, ***, **, and*, which are significant at the 1%, 5%, and 10% levels, respectively.

On average, indigenous chicken farmers who engaged in market activities had around 9 years of trade experience, while those who remained outside the market had only about 3 years of experience. Farmers' trading experience significantly increases the likelihood of market participation at 1% significance level. The more exposure the farmer has in trading, the more equipped knowledge, skills and necessary contacts, hence, a better likelihood to engage in the market. Abeykoon *et al*. (2013) supports this, stating that experienced traders often have better knowledge of market dynamics, including demand, pricing, and buyer preferences. This information helps farmers to decide more effectively on the timing and location of sales, thereby improving their level their intensity to participate.

Agricultural extension services in the study area are primarily provided by government officials at the district level. Farmers who sold their chickens in the market visited extension offices an average of 0.51 times, compared to 0.25 times for those who did not participate in the market. Although the low averages, visiting extension offices significantly increased the likelihood to participate in indigenous chicken markets at 5%. This suggests limited access to extension services, and low influence on market participation. This is however against the idea of extension service delivery, to give awareness, change mindsets and influence decisions for the greater good. Even Muricho *et al*. (2017) supports this by stating that market-participating households usually would have more engagement with extension services.Ochieng *et al.* (2011) also emphasizes that regular visits from extension officers provide farmers with essential knowledge and skills to effectively address production challenges.

Majority of market participants were familiar with local indigenous chicken traders as compared to non-market participants. The analysis indicates that the relationship between market participation and the number of known traders is statistically significant at 5%. This could imply that traders are indeed necessary for facilitating market participation by influencing both demand and supply, as well as improving access to markets. Akidi (2016) supports this finding by sharing that farmers with greater access to traders are encouraged to participate in the market.

At 5% signaificance level, access to the main road improves market engagement. That is the less further away from the main road the more likely the farmer is to engage in market activities. On average, market participants are 1.66 km away from the main road, compared to 2.20 km of non-participating farmers. Implication, long distances to the markets lead to higher transport costs, which in turn reduce indigenous chicken farmers' ability to participatite effectively in the markets. This was also uncovered by Martey *et al*. (2012).

Support from relatives had a mean of 1.76 for farmers who participated in the market and a mean of 1.25 for farmers who did not participate in the market. There was a statistically significant relationship between farmers' relative support and market participation at a 5% level. This is probably because relatives provide essential financial, moral and logistical support that enables farmers to scale their production and improve market access for farmers who participate in the market. This support can be in the form of finances for feeds or vaccines, labor and funds for transporting chickens to the markets. The results align with the findings of Deegun and Dunne (2022), who in their study observed that family support can motivate an indigenous chicken farmer during challenging times. This helps mitigate financial stress related to farming allowing farmers to focus more on their agricultural activities.

Table 6 shows the chi-square findings on the mean value of both market and non-market participants' socioeconomic, market and institutional characteristics.

Table 6 indicates that every small-scale indigenous chicken farmer who sold in the market (100%) had some level of market bargaining power, whereas just 16.36% of farmers who participated in the market reported having none. Comparatively, most farmers who did not participate in the markets (83.64%), had no bargaining power in the marketplace. The statistical association between market participation and market participation was significant at 1%. A possible reason is that the indigenous chicken farmers' ability to negotiate reasonable prices and access profitable markets is shaped by their negotiation skills. More bargaining power translates

to more profits thereby encouraging the farmer to stay in the market. In support, African Farm Institute Limited (2020), explained that farmers have a greater chance to engage actively in the market when they have more substantial bargaining power.

A significant association was observed between market participation and farmers' trust in indigenous chicken traders at a 5% level. The results show that within market participants 56.49% trust local indigenous chicken traders, while 44.14% distrust. Conversely, about 55.86% of the non-market participants did not trust indigenous chicken traders, while 43.51% trusts indigenous chicken traders. Trust in indigenous chicken traders has its own advantages (long-term relationships, low transaction costs, better price negotiation, transparency) which leads to increased market participation. Trust also facilitates better access to vital market information, enabling farmers and traders to exchange insights about trends, pricing, demand and to make informed decisions about when and how much to sell. Hailu (2017), shared that a traders' good reputation and trustworthiness increases the farmers commitment to these traders as it reduces opportunistic behaviour.

Table 6: Socioeconomic, institutional and market characteristics by market participation (categorical explanatory variables)

Variable		Market participants n=138	Non-market participants n=138	Pooled n=276	χ^2
Gender	Female	101(48.56)	107 (51.44)	208(75.36)	
	Male	37(54.41)	31(45.59)	68(24.63)	0.70
Marital status	Married	51(44.35)	64(55.65)	115(41.67)	
	Single	87(54.04)	74(45.96)	161(58.33)	2.52
Market	No	27(16.36)	138(83.64)	165(59.79)	
bargaining power	Yes	111(100)	0(0)	111(40.22)	**185.67*** **
Trusting	No	64(44.14)	81(55.86)	145(52.54)	
indigenous	Yes	74(56.49)	57(43.51)	131(47.46)	**4.20** **
chicken traders					
Vaccination	No	107(46.12)	125(53.88)	232(84.06)	
	Yes	31(70.45)	13(29.55)	44(15.94)	**8.76*** **
	No	51(42.86)	68(57.14)	119(43.12)	

Ownership of Television	Yes	87(55.41)	70(44.59)	157(56.88)	**4.27****
Receive	No	114(48.31)	122(51.69)	236(85.51)	
Extension	Yes	24(60.00)	16(40.00)	40(14.49)	0.17
services					
Group	No	127(48.47)	135(51.53)	262(94.92)	
membership	Yes	11(78.57)	3(21.43)	14(5.07)	**4.82****
Access to Market	No	104(44.25)	131(55.74)	235(85.14)	
information	Yes	34(82.93)	7(17.07)	41(14.86)	**20.88*****
Leadership	No	107(47.56)	118(52.44)	225(81.52)	
position of	Yes	31(60.78)	20(39.22)	51(18.48)	**2.91***
relatives					
Receive	No	111(48.26)	119(51.74)	230(83.33)	
government	Yes	27(58.70)	19(41.30)	46(16.67)	1.67
assistance					
Support from	No	52(46.43)	60(53.57)	112(40.58)	
both relatives and	Yes	86(52.44)	78(47.56)	164(59.42)	0.96
friends					
Ownership of	No	103(51.24)	98(48.76)	201(72.83)	
transport means	Yes	35(46.67)	40(53.33)	75(27.17)	0.46
Type of Main	Murrum	26(42.62)	35(57.38)	61(22.10)	
Road					
	Tarmac	112(52.09)	103(47.91)	215(77.90)	1.70
Off-farm income	No	20(54.05)	17(45.95)	37(13.41)	
	Yes	118(49.37)	121(50.63)	239(86.59)	0.60

Note: ***, **, and * represent significance at 1%, 5%, and 10%, respectively. Figures in parentheses represent percentages.

Most market participants (70.45%) vaccinated their chickens against diseases and 46% did not vaccinate their chicken even though they participated in the market. For non-participants only 29.55% vaccinated their indigenous chickens and about 55.88% did not vaccinate their chickens. The association between vaccination practice and market participation showed a statistical

significance at 1% level. This implies that vaccination is important since it helps in lowering the mortality rates and increases the productivity, leading to high market participation. Reduction of negative impacts caused by diseases was observed from farmers who participated in the market. Even though vaccinating the flocks is an effective practice, challenges such as costly vaccines, lack of information and skills lead to farmer's inability to vaccinate their chickens (Njue *et al*., 2006).

About 55.41% households were market participants who owned televisions, whereas 42.86% participants did not own televisions. On the contrary, for the non-market participants, 57.14% did not own televisions while 44.59% owned them. Results indicate that owning a television is positively and significantly associated with farmers' likelihood of participating in the market, with significance observed at the 5% level. Likely cause is that information on market prices, demand trends, and modern farming practices is mostly distributed through televisions. Kiprop *et al*. (2020) supports that access to media contributes to better awareness of market opportunities and improves the ability of farmers to negotiate favorable terms when selling their products.

Most market participants are members of a farmer group. About 78.57% of market participants were also in a farmer group, compared to a few 48.47% of participants. In comparison, 51.53% of non-participating farmers did not belong to any group, while only 21.43% had group membership. The model finding is that belonging to a farmer group enhances market participation, at 5%. Meaning, farmer groups provide a platform for exchange of knowledge and skills, while helps to lower transaction costs. Poulton *et al.* (2006) shares that indeed group membership strengthens farmers' ability to negotiate and secure better trade terms. Similarly, Njuki *et al.* (2009) noted that collective marketing reduces transaction costs, enabling farmers to obtain higher prices and more favorable trading conditions.

The analysis showed that access to market information was strongly linked to market participation with the relationship significant at the 1% level. Among farmers who participated in markets, approximately 82.93% had access to market information, compared to 44.25% who did not. Conversely, 55.74% of non-participating farmers lacked access, while only 17.07% were able to obtain market information. These findings indicate that access to market information increases the likelihood that farmers will participate in markets. Such information keeps farmers informed about existing market outlets, price changes, and potential buyers and sellers. These findings are

consistent with Glendening *et al.* (2010), who highlighted that farmers benefit from access to wide range of information, which helps them boost production, take advantage of market opportunities, and achieve favorable prices.

4.2 Choice of market outlets and their price differentials

4.2.1 Preferred market outlets by indigenous chicken farmers

The choice of preferred market outlets was analyzed using frequencies, percentages and presented in Table 7 and a bar chart (see appendix). The smallholder farmers in the Kweneng East district preferred only three market outlets: selling directly at the farm gate (to farmers and customers), selling to restaurants/ hotels and selling to traders. The findings further indicate that farmers have the option to supply their produce to any of the three outlets.

Table 7: Market-outlet choices

Market Outlets	Farm gate		Restaurant		Traders	
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)
No	189	68.48	235	85.14	233	84.42
Yes	87	31.52	41	14.86	43	15.58

Among smallholder farmers participating in the market, only 31.52% opted to sell their produce directly at the farm gate, either to fellow farmers or consumers. By contrast, 68.48% of indigenous chicken farmers opted not to sell through the farm gate market outlet. Table 7 shows that farm gate was the most preferred market outlet as compared to other market outlets. Farm gate buyers mostly buy for their household consumption or rearing by other farmers. Due to unreliable markets, small-scale indigenous chicken farmers preferably market their chickens at the farm gate. Another reason is that selling at the farm gate is cost effective and convenient as transportation and transaction costs are minimized. These results correspond with Zanello *et al.* (2012), who observed that farmers tend to favor buyers who visit the farm gate, as this selling method helps reduce proportional transaction costs.

Farmers preferred the traders' market as the second market outlet. The results show that 84.42% are the indigenous farmers who chose not to sell to traders, while 15.58% sold to traders.

Traders serve as middlemen between farmers and consumers. By selling directly to the indigenous traders, farmers are able to connect to larger markets intensive marketing. Farmers also get to focus on their production more since most of the logistics are handled by the traders. Connecting farmers and potential consumers is a very important role played by the traders, and this leads to closing information gap and reducing transportation costs. These results conform with the findings of (FAO, 2023), who noted that traders purchase live chickens from small farmers but more frequently from primary markets and resell them in Nairobi, ensuring a constant supply of indigenous chickens directly to supermarkets.

The results on Table 7, show that the restaurants/hotels were the third and least preferred market outlet by indigenous chicken farmers. Restaurants/hotels are identified as street vendors who cook traditional foods and big hotels that cater for tourists and locals who prefer traditional foods. Most (85.14%) of smallholder indigenous chicken farmers did not sell their produce to restaurants/hotels. A small portion (14.86%) of indigenous chicken farmers who participated in the market preferred to sell their chickens to restaurants/hotels. A plausible explanation is that restaurants/hotel outlets often demand consistent quality and specific quantities of chickens, which can be a challenge for small-scale indigenous chicken farmers to meet. In addition, these outlets operate on credit terms or delayed payment, which can strain farmers' cash flow.

4.2.2 Price differentials of market outlets

The descriptive statistics analysis for price differentials of small-scale indigenous chicken market outlets are presented in Table 8. The average price for cocks and hens was determined because smallholder farmers preferred selling adult chickens only. Farmers reported that chicks were not sold as they kept them for production.

