ECONOMIC AND MARKETING ANALYSIS OF SMALLHOLDER BROILER PRODUCTION IN MOPANI DISTRICT OF LIMPOPO PROVINCE, SOUTH AFRICA

by

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Dedication

This dissertation is dedicated to my mother, my younger brother, my late father and the rest of my family. Thank you for all your support.

Declaration

I, Tanya Ashley Machethe hereby declare that this dissertation submitted to the University of Limpopo for the degree, Master of Science in Agriculture, Agricultural Economics has not been previously submitted for a degree at this or any other University. This is my own work in design and in execution, and that all material contained within has been acknowledged.

Machethe, T.A. (Ms)	16 August 2016
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Surname, Initials (title)	**Date**

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Abstract

The broiler industry in South Africa consists of both small-scale and commercial poultry farmers. It provides the cheapest source of protein, absorbs labour and contributes massively to the agricultural sector. Broiler industry absorbs labour from the labour market, both skilled and unskilled; therefore it is a good source of employment.

The specific objectives of the study included determining factors influencing productivity among smallholder broiler producers in Mopani District using Stochastic Frontier Production Function and technical efficiency analysis. The profitability of smallholder broiler production in the study area was also estimated using the Gross Margin Analysis. Furthermore, determinants of market participation among smallholder broiler producers in the study area were analysed using the Logit model. The Stochastic Frontier Production Function results revealed a positive relationship between the productivity of the farmers in their broiler production and labour, feeds, stock size and vaccines. The results also showed that feeds was significant at 1% while stock size was significant at 10% level. The technical efficiency results indicated that smallholder broiler farmers in Mopani District could save an average of 23.4 % in production costs and realize a maximum cost saving of 95.8% in production costs. The Gross Margin Analysis revealed that the cost of feeds were the highest incurred, taking up 70.61% of the total costs of production and the second highest being cost of stock comprising of 15.11% of the total production costs. The Logit results on the determinants of market participation showed that household size, income received per month, experience, land size, access to market information, distance to the market, profitability and land ownership are statistically significant in determining participation in the market. Based on the findings from the study, it is recommended that linkages between the formal markets and the smallholder farmers be established for farmers not participating in the market. Farmers who making profit and have more experience in broiler production should be provided with a platform to grow into commercial farming. This could be through subsidies or provision of other incentives that are key to enhancing expansion, such as land and funds.

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List of abbreviations and acronyms

DAFF	Department of Agriculture, Forestry and Fisheries
DPFO	Developing Broiler Farmers' Organization
GMA	Gross Margin Analysis
LITI	Livestock Training Institute
MSc	Master of Science
NAMC	National Agricultural Marketing Counsel
PPP	Public Private Partnerships
SAPA	South African Poultry Association
SUA	Sokoine University of Agriculture

CHAPTER ONE
INTRODUCTION

1.1 Background

The poultry industry in South Africa consists of both small-scale and commercial poultry farmers (Ndiyoi et al. 2007). This poultry industry consists of the broiler production and the production of indigenous chickens. The broiler industry provides the cheapest source of protein, absorbs labour and contributes massively to the agricultural sector. Broiler industry absorbs labour from the labour market, both skilled and unskilled; therefore it is a good source of employment (DAFF, 2012). By 2010, broiler meat production was found to be the largest segment of South African agriculture accounting for about 17.5% (DAFF, 2011).

Broiler meat accounts for about 93.6% to the total poultry-meat production and it is produced throughout South Africa with North West, Western Cape, Mpumalanga and KwaZulu–Natal Provinces being the largest producers accounting for approximately 79% of total production (DAFF, 2011).

The study by the Department of Agriculture, Forestry and Fisheries (DAFF) showed that Limpopo Province along with Northern Cape were Provinces in South Africa that produced the least broiler meat in 2010 with just 2% production each (DAFF, 2011). This indicates that broiler farmers in these Provinces may still be facing some constraints in the production of poultry. These constraints may lead to ultimate consequences causing some of the broiler meat producers in these Provinces to exit the broiler market because they are unable to remain competitive and earn desirable revenue.

South African Poultry Association (SAPA) (2012) explained that poultry industry in South Africa is the biggest contributor to the economic growth through Gross Domestic Product, food security and employment creation. This industry has a significant impact on the lives of South Africans mainly through its creation of informal employment where

it employs approximately 375 000 people (SAPA, 2012). It is also the biggest consumer of maize in South Africa, therefore contributing to other industries in South Africa.

1.2 Problem statement

Broiler farming might be very popular among South Africa‘s smallholder farmers, but this industry still faces major challenges. These challenges include financial constraints for the farmers to succeed in their production; external constraints such as taxes and high interest rates, lack of technical information and training on the required quality standards in the market for broiler products, infrastructural constraints such as the lack of roads, electricity, production and processing facilities and market constraints (Rota and Sperandini, 2010).

Over the years, studies have shown that the consumption of broiler meat in South Africa has been more than what was produced locally, therefore leading to South Africa having to import broiler meat in order to meet the local demand (DAFF, 2012). According to Rota and Sperandini (2010), the production of broiler by the smallholder farmers is mainly for income generation and poverty reduction. It contributes to the household nutrition and provides income to buy food. However, most of these smallholder farmers still lack the resources to grow their farm businesses and produce commercially. Some studies shown that majority of these smallholder farmers that produce broiler are women, but these women lack the technical information on how the industries operates.

According to Ahmad, et al. (2008), broiler production as a business is mainly practised by farmers as a source of income, however due to the high costs of production and lesser profits, most commercial farmers exit the broiler market. These smallholder broiler farmers lack the credit to grow their businesses and are subjected to price fluctuations in input and output markets which they are unable to do anything about. The situation shown above explains why majority of these farmers operate at subsistence level.

The constraints faced by smallholder broiler farmers including lack of access to markets, high costs of production and poor quality of finished products in packaging and

standards make it difficult for the smallholder broiler farmers in South Africa to meet the local market demand and export the broiler products. Therefore, efforts need to be intensified to overcome these constraints through research, policy formulations, assistance from the public sector and other stakeholders. These and many more gave rise to the need to carry out this study and find means of assisting smallholder broiler farmers in their production and marketing of their products .

1.3 Motivation of the study

A number of studies have found that the gap between the commercial broiler farmers and the smallholder broiler farmers is too great. The number of broiler commercial farmers is significantly lower than the number of smallholder broiler farmers in South Africa, and yet these smallholder broilers farmers make very less profits even with government assistance, widening the gap even further. DAFF (2013) found that around 13 commercial broiler producers account for approximately 70% of the total broiler produced in South Africa, while the large number of smallholder broiler producers account for just 30%. DAFF (2013) further discovered that South Africa imports a large number of broiler meat and these imports have been growing annually. However, there are prospects for growth for both the smallholder and commercial farmers in the South African broiler industry. This growth will enable higher production, and thus increased employment, food security and rural development.

The smallholder broiler farmers face many constraints in their production and are unable to produce enough quantities and make significant profits; therefore this study identified the specific constraints faced by the smallholder broiler farmers in Mopani District to assist in the production and marketing of their products.

1.4 Purpose of the study

1.4.1 Aim of the study

The aim of the study was to examine economic and marketing factors affecting smallholder broiler production in Mopani District

1.4.2 Objectives of the study

i. Identify and describe smallholder broiler producers in Mopani District based on their socio-economic and demographic characteristics.
ii. Determine factors influencing productivity among smallholder broiler producers in Mopani District.
iii. Estimate the profitability of smallholder broiler production in the study area.
iv. Analyse the determinants of market participation among smallholder broiler producers in the study area.
v. Identify the constraints facing smallholder broiler production in Mopani District.

1.4.3 Research questions

i. What are the socio-economic characteristics of smallholder broiler producers in Mopani District?
ii. What are the factors influencing productivity among smallholder broiler produces in Mopani District?
iii. Is smallholder broiler production in the study area profitable?
iv. What are the determinants of market participation among smallholder broiler producers in the study area?
v. What are the constraints facing smallholder broiler producers in Mopani District?

1.5 Organizational structure

This research paper consists of 5 chapters. The first chapter provides the general introduction of this paper. It consists of the background, problem statement and aim and objectives of the study. Chapter 2 consists of literature review where a review of previous studies related to this study was conducted. This review was of South African and International studies. Chapter 3 shows the methodology and analytical procedures that were used to conduct this study. Chapter 4 indicates the results obtained from the

study and their interpretation. The final chapter in this paper, which is chapter 5, consists of the summary, conclusion and policy recommendations.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter gives review of previous studies in the broiler industry. The roles of smallholder poultry farmers in rural development, value chain analysis of broiler production, profitability and market participation of smallholder broiler farmers in South Africa and that of other smallholder farmers across the world are indicated.

2.2 Review of Previous Studies

2.2.1 Background of South African Boiler Industry

Broiler production in South Africa was found to be the largest segment of all agricultural production comprising of 24% and 17.5% of all animal agricultural production in 2009 and 2010 respectively, as reported (DAFF, 2010 ; DAFF, 2011). Broiler is produced in all Provinces of South Africa with the largest producing Province being the North West Province and the least producing being Limpopo Province (DAFF, 2013).

The broiler meat produced in South Africa is consumed both locally and also exported to other countries like Zimbabwe and Mozambique, allowing South Africa to earn foreign currency through its exports. In the production period 2008-2009, the results from a study conducted by DAFF (2010), established that the production of broiler in South Africa was relatively less than the local consumption. This implied that South Africa was unable to meet its local demand for broiler products. In addition, this study also showed that South African broiler industry had 404 commercial broiler farmers and 1554 smallholder broiler farmers in 2009. This indicated that the number of commercial farmers in South Africa was significantly lower than the number of smallholder broiler farmers. These farmers, both commercial and smallholders contribute significantly to the creation of employment in South Africa.

Uchezuba (2010) describes poultry meat as the highest demanded meat over any other red meat in South Africa, with the largest portion of this poultry meat being broiler meat production. The poultry industry is the largest and fastest growing industry in the South

African economy. Any farmer can practise production since it does not require large spaces to practise, even the farmer with no land can farm broiler in their backyard and still contribute to the development of his/her community and the rural economy, unlike with red meat production that requires larger spaces. Therefore, it is cheaper and convenient for farmers to practise broiler production than to practise red meat production.

2.2.2 Roles of Smallholder Poultry Farmers in Rural Development

Poultry farming is an important way of improving income and employment for the rural poor population in developing countries. Poultry production is also a strategic way of addressing animal protein intake shortage in human nutrition because of its high productiveness and fast growth rate (Masuku, 2011). Broiler meat is the cheapest source of protein and the broiler industry is considerably easy to enter because the costs of production are not that high when compared to other industries within the agricultural sector. Rural farmers are able to enter this industry and improve their own living standards and that of their communities, through creation of employment, income generation and provision of the broiler products to the local communities.

Poultry is a traditional activity popular with poor people because of low capital cost (Singh, 2011). Broiler is produced at household smallholder level and at commercial level in an attempt to meet the market demand. The fast growing poultry sub-sector provides opportunities for the rural producers to engage with the market to ensure a sustainable livelihood. From his study, Singh (2011) further discovered that the evenly distributed income from poultry has helped in stabilizing household economy, smoothing the household cash flow and made it easier for producers to plan the household expenditure. Producers recognize that poultry rearing presents an excellent opportunity for producers to generate income by using their slack labour at household.

2.2.3 Value Chain Analysis of Broiler Production

The value chain analysis of poultry production shows a lot of different actors in each stage of the value chain. The analysis also indicates that broiler is marketed through

agents and shops to household consumers, institutions, high profile and local hotels and restaurants. The prices of these chickens are often found to be expensive because of the cost of transport, middlemen and traders. In Tanzania for example, Kisungwe et al. (2010), discovered that the stakeholders involved in the value chain included the extension officers of the Tanzanian Department of Agriculture, regional and urban traders' association, SUA and LITI (which are institutions that provide training to the poultry farmers), Central Veterinary Laboratory (which manufactures and supplies vaccines for Newcastle disease that affect the poultry) and Tanzania Veterinary Association.

With the realization that Ghana has a lot of smallholder farmers practising their farming in their backyards, study by Asem-Bansah et al. (2012) revealed that the success of the backyard poultry producers was mainly due to the strong relationship between the backyard producers and the suppliers. The intensity of the production activities and efficient input use also contributed to the performance of the backyard poultry producers. These producers have opportunities to import their poultry products to other countries, but face certain constraints such as lack of facilitating organization to coordinate and negotiate activities among these farmers, and between farmers and their stakeholders. Asem-Bansah et al. (2012) further concluded that the relationship between the different stakeholders in the value chain should be made strong and support of market institutions for traders be built for future development.

However, in South Africa smallholder broiler farmers face different barriers or constraints in participating in the value chain; these barriers include the transaction costs of the emerging farmers being much higher than those of their large developed counterparts in the commercial sector, the availability of day-old chicks seeing that suppliers prefer to work with commercial, some suppliers are located far from the farms, therefore damages or mortality may result due to long distance transportation, the lack of slaughter houses to sell chickens in the formal markets, the lack of appropriate storage facilities, the volumes produced and their location places them at a disadvantage to supply to the retail sector. These lead to most smallholder farmers selling their live birds to the informal sector at low prices (DAFF, 2012).

DAFF (2012) further explains that there are different stakeholders that are involved in the value chain of broilers and these stakeholders assist farmers to participate successfully in these value chains. These stakeholders include Land Bank, government departments such as the Department of Agriculture and the Department of Social Development, the South African Broiler Association, and the Developing Broiler Farmers' Organization (DPFO) to serve as a conduit to the developing broiler farmers for information dissemination and to co-ordinate and address collective issues in the industry.

According to Taru et al. (2010) productivity in broiler production is negatively affected by inadequate training, lack of enough experience and little contact with extension agents. In addition, he concluded that poor financial base and little access to credit leads to the small-scale broiler producers not been able to provide capital assets that are necessary in the rearing, processing and marketing of broiler products leading to poor quality and quantity of the products. The broiler industry is profitable (Taru et al. 2010), therefore, productivity increases if farmers make a more effective and economic use of farm resources.

2.2.4 Market Participation of Smallholder Broiler Farmers in South Africa

Smallholder farmers face such barriers in the marketing of their broilers. These include resources, market information, infrastructure and farmer support services. In his study, Mthembu (2008) found that due to these barriers, these smallholder farmers end up producing less output for the market.

Smallholder broiler farmers sell their produce through live broiler meat market which mainly depends on hawkers and small retailers for distribution to customers (DAFF, 2013). Possible market entry for smallholder farmers includes contract growing, central distribution points that allows farmers to organize into buyer groups or small cooperatives. Farmers lack resources such as land and financial capital that they need to be able to expand their operations and produce on contract (Ncube, 2014). Furthermore, he recommended that government should establish a Public Private Partnerships (PPP) to support development of smallholder broiler farmers. Encouraging

formal market participation by smallholder broiler farmers, government should support the informal broiler market to ensure its development and enhanced standard of services for the customers.

However, DAFF (2013) explained that some barriers to participation in the market by the smallholder broiler farmers are transaction costs which are much higher than those of the commercial sector. The availability of day-old chicks is also a challenge because the commercial farmers are given preference. Further distance from the production points to the market may result in high fatalities (DAFF, 2013), the amount of broiler quantity produced and the place of production puts them at a disadvantage to supply to the retail sector.

Again, Baloyi (2010) found that because producing for the market requires production resources, such as land, water, infrastructure, labour force, capital, and good management, poor access to these resources will have an effect on the potential benefits attained by smallholder farmers in agricultural markets, especially in terms of the volume of products traded and the quality and quantity of those products.

The study also revealed that the smallholder broiler farmers faced constraints in the participating in high-value markets. These constraints constitute the greatest barrier for smallholder farmers when it comes to accessing high-value markets, and overcoming these constraints is critical if smallholder farmers are to access lucrative markets. There is relatively low participation among farmers in collective action, more especially at production and marketing levels. The results of his study also revealed that the participation of smallholder farmers in high-value markets is also constrained due to poor access to comprehensive agricultural support services. The majority of sales by farmers are at either the local market or the farm gate level. Lack of access to sufficient and productive land for expansion, sufficient water, modern irrigation systems, mechanisation, transport logistics, and market information were found to be the major constraints to market participation for smallholder farmers in Limpopo Province. Ntuli and Oladele (2013) indicated that smallholder broiler farmers have limited market outlets, whereas some markets were unorganised which implies that broiler farmers sell

anywhere and at whatever price they desire. These farmers feel their customers perceive their products as poor or of low quality and this might be due to the fact that smallholder farmers might be lacking infrastructure for handling the broilers. Ntuli and Oladele (2013) further explained that over 90% of the smallholder broiler farmers do not have enough storage facilities for their broilers and their customers are far which means farmers have to travel long distances to reach their customers.

2.2.5 Profitability of Smallholder Broiler Production

Begum et al. (2014) explained that the profitability of poultry farming in Bangladesh was measured in terms of gross margin and net profit. The gross margin and net return of contract farms were much higher than those of independent farms, but in spite of these differences, both systems operated profitably. The results of the two farming systems indicating that if small farms enter into the Contract Farming System (that is; producing for the consumers or wholesalers they have binding contracts with), they will obtain substantial income gains.

Mabelebele et al. (2011) found that there are four categories of broiler farmers found in the poultry sector of the Greater Tzaneen Municipality, namely the contract growers, the market assured small-scale farmers, and the infrastructure subsidized farmers and the resource poor farmers. Although the small-scale and resource poor farmers operate under an open system and the study concluded that the costs of inputs (feeds, chicks, medication and transport) were very high for broiler farmers. Poor quality infrastructure and inaccessibility to formal market posed a threat of losing profits and therefore sustainability to these farmers, and may have been the reason for the farmers' inconsistent production.

Mabelebele et al. (2011) further highlighted that high cost of feed is also a challenge to the resource-poor and small-scale farmers. Some farmers have advantage over others that the strategic partner is capable of negotiating for better prices with suppliers and also buy in bulk to make provision for years with shortages. This will be positive for the contracted farmers and for small-scale farmers to increase their profit margins and move to higher production levels. Training programmes on technical and marketing

skills should be made available to these farmers. This would assist in reducing the production cost, graduate from the strategic partnership model and increase savings that are a necessity in covering for emergencies.

According to Tuffour and Oppong (2014), the price of labour significantly reduced profit but the price of day old chick increased profit in their study in Greater Accra Region of Ghana. The study further showed that broiler producers were able to realize 54% of their frontier profit on the average. Number of years of experience in broiler production was found to reduce inefficiency in production whilst farms owned by sole proprietors were less economically efficient. They later recommended that inputs should be made available to farmers at competitive prices and the quantity of labour utilization should be reduced because the current level is uncompetitive. Training should also be provided to less experienced farmers to enable them adopt the poultry farming practices and thus create opportunities for profit realization.

2.2.6 Resource Use Efficiency of Smallholder Broiler Farmers in South Africa

Despite the free marketing system in South Africa, feed was identified as the main cost factor for broiler producers and a perennial problem area (NAMC, 2007). Feed makes up 50% or more of the total production costs incurred by broiler producers. NAMC (2007) explained that this could be due to the impact of high transport costs for raw materials. These high feed cost and limited resources accessed by smallholder farmers result in these farmers having to reduce their broiler production to a number of broiler chickens they can afford to feed and for other farmers producing broiler chickens that are small due to improper feeding.

NAMC (2007) further explained that in a free range system for chickens, birds (even those that are diseased) are allowed to move freely. These birds can spread disease effectively and the practice runs counter to general bio-security rules. This becomes difficult for farmers to use the medication for the broiler chickens effectively, resulting in increased mortality rate.

2.2.7 Resource Use Efficiency of Smallholder Broiler Farmers around the World

Ukwuaba and Inoni (2012) found that smallholder broiler farmers in Oshimili North Local Government Area of Delta State in Nigeria were profitable in their production. This was despite the high costs of feeds and other variable costs incurred in the production of broiler. The study showed that labour and day-old chicks had a negative relationship with the total output of broiler produced. This indicates that the more labour and day-old chicks the farmers used in their production, the less broiler output they yielded. Excluding the high production costs, these smallholder broiler farmers still faced constraints in their production. These constraints include inadequate finance (lack of access to credit), which is necessary to enhance productivity and profitability in broiler production.

However, in some areas of Africa such as the Meme Division of Cameroon, broiler producers face major problems such as low market prices, high cost of feed, veterinary services, transportation, lack of access to credit and extension services (Taru, et al. 2010). Broiler production was found to have resulted in overutilization of feeds, chicks and labour in the area. The results of a study by Tuffour and Oppong (2014) showed that broiler producers were able to realize 54% of profit on average. Number of years of experience in broiler production was found to reduce inefficiency.

Tuffour and Oppong (2014) indicated the ability of more experienced farmers to adopt the best farm practices through continuous learning process to produce the output using the less cost combination of the productive inputs available resulted in profit efficiency. These experienced farmers should share their production methods with the less experienced farmers to increase their efficiency in profit.