Table 8: Price differential across various market outlets

Market outlets	Average Price of Hen in BWP (USD)	Average Price of Cock in BWP (USD)
Farm gate	99.45	127.06
	(13.31)	(36.07)
Restaurant	103.24	143.33
	(8.18)	(39.22)
Traders	99.50	129.62

	(3.89)	(22.61)

Note: Figures in parenthesis represent standard deviations. 1USD is equal to 13.57BWP

Table 8 presents the results showing how different indigenous chicken market outlets priced their live/slaughtered hen/cock. Live or slaughtered hen/cock were sold to different market outlets depending on their particular preferences. The results indicate that, even though restaurants/hotel market outlet was the least preferred among the other outlets it offered better prices for both hen and cock at 103.24 BWP and 143.33 BWP respectively. This is likely because such markets are formal in nature, requiring adherence to specific standards related to quality, grading and pricing. The trader market outlet was the second after the restaurants/hotels market. A cock was sold at 129.62BWP, and a hen was sold at 99.50BWP at the trader's market outlet. However, there was a small margin between the farm gate market outlet and the traders' market outlet. The results show that the cock price was 127.06BWP more than that of the hen, which was 99.45BWP at the farm gate. Meaning, although the farm gate market outlet offered lower prices for both hens and cocks compared to other outlets, it remained the preferred choice for most farmers.

4.3 Determining factors influencing market participation and the intensity of participation among small-scale indigenous chicken farmers

4.3.1 Double hurdle diagnostic tests

To examine factors influencing market participation and the intensity of market participation among small-scale indigenous chicken farmers Kweneng East district a double hurdle model was employed. To assess the model's suitability relative to the Tobit alternative, a likelihood ratio test was conducted. The resulting Wald chi-square statistic of 70.45 provided strong evidence against the null hypothesis, confirming the DH model as the more appropriate specification. This test also evaluated whether the set of independent variables significantly influenced market participation compared to a model with only the intercept. The chi-square value was significant at 1% level, this shows that at least one explanatory variable had a meaningful effect on market participation, as presented in Table 9.

4.3.2 Market participation results

The indigenous chicken farmer's decision to either participate in the market or not to participate in the market is usually analyzed on the first hurdle of the model. To analyze this decision, a standard Probit model was employed. The results of tier one is presented in Table 9. The results suggest that market access, leadership position, trust in chicken traders, marital status, experience in trading and vaccination had a significant influence on the smallholder's decision to participate in the market.

Table 9: The first hurdle of the double hurdle model

	First Hurdle		
	Market participation (0=No 1=Yes)		
Variables	Coefficient	Std Error	P-value
Gender (0=Female 1=Male)	0.131	0.205	0.525
Years of schooling	-0.015	0.021	0.475
Dependency Ratio	-0.006	0.111	0.958
TLU	**-0.022***	0.013	**0.090**
Receive Extension (0=No 1=Yes)	-0.194	0.269	0.471
Market Access (0=No 1=Yes)	**1.062*****	0.281	**0.000**
Leadership Position (0=No 1=Yes)	**0.452***	0.232	**0.051**
Trust chicken Trader (0=No 1=Yes)	**0.333***	0.190	**0.079**
Main Road Km	**-0.075***	0.044	**0.088**
Ln Land size	**-0.332****	0.150	**0.026**
Marital Status (1=Married 0=Single)	**0.453****	0.184	0.014
Rely Support (0=No 1=Yes)	0.210	0.194	0.278
Trade Experience years	**0.075*****	0.017	**0.000**
Vaccination (0=No 1=Yes)	**0.667****	0.267	**0.012**
Years of staying in the village	-0.003	0.005	0.527
Type of Main Road	0.327	0.227	0.150
Constant	**-1.877*****	0.678	**0.006**
Wald chi2(16) = 70.45 & Prob > chi2=0.000			

Note: *, **, *** represent significant at 10%, 5%, 1% level respectively.

The results in Table 9, show a positive statistical association between access to reliable markets and market participation at a 1% level.

The results indicate that if an indigenous chicken farmer has access to a reliable market, it increases the likelihood of participation in indigenous chicken markets by 106.2%. A plausible explanation is that access to a reliable market enhances market participation as it gives the farmer assurance that his products will be bought and this reduces his uncertainty. Therefore, indigenous chicken farmers will be more consistent in supplying the product in order to meet the customers' demand at reasonable better prices. Additionally, when indigenous chicken farmers have a reliable market, they have a guaranteed and timely purchase. Consequently, access to market information helps farmers overcome the constraints associated with market participation. These results correspond with those of Nanyonjo *et al.* (2020), who highlighted that engaging in agricultural marketing and having access to reliable markets are essential for both male and female producers, as they contribute to income generation and the development of social networks.

The area of land allocated to indigenous chicken production had a negative effect on market participation. An increase in land size reduces the likelihood of participation by 33.2%. This indicates that farmers with a relatively big area of land may prioritize other farming activities over indigenous chicken production, thereby lowering their participation in the market. Such farmers often focus on farm activities that require more land and intensive care, leaving less attention for indigenous chickens. Contrarily, Raghbendra *et al.* (2005) reported a positive association between size of land and smallholder agricultural production, indicating that larger landholdings can sometimes support increased market participation.

Marital status has a positive and significant effect on participation of farmers in the indigenous chicken market. Being married causes a 45.3% increase in market participation. This relationship may be explained by the financial responsibilities of supporting a household, which can motivate married farmers to seek additional income through poultry sales. Onya *et al*. (2016) also found out that marital status had a positive and significant impact on farmers' participation in cassava and garri markets.

Indigenous chicken farmers' participation in the market was positively and significantly influenced by experience trading. This implies that an additional year of experience increases the likelihood to take part in the market by 7.5%. More experienced farmers are knowledgeable about the market, and have developed strong connections within the market. In addition, farmers get

significant contacts in the market, giving them more trading opportunities. Mailu *et al*. (2012) findings confirm with the results, indicating that farmers with more trading experience were better positioned to negotiate suitable trading terms, which lead to increased market participation.

Farmers' vaccination of chickens had a significant and positive effect on market participation. The results indicate that an increase in the vaccination rate of chickens by one yield the probability to participate in the market by 0.66%. Vaccination of indigenous chickens helps in strengthening their immunity, making then infection resistant. Therefore, farmers' productivity and market participation would increase as there will be less or no losses to incur. The findings of Otiang *et al.* (2012) align with the findings by noting that regular vaccination is associated with significant increases in flock sizes. The reduction in disease incidence allows farmers to sell healthier birds at reasonable prices, mitigating the low farm gate prices often experienced when selling through middlemen (Mathiu, 2021).

4.3.2 Factors that influence the intensity of participation-second hurdle

A truncated regression model was applied to achieve this objective, and non-market participant were excluded from the sample. Participation intensity was measured by the quantity of indigenous chickens sold in the market. Years of formal education, household dependency ratio, Tropical Livestock Units (TLU), access to markets, frequency of extension service contact, reliance on support from friends or family, and the duration of residence in the village are market participation indicators among participant farmers. These variables helped explain differences in sales volume, providing an understanding on the socio-economic and institutional factors that influence the degree of commercialization in indigenous poultry farming.

Table 10: Second hurdle truncated regression results

	Second Hurdle		
	Ln Number of chickens sold		
Variables	Coefficient	Std Error	P-value
Gender (1=Female 2=Male)	0.086	0.135	0.524
Years of schooling	**0.039****	0.016	**0.013**
Dependency Ratio	**0.212****	0.093	**0.022**
TLU	**0.016****	0.007	**0.030**
Receive Extension (0=No 1=Yes)	**0.344***	0.190	**0.070**
Market Access (0=No 1=Yes)	**0.290****	0.145	**0.046**
Leadership Position (0=No 1=Yes)	0.036	0.121	0.764
Trust Chicken Trader (0=No 1=Yes)	-0.087	0.123	0.478
Main Road Km	0.048	0.033	0.142
Ln Land size	-0.221	0.176	0.209
Marital Status (1=Married 2=Single)	0.049	0.128	0.702
Rely Support (0=No 1=Yes)	**-0.286****	0.130	**0.027**
Trade Experience years	0.000	0.007	0.986
Vaccination (0=No 1=Yes)	0.169	0.167	0.311
Years stayed in the village	**0.006***	0.003	**0.062**
Type of Main Road	0.206	0.150	0.169
Constant	0.910	0.428	0.034
Wald chi2(16) = 70.45 & Prob > chi2=0.000			

*: significant at 10% level **: significant at 5% level ***: significant at 1% level

Years of formal education had a positive and significant effect on the intensity of market participation, implying that additional years of formal education will lead to an increase in the intensity of participation in the market by 3.9%. Farmers with formal education often understand the market, and make wise choices of adopting favourable marketing and production strategies which joining the market is one of as it improves household income. Barrett (2008) with a like-mind states that education strengthens managerial skills and facilitates the adoption of new agricultural and marketing practices. Enete and Igbokwe (2009) and Randela *et al*. (2008) suggest

that households with higher education levels acquire better production and management skills, necessary to increase their engagement in the market activities. Akrong *et al.* (2021) similarly observed that additional years of schooling positively and significantly impacted the participation of small-scale mango farmers in the export market in Southern Ghana.

The dependency ratio had a positive and significant effect on the intensity of market participation at a 1% level. An increase in the dependency ratio by one causes a 21.1% increase on the intensity of the indigenous chicken farmer's participation. A dependency ratio represents the proportion of dependents (children of 0-14years and above 65years adults) and the working population (15-64years). The results reveal that indigenous chicken farming in a family can be affected by a higher number of dependents. Therefore, this can encourage indigenous chicken farmers to increase their intensity of participation since the business requires less capital to avoid financial strains. The results agree with Simon *et al*. (2015), who highlighted that poultry farming plays an important role on improving the standard of living of farmers by quick income generation.

Tropical Livestock Units (TLU) had a positive and significant effect on the intensity of market participation among indigenous chicken farmers. The findings imply that an increase in the number of other livestock owned corresponds to a 1.6% rise in the volume of indigenous chickens sold. This suggests that farmers with mixed livestock production are more profit-driven and have higher chances to expand their poultry sector. Ownership of additional livestock may also reflect greater access to resources, infrastructure, and market networks, all of which can facilitate increased engagement in indigenous chicken marketing. A potential reason is that livestock ownership increases resource availability, such as chicken manure for crop production, better land utilization, and extra income, which can support indigenous chicken farming and market engagement indirectly. The results are in agreement with Singh *et al*. (2023), who discovered that farmers with easy access to resources from other livestock holdings have improved production capacity, enabling them to expand operations and participate more actively in markets. In a similar manner, Talihun *et al*. (2023) showed a positive relationship between TLU and market participation status, supporting the evidence that owning more livestock strengthens farmers' ability to take part in commercial activities.

Access to market information improves a farmer's willingness to participate in the market. Specifically, having access increases quantity supply by 29%. This highlights the critical role information plays in shaping farmers' commercial decisions. Farmers who are well-informed can

make favourable choices, optimize their sales, and respond more effectively to opportunities in the market. Nwafor *et al*. (2020) agrees that when indigenous chicken farmers are likely to engage in a market fully when they are fully aware of what the market holds for them.

As supported by Dercon and Krishnan (2000), income support from other household members improves food security thereby reducing the need for intensive market participation. At 5%, farmers who relied on assistance from both relatives and friends were likely to reduce their market participation by approximately 28.6%.

4.4 Factors influencing the choice of market outlets

Multicollinearity and heteroskedasticity were tested before running the regression model of indigenous chicken farmers' choice of market outlets. Multicollinearity among continuous explanatory variables was assessed using the Variance Inflating Factor (VIF), whereas the relationships among categorical variables were examined using the contingency coefficient (CC) method. Multicollinearity can inflate standard errors, which in turn may obscure the statistical significance of certain predictor variables (Akinwande et al., 2015). The results for the multicollinearity test are presented in Tables 7 and 8 for VIF and CC, respectively. The mean VIF was 1.24, below the threshold level of 10, as indicated in Table 11. This VIF (1.24) indicates no serious multicollinearity between the continuous explanatory variables. According to Gujarati (2003), a variable with a Variance Inflation Factor value greater than 10 indicates the presence of multicollinearity.