A study by Al-fawwaz and AL-Sharafat (2013) found that the total number of birds, amount of labour, cost of veterinary services, drugs, and vaccines, cost of feeds, farmer experience in poultry production, educational level of the farmer, and cost of poultry equipment considerably affected broiler production in Jordan. The results of the study also showed that the use of the inputs was inefficient. Al-fawwaz and AL-Sharafat (2013) further recommended that government should subsidize inputs to farmers along

with proper extension services. This will assist broiler farmers to be productive and profitable in their broiler production.

Feed, bird stocks, operating costs, and other costs were important factors to broiler output in the Chiang Mai Province of Thailand (Todsadee, et al. 2012). The socio-economic state of farmers showed that there was technical efficiency at farm level. The results of this study (Todsadee, et al. 2012) implied that the adoption of better management practises by the broiler farmers presented better opportunities for the farmers to improve broiler production and increase profits in their broiler operations.

2.3 Chapter summary

The focus of this chapter was to indicate the previous studies conducted focusing on the resource use efficiency of boiler production. This chapter also reviewed studies done in profitability and marketing of the smallholder broiler producers both in South Africa and across the world. The results of the studies were indicated and discussed. The literature reviewed indicated that the South African broiler industry played a major role in rural development through the provision of the cheapest source of protein, employment and income generation (for those practising broiler farming). This chapter also highlighted that smallholder farmers face barriers in the marketing of their broilers. These include resources, market information, infrastructure and farmer support services due to these barriers, these smallholder farmers end up producing less output for the market. However, some smallholder broiler farmers do produce sufficient quantities, but have limited market outlets, whereas some markets are unorganised leading to farmers having to sell their broiler produce anywhere and at whatever price they desire. On the production side, farmers found that feeds took over 50% of their total cost of production. These high feed cost and limited resources accessed by smallholder farmers result in these farmers having to reduce their broiler production to a number of broiler chickens they can afford to feed and for other farmers producing broiler chickens that are small due to improper feeding.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodology and the analytical procedures that were undertaken to obtain the results of the study. It describes the study area where the data were collected, the data sources and sampling techniques, analytical models used in the study and the limitations of the study

3.2 Description of the Study area

The study was conducted in Mopani District of Limpopo Province. Mopani District is located in the northern parts of South Africa with coordinates 23°19′S 30°43′E / 23.317°S 30.717°E. Mopani District is divided into five municipalities namely; Greater Tzaneen Municipality, Maruleng Municipality, Ba-Phalaborwa Municipality, Greater Giyani Municipality and Greater Letaba Municipality. The area is 20011.09 km² big, has 296 320 households and a population of approximately 964 195 and the majority of these residents speak Northern Sotho and Xitsonga (Statistics South Africa, 2011). Agricultural enterprises practised in the district include poultry production, vegetable production, livestock production, fodder grazing and production of other crops (Statistics South Africa, 2011). Mopani district is one of the major producers of tea, bananas, mangoes, nuts and pawpaws in South Africa, which are consumed locally and internationally. The production of these commodities in the region makes Mopani district's agricultural industry one of the biggest employers of labour in the region (Statistics South Africa, 2011). The main focus was on the smallholder farmers who practise broiler production in the District.

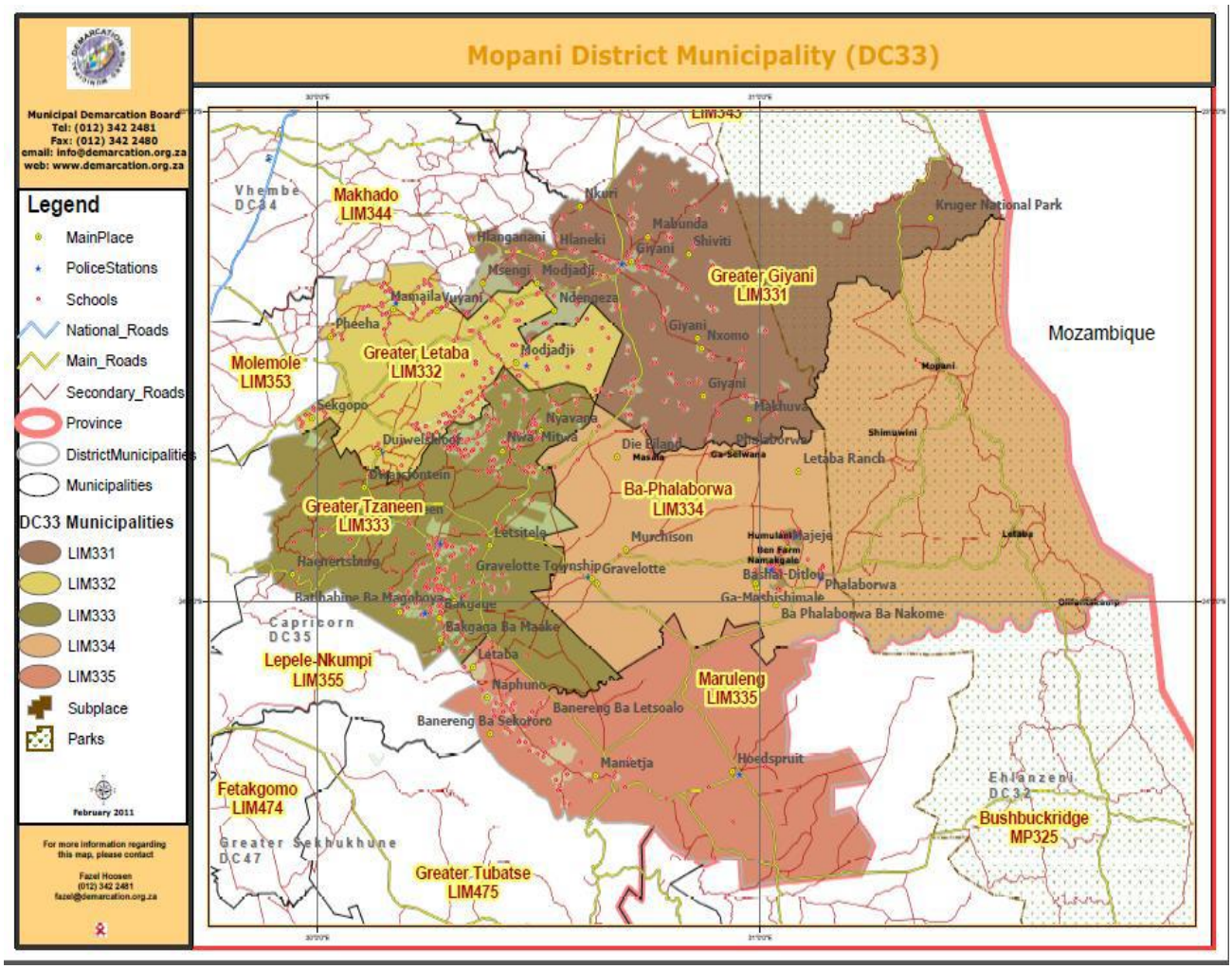

Figure 3.1: Map of Mopani District

Source: South African Treasury, 2011/12

Figure 3.2: A broiler farmer feeding her broiler chicken

Source: Picture taken by author during survey (2015)

Figure 3.2 indicates a farmer in Mopani District working on her broiler chicken farm in a house that accommodates up to 2 000 broiler chicken. The image shows the farmer using chicken feeders to feed the broiler chicken.

3.3 Data source and sampling method

A sample of 86 smallholder broiler farmers was selected in Mopani District using multistage random sampling technique. The random sampling technique gives equal opportunity for all farmers in the population to be selected (Ross, 2005). This sampling technique was used to select areas and ultimately individual farmers in Limpopo Province who farm broiler at a small-scale level, to investigate the challenges they face in production and marketing of their broiler produce. At village level, random sampling was implemented so that each broiler farmer could have equal probability of being chosen. Three municipalities were selected in Mopani Districts namely; Greater Tzaneen Municipality, Greater Letaba Municipality and Maruleng Municipality. From each Municipality, villages were selected, and from these villages the sample of 86

smallholder broiler producers was selected randomly. Data were collected using structured questionnaires from 44 smallholder broiler farmers in Greater Tzaneen Municipality, 26 smallholder broiler farmers in Greater Letaba Municipality and 16 selected in Maruleng Municipality based on probability proportionate to size. Information on the availability of the farmers and where to find them was taken from the Department of Agriculture in Mopani District and with the assistance of extension officers the data were collected.

3.4 Analytical techniques/models

The primary data collected for this study were analyzed using descriptive statistics, Stochastic Frontier Production Function, the Logit model and the Gross Margin Analysis techniques.

3.4.1 Objectives (i) and (v) were addressed using descriptive statistics

Descriptive statistics was used in analysing and describing the socio-economic characteristics of smallholder broiler farmers and also identifying the constraints facing smallholder broiler producers in Mopani District. This involved the use of tables, frequencies, percentages, sums and averages. Descriptive statistics was employed to present the specific characteristics of the broiler farmers in the study area to check in which categories most or the least of the farmers fall under. They were also used to present the constraints that the farmers face in percentages, to say how much percentage of the broiler farmers in the study area have the same problem, and how much percentage does not. Descriptive statistics allowed for the best presentation of the discovered results of the study. Wiley and Pace (2015) highlighted that descriptive statistics involve procedures of using numerical means and graphics to present collected data.

3.4.2 Stochastic Frontier Production Function and Technical efficiency

Stochastic Frontier Production Function was used to determine factors influencing the productivity of the smallholder broiler farmers. These two models (Stochastic Frontier Production Function and Technical Efficiency) models were used to address the second

objective. The stochastic production function was originally introduced by Aigner et al. (1977), explaining that the model should not only account for the random disturbance reflecting that each firm's output must lie on or below its frontier due to factors outside the firm's control. Such factors included the technical and economic inefficiency, the will and effort of the producer and his employees, and perhaps such factors as defective and damaged product and that the frontier itself can vary randomly across firms, or over time for the same firm. The model must also account for another source of random disturbance where the frontier is stochastic, resulting from favourable as well as unfavourable external events such as luck, climate, topography, and machine performance (Aigner et al., 1977). The addition of these two random disturbance terms to the equation resulted in the technical efficiency model (Marschak and Andrews, 1944). Due to these models' nature of considering all internal and external factors, they were considered the best choice to analyze the productivity of broiler production in Mopani district.

''*A Stochastic Frontier Production Function is defined for panel and cross sectional data on sample firms, such that the disturbances associated with observations for a given firm involve the differences between traditional symmetric random errors and a non-negative random variable, which is associated with the technical efficiency of the firm*'' (Battese and Coelli, 1987).

General Stochastic Frontier Production Function:

$Y_i = f(X_{ij}, B_i) + v_i - u_i \quad (i = 1,2,3,\ldots,n)$

Where:

Y_i is the output of the *i*-th farm; X_{ij} represents the inputs used in the production of Y_i by the *i*-th farm; B_i are the parameters or production coefficient to be estimated, v_i= Random variability in the production that cannot be influenced by the farm; and u_i= Deviation from maximum potential output attributable to the technical efficiency.