4.4.1 Multicollinearity tests

Table 11: Multicollinearity test for continuous variables (Variance Inflation Factor)

Variable	VIF	1/VIF
Main road-KM	1.61	0.619481
Extension _ km	1.43	0.700585
Trade experience	1.35	0.739020
Received off-farm income	1.33	0.754385
Bargaining power	1.30	0.766538

Market access	1.27	0.785920
Television	1.23	0.809917
Group membership	1.21	0.826894
Schooling years	1.21	0.828848
Rely support	1.19	0.839992
Household size	1.17	0.857325
Leadership position	1.17	0.857790
Trust chicken traders	1.14	0.874303
TLU	1.14	0.879611
Gender	1.11	0.899733
ln-land size	1.08	0.921935
Output market _ KM	1.05	0.950009
Mean VIF	**1.24**	

The contingency coefficient (CC) values from Table 12 are below 0.5, indicating no serious level of multicollinearity amongst the categorical explanatory variables.

Table 12: Correlation coefficiency test for categorical explanatory variables

Variables	Group Membership	Market access	Leadership position	Trust indigenous traders
Group membership	1.000			
Market access	0.2749	1.000		
Leadership position	0.0601	0.0899	1.000	

Trust indigenous chicken	0.1109	0.0314	0.089	1.000

4.4.2 Heteroscedasticity tests

The Breusch-Pagan test was applied to check for heteroskedasticity, as it is appropriate for models with continuous dependent variables. In contrast, the White test, used for models with categorical outcomes, is included in the appendices for reference. The Breusch-Pagan test produced a p-value below the 0.05 threshold, prompting the rejection of the null hypothesis of homoscedasticity and confirming the existence of heteroskedasticity in the residuals. This finding indicates that the variance of the error terms is not constant across observations. As recommended by Stock and Watson (2008), heteroskedasticity was corrected using Robust Standard Errors. This was done to also ensure reliability of statistical inference.

Breusch–Pagan/Cook–Weisberg test for heteroskedasticity

Assumption: Normal error terms

Variable: Fitted values of MARKET_PARTICIPATION

H0: Constant variance

chi2(1) = 51.38

Prob > chi2 = 0.0000

The likelihood ratio test assessing the joint significance of the correlation coefficients ($\rho21 = \rho31 = \rho32 = 0$) yielded statistical significance at the 10% level. Consequently, the null hypothesis is rejected with the assumption that all Rho values jointly, are equal to zero. This suggests that farmers' decisions about market outlet selection are interdependent. Therefore, applying MVP model in this study is suitable for identifying the factors that influence indigenous chicken farmers' preferences of marketing outlets.

Table 13 presents the estimated MVP model results of the small-scale indigenous chicken farmers' choice of available market outlets where they sell their chickens. These results show that among the thirteen predictor variables included in the MVP model, ten significantly affected the farmers' choice of indigenous chicken market outlet at 1%, 5% and 10% significance levels. The likelihood of choosing to sell at the farm gate market outlet in the study area is influenced by five variables (household size, off-farm income, leadership position, extension agent distance and

distance to main road), and the restaurants/hotels market outlet is influenced by five variables (household size, group membership, market access, trust chicken trader and indigenous output market distance) while only three determinants (off-farm income, trade experience and main road distance) influenced traders market outlet choice.

Significant at 5%, off-farm income increases the probability of selling at the farm gate by 132% while decreasing the probability of selling at traders' market outlets by 83.6%. This implies that a P1 (0.14USD) increase in the farmers' off-farm income raises the likelihood of the farmer choosing a farm gate as a market outlet than otherwise, and oppositely reduces the likelihood of the farmer choosing traders' market as a market outlet. When earnings from other commitments (other than indigenous chicken farming) improve, the farmer is less likely to prefer selling away from the farm. This can be linked to time-limitation resulting from activities that generate off-farm income, limiting farmers to dedicate time to market their indigenous chickens. As a result, farmers choose to market at the farm gate due to its convenience. These findings correspond with Van den Berg (2001), who discovered that farmers might choose farm gate market for convenience and to maintain cash flow while balancing the demands of off-farm employment. Kiprop *et al*. (2020) also indicated that households with more off-farm incomes often have more financial options that allow them to avoid middlemen that may impose unfavorable conditions.

Table 13: Factors influencing the choice of indigenous chicken market outlets in Botswana

	Farm Gate			Restaurant			Traders		
Variable	Coefficient	Robust SE	P-Value	Coefficient	Robust SE	P-Value	Coefficient	Robust SE	P-Value
Gender (1=Female 2=Male)	-0.302	0.215	0.161	-0.001	0.232	0.997	0.303	0.236	0.200
schooling years	-0.020	0.020	0.328	0.033	0.026	0.209	-0.016	0.025	0.535
Household size	**-0.034***	0.018	0.058	**0.039***	0.023	0.091	0.019	0.025	0.438
Off-farm Income	**1.320*****	0.465	0.005	-0.214	0.346	0.536	**-0.836*****	0.292	0.004
Trade Experience	0.025	0.015	0.100	-0.006	0.016	0.690	**0.025****	0.013	0.049
Tropical Livestock Unit (TLU)	0.022	0.018	0.229	-0.022	0.014	0.113	-0.012	0.013	0.364
Group Membership (0=No 1=Yes)	-0.454	0.442	0.304	**0.777****	0.386	0.044	-0.382	0.446	0.392
Market access (0=No 1=Yes)	0.287	0.252	0.256	**0.638****	0.267	0.017	-0.270	0.277	0.328

Trust chicken Trader (0=No 1=Yes)	0.248	0.194	0.202	**0.511****	0.216	0.018	-0.170	0.222	0.442
Distance to nearest Extension agent office in KM	**0.035****	0.015	0.019	-0.017	0.015	0.263	-0.011	0.019	0.566
Distance to nearest Main Road in Km	**-0.114****	0.052	0.030	-0.046	0.068	0.496	**0.093***	0.050	0.064
Distance to nearest Indigenous Output Market in Km	0.003	0.005	0.578	**-0.125***	0.065	0.054	0.000	0.007	0.954
Own Television (0=No 1=Yes)	**-0.550*****	0.213	0.010	**0.420***	0.249	0.091	0.387	0.243	0.112
Rely Support during crital times of need (0=No 1=Yes)	**0.568*****	0.219	0.009	0.016	0.224	0.944	-0.061	0.228	0.790
Log Land size owned	-0.155	0.165	0.346	-0.111	0.204	0.586	**-1.128***	0.649	0.082
Market bargaining power (0=No 1=Yes)	**1.772*****	0.221	0.000	**1.123*****	0.273	0.000	**1.431*****	0.247	0.000
Constant	**-1.995*****	0.621	0.001	**-2.480*****	0.520	0.000	**-1.465****	0.548	0.008

Number of observations: 276

Likelihood ratio test of rho21 = rho31 = rho32 = 0:

chi2(3) = 17.7688 Prob > chi2 = 0.0005

Note: * -significant at 10% level **- significant at 5% level *** - significant at 1% level

Trade experience positively and significantly influenced the choice of traders' market outlets at 5%. An increase in experience in indigenous chicken trading by a year yields to the likelihood of selling to traders by 2.5%. The possible explanation is that experienced farmers in trading have more understanding of the industry and have developed more relationships in the market. Experience on the other hand enables them the ability to negotiate favorable prices in the market. These findings differ from those reported by Mailu *et al.* (2012), who discovered that although experienced farmers are aware of price variations between farm gates and other outlets, they often prefer selling at farm gate for convenience.

Membership in farmer groups had a positive and significant influence on the choice of restaurant and hotel market outlets at the 5% level. The results indicated that the likelihood of

farmer group members to sell to the restaurants and hotels increases by 77.7%. Group membership enables farmers to combine their produce to larger quantities required by the hotels and restaurants. In addition, member of the farmer groups might have access to important information such as prices, purchasing behavior, and other special requirements of the hotels and restaurants. Berhanu *et al*. (2013) is against this finding, sharing that farmers who are members of the farmer groups participate more than those who are not. This is because they are able to meet quality standard requirements and can negotiate better prices.

Access to market information significantly improves farmers' choice of restaurant and hotel market outlets at 5%. More access to market information leads to more likelihood of selling to hotels and restaurants by 63.8%. Informed farmers know which outlet offers favourable market prices, and quantity demands which in some cases are hotels and restaurants. These findings also align with Kiprop *et al.* (2020), who noted that farmers with detailed market knowledge are better positioned to negotiate favorable terms such as prices, delivery schedules, and contracts which is particularly important when dealing with restaurants.

Farmers who trusted these traders were 51.1% more likely to choose restaurants market outlet at 5%. Trust allows farmers to collaborate with traders who have connections to larger institutional markets, offering better opportunities and higher-value sales compared to local or informal markets. In correspondence, Abbasi *et al.* (2023) emphasized the importance of trust in gaining access to institutional market opportunities.

Increase in distance raised the likelihood of selling at the farm gate by 3.5%. This might be linked with larger transaction costs discussed earlier. The further it is for a farmer to reach other markets implies higher transport costs hence remaining with an option of a farm gate market route. This could also imply that farmers are informed and directly linked with potential buyers and input suppliers who can come to the farm for exchange of goods. Olufadewa and Obi-Egbedi (2018) suggests that access to extension services enables farmers to receive timely market information and reach larger markets easily, even if there is a barrier of distance.

The distance from the farmers' residential home to the main road had a negative effect on the farm gate market outlet. The results indicate that an increase in distance from the farmers' home reduced the likelihood to choose a farm gate market outlet by 11.4%. This could be due to lack of improved roads which demotivate farmers who stay far to participate in the market. Poor infrastructure is a challenge that can chase away potential buyers, hence their preference to buy at

the farm gate reduces. They therefore choose to use traders' markets which are easily accessible because of good roads. On the other hand, farmers also opt to take their products to traders' markets, where there is high competition. These findings correspond with Barret (2008), who found that access to good roads reduces transaction costs and improves access to both inputs and markets.

Ownership of television had a negative impact on the farm gate market outlet, implying that owning a television reduced the probability of farmers to sell at farm gate by 55%. The possible reason is that farmers who own television have access to current market and agricultural information and opportunities in the market. Therefore, they may not choose a farm gate market outlet. These results are in line with Abbasi *et al*. (2023), who demonstrated that farmers who own television have an advantage of learning effective market practices, negotiation skills to interact with potential buyers. The increased knowledge can lead them to more profitable and larger market channels.

Relying on support from friends or family had a positive influence on the choice of selling at farm gate market outlet. This indicate that support from friends or family yielded the probability to sell at the farm gate outlet at 56.8%. This can be explained by the reliability that is brought by the support from the friends and family during financial difficulties and fluctuations in the market. The financial assistance that is offered by friends and family enable farmers to overcome any market challenge. This support helps indigenous chicken farmers manage operations more effectively and sustain direct sales at the farm gate. These findings coordinate with Mutombo (2022), who discovered that farmers with strong social networks, including family and friends, are able to overcome challenges and maintain their participation in local markets.

Market bargaining power had a positive and significant impact on the choice of all market outlets (farm gates, restaurants/hotels, and traders) at a 1% level. This means that higher bargaining power increases the likelihood of selling at farm gates, restaurants/hotels, and traders' market outlets by 177.2%, 112.3%, and 143.1%, respectively. Bargaining power is an important skill required when setting prices and identifying potential buyers. Farmers with high bargaining power are able negotiate and engage in suitable trading terms. Villacis (2024) supports the findings by stating that farmers with good negotiation skills are likely to secure favorable prices at the farm gate. In similar manner, farmers who are able to bargain are more likely to secure favorable deals with traders (Kariuki *et al*., 2023). Moreover, Woldie and Nuppenau (2008) explained that in the

restaurant and hotel markets, farmers with stronger bargaining positions can avoid being misused by middlemen and demand higher prices for their quality products.

4.5 Effects of market participation on household income

4.5.1 Descriptive results of household income on market participation

Table 14 shows the t-tests results for household income are significant at a 5% level. The t-test results indicate that household income varies between farmers who participate in the market and those who do not. Smallholder indigenous chicken farmers who participated in the market reported an income of 43600.45 BWP, while farmers who did not participate in the market had an income of 30711.08 BWP. The results highlight that non-participants in the indigenous chicken market earned less income (12899.37 BWP) than those who participated.

Table 14: Household income on market participation

Variables	Non-participators n=138	Market participators n=138	Pooled n=276	t-test
Household income	30711.08 (3769.819)	43600.45 (4036.565)	37155.77 (2783.819)	-2.3337**

Note: Figures in parentheses represent standard errors and ** represents a 5% significance level.