Specific models:

Stochastic Frontier Production Function:

$\ln Y_i = B_0 \sum_{j=1}^{4} B_j \ln X_{ij} + v_i - u_i$

Where:

In = The natural logarithm

B_0 = The constant term

B_j = Production coefficient to be estimated

Yi = Broiler output (in Kgs)

X_1 = Labour (in man days)

X_2 = Feeds (in Kgs)

X_3= Stock size (chicks) (in numbers)

X_4 = Vaccines [in Rands (R)]

V_i= Statistical noise

U_i = Technical inefficiency

Technical Efficiency:

The Technical Efficiency model was used to determine the factors that affect the technical efficiency of smallholder broiler producers (Khai and Yabe, 2011).

$TE_i = \alpha_0 + \alpha_1 W_1 + \alpha_2 W_2 + \alpha_3 W_3 + \alpha_4 W_4 + \alpha_5 W_5 +$ error term

Where:

TE_i= Technical efficiency effect of the *i*-th farmer; W_i is the variable representing socio-economic characteristics of farmers to explain technical inefficiency and δ co-efficient are unknown parameters to be estimated.

α_0= The constant term

α_i = the parameters/coefficients to be estimated

W_1 = Age (in years)

W_2 = Gender (Dummy; 1 = male, 0= female);

W_3 = Household size (in numbers)

W_4 = Level of education (in years)

W_5 = Experience in broiler production (in years)

The technical efficiency of a farm ranges from 0 to 1. Maximum efficiency in production has a value of 1. Lower values represent less than maximum efficiency in production (Ali and Samad, 2013).

3.4.3 Gross Margin Analysis

This method was used to estimate the costs and revenue of the smallholder broiler farmers (Ali and Samad, 2013). A gross margin is the sum of money remaining from the broiler production and marketing (Horticulture Australia, 2011). It is determined by subtracting the variable costs from the revenue of the farm (Firth, 2002). The variable costs included the costs of feeds, vaccines, saw dust, labour, stock, water and electricity. Gross margins are valuable in making decisions. They assist in assessing each activity including input costs such as water, vaccines and labour or market prices. This can assist farmers make relevant decisions on the amount of broiler to produce looking at their inputs capacity (Horticulture Australia, 2011). This in turn provided information on the profitability of the smallholder broiler farmers in Mopani District.

GM = TR-TVC

Where:
GM = Gross Margin
TR = Total Revenue
TVC = Total Variable Cost (The costs incurred in utilizing variable inputs)

3.4.4 Logit model

Analysis of the determinants of participation of the smallholder broiler farmers in the market was executed using a Logit model. This model indicates whether the determinants analysed makes the farmers participate in the market or not participate in the market. The Logit model is a binary logistic regression model which uses the dichotomous dependent variables. O'Halloran (2005) revealed that the Logit coefficients can be interpreted as the effect of a unit of change in the independent variable on the predicted logits with the other variables in the model held constant. She further added that one unit change in X affects the log of the odds when the other variables in the

model are held constant. Hailpern and Visintainer (2003) explained the model as a direct probability model, therefore giving the likelihood of individuals giving a negative or positive response; that is, a yes or no answer. Another benefit of the Logit model is its capacity to give legitimate estimates that are interpretable, regardless of study design (Hailpern and Visintainer, 2003). The simplicity of this model and its ability to give accurate probability estimates given the X variables (independent variables) led to it being the best choice model for addressing the market participation objective.

General model:

$\frac{\log(P)}{1-P} = B_0 + B_1 \sum_{i=1}^{n} Xi + Ui$

Where:

P = Probability that farmers participate in market

1-P = Probability that farmer do not participate in market

X_i = Various factors that considered in the study

B_0 = Intercept

B_1= Parameters estimated; and

U_i = Disturbance term

Table 3.1: Definition of Logit variables

Variables	Description	Unit of measurement
Independent/Explanatory variables		
AG	Age	Years
GEN	Gender: 1 if farmer is male, 0 if farmer is female	Dummy
EDU	Level of education	Years
HS	Household size	Numbers
FS	Land size	Hectares
FO	Land ownership: 1 if farmer owns land, 0 if farmer doesn't own land	Dummy
AI	Amount of income	Rands

SI	Source of income: 1 if farmer has other sources of income besides broiler production, 0 if farmer doesn't have other source of income	Dummy
ALA	Amount of labour available: (man power)	Numbers
AC	Access to credit: 1 if farmer has access to credit, 0 if farmer doesn't have access to credit	Dummy
AE	Access to extension services: 1 if farmer has access to extension services, 0 if farmer doesn't have access to extension services	Dummy
EXP	Experience in broiler production	Years
ASF	Access to storage facilities: 1 if farmer has access to storage facilities, 0 if farmer doesn't have access to storage facilities	Dummy
MI	Access to market information: 1 if farmer has access to market information, 0 if farmer doesn't have access to market information	Dummy
DM	Distance to output market	Km
FP	Farmer Profit	Rands
U_i	Unexplainable variable	-

The specific estimated model:

$$\frac{\log(P)}{1-P} = B_0 + B_1AG + B_2GEN + B_3EDU + B_4HS + B_5FS + B_6FO + B_7AI + B_8SI + B_9ALA + B_{10}AC + B_{11}AE + B_{12}EXP + B_{13}ASF + B_{14}MI + B_{15}DM + B_{16}FP + U_i$$

Table 3.2: Description of hypothesized effects of independent variables on market participation and their expected signs

Independent market participation variables	Expected sign
Age	+

Gender	+/-
Education level	+
Household size	-
Income received per month	+
Sources of income	+/-
Experience	-
Labour	+
Land size	+
Access to storage	+
Access to market information	+
Distance to market	+
Profit	+
Access to extension services	+
Access to credit	+
Land ownership	+

3.5 Chapter summary

This chapter showed the study area where the data was collected, the data set and the analytical procedures that were used to analyse the data. The data was analysed using the Stochastic Frontier Production Function and technical efficiency model which are used to determine the resource use efficiency of the smallholder broiler farmers, the Logit model to check if the farmers participate in the market and the Gross Margin Analysis to check the farmers' profitability in their broiler production.

3.6 Limitations of the study

- Farmers in the study area were scattered, therefore it was quite difficult to reach some farmers in areas that had poor roads.
- Sampling was also very difficult due to the fact that some farmers are not registered with the department of agriculture and extension officers do not know of their existence.

- Another limitation was older farmers having difficulty remembering the exact costs they incur in their production and quantities of inputs they purchase due to not keeping records.

CHAPTER FOUR
DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The aim of this study was to examine the economic and marketing factors affecting smallholder broiler production in Mopani District. The specific objectives were to describe smallholder broiler producers in Mopani District based on their socio-economic and demographic characteristics using descriptive statistics, to determine factors influencing productivity among smallholder broiler producers using Stochastic Frontier Production Function and to estimate the profitability of smallholder broiler production using the Gross Margin Analysis. They were also to analyse the determinants of market participation among smallholder broiler producers using the Logit model and to identify the constraints facing smallholder broiler production in Mopani District using descriptive statistics. This chapter presents and discusses the empirical results found when the data collected was analysed to achieve the set objectives.

4.2 Socio-economic and demographic characteristics of smallholder broiler producers

The results of the study show that the farmers interviewed in the study area were between the ages of 26 and 81, with the average age of the farmers being 53 years old. The study also showed the interviewed farmers had education years of between 0 and 16 with the average farmer only having gone to school for 6 years. The household sizes of the farmers in the study area were found to range between 1 and 15; the income received per month between R0.00 and >R10 000 and the experience in broiler production to range between 1 and 35 years.

Table 4.1: Socio-economic and demographic characteristics of smallholder broiler farmers in Mopani District

	Mean	Median	Standard deviation	Variance	Minimum	Maximum
Age of the farmer	52.9535	52	13.82573	191.151	26	81
Household size of the farmer	6.2907	6	2.67831	7.173	1	15
Income received per month	2.130	2	0.665	0.442	1	4
Experience in broiler production	4.9535	4	4.82861	23.315	1	35

Source: Computed by author from survey data (2015)

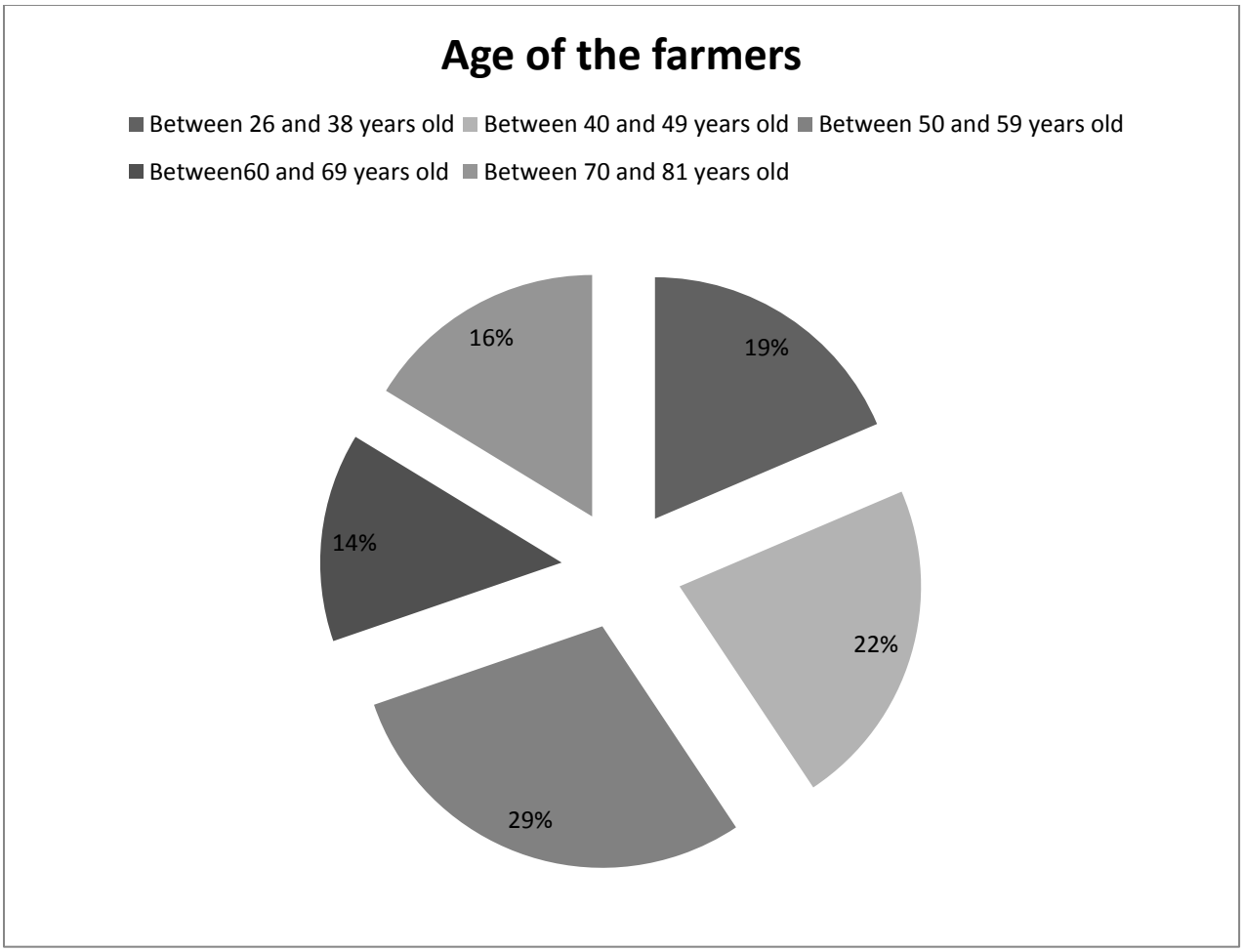

Figure 4.1: Age of the farmers

Source: Computed by author from survey data (2015)

Out of the total interviewed farmers, 14% were of the ages between 60 and 69, 16% were between 70 and 81 years of age, and 19% between 26 and 38 years old. The two largest age groups of farmers were found to be between the ages of 40 and 49, and between the ages of 50 and 59 years of age, with 22% and 29% of the sampled farmers respectively. Okoli et al. (2004) discovered that most broiler farmers at 70.92% are between the ages of 31 and 50, explaining that majority of the broiler farmers are the ones who are still active enough to run the broiler production enterprises.

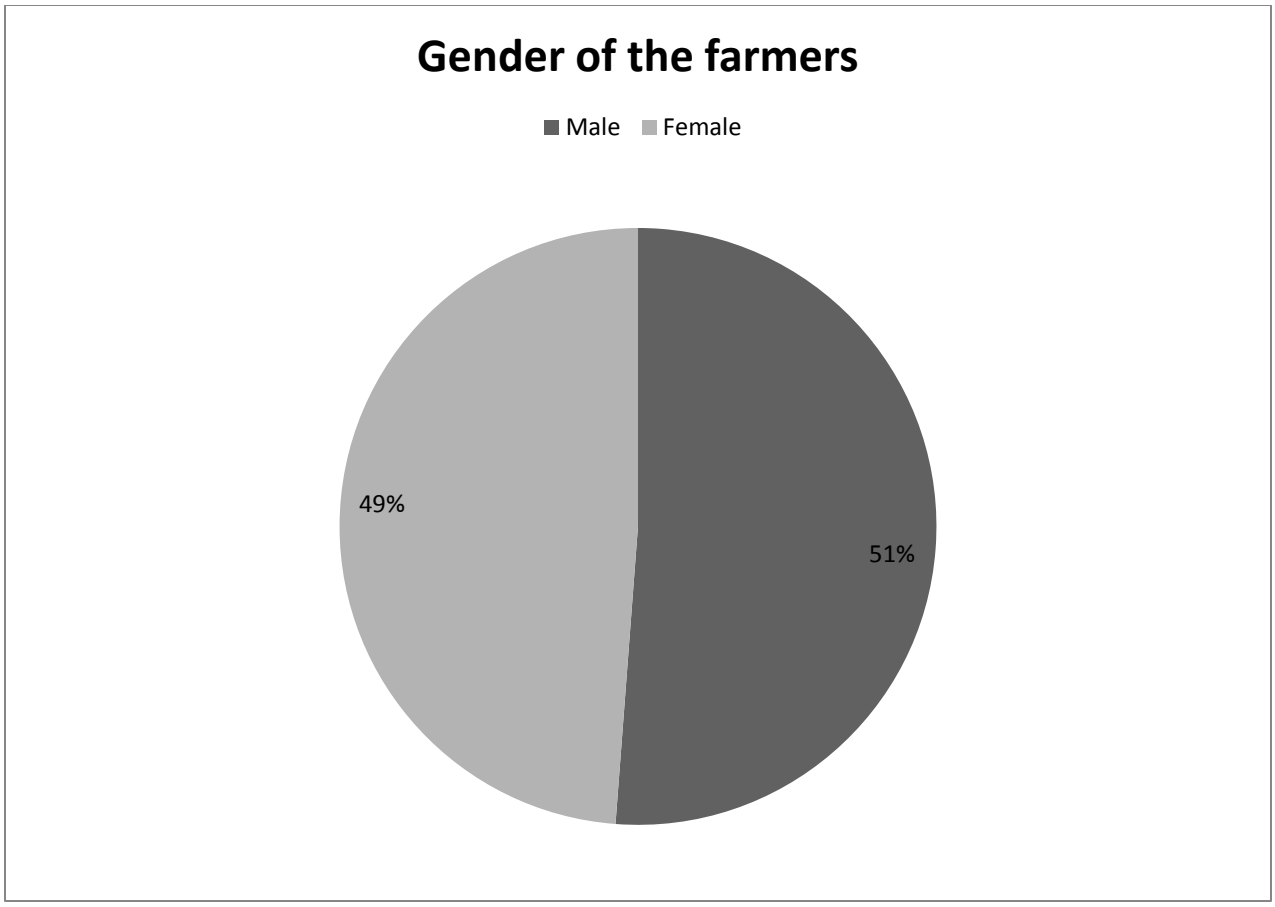

Figure 4.2: Gender of the farmers

Source: Computed by author from survey data (2015)

Mopani District was found to be dominated by a number of male smallholder broiler farmers with 49% of the farmers in the area being female and 51% being male farmers. This may be due to the fact that most broiler producing households are headed by males in Mopani district. Majority of these farmers practise broiler production as their main economic activity due to lack of employment. Therefore, given the resources these farmers are likely to attain higher resource use efficiency and participate in the market. However, Adeniyi and Oguntunji (2011) found that poultry production is usually dominated by female farmers in African societies. Adeniyi and Oguntunji (2011) further explained that these women mostly keep poultry because it is easily manageable and has lower procurement foundation costs and replacement stocks.

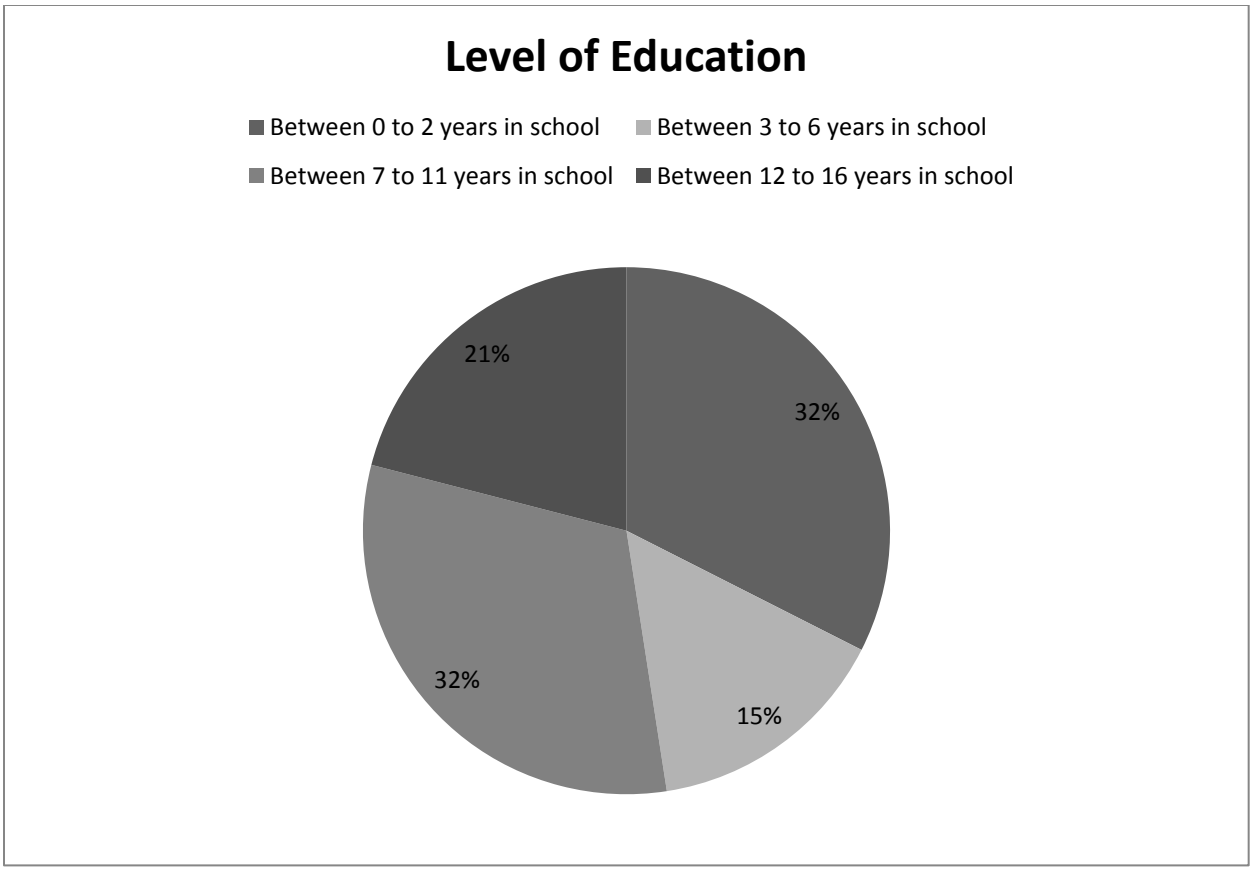

Figure 4.3: Level of education

Source: Computed by author from survey data (2015)

The majority of farmers in Mopani District were found to have attended school for 0 to 2 years and between 7 to 11 years. Each with a 32% aggregate of the interviewed farmers. On the other hand, 15% of farmers in the District were found to have between 3 to 6 years of schooling years. Those who have attained matric and some form of tertiary education were found to be forming 21% of the total sample. These results show that majority of the broiler farmers in Mopani District are not entirely literate and lack some form of proper formal education. This is an indication that these farmers may not be able to use their resources efficiently and produce enough output for the market. However, Luvhengo et al. (2015) explained that the 32% of farmers with 7 to 11 years of education are expected to be resource-use efficient compared to the other 32% of farmers who have education levels between 0 and 2 years. Jatto (2012) found that in some areas, around 78% of broiler farmers have some form of tertiary education and 17.3% have secondary level education.