4.5.2 The effect of market participation on household income

To examine the impact of market participation on household income among small-scale indigenous chicken farmers the study employed an Endogenous Switching Regression model. The outcome equations for household income among small-scale indigenous chicken market participants and non-participants were jointly estimated using the selection equation for the decision to participate in the indigenous chicken market. The instrumental variables (television ownership and trade experience) were tested for validity to determine their suitability for the model. The diagnostic test showed that the coefficient of the two instrumental variables is jointly insignificant (F2, 116, p-value = 0.5549) in the outcome equation for the market participants and non-participants. The instrumental variables were both significant in the participation decision equation and suitable for identifying the income equation since they did not directly influence

the household income of indigenous chicken farmers. The Wald test [$\chi 2(19) = 87.04$; $p < 0.00$] showed the overall significance of the instruments reject the null hypothesis of weak instruments. The ESR model estimation results on the effects of market participation on the income of the household among small-scale indigenous chicken farmers are presented in Table 15.

Table 15 presents the first stage of the ESR in which a Probit model was employed to estimate the coefficients of the selection equation on the determinants of market participation and these are presented in column 1. Farmer's access to relevant market information, trust in indigenous chicken traders, marital status of the indigenous chicken farmer, vaccination, support from relatives, television ownership, and trade experience positively and significantly influenced participation in indigenous chicken farming. The second stage of the ESR which shows the income equations for the market participants and non-participants is presented in Columns 2 and 3, respectively. To explicitly identify the model, the instrumental variables (television ownership and trade experience) in the participation (Probit model) were excluded from the income equation. According to the diagnostic tests, these instrumental variables did not directly influence income but rather influenced participation in the indigenous chicken markets.

A positive statistical association between the years of schooling of the small-scale indigenous chicken farmer and household income of market participants was observed at a 1% level. The results indicate that increased schooling years increase the market participants' income. This outcome may be explained by the observation that longer years of schooling increase household incomes, as educated farmers are more likely to secure better-paying jobs and engage in diverse income-generation activities. If indigenous chicken farmers have more disposable income, they can choose to reinvest in indigenous chicken farming or other income-generating activities that boost household income as a way of diversifying family income. Additionally, educated farmers are more likely to understand and adopt new technologies that enhance productivity and higher profits. Manzvera *et al*. (2023), supports these findings by explaining that best management practices (proper feeding, record keeping, disease control) are more likely to be implemented by educated farmers. These best practices can result to increased sales and more income generation (eggs and chickens) because of healthier flocks and reduced mortality rates.

At a 5% level, the research noted a positive and significant influence of the number of inactive members in the indigenous chicken farmer's household on the household income of farmers who participated in the market. If the number of inactive members of a household increase

by a unit, there is probability of increasing the market participant's income by 3937.3 BWP. This can be attributed to the fact that, the dependent group (elderly members and young children) often help around the household (child care for elders) and other non-farm activities. This help the working group to focus on indigenous chicken farming and this increase the household income as they have support from the inactive group. These findings correspond with Cele and Mudhara (2022), who highlighted that active members often give more time to farming activities if there is division of labor in the household.

The number of active members in the indigenous chicken farmer's household positively and significantly influenced the household income of farmers who participated in the market at a 10% level. An increase in the number of active members involved in indigenous chicken farming increases the household income. A plausible explanation is that active members enhance household income in market participation by improving access to market information on demands, trends of the market, pricing and available market outlets, access to credit, and agricultural training. This can collectively increase the indigenous chicken farmers' productivity leading to better economic outcomes for smallholder farmers. Active members also help with free labour in indigenous chicken farming and this reduces labour costs, increases production, leading to increased household income. Furthermore, active members involved in other off-farm activities can help increase household income and reduce dependence on only one income-generation activity (indigenous chicken farming). These results are consistent with the findings of Leza (2019), who explained that economically active members at home positively influence household income by increasing the likelihood of participation in non-farm and mixed activities, thereby enhancing income diversification. This leads to higher total household income as they absorb available labour for income-generating activities.

Tropical Livestock Units (TLU) positively and significantly affected the household income of farmers who did not participate in the market at the 5% level. This shows that non-market participants earn more income as their TLU increases. This outcome may be due to the fact that farmers who did not participate in the market were more likely to prioritize other livestock farming activities because they offer higher returns as compared to indigenous chicken farming. A possible reason is that farmers value other livestock over indigenous chickens and are less likely to engage in indigenous chicken farming and focus on other livestock farming activities, which bring more income. This is because livestock serves as production assets, a sign of wealth/status, a source of

manure, a source of income and food for the household. These results are consistent with the findings of Abdurezak *et al.* (2015), who stated that households with higher TLU are more likely to participate in non-farm activities, which supplement agricultural income and provide resilience against crop failures.

The results show a positive association between number of visits made by indigenous chicken farmers to the extension officers and the household income of farmers who participated in the market at a 1% level. An increase in the number of visits to agricultural extension officers made by the farmer increased the household income. The possible reason could be that indigenous chicken farmers who visited extension offices applied the techniques (vaccination of chickens, record keeping, regular cleaning of chicken houses) and services suggested by the extension officers. These regular contact with extension officers helped farmers to be more innovative, productive thereby increasing household income. These results align with the findings of Anang *et al*. (2020), who noted that participating in agricultural extension services increases farm income of farmers.

Group membership positively and significantly influenced the household income of both market participants and non-participants at 1% and 10%, respectively. An increase in the farmer's involvement in farmer groups increased the household income of farmers who participate in the market as well as non-market participants. The justification is that indigenous chicken farmers participating in farmer groups can collectively market their produce to distant places and share transportation costs. Members of the group benefit from shared benefits such as resources and market information, which improve indigenous chicken farming. Similarly, group membership is also beneficial to non-market participants as groups frequently organize training on farming techniques and sustainable agricultural practices and attendance is usually extended to everyone, including non-group members. These results are consistent with the findings of Mutonyi (2019), who found that group membership allows farmers to negotiate better prices for their products collectively, which can lead to higher sales revenue and improved household income. These skills help non-market participants increase their productivity and diversify their subsistence farming activities, contributing to higher household food security and savings and indirectly boosting income (Mammo *et al*., 2021).

At the 5% significance level, the study showed that access to market information was negatively associated with the income of households participating in the market. An additional

unit to market information leads to a decrease in farmers' household income. A possible explanation can be the fact that when indigenous chicken farmers have access to the same market information, they are most likely to make similar decisions on where, when and how much to sell their chickens. This can lead to market saturation and increased competition. Consequently, this can reduce farmers' profitability and household income. Chikuni and Kilima (2019), supports these results by highlighting that indigenous chicken farmers may still face barriers (high transportation costs, poor infrastructure, lack of resources) and this can make them fail to meet quality standards. Therefore, eliminating any chance of them having financial gains from improved market participation.

The leadership position of the indigenous chicken farmers' friend or relative increased the likelihood of increasing the household income of market participants at a 1% level. This can be explained by the fact that, if an indigenous chicken farmer has a friend or relative in a leadership position he/she may benefit from having insider knowledge about trends, policies and lucrative opportunities. This can be advantageous to an indigenous chicken farmer to improve their production and household income. Additionally, a friend or relative in a leadership position often has great networks and connections that can help farmers access better markets, leading to higher prices for their produce. Cannon *et al*. (2024), supports these results by highlighting that increased economic connections or networks aligns with greater participation in savings and investments. This can indirectly boost income by enabling capital for farm improvements.

The results reveal a negative association between trust in indigenous chicken traders by farmers and the household income of non-participants in the market at a 5% level. Indigenous chicken farmers' trust in traders reduced the likelihood of increasing the household income of non-participants. A possible reason is that sometimes indigenous chicken farmers do not participate in the market because they lack direct access to the market and depend on traders to negotiate prices. Therefore, traders can be opportunistic and take advantage of this trust and may exploit farmers by offering them lower prices, knowing very well that these farmers have limited alternatives. Additionally, if traders are trusted as the primary market agents, they may undervalue the farmers' produce and this reduces the potential of households that do not participate directly in the market to earn more income. These results are correspondent with the findings of Ayieko *et al*. (2015), who found that intermediaries (traders) in Kenya took advantage of producers and this increased

the likelihood of producers withdrawing in the markets because of traders' exploitation (unfair pricing practices).

A significant negative relationship was observed between the distance from the indigenous chicken farmer's residential place to the indigenous chicken output and the household income of market participants at a 5% level. An extra kilometer from the farmer's residential home to the indigenous chicken output market reduced the household income of market participants. This can be attributed to the fact that longer distances are associated with more transportation resources, reducing the net income from indigenous chicken sales. Additionally, farmers can choose to do other productive activities instead of traveling longer distances to reach the output market. Hence, indigenous chicken farmers who participate in the market often avoid costs associated with long distance and choose to market at farm gate where they are offered affordable prices for their products. Hlongwane *et al*. (2014), supports these results by concluding that each additional kilometer to the market reduces farmers' participation in South Africa.

Ownership of transport means positively and significantly influenced the household income of farmers participating in the market at a 5% level. Having means of transport by indigenous chicken farmers participating in the market increases their household income. The justification for this is that having their own transport reduces transportation costs, enabling farmers to transport goods directly to market centers, hence reducing reliance on costly middlemen and reaching more lucrative markets where they can sell their chickens at higher prices. These results are in line with those of Baum (2009), who found that vehicle ownership increases employment, with positive effects not differing for urban and rural residents, but changing with economic conditions.

The study found that, at a 1% significance level, receiving government programs had a negative and significant effect on the household income of indigenous chicken farmers participating in the market. Specifically, greater reliance on government support programs such as Nyeletso Lehuma, LIMID, YDF, Thuo Letlotlo, and other subsidies or grants wa associated with reduced household income among market participants. One possible explanation is that dependence on these programs may discourage innovation, diversification, or productivity, limiting long-term income growth. Additionally, government interventions such as price controls and subsidies can lower the market prices of indigenous chickens, which may further reduce sales and household income. These findings are consistent with Mammo *et al.* (2021), who observed

that farmers who rely heavily on government subsidies and inputs, such as nets, chickens, or fertilizers, may be less motivated to adopt sustainable farming practices or pursue alternative income sources, constraining their economic growth and independence.

A positive association between marital status of indigenous chicken farmers and market participation was observed at a 1% significance level. A possible reason is that, married indigenous chicken farmers are more likely to engage with community groups that facilitate access to markets, information, and resources. These networks can provide vital support for marketing efforts and collective bargaining. Similarly, support from relatives to indigenous chicken farmers was found to positively and significantly influence the participation of farmers in to the indigenous chicken market at a 10% significance level.

On the endogenous switching regression results in Table 15, the last two rows indicate the estimations for correlation coefficient (σ & ρ) of covariance terms of the error term of the selection and outcome equation. The negative sign of ρ indicates the presence of selection bias, thus, farmers with above-average household income have high chances of participating in indigenous chicken markets. The result implies that unobservable characteristics that influence the decision of farmers to engage in indigenous chicken markets influenced household income. Therefore, deciding to participate in indigenous chicken markets may not have a similar effect on household income in non-market participants farmers if they decide to take part in indigenous chicken markets.