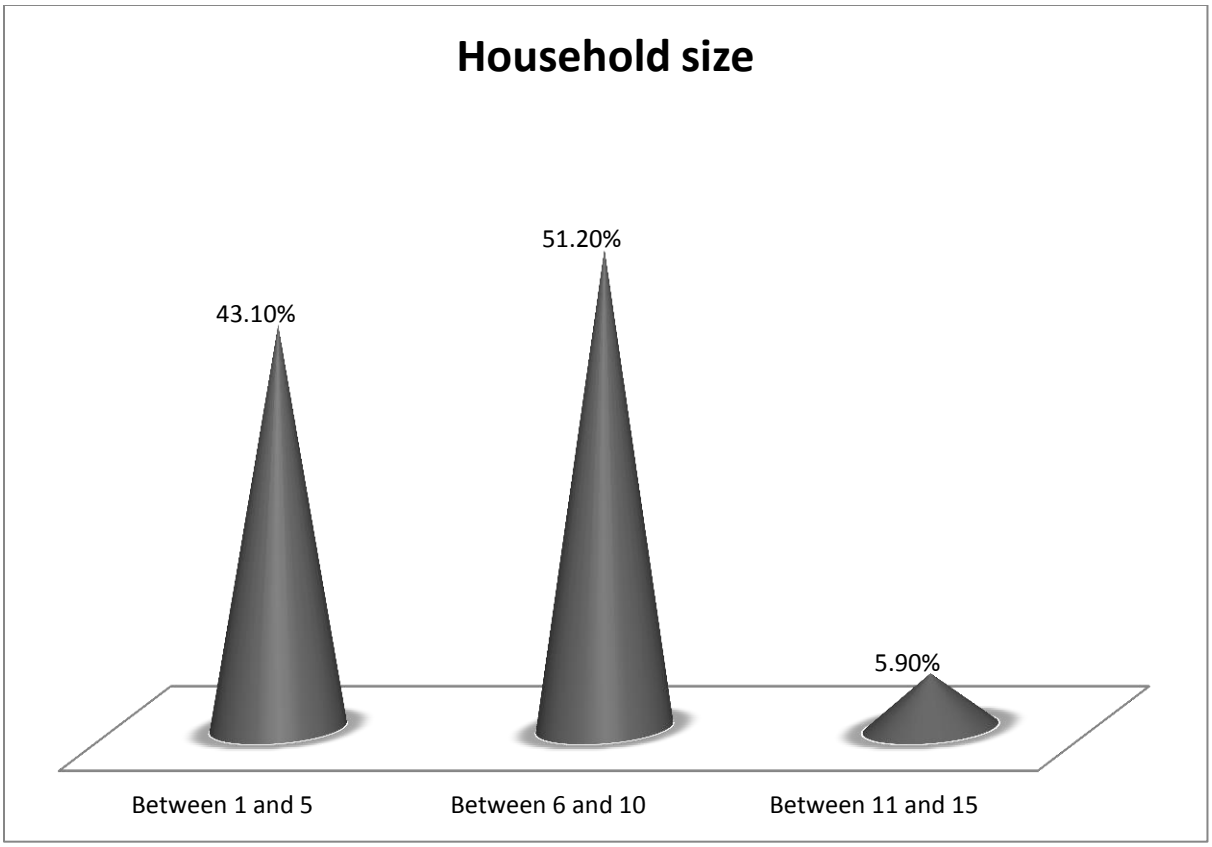

Figure 4.4: Household size of the farmers

Source: Computed by author from survey data (2015)

The percentage of 51.20% indicates that the majority of smallholder broiler farmers have household sizes of between 6 and 10 members. Smallholder broiler production usually does not require a lot of labour. These household members are usually employed without wages as the labourers in the broiler production, cutting costs of hiring external labour, and thus increasing profitability in broiler production. The smallest group of farmers at 5.90% has household sizes of between 11 and 15 members. The remaining 43.10% of the broiler farmers in Mopani District have household sizes of between 1 and 5 members. Jatto (2012) indicated that majority of poultry farmers have household sizes of between 0 and 4 with 71.3% followed by household sizes between 5-10 with 28.6% in some study areas. This indicates that these farmers incur fewer expenses in feeding, providing healthcare and education for their households, compared to farmers in Mopani District.

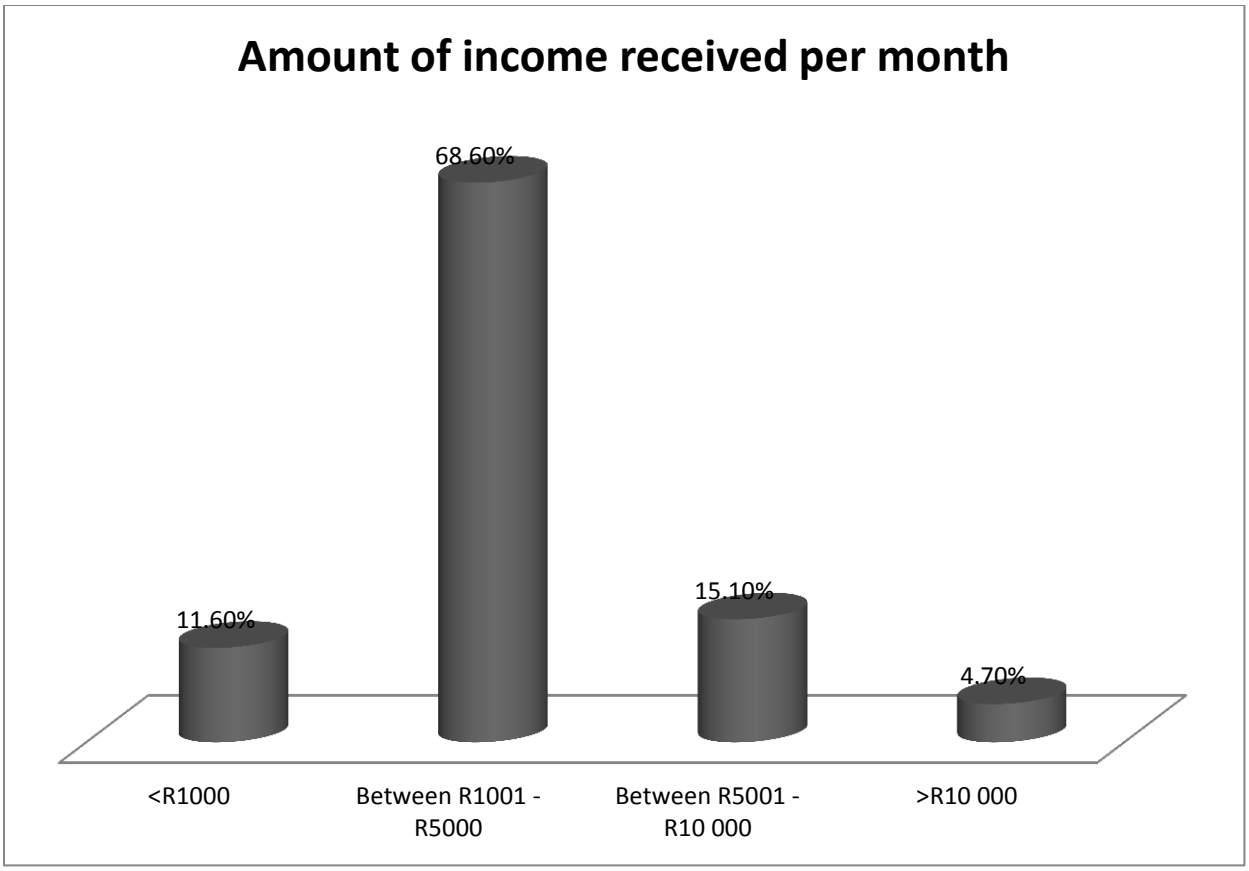

Figure 4.5: Income received per month

Source: Computed by author from survey data (2015)

The smallest group in the sampled farmers in Mopani District which constituted just 4.70% was found to be receiving an income that is greater than R10 000.0 a month, whilst the largest group with 68.60% of the farmers were found to be receiving a monthly income of between R1001.00 and R5000.00. Other groups constituting 11.60% and 15.10% were found to be receiving a monthly income of less than R1000 and between R5001.00 and R10 000.00 respectively. This was income received from all sources including non agricultural activities. Farmers who receive more monthly income are more likely to expand their scale of broiler production and participate in the market; however the results of the study indicate that the majority of the farmers with household sizes of between 6 and 10 members are receiving between R1001.00 and R5000.00. This amount of income was not encouraging for the farmers as they deemed it not enough to support their families and grow their broiler businesses.