Table 15: Endogenous switching regression results for indigenous chicken market participation

	Selection equation			Market Participation=1 Household income			Market Participation=0 Household income		
Variables	Coefficient	SE	P>Z	Coefficient	SE	P>Z	Coefficient	SE	P>Z
Gender (1=Female 2=Male)	0.155	0.208	0.458	-2309.457	7872.568	0.769	-674.235	8458.561	0.936
schooling years	-0.013	0.020	0.538	**2218.571***	811.311	**0.006**	884.151	809.248	0.275
Inactive members	0.008	0.043	0.856	**3937.314***	1637.807	**0.016**	-1113.407	1799.798	0.536
Active members	0.014	0.042	0.738	**2547.640***	1487.394	**0.087**	2378.770	1852.755	0.199
TLU	-0.027	0.017	0.110	805.593	529.990	0.129	**1617.185****	658.577	**0.014**
Extension Visits	0.108	0.126	0.394	**10114.280***	3445.714	**0.003**	-4922.377	5724.679	0.390
Group Membership (0=No 1=Yes)	0.125	0.480	0.794	**50894.030***	14414.950	**0.000**	**50291.370***	28690.870	**0.080**

Market info Access (0=No 1=Yes)	**1.004*** **	0.297	**0.001**	**-18895.910 ****	9330.315	**0.043**	5273.052	16914.910	0.755
Leadership Position (0=No 1=Yes)	0.406	0.248	0.102	**25080.880 ***	8514.361	**0.003**	17049.360	11141.240	0.126
Local chicken Traders	-0.061	0.062	0.328	-930.986	2550.425	0.715	2621.667	2399.190	0.275
Trust chicken Trader (0=No 1=Yes)	**0.390****	0.189	**0.039**	-332.368	7202.106	0.963	**-16469.750** ***	8254.641	**0.046**
Output Market Km	-0.003	0.018	0.870	**-3922.393** ***	1661.059	**0.018**	-50.600	222.184	0.820
Main Road Km	-0.067	0.049	0.175	-2891.062	2015.622	0.151	**-2552.723***	1538.670	**0.097**
Ln Land Size	-0.311	0.202	0.123	-9141.169	8361.524	0.274	-7628.218	7104.980	0.283
Marital Status (1=Married 2=Single)	**0.539*****	0.197	**0.006**	-4897.305	7817.393	0.531	1713.777	7685.211	0.824
Own Transport Means	-0.087	0.225	0.699	**18257.660 ****	8504.824	**0.032**	8862.368	8576.628	0.301
Vaccination (0=No 1=Yes)	**0.676****	0.269	**0.012**	**-17283.670 ***	9418.054	**0.066**	3194.673	12497.780	0.798
Received Government Program (0=No 1=Yes)	0.097	0.243	0.689	**-22203.880 ***	8566.594	**0.010**	-1903.496	10293.350	0.853
Relatives Support (0=No 1=Yes)	**0.059***	0.036	**0.098**	550.167	1175.381	0.640	2033.188	2013.603	0.313
Television (0=No 1=Yes)	**0.343***	0.185	**0.064**						
Trade Experience	**0.076*****	0.013	**0.000**						
Constant	-1.851	0.479	0.000	**34599.360 ****	17040.200	**0.042**	19049.300	17791.910	0.284
σ				**10.573*****	0.081	**0.000**	**10.556*****	0.060	**0.000**
ρ				**-0.673****	0.226	**0.003**	0.045	0.206	0.828
LR test for independent Equations: Rho 1 =rho 0, chi2=7.58, Prob >chi2 = 0.0067**									

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

The effects of market participation on the household income of market participants (actual group) and non-market participants (counterfactual group) were assessed by comparing the expected outcomes as presented in Table 16. The observed household income for market participants is 43 442.64BWP and 30 711.38BWP for non-market participants. Columns (b) and (c) denote the counterfactual outcome for non-market and market participants. The ATT results show that actual market participants would earn BWP 23 472.84 less if they did not participate in

the indigenous chicken markets. Similarly, counterpart farmers would earn 22 274.81BWP if they decided to participate in indigenous chicken markets. This indicates that market participation among small-scale indigenous chicken farmers positively and significantly affects household income for the actual groups. This shows that the counterfactual incomes are consistently lower than the observed incomes for both groups.

Table 16: Conditional expectation, treatment, and heterogeneity effects

Decision Stage			
Treatment effect	Market Participants	Non-Market Participants	ATE
Market Participants	(a)43,442.64	(b)66,915.48	ATT=--23,472.84
	(2715.455)	(2866.037)	(3948.147)
Non-Market Participants	(c)52,986.19	(d)30,711.38	ATU=22,274.81
	(5879.305)	(1860.302)	(5337.013)
Heterogeneity effects	B1=-9543.55	B2=36204.10	TH=-45747.65
	(2266.721)	(5337.013)	(5798.425)

The final row of Table 16 shows the potential heterogeneity effects between indigenous chicken farmers who participate in the market and those who do not. If non-market participants indigenous chicken farmers had decided to participate in indigenous chicken markets, they would be anticipated to earn more household income by 9 543.55BWP than current indigenous chicken farmers who participated in the market. This implies that indigenous chicken farmers who did not participate in the market would have been better off in indigenous chicken farming than current market participants farmers. Non-participant indigenous chicken farmers should participate in indigenous chicken markets to earn more household income. The second column indicates that if

market participants decided not to engage in indigenous chicken markets, they would be anticipated to earn a household income of BWP 36 204.10 than indigenous chicken farmers who did not participate in the market. A transitional heterogeneity of – 45 747.65BWP indicates less effect of market participation on the household income of the market participants. The result reveals that market participation would had even greater effect on household income if the non-participants had been allowed to participate. These findings showed that those who participated self-select into the markets based on their advantages over the non-participants based on unobservable heterogeneity within them. These findings align with the Manzvera *et al*., (2023), who reported that participation in indigenous chicken markets increases household income. Their study further showed that 76% of participating farmers were 60% more likely of achieve higher dietary diversity scores, which is associated with improved income and food security. Therefore, the study concludes that participation in indigenous chicken markets increases smallholder farmers' household income.

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

In this chapter, the conclusions drawn reflect study objectives and findings provides answers to the research questions. It also shares recommendations which are based on specific objective findings. Lastly, it presents the areas of further research based on gaps identified that the study did not cover.

5.1 Conclusions

Generally, this study aimed to promote improved household welfare of small-scale indigenous chicken farmers using intensive market participation and access to profitable market outlets in the Kweneng East district, Botswana. Specifically, this study identified the preferred small-scale indigenous chicken market outlets and their price differentials. Moreover, it uncovered the determinants of market participation and participation intensity among small-scale indigenous chicken farmers. The study further determined farmers choice of market outlets. Finally, it measured the effectiveness of engaging in a market on a farm household income. Cross-sectional data were collected from small-scale indigenous chicken farmers using semi-structured questionnaires, and data were analyzed using descriptive and inferential statistics. Under the analysis, the study used the following regression models to measure impacts; the double hurdle for market participation and participation intensity, and MVP for market outlets choice, and ESR for farm household income. Relevant to the objectives, the following key conclusions were drawn:

i. The study results revealed that from all the indigenous chicken market outlets, farmers mostly prefer farm gate outlets, and least prefer selling via restaurants/hotels. The descriptive results show that even though the farm gate market outlet was the most preferred, it offered lower prices to farmers as compared to the restaurant/hotel market outlet, which offered higher prices for both the cock and hen price.
ii. The double hurdle analysis shows that TLU, access to the main road and land size allocated for indigenous chicken farming significantly reduce the likelihood of market participation. Market participants are defined by access to profitable markets, leadership positions, trust in indigenous chicken traders, married status, trading experience, and regular vaccination. The number of schooling years, dependency ratio, TLU, access to extension services and

reliable markets, and years of village residency improve market participation. When friends and family assist in the farm, market participation intensity drops

iii. MVP shows that farmers' choice of the farm gate market outlet is increased by off-farm income, distance to extension agent office, support from friends and family, and market bargaining power. However, the household size, leadership position of the farmers' friends/relatives, and distance to the main road reduced farm gate market outlet preference. Farmers have a probability to choose the restaurant/hotel market outlet due to large household sizes, group membership, access to a reliable market, trust in indigenous chicken traders, television ownership, and market bargaining power. Farmers in remote areas (further from markets) have a reduced preference for restaurants/hotels. When farmers have more trade experience, access to the main road, and market bargaining power, they are more likely to choose the traders' market outlet. The traders' market outlet is less preferred by farmers with more off-farm income and larger land sizes.

iv. Under ESR, the study compared the results of household income among the actual and the counterfactual group. Group membership improves household income of both groups in market participation. Comparatively, household income of the actual participants increases with the number of schooling years, inactive members, active members, number of extension visits, leadership position, and transport ownership. Distance to the output market, vaccination, and receiving government assistance negatively and significantly influenced the household income of the actual group. Concerning the counterfactual group, the findings reveal that active members and the number of extension visits positively and significantly influenced their household income. However, trust in indigenous chicken traders and distance to the main road negatively and significantly influenced the household income of the counterfactual group. The study concludes that market participants are more likely to see higher household income than if they did not. A comparison between the two groups of farmers indicated that non-market participants (counterfactual) would earn higher household incomes than market participants (actual) had they decided to participate in indigenous chicken markets.

5.2 Recommendations

From the findings, the following suggestions are made for implementation by relevant stakeholders.

i. Encourage collaborations among farmers through cooperatives (farmer groups) to enhance collective marketing and access to diverse market outlets. If indigenous chicken farmers collaborate and work together through farmer groups, they would pool resources together for transport, meet quality standards and do collective marketing through negotiations for better prices and have access to more diverse, profitable market outlets such as restaurants/hotels. The government may offer training programs focusing on market analysis and price monitoring to help farmers make informed selling decisions.

ii. Since farmers' participation in indigenous chicken market declines with limited access to extension services, the government could allocate agricultural extension officers to all villages across the country. Improved access extension services could help reach farmers in remote areas and educate them on market requirements, quality standards and value-addition techniques and encourage market participation and productivity. To achieve this, the government may work with non-governmental organizations to deploy extension agents closer to farming communities.

    The government may improve road and transport networks around the villages. Improved road and transport networks translate to improved access to markets and extension services. Consequently, this leads to improved productivity and quality of production. Additionally, indigenous chicken farmers can strengthen linkages with high-value market segments such as hotels, restaurants, and supermarkets through facilitated networking events because these markets offer higher prices and contract basis for the farmer's produce.

iii. The government could ensure that all programs are designed to complement rather than accidentally issuing programs that hinder household income generation. To achieve this, the government may reassess all programs (Thuo Letlotlo, Nyeletso Lehuma, YDF) to ensure they provide tools and resources that enable farmers to participate effortlessly in the markets. Farmers can be motivated to reinvest in farm productivity because they have access to affordable agricultural inputs and technology upgrades. Therefore, farmers can shift from traditional subsistence farming methods to market oriented practices.

iv. it can be easier for farmers to transform their farming methods away from traditional subsistence farming methods to market oriented practices, leading to sustained income growth.

5.3 Areas of further research

i. The research was primarily on market participation and effects on household income among small-scale indigenous chicken farmers. So, further research can be done on the sustainability practices of indigenous chicken farming (use of organic feeds, waste management, effects on the environment and farm productivity).

ii. Additionally, other studies can focus on the structure, conduct, performance and value chain analysis of the indigenous chicken farming chain.

iii. Further research can be done on how digitalization affects indigenous chicken farmers' market participation and their income levels.

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APENDICES

Appendix A: Questionnaire

My name is Lerato Pheko, a student at Egerton University, Kenya. I am conducting a study titled Determinants of market participation of indigenous chicken and household income among small-scale farmers in Kweneng East District, Botswana. You have been selected as one of the respondents in this study and I believe with your maximum cooperation you can provide valuable information and support me in achieving the objectives of this research project. The information that you will provide here will be treated with utmost confidentiality.