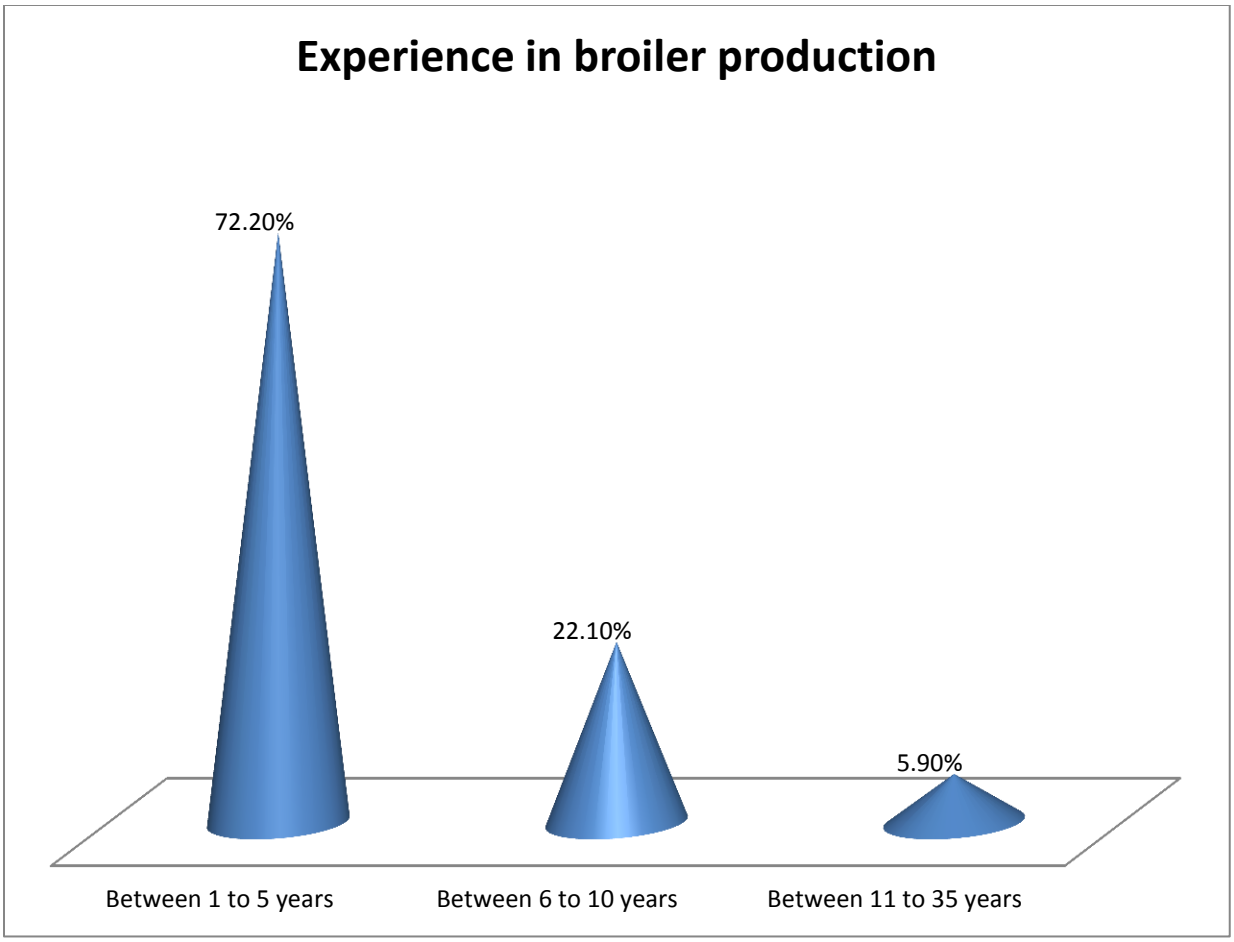

Figure 4.6: Experience in broiler production

Source: Computed by author from survey data (2015)

The percentage of farmers who have broiler farming experience of between 1 to 5 years was found to be the maximum at 72.20%, followed by those farmers with 6 to 10 years broiler farming experience, with the smallest group of farmers at 5.90% having 11 to 35 years of experience in broiler farming. Farmers with more years of broiler farming tend to have to know how for efficient production and links to the market. However, the descriptive results of this study show that over 72% of farmers are new to the industry and this may lead to less resource-use efficiency and less participation in the market. Okoli et al. (2004) found that the majority of broiler farmers had 1 to 10 years' experience in broiler production. Their study revealed that 67.3% of the farmers had the 1 to 10 years farming experience and 61.8% of these broiler farmers were combining the broiler production with other means of livelihood such as teaching and crop farming.

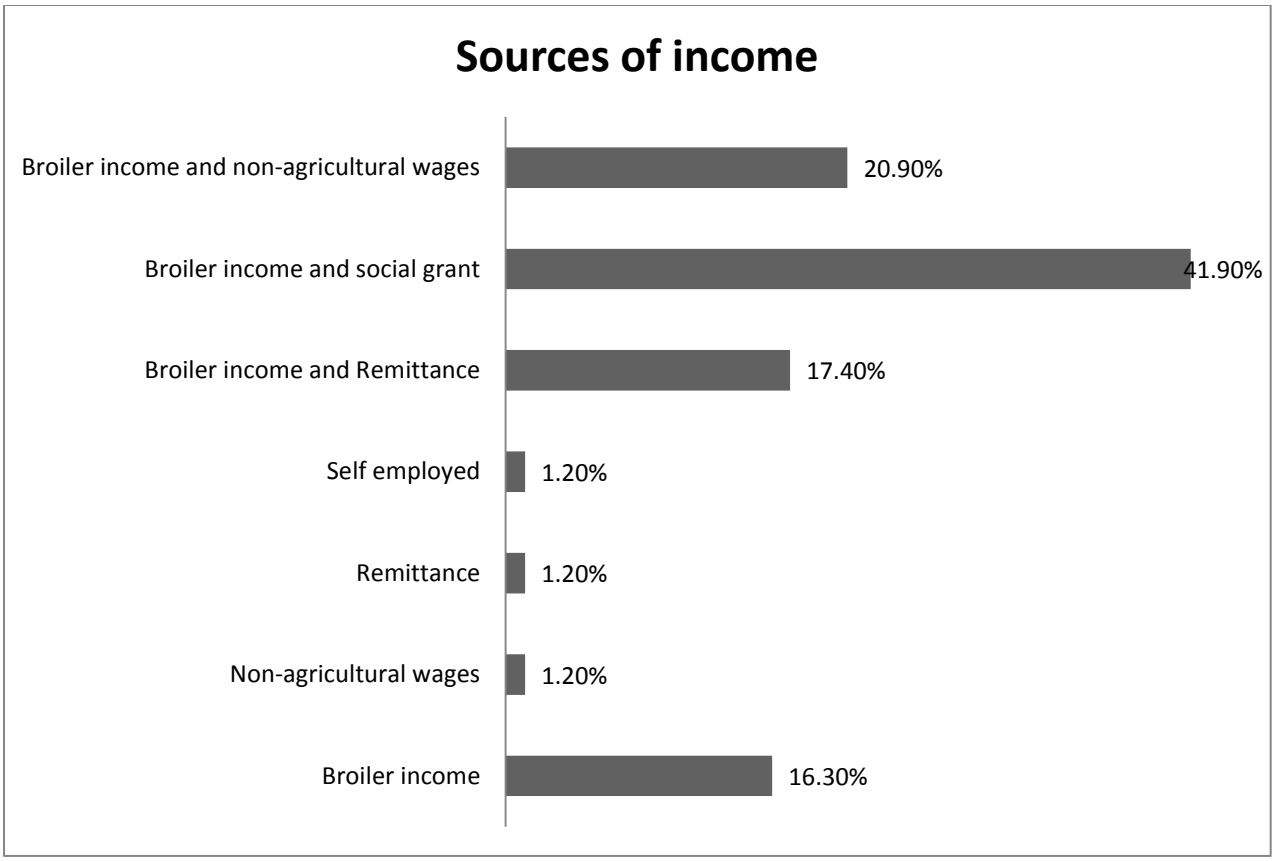

Figure 4.7: Sources of income

Source: Computed by author from survey data (2015)

At 41.90%, broiler income and social grant combined were found to be the highest sources of income for most smallholder broiler farmers. This is due to the fact that most broiler farmers in Mopani District were found to be unemployed and depending mainly on social grant and broiler income. Broiler income and non-agricultural wages combined were the second largest sources of income that broiler farmers depend on. With broiler income and remittance combined, and broiler income only, being the next largest sources of income for farmers comprising of 17.40% and 16.30% of the sampled farmers in Mopani District respectively. Sharmin et al. (2012) explained that majority or farmers at 86% had farming as their primary occupation. This farming had many different enterprises such as crop production, livestock rearing and poultry rearing. Only 8% of them owned their own businesses and the other 6% were employed in salaried jobs.

4.3 Stochastic Frontier Production Function results

Productivity of broiler producers in Mopani District was determined using the Stochastic Frontier Production Function given a specific set of variables. These variables were; labour, feeds, stock size and vaccines. The results presented by the study are indicated in table 4.2.

Labour

The results discovered that labour has a positive relationship with the productivity of the farmers in their broiler production. This relationship was found to be statistically insignificant. The production elasticity coefficient of 2.151 explains that an increase in labour by one man power may lead to an increase of broiler output by 2.151. These results show that the more labour that is available; the more broiler output would be produced, ceteris paribus. This further demonstrates that smallholder broiler production in Mopani District is labour intensive. The positive relationship between labour and productivity was in contrary to Ohajianya et al. (2013), who found labour to be significant at 1% level.

Feeds

The production elasticity with respect to feeds was found to be positive at 0.018 and statistically significant at 1% level. When feeds used in broiler production increase by one kilogram, broiler output may increase by 0.018 units, keeping all other things constant. This indicates an efficient use and consumption of the feeds by the broiler chickens. For farmers to produce more output, more feeds would have to be used. Therefore, leading to farmers having to spend a lot of their funds on the purchasing of feeds for the broiler production. This variable was found to be significant at 1% level, showing that a 10% increase in the feed used in broiler production will lead to an increase in broiler output produced. Adedeji et al. (2013) found that one of the major productive input that has great impact on the poultry output of poultry farmers is the feed. Feed was found to have the highest coefficient. This implied that an increase in input would lead to an increase in output.

Stock size

With a significance level of 10% and production elasticity of 0.074, the results of the study found that when stock size increases, the broiler output produced may also increase. Stock size was found to have a positive correlation with the broiler output produced, with a production elasticity coefficient of 0.074. The results of the study indicated that the more stock of broiler chickens the farmers acquire, the higher the output of the broiler produce they are likely to attain; this could be due to having more chickens and lower mortality rates. Todsadee et al. (2012) discovered that the birds stock appeared to be the second most important production factor after feeds (which is the most important), and implying that every increase in stock size, would lead to an increase in the quantity of broiler produced.

Vaccines

The more money broiler farmers spent on vaccines, the more broiler output they produced. This was indicated by a positive relationship between the vaccine cost and the output produced, with an elasticity coefficient of 0.814. This variable was found to be statistically insignificant. This is because when farmers spend more on vaccines, the mortality is most likely to reduce due to the treatment given to the broiler chickens. Ohajianya et al. (2013) confirmed these results by establishing that drugs and medication have a positive correlation with the output produced and thus more medication used in broiler production, the more output will be produced.

Table 4.2: Estimated Stochastic Frontier Production Function for smallholder broiler farmers

Variable	Parameters	Coefficient	Standard Error
Constant	B_0	657.958	7370.646
Labour	B_1	2.151	1.603
Feeds	B_2	0.018***	0.010
Stock size	B_3	0.074*	0.018
Vaccines	B_4	0.814	0.090

Diagnostic statistics			
Sigma	σ^2	0.2474628	0.066
	σ_v	1.12e-09	7.94e-07
	σ_u	0.497	0.066
Lambda	Λ	0.444	0.0664754
Log likelihood	-	-0.77122716	

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

Source: Computed by author from survey data (2015)

4.3.1 Returns to scale

Returns to scale is determined by adding the values of B (Tan, 2008).A value greater than one indicates that there is increasing returns to scale (Chen, 2007). When inputs used in broiler production were increased, the broiler output more than doubled. Smallholder broiler farmers were found to be having returns to scale of 1.681, which is greater than 1. Therefore, smallholder broiler production in Mopani District was found to be having increasing returns to scale. Indicating that farmers can reduce cost of production by increasing their scale of production (Etuah, 2014). The study shows that smallholder broiler production in Mopani District is profitable. The study by Eze et al. (2013) found that broiler production in Imo state in Nigeria had increasing returns to scale, therefore was profitable but had inefficiency in resource allocation.