Are you willing to participate (Consent) Yes [] No {} if No end the interview and if yes continue to section A

Section A: Identification variables

Identifiers	**Response**
1. Questionnaire No	
2. Date of the interview	
3. Enumerator name	
4. Name of the supervisor	
5. Household identification Number (HHID)	
6. Name of the Respondent	
7. Phone No	
8. District	
9. Ward	
10. Village	
11. GPS Location	

Section B: Demographic characteristics

1. Household size	2.Household member roster	3. Age	4. Gender 1=male 2=female	5.Marital Status	6. Highest Education level attained	7. Years of schooling completed?	8.Main occupation	9.Number of years of experience in indigenous chicken farming	10. Did the member receive income from **business/ casual employment**? 1=yes 2=no	11.If Yes what is the amount in Pula	12.Did member receive income from **salaries employment, pension, remittance**, or pension? 1=yes 2=no	13 If Yes what is the amount in Pula
A1	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**	**A10**	**A11**	**A12**	**A13**

Occupation: 0=none 1=agriculture 2=permanent employment 3=self-employment 4=temporary employment (casual) 5=business 6=others specify
Marital status: 1=single 2=married 4=divorced 5=widowed 6=others specified
Education level: 1=no formal education 2=primary 4=secondary 5= tertiary college 6=university

Section C: Livestock Ownership

1. Do you own some of the following animals in your farm from January 2023 to December 2023?

Animal type	Yes [] No [] If yes continue	Number owned in Jan 2023	Number Sold between Jan to Dec 2023	Average selling price per Animal	Main Buyer (Market outlet)	Number Purchased between Jan to Dec 2023	Average purchase price per animal	Number died between Jan to Dec 2023	Number owned in Dec 2023
Cattles									
Donkey									
Goats									
Sheep									
Dove/Quails									
Turkey									
Ducks/Goose									
Ostrich									
Pigs									
Rabbits									
Indigenous Chicken									
Others specified									

2. Did you produce the following livestock product between January to December 2023?

Livestock Product	Number of Production Months between Jan to Dec 2023	Quantity produced per Month	Quantity sold	Price per unit	Number of months of sales	How do you transport your produce to the market?	Main Buyer of your produce?
Milk							
Eggs							
Beef							
Mutton							
Wool							
Pork							

Other livestock products							

Section D: Institutional Factors

1.Did you have contact with agricultural extension officers in the last 12 months? Yes ( ) No ( )	2. If yes what is the total number of extension visits did you received ?	3.Do any of the household member belong to any group? 0=no 1=yes	4.Did you receive market information in the past one year on sorghum sales? 1=yes 0=no	5.Did you use the information ? 1=yes 0=no	6.Did your household receive credit for the last one year? 0=yes 1=no	7.Amount Borrowed	8.Have you benefited from the government programs? 1=yes 0=no	If yes, which programs? 1=LEA 2=Nyeletso 3=Lehuma 4=YDF 5=CEDA 6=Others
D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**

Section E: Social Capital and Network

1.For how many years have the household head been living in this village?	2.How many **relatives** can you rely on for critical support in times of need within this village?	3.How many **Non-relatives** can you rely on for critical support in times of need within this village?	4.Are any of your friends or relatives in Leadership Positions in formal or informal institutions within and outside this village? 1=yes 0=no	5.How many local chicken traders are you aware of in the village who can purchase your chicken?	6.Generally speaking, do you trust local chicken traders? 1=yes 0=no
E1	**E2**	**E3**	**E4**	**E5**	**E6**

Section F: Distance to facilities

Nearest facility	**Distance in KM**	**Distance in Walking Minutes**
Extension Agent office		
Main Road		
Indigenous chicken market		
Indigenous chicken Input market		

Section G: Household Assets

1. Do you own the following assets?

Asset	Yes	No
Indigenous chicken house		
Smart phone		
Transport facility		
Farm store		
Water Tank		
Tap water in the dwelling		

Section H: Crop Production and sales

Acres of land owned by the household	Acres under cropping activity (Both rented and owned or given)	Did You do any farming during the main and short season in 2023? 1=yes 0=no	Total Cost of all inputs {seed, cultivation, labour (weeding, planting, harvesting), transport} incurred per crop?	Total quantity of harvested crops	Total quantity of harvested crop sold	Price per unit of the quantity of crop sold
H1	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**

Section I: Constraints in IC Farming

1. According to your knowledge, what are the major hindrances in indigenous chicken farming?

HINDRANCES	**Yes ( )**	**No ( )**
Extension service		
Climate conditions		
Break in/ theft		
Illiteracy		
Competition from other farmers		
Market information		
Distance to the market		
Resources		
Low price/ sales of goods		
Diseases		
Transport		
Slaughter facilities		
Supply of quality feeds and stock		
Vaccines		
Market for output		
Water		
Others, specify		

2. What are the possible solutions to these hindrances?

……

……

……

……

……

……

……

Appendix B: Ethical clearance

EGERTON UNIVERSITY
TEL: (051) 2217808
FAX: 051-2217942
P. O. BOX 536
EGERTON

EGERTON UNIVERSITY INSTITUTIONAL SCIENTIFIC AND ETHICS REVIEW COMMITTEE

EU/RE/DIR/009
Approval No. EUISERC/APP/367/2024 ***22nd October 2024***

Lerato Pheko
P.O.Box 536-20115,
Egerton- Njoro, Kenya
Telephone +254795182920 / +26777678579
Email: phekolerato733@gmail.com

Dear Lerato,

RE: ETHICAL APPROVAL: DETERMINANTS OF MARKET PARTICIPATION AND EFFECTS ON HOUSEHOLD INCOME AMONG SMALL-SCALE INDIGENOUS CHICKEN FARMERS IN KWENENG EAST DISTRICT, BOTSWANA.

This is to inform you that the ***Egerton University Institutional Scientific and Ethics Review Committee*** has reviewed and approved your above research proposal. Your application approval number is ***EUISERC/APP/367/2024.*** The approval period is ***22nd September 2024 – 23rd October 2025***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***Egerton University Institutional Scientific and Ethics Review Committee***.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***Egerton University Institutional Scientific and Ethics Review Committee*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to ***Egerton University Institutional Scientific and Ethics Review Committee*** within 72 hours.

v. Clearance for Material Transfer of biological specimens must be obtained from relevant institutions.

vi. Submission of a request for renewal of approval at least 60 days prior to the expiry of the approval period. Attach a comprehensive progress report to support the renewal.

vii. Submission of an executive summary report within 90 days upon completion of the study to ***Egerton University Institutional Scientific and Ethics Review Committee***.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

EGERTON UNIVERSITY
Date. 22/10/2024
RESEARCH ETHICS

Yours sincerely.

Prof. Kennedy N. Ondimu PhD

CHAIRMAN, EGERTON UNIVERSITY INSTITUTIONAL SCIENTIFIC AND ETHICS REVIEW CTTEE

KNO/BK/

Appendix C: Research permit

Telephone: 5916203/5920125
Fax No: 5921824
REFERENCE: DAP 9/8

Department of Animal Production
P.O. Box 4
Molepolole

Republic of Botswana

10 Oct 2024

MINISTRY OF AGRICULTURAL DEVELOPMENT AND FOOD SECURITY

TO WHOM IT MAY CONCERN

REQUEST FOR POULTRY RESEARCH DATA COLLECTION – MS LORATO PHEKO

Reference is made to the above subject matter, and copy of letter attached for ease of reference.
By this communique you are therefore authorized to collect data for the purpose of facilitating the writing of Thesis and the resultant research outcome will be shared with the Ministry(Department).

Thank you.

DEPARTMENT OF ANIMAL PRODUCTION
10 OCT 2024
P O BOX 4, MOLEPOLOLE
REPUBLIC OF BOTSWANA

Yours Faithfully

Tebogo Letshotelo
POULTRY OFFICE KWENENG DISTRICT

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

Appendix D: Market outlets and price differentials

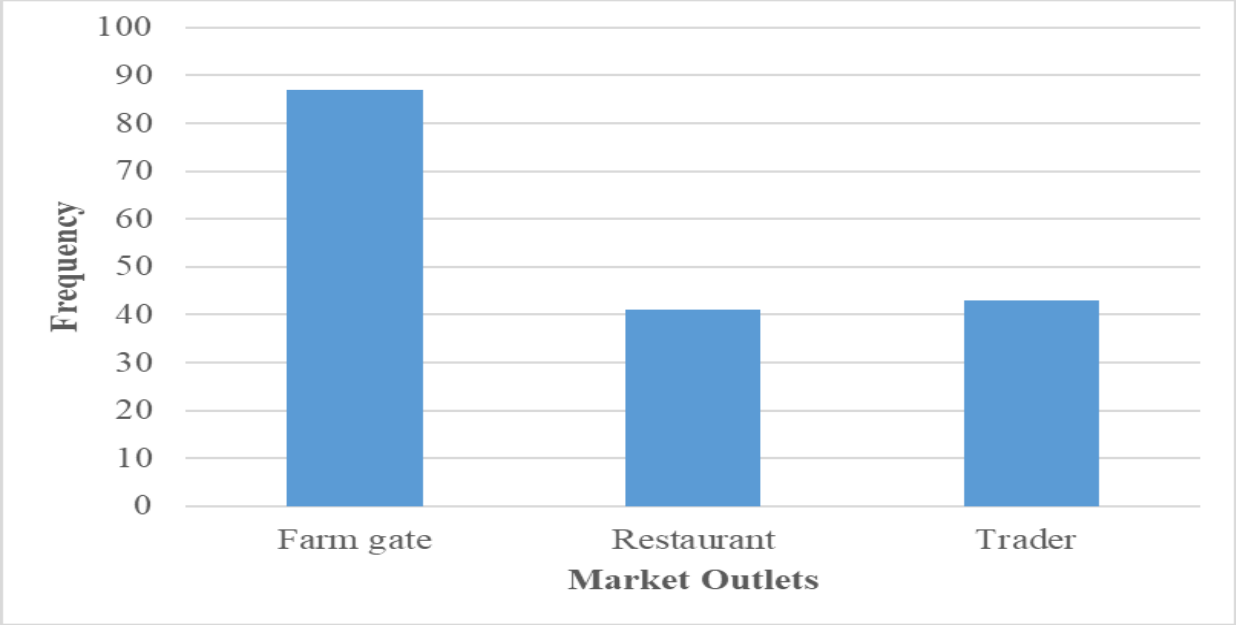

Figure 3: Distribution of various market outlets

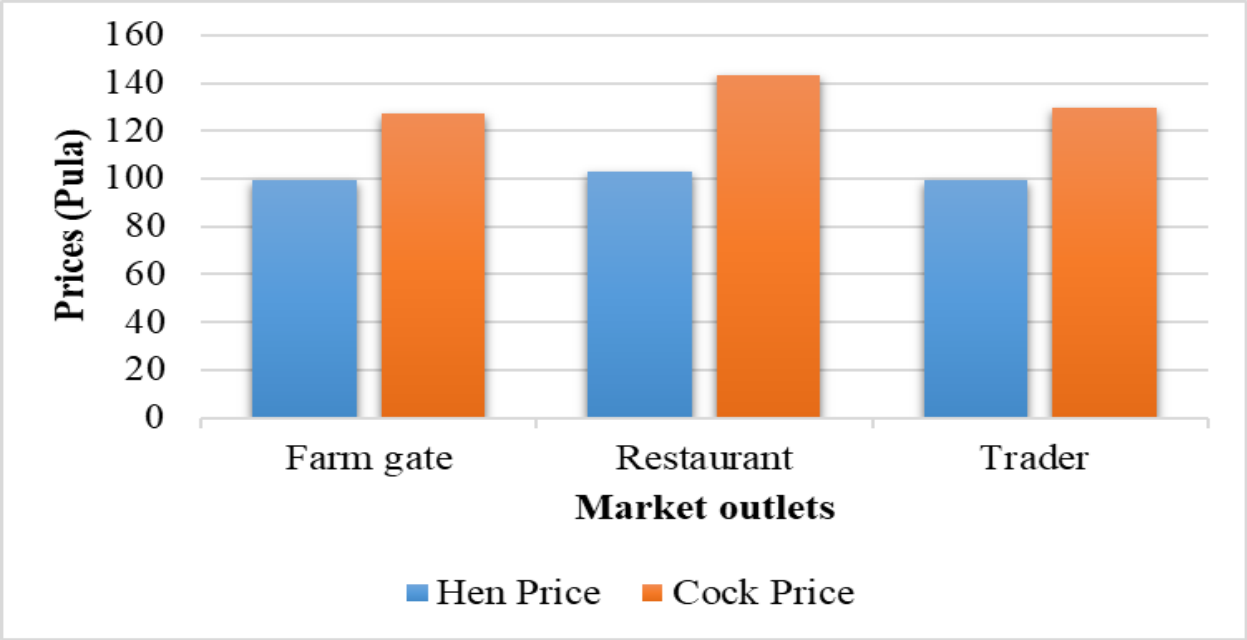

Figure 4: Price distribution across different market outlets

Appendix E: Double hurdle results

```
craggit MARKET_PARTICIPATION $X3_3, sec( LN_CHICKEN_SOLD $X3_3) vce(robust)

Estimating Cragg's tobit alternative
Assumes conditional independence

initial:       log pseudolikelihood =     -<inf>  (could not be evaluated)
feasible:      log pseudolikelihood = -1098.8017
rescale:       log pseudolikelihood = -506.10343
rescale eq:    log pseudolikelihood = -354.98709
Iteration 0:   log pseudolikelihood = -354.98709  (not concave)
Iteration 1:   log pseudolikelihood = -329.02831
Iteration 2:   log pseudolikelihood =  -315.3021
Iteration 3:   log pseudolikelihood = -284.02622
Iteration 4:   log pseudolikelihood = -281.95017
Iteration 5:   log pseudolikelihood = -281.90362
Iteration 6:   log pseudolikelihood = -281.90354
Iteration 7:   log pseudolikelihood = -281.90354

                                                      Number of obs =    276
                                                      Wald chi2(16) =  70.45
Log pseudolikelihood = -281.90354                     Prob > chi2   = 0.0000

------------------------------------------------------------------------------
                     |               Robust
                     | Coefficient  std. err.      z    P>|z|     [95% conf. interval]
---------------------+--------------------------------------------------------------
Tier1                |
              Gender |   .1305938   .2053958     0.64   0.525    -.2719744    .5331621
    schooling_years |  -.0151768   .0212559    -0.71   0.475    -.0568376     .026484
   Dependency_Ratio |  -.0057713   .1105924    -0.05   0.958    -.2225286    .2109859
                TLU |  -.0216817   .0127985    -1.69   0.090    -.0467663    .0034029
  Receive_Extension |  -.1940727   .2694469    -0.72   0.471    -.7221789    .3340334
      Market_access |   1.062347   .2810073     3.78   0.000     .5115829    1.613111
Leadership_position |   .4519758   .2316253     1.95   0.051    -.0020014     .905953
Trust_chiken_Trader |   .3334024   .1898847     1.76   0.079    -.0387647    .7055695
       Main_Road_Km |  -.0745354   .0436348    -1.71   0.088     -.160058    .0109872
       Ln_Land_size |    -.33229   .1495052    -2.22   0.026    -.6253147   -.0392652
     Marital_Status |   .4530611    .184425     2.46   0.014     .0915946    .8145275
       Rely_Support |   .2102159   .1939223     1.08   0.278    -.1698648    .5902966
   Trade_Experience |   .0745535   .0169631     4.40   0.000     .0413064    .1078006
        Vaccination |   .6672643   .2665905     2.50   0.012     .1447566    1.189772
```

Village_years	-.0030657	.0048506	-0.63	0.527	-.0125726	.0064412
Type_MainRoad	.3268967	.2269156	1.44	0.150	-.1178496	.771643
_cons	-1.876751	.6776732	-2.77	0.006	-3.204966	-.5485357
Tier2						
Gender	.0857145	.1345322	0.64	0.524	-.1779638	.3493929
schooling_years	.0387991	.0155963	2.49	0.013	.008231	.0693673
Dependency_Ratio	.2124601	.0929653	2.29	0.022	.0302515	.3946687
TLU	.0162503	.0074874	2.17	0.030	.0015753	.0309253
Receive_Extension	.3440673	.1899462	1.81	0.070	-.0282203	.716355
Market_access	.2898183	.1449466	2.00	0.046	.0057283	.5739083
Leadership_position	.0362428	.1209424	0.30	0.764	-.2007999	.2732855
Trust_chiken_Trader	-.0870535	.122665	-0.71	0.478	-.3274725	.1533656
Main_Road_Km	.0478573	.0325695	1.47	0.142	-.0159778	.1116925
Ln_Land_size	-.2214994	.1764557	-1.26	0.209	-.5673462	.1243474
Marital_Status	.0491708	.1283118	0.38	0.702	-.2023157	.3006574
Rely_Support	-.2862976	.1297543	-2.21	0.027	-.5406114	-.0319838
Trade_Experience	-.0001259	.0071516	-0.02	0.986	-.0141427	.0138909
Vaccination	.1693296	.1670379	1.01	0.311	-.1580587	.4967179
Village_years	.0062432	.0033506	1.86	0.062	-.0003239	.0128102
Type_MainRoad	.2055866	.1496197	1.37	0.169	-.0876627	.4988358
_cons	.9098893	.4284934	2.12	0.034	.0700578	1.749721
sigma						
_cons	.6480682	.0496797	13.04	0.000	.5506978	.7454386

Appendix F: Multivariate Probit Results

```
 mvprobit ( FARM_GATE=$x6_1) ( RESTAURANT=$x6_1) (TRADERS=$x6_1), vce(robust)

Iteration 0:   log pseudolikelihood = -262.75297
Iteration 1:   log pseudolikelihood = -255.39808
Iteration 2:   log pseudolikelihood = -253.93318
Iteration 3:   log pseudolikelihood =  -253.8686
Iteration 4:   log pseudolikelihood = -253.86856
Iteration 5:   log pseudolikelihood = -253.86856

Multivariate probit (SML, # draws = 5)            Number of obs   =        276
                                                  Wald chi2(51)   =     290.33
Log pseudolikelihood = -253.86856                 Prob > chi2     =     0.0000

------------------------------------------------------------------------------
                             |               Robust
                             | Coefficient  std. err.      z    P>|z|     [95% conf. interval]
-----------------------------+------------------------------------------------------------------
FARM_GATE                    |
                      Gender |  -.3251372   .2200858    -1.48   0.140    -.7564973     .106223
              schooling_years |  -.0207695   .0202561    -1.03   0.305    -.0604707    .0189317
               Household_size |   -.032493   .0176928    -1.84   0.066    -.0671701    .0021842
Received_Offfarm_Income |   1.278922    .445208     2.87   0.004     .4063307    2.151514
             Trade_Experience |   .0231483    .014515     1.59   0.111    -.0053006    .0515972
                          TLU |   .0230332   .0161241     1.43   0.153    -.0085695    .0546358
             Group_Membership |  -.4637447    .421267    -1.10   0.271    -1.289413    .3619235
                Market_access |    .316142   .2430044     1.30   0.193    -.1601378    .7924218
          Leadership_position |  -.4606733   .2456499    -1.88   0.061    -.9421384    .0207917
          Trust_chiken_Trader |   .2334826   .1974958     1.18   0.237    -.1536021    .6205673
                 Extension_KM |   .0354358   .0151722     2.34   0.020     .0056988    .0651727
                 Main_Road_Km |   -.1225457    .0539621     -2.27    0.023     -.2283094     -
.016782
               OutputMarket_Km |   .0029945   .0054196     0.55   0.581    -.0076277    .0136168
                    Television |  -.5578493   .2148232    -2.60   0.009     -.978895   -.1368035
                 Rely_Support |   .5569089   .2201972     2.53   0.011     .1253304    .9884875
                 Ln_Land_size |   -.159436   .1720534    -0.93   0.354    -.4966544    .1777825
             bargaining_power |   1.750656     .21733     8.06   0.000     1.324697    2.176615
                        _cons |   -1.912338    .6149016     -3.11    0.002     -3.117523     -
.707153
```

RESTAURANT						
Gender	.0221212	.2583364	0.09	0.932	-.4842089	.5284513
schooling_years	.032446	.0266297	1.22	0.223	-.0197472	.0846393
Household_size	.0398653	.0244174	1.63	0.103	-.007992	.0877225
Received_Offfarm_Income	-.3436567	.3769085	-0.91	0.362	-1.082384	.3950705
Trade_Experience	-.0043684	.0156348	-0.28	0.780	-.0350119	.0262752
TLU	-.0169559	.015763	-1.08	0.282	-.0478508	.0139391
Group_Membership	.6775458	.441386	1.54	0.125	-.1875549	1.542647
Market_access	.6208512	.2680417	2.32	0.021	.095499	1.146203
Leadership_position	.1514332	.2715357	0.56	0.577	-.3807671	.6836334
Trust_chiken_Trader	.3977064	.2260079	1.76	0.078	-.0452609	.8406737
Extension_KM	-.0129068	.0161256	-0.80	0.423	-.0445125	.0186989
Main_Road_Km	-.057311	.0730705	-0.78	0.433	-.2005265	.0859046
OutputMarket_Km	-.0890074	.0703883	-1.26	0.206	-.226966	.0489511
Television	.4950978	.2692802	1.84	0.066	-.0326816	1.022877
Rely_Support	-.0409173	.2348119	-0.17	0.862	-.5011401	.4193056
Ln_Land_size	-.1317927	.2022235	-0.65	0.515	-.5281435	.264558
bargaining_power	1.130632	.2787185	4.06	0.000	.584354	1.676911
_cons	-2.361207	.5427062	-4.35	0.000	-3.424891	-1.297522
TRADERS						
Gender	.21895	.2394644	0.91	0.361	-.2503916	.6882916
schooling_years	-.0134656	.025441	-0.53	0.597	-.0633292	.0363979
Household_size	.0342698	.0238501	1.44	0.151	-.0124756	.0810151
Received_Offfarm_Income	-.816697	.3012847	-2.71	0.007	-1.407204	-.2261898
Trade_Experience	.0256112	.0122866	2.08	0.037	.00153	.0496924
TLU	-.0077488	.0125012	-0.62	0.535	-.0322507	.0167531
Group_Membership	-.6262004	.5252278	-1.19	0.233	-1.655628	.4032272
Market_access	-.1799811	.2907976	-0.62	0.536	-.7499339	.3899717
Leadership_position	.2724829	.2660673	1.02	0.306	-.2489994	.7939651
Trust_chiken_Trader	-.2253591	.2245719	-1.00	0.316	-.665512	.2147938
Extension_KM	-.0145848	.0197485	-0.74	0.460	-.0532911	.0241216
Main_Road_Km	.0828044	.0487094	1.70	0.089	-.0126644	.1782731
OutputMarket_Km	-.0012459	.0069845	-0.18	0.858	-.0149352	.0124435
Television	.3652846	.2462596	1.48	0.138	-.1173754	.8479446
Rely_Support	-.0725682	.2397953	-0.30	0.762	-.5425583	.3974218
Ln_Land_size	-1.442481	1.280128	-1.13	0.260	-3.951486	1.066524
bargaining_power	1.376605	.2523834	5.45	0.000	.8819426	1.871267
_cons	-1.328081	.6621708	-2.01	0.045	-2.625912	-.0302501

```
-------------------------+------------------------------------------------------------------
---
    /atrho21 |  -.5817528   .1567946    -3.71   0.000    -.8890645   -.2744411
-------------+----------------------------------------------------------------
    /atrho31 |  -.3069243   .1423715    -2.16   0.031    -.5859673   -.0278814
-------------+----------------------------------------------------------------
    /atrho32 |  -.1943181   .1651624    -1.18   0.239    -.5180304    .1293943
-------------+----------------------------------------------------------------
       rho21 |  -.5239383   .1137527    -4.61   0.000    -.7109314   -.2677524
-------------+----------------------------------------------------------------
       rho31 |  -.2976365   .1297591    -2.29   0.022     -.526989   -.0278742
-------------+----------------------------------------------------------------
       rho32 |  -.1919087   .1590796    -1.21   0.228    -.4761785    .1286769
------------------------------------------------------------------------------
Likelihood ratio test of  rho21 = rho31 = rho32 = 0:
             chi2(3) =  17.7688   Prob > chi2 = 0.0005
```

Breusch Pagan and white test

```
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: Normal error terms
Variable: Fitted values of MARKET_PARTICIPATION

H0: Constant variance

    chi2(1) =  51.38
Prob > chi2 = 0.0000

.
. estat imtest, white

White's test
H0: Homoskedasticity
Ha: Unrestricted heteroskedasticity

  chi2(158) = 175.78
Prob > chi2 = 0.1581
```

Appendix G: Endogeneous Switching Regression results

```
movestay HOUSEHOLD_INCOME $X2_2, select(MARKET_PARTICIPATION = Television Trade_Experience)
Fitting initial values .....
Iteration 0:   log likelihood =  -3442.833
Iteration 1:   log likelihood = -3438.7896
Iteration 2:   log likelihood = -3438.6908
Iteration 3:   log likelihood = -3438.6905

Endogenous switching regression model             Number of obs   =        276
                                                  Wald chi2(19)   =      87.04
Log likelihood = -3438.6905                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
                     | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
---------------------+--------------------------------------------------------------
HOUSEHOLD_INCOME_1   |
              Gender |  -2309.457   7872.568    -0.29   0.769    -17739.41    13120.49
      schooling_years |   2218.571   811.3109     2.73   0.006      628.431    3808.711
     Inactive_members |   3937.314   1637.807     2.40   0.016     727.2718    7147.357
       Active_members |    2547.64   1487.394     1.71   0.087    -367.5994     5462.88
                  TLU |   805.5929   529.9895     1.52   0.129    -233.1674    1844.353
     Extension_Visits |   10114.28   3445.714     2.94   0.003     3360.808    16867.76
     Group_Membership |   50894.03   14414.95     3.53   0.000     22641.25    79146.82
        Market_access |  -18895.91   9330.315    -2.03   0.043    -37182.99   -608.8254
  Leadership_position |   25080.88   8514.361     2.95   0.003     8393.038    41768.72
Local_chieken_Traders |  -930.9856   2550.425    -0.37   0.715    -5929.727    4067.756
  Trust_chiken_Trader |  -332.3677   7202.106    -0.05   0.963    -14448.24     13783.5
     OutputMarket_Km |  -3922.393   1661.059    -2.36   0.018    -7178.009    -666.777
        Main_Road_Km |  -2891.062   2015.622    -1.43   0.151    -6841.608    1059.484
        Ln_Land_size |  -9141.169   8361.524    -1.09   0.274    -25529.46    7247.118
      Marital_Status |  -4897.305   7817.393    -0.63   0.531    -20219.11     10424.5
  Own_Transport_Means |   18257.66   8504.824     2.15   0.032      1588.51    34926.81
         Vaccination |  -17283.67   9418.054    -1.84   0.066    -35742.72    1175.374
Received_GovtProgramm |  -22203.88   8566.594    -2.59   0.010     -38994.1   -5413.669
    Relatives_Support |   550.1668   1175.381     0.47   0.640    -1753.537     2853.87
                _cons |   34599.36    17040.2     2.03   0.042      1201.17    67997.55
---------------------+--------------------------------------------------------------
HOUSEHOLD_INCOME_0   |
              Gender |  -674.2345   8458.561    -0.08   0.936    -17252.71    15904.24
      schooling_years |   884.1508   809.2481     1.09   0.275    -701.9464    2470.248
     Inactive_members |  -1113.407   1799.798    -0.62   0.536    -4640.947    2414.132
       Active_members |    2378.77   1852.755     1.28   0.199    -1252.564    6010.104
                  TLU |   1617.185   658.5769     2.46   0.014     326.3976    2907.972
     Extension_Visits |  -4922.377   5724.679    -0.86   0.390    -16142.54    6297.787
     Group_Membership |   50291.37   28690.87     1.75   0.080    -5941.694    106524.4
        Market_access |   5273.052   16914.91     0.31   0.755    -27879.57    38425.67
  Leadership_position |   17049.36   11141.24     1.53   0.126    -4787.068     38885.8
```

Local_chieken_Traders	2621.667	2399.19	1.09	0.275	-2080.659	7323.994
Trust_chiken_Trader	-16469.75	8254.641	-2.00	0.046	-32648.55	-290.9488
OutputMarket_Km	-50.60017	222.1843	-0.23	0.820	-486.0734	384.873
Main_Road_Km	-2552.723	1538.67	-1.66	0.097	-5568.46	463.0149
Ln_Land_size	-7628.218	7104.98	-1.07	0.283	-21553.72	6297.288
Marital_Status	1713.777	7685.211	0.22	0.824	-13348.96	16776.51
Own_Transport_Means	8862.368	8576.628	1.03	0.301	-7947.515	25672.25
Vaccination	3194.673	12497.78	0.26	0.798	-21300.53	27689.88
Received_GovtProgramm	-1903.496	10293.35	-0.18	0.853	-22078.09	18271.1
Relatives_Support	2033.188	2013.603	1.01	0.313	-1913.402	5979.777
_cons	19049.3	17791.91	1.07	0.284	-15822.2	53920.79
MARKET_PARTICIPATION						
Gender	.1547334	.2084053	0.74	0.458	-.2537335	.5632004
schooling_years	-.0125883	.020465	-0.62	0.538	-.0526989	.0275224
Inactive_members	.0077505	.0426187	0.18	0.856	-.0757805	.0912816
Active_members	.014117	.0422408	0.33	0.738	-.0686734	.0969074
TLU	-.0274786	.0172012	-1.60	0.110	-.0611923	.0062352
Extension_Visits	.1075381	.126168	0.85	0.394	-.1397466	.3548229
Group_Membership	.1251403	.4797948	0.26	0.794	-.8152402	1.065521
Market_access	1.004185	.2971628	3.38	0.001	.4217566	1.586613
Leadership_position	.4061766	.2482169	1.64	0.102	-.0803195	.8926727
Local_chieken_Traders	-.0609267	.0622455	-0.98	0.328	-.1829256	.0610721
Trust_chiken_Trader	.3900915	.1893936	2.06	0.039	.0188868	.7612962
OutputMarket_Km	-.0029574	.0180455	-0.16	0.870	-.0383259	.0324112
Main_Road_Km	-.0671557	.0494995	-1.36	0.175	-.164173	.0298616
Ln_Land_size	-.3114359	.2019989	-1.54	0.123	-.7073465	.0844747
Marital_Status	.5387999	.1974188	2.73	0.006	.1518661	.9257337
Own_Transport_Means	-.0869106	.2249364	-0.39	0.699	-.527778	.3539567
Vaccination	.6763542	.2693999	2.51	0.012	.1483401	1.204368
Received_GovtProgramm	.0974774	.243198	0.40	0.689	-.379182	.5741367
Relatives_Support	.0590814	.0357204	1.65	0.098	-.0109293	.1290921
Television	.3433261	.1854493	1.85	0.064	-.0201479	.7068001
Trade_Experience	.0764663	.0130144	5.88	0.000	.0509587	.101974
_cons	-1.85085	.4787449	-3.87	0.000	-2.789173	-.9125275
/lns1	10.57321	.0810141	130.51	0.000	10.41443	10.732
/lns2	10.55573	.0603783	174.83	0.000	10.43739	10.67407
/r1	-.6733777	.2262123	-2.98	0.003	-1.116746	-.2300098
/r2	.0447697	.2058787	0.22	0.828	-.3587451	.4482846
sigma_1	39073.95	3165.541			33337.11	45798.01
sigma_2	38396.76	2318.331			34111.48	43220.39
rho_1	-.5871974	.1482141			-.806434	-.2260376
rho_2	.0447398	.2054666			-.3441082	.4204879

LR test of indep. eqns. : chi2(1) = 7.53 Prob > chi2 = 0.0061

```
. mspredict mymills1, mills1

.
. mspredict xx, yc1_1

.
. mspredict xy, yc1_2

.
. mspredict yy, yc2_2

.
. mspredict yx, yc2_1

.
. *Estimating effect of market participation on household income

.
. ***** Average Treatment effect on the treated

.
. ttest xx=xy

Paired t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
      xx |     138    43442.64    2715.455    31899.38    38073.02    48812.27
      xy |     138    66915.48    2866.037    33668.31    61248.09    72582.87
---------+--------------------------------------------------------------------
    diff |     138   -23472.83    2266.721    26627.94   -27955.12   -18990.55
------------------------------------------------------------------------------
     mean(diff) = mean(xx - xy)                                     t = -10.3554
 H0: mean(diff) = 0                              Degrees of freedom =      137

 Ha: mean(diff) < 0           Ha: mean(diff) != 0           Ha: mean(diff) > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000

.
. ttest yy=yx

Paired t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
      yy |     138    30711.38    1860.302     21853.6    27032.76       34390
      yx |     138    52986.19    5879.305     69066.2    41360.27    64612.12
---------+--------------------------------------------------------------------
```

```
    diff |     138   -22274.81    5337.013    62695.71   -32828.39   -11721.24
------------------------------------------------------------------------------
     mean(diff) = mean(yy - yx)                                     t =  -4.1736
 H0: mean(diff) = 0                              Degrees of freedom =      137

 Ha: mean(diff) < 0           Ha: mean(diff) != 0           Ha: mean(diff) > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0001          Pr(T > t) = 1.0000

.
. ttest xx=xy, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
      xx |     138    43442.64    2715.455    31899.38    38073.02    48812.27
      xy |     138    66915.48    2866.037    33668.31    61248.09    72582.87
---------+--------------------------------------------------------------------
Combined |     276    55179.06    2093.724    34783.56    51057.29    59300.82
---------+--------------------------------------------------------------------
    diff |           -23472.83    3948.147               -31245.39   -15700.28
------------------------------------------------------------------------------
    diff = mean(xx) - mean(xy)                                     t =  -5.9453
H0: diff = 0                                     Degrees of freedom =      274

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000

.
. ttest yy=yx, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
      yy |     138    30711.38    1860.302     21853.6    27032.76       34390
      yx |     138    52986.19    5879.305     69066.2    41360.27    64612.12
---------+--------------------------------------------------------------------
Combined |     276    41848.79    3150.116    52333.66    35647.38    48050.19
---------+--------------------------------------------------------------------
    diff |           -22274.81      6166.6               -34414.75   -10134.88
------------------------------------------------------------------------------
    diff = mean(yy) - mean(yx)                                     t =  -3.6122
H0: diff = 0                                     Degrees of freedom =      274

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0002         Pr(|T| > |t|) = 0.0004          Pr(T > t) = 0.9998
```

```
.
. *Average Treatment effect on the untreated

.
. ttest xx == yy, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
      xx |     138    43442.64    2715.455    31899.38    38073.02    48812.27
      yy |     138    30711.38    1860.302     21853.6    27032.76       34390
---------+--------------------------------------------------------------------
Combined |     276    37077.01    1687.041    28027.22    33755.86    40398.17
---------+--------------------------------------------------------------------
    diff |            12731.26    3291.568                6251.284    19211.24
------------------------------------------------------------------------------
    diff = mean(xx) - mean(yy)                                    t =   3.8678
H0: diff = 0                                     Degrees of freedom =      274

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9999         Pr(|T| > |t|) = 0.0001          Pr(T > t) = 0.0001

.
. ttest xy == yx, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
      xy |     138    66915.48    2866.037    33668.31    61248.09    72582.87
      yx |     138    52986.19    5879.305     69066.2    41360.27    64612.12
---------+--------------------------------------------------------------------
Combined |     276    59950.83    3291.291    54679.03    53471.51    66430.16
---------+--------------------------------------------------------------------
    diff |            13929.28    6540.673                1052.923    26805.64
------------------------------------------------------------------------------
    diff = mean(xy) - mean(yx)                                    t =   2.1296
H0: diff = 0                                     Degrees of freedom =      274

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9830         Pr(|T| > |t|) = 0.0341          Pr(T > t) = 0.0170

.
.
.
. *****heterogeneity effects
```

```
.
. gen xxxy = xx-xy
(138 missing values generated)

.
. gen yyyx= yx-yy
(138 missing values generated)

.
. ttest xxxy == yyyx, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. err.   Std. dev.   [95% conf. interval]
---------+--------------------------------------------------------------------
    xxxy |     138   -23472.83    2266.721    26627.94   -27955.12   -18990.55
    yyyx |     138    22274.81    5337.013    62695.71    11721.24    32828.39
---------+--------------------------------------------------------------------
Combined |     276   -599.0101    3205.847    53259.54    -6910.13     5712.11
---------+--------------------------------------------------------------------
    diff |           -45747.65    5798.425               -57162.77   -34332.52
------------------------------------------------------------------------------
    diff = mean(xxxy) - mean(yyyx)                                t =  -7.8897
H0: diff = 0                                     Degrees of freedom =      274

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 1.0000
```

Appendix H: Publication abstract

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A Double Hurdle Approach on Factors Influencing Market Participation and Intensity of Participation Among Small-Scale Indigenous Chicken Farmers in Botswana

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Abstract
Indigenous chicken farming is a crucial agricultural activity for small-scale farmers in rural areas as it provides high-quality protein from meat and eggs, create employment and income for the family. This helps to alleviate poverty in developing countries of Africa. Market participation and intensity of participation are critical determinants of income generation and economic sustainability for small-scale indigenous chicken farmers in Botswana. However, indigenous chicken farmers' market participation is still minimal and has received little attention from policymakers. This paper seeks to analyze factors influencing market participation and intensity of participation among small-scale indigenous chicken farmers. The paper is based on the data collected in the Kweneng East district in Botswana. A multi-stage sampling technique was used to select 276 respondents, and a semi-structured questionnaire was used to collect primary data. Data was analyzed using STATA and a double hurdle model was used to analyze the data. The findings revealed that the Tropical Livestock Unit, market access, leadership position of a friend/relative, trust in indigenous chicken traders, distance to main road, land size, marital status, trade experience and vaccination of chickens influence the farmers decision to participate in the market. Intensity of participation was influenced by the number of schooling years, dependency ratio, TLU, extension services, market access, support from friends/family and number of years stayed in a village. The paper proposes the posting by the government of extension officers in the villages for easier access to small-scale farmers.
Keywords: Market participation, intensity of participation, small-scale farmers, indigenous chicken, double hurdle.
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