4.3.2 Hypotheses testing and model fitness

The technical efficiency of a farm ranges from 0 to 1. Maximum efficiency in production has a value of 1. Lower values represent less than maximum efficiency in production (Ali and Samad, 2013). Therefore, having technical efficiency value (σ^2) that is equal to 0 will represent no technical efficiency at all. The results of the study found that σ^2=0.2474628 which is higher than 0.

The results of the study found the estimated lambda to be 0.444. The findings of this study further explain that 0.44% of the variation in smallholder broiler production in Mopani District is explained by the socio-economic factors and the difference in technical inefficiencies.

4.3.3 Sources of technical efficiency in broiler production

The technical efficiency results of the study are represented in table 4.3 below. The results show that the age of the farmer, gender, household size and experience of the farmer were found to be statistically significant at different levels.

Age

The age of the farmer was found to be statistically significant at 1% level, with a negative production elastic coefficient of -0.838. The age of the farmer negatively affects the farmer‘s broiler output and thus his/her technical efficiency. The older broiler farmers in the study area are likely to produce less broiler output as compared to the younger farmers. This is due to older farmers not being active enough to perform daily operations that require more energy to increase efficiency. This was found to be in contrast with Todsadee (2012) who discovered that age of the farmer has a negative correlation with the technical inefficiency. This indicated that younger farmers were less technically efficient compared to older ones.

Gender

The gender of the farmers was found to be significant at 10% level. The relationship between the gender of the farmers and the technical efficiency was found to be positive, having an elasticity coefficient of 0.539. The study found that 51% of the farmers in the study area were found to be male and 49% female. This is due to the fact that most females are employed as domestic workers and for those that are not employed, usually spend most of their days doing domestic chores around their households and caring the children, leaving them with slightly less time to engage in broiler production.

Household size

The household size of the farmers was found to be statistically significant at 1% level. A positive elasticity correlation of 0.214 implied that farmers with bigger households are likely to be more technically efficient. High numbers of household members in the study area led to farmers producing more broiler output. This is due to the fact that the

farmers' household members contribute to the labour force in the broiler production and thus increasing technical efficiency in broiler production. This was in contrary with Alrwis and Francis (2010) who explained that household size negatively affects the technical efficiency in smallholder broiler farms. This implies that the higher the household size, the lower the output produced. This could be due to the farmers having to spend more money on household expenses and having fewer funds to spend on broiler production.

Level of education

The farmers' level of education was found to be having a positive relationship with technical efficiency with a production elasticity coefficient of 0.84 and a significance level of 1%. For the farmers with more years in formal education, higher broiler output is realized and therefore higher technical efficiency. This was confirmed by Todsadee (2012) who found that there was a positive correlation between the years of formal education and technical efficiency. This implied that an increase in the years of formal education will lead to a rise in production efficiency. That is, the level of technical inefficiency decreases when farmers acquire more years in formal education.

Experience

The experience of farmers in broiler production was found to be statistically significant at 10% significance level with a production elasticity coefficient of -0.285. This negative coefficient indicates a negative relationship between the experience of farmers in broiler production and broiler output, and ultimately technical efficiency. The results of the study show that farmers with more years in broiler production produced less output and therefore are technically inefficient. When farmers have been farming for many years, they tend to remain in their comfort zone in their production instead of trying new innovative methods of production that increase productivity. These results were supported by findings from Alrwis and Francis (2010) who explained that experience has a positive relationship with technical inefficiency. This indicates that as the farmers' years of experience increase, the farmers' output will tend to decrease.

Table 4.3: Sources of technical efficiency in broiler production

Variable	Parameter	Coefficient	Standard error	P values
Constant	α_0	8.100	2.458	0.095*
Age	α_1	-0.838	0.033	0.001***
Gender	α_2	0.539	0.284	0.107*
Household size	α_3	0.214	0.242	0.004***
Level of education	α_4	0.840	0.205	0.001***
Experience	α_5	-0.285	0.156	0.061*

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

Source: Computed by author from survey data (2015)

4.3.4 Distribution of technical efficiency in broiler production

Table 4.4 indicates the technical efficiency distribution scores of the broiler farmers in Mopani District. The results found the maximum technical efficiency value of broiler production to be 100%, with a minimum value at 4.2% and average at 76.6%.

The results indicated that smallholder broiler farmers in Mopani District could save an average of 23.4% [(that is; 1-(76.6/100)] in production costs and realize a maximum cost saving of 95.8% [(that is; 1-(4.2/100)] in production costs.

Table 4.4: Distribution of technical efficiency scores in smallholder broiler production

Technical efficiency (%)	**Scores**
0-20	9
21-46	10
47-60	4
61-80	13
81-100	50
Total	86

Maximum technical efficiency 100 %

Minimum technical efficiency 4.2 %

Average technical efficiency 76.6 %

Source: Computed by author from survey data (2015)

4.4 Description of major broiler production inputs in Mopani District

Table 4.5represents the different inputs that are used by the smallholder broiler farmers in the study area. The farmers acquire these inputs from different sources. Inputs such as feeds are acquired from suppliers that specialize in the provision agricultural inputs, such as; NTK and Snyman**.** Farmers in the study area purchase their stock (day old chicks) and vaccines from suppliers such as Afcolaco, Lufafa and Bushvalley, sawdust is obtained from sawmills such as Visagie sawmill. For some farmers, labour comes from family members, while other farmers hire local community members in their broiler production. This labour is hired on a temporary and permanent basis.

Table 4.5: Description of major inputs

Input	Description
Feed	This is used as food for the broiler chicks
Stock	This refers to the day old chicks that are raised to be sold in the market
Labour	Labour refers to the workers in man days that are available to farmers in their broiler production
Vaccines	This is medicine used to treat the broiler chickens to reduce mortality
Sawdust	This is wood residues that are used to insulate the broiler houses

Source: Computed by author from survey data (2015)

4.5 Broiler marketing

The results of the study found that 56% of the farmers do not participate in any formal market of their produce, instead these farmers sell their produce from their farms, that is; consumers come to them when they want to purchase their products. However, the remaining 44% of the farmers were found to be taking their products to the market. Some farmers were found to have storage facilities for their produce, therefore these farmers were able to continuously have output at their disposal to sell in the market. Therefore, these farmers did not only sell live broiler chickens, but were able to sell slaughtered chickens as well, and at a higher price.

Out of the 44% of farmers who market their broiler products, majority of them were found to be selling their produce as live chickens out of the back of their bakkies in the streets around communities. Another portion of these farmers indicated that they sell their produce at the social grant pay points where a large group of community individuals gather to collect their social grants and a significantly small portion of these farmers were found to sell their produce to the local butcheries. Britz (2011) indicated that some smallholder broiler farmers who produce broiler products of the highest quality are able to sell their products to abattoirs. This leads to the assumption that if smallholder broiler farmers in the study area increase the quality standards of their broiler products, they can be able to take their products to any formal market.

4.6 Gross Margin Analysis of smallholder production in Mopani District

Gross margin is most popular among farm managers who are concerned with the performance of their farm businesses. It uses financial outputs minus the variable costs to determine the farm business' profitability and this allows for knowledgeable planning purposes (Firth, 2002). Table 4.6 below presents the costs and returns of broiler production in Mopani District. The cost of wages for all the farmers in Mopani District who hire labour was found to contribute 9.55% towards the total variable costs incurred in broiler production in Mopani District. The highest cost of production for the broiler farmers was found to be the cost of feeds which took a total of 70.61% of the total variable costs of broiler production. This high cost of feeds leads to some smallholder

broiler farmers being unable to realize significant profits, or having to raise the prices of their output, and consequently reducing purchases by consumers, and this may in turn contribute to food insecurity in the area (Nkukwana, 2014).

The second largest portion of the total variable production cost of broiler production is at 15.11%, being the cost of the stock or day old chicks that are bred to become the sold output. This cost is high because some of the farmers in Mopani District purchase large number of chicks to be able to produce more output. Farmers in the District purchased as high as 2200 number of day old chicks. The farmers spent R113 740, R64 300, R113 900, R51 400, R188 866, R23 750 on sawdust, electricity, transport to input market, transport to output market, vaccines and water respectively.

The cost of wages was high at R1 121 800 per year because labourers were expected to work every day of the week due to the vulnerability nature of broiler chickens and therefore, the labourers had to be compensated for working extra days, that is; on weekends. This leads to increased costs of hiring the labour. The cost of saw dust is low because it is very cheap to purchase sawdust, at R5 per R80 kg bag. Therefore, broiler farmers do not spend too much of their funds on acquiring the sawdust. At R64 300 per year, electricity was found to not be used by all the broiler farmers in the study area. Some farmers used generators and paraffin heaters to maintain the required temperature in the chicken houses, whilst other farmers did not purchase a large number of day old chicks to breed, and thus reducing the cost of electricity in the study area.

The cost of transport to the input market was found to be low because the input markets are not situated very far from the farmers' chicken houses; therefore, the costs incurred were low. Some suppliers of the broiler inputs deliver the inputs to the farmers and charge a certain fee, which is still low. There are however, those farmers to whom the suppliers do not charge a transport fee due to the large number of inputs they are purchasing. The cost of transporting goods to the market was found to be very low for farmers in Mopani District because not all farmers in the District transport their output to the market, but instead rely on the consumers coming to purchase the broiler chickens where they are bred (at the farmers' chicken houses).

The fourth largest cost of production was found to be the cost of vaccines. This cost was found to be the fourth largest, but the amount incurred was still quite low at R188 866 per year. The smallholder farmers in Mopani District were found to be purchasing from 100 to 2200 number of day old chicks; and majority of these farmers were purchasing day old chicks at an average 500 in number. These farmers therefore do not spend much on the purchases of vaccines as compared to those farmers who breed between 1100 to 2200 day old chicks. The lowest cost at R23 750 per year was found to be the cost of water. Farmers in Mopani District do not spend a lot of their funds on water because most have the farmers have boreholes and some acquire water free from public taps that were erected by the government.

The ratio of Total variable cost to Gross margin was found to be 16.50, meaning that for every R1 spent on production of broiler, the farmers stand to make R16.50 in profits. Farmers are able to cover the costs of their production and make profit from the sales of their products. Therefore, the Gross Margin Analysis shows that broiler farmers in Mopani District are making profit in their broiler production.

Table 4.6: Gross Margin Analysis of boiler production

Costs and Revenue	**Amount (in Rands)**	**Percentage %**
Gross Revenue	12 459 755	-
Variable costs		
Cost of wages	1 121 800	9.55%
Costs of feeds	8 295 338	70.61%
Cost of stock/day old chicks	1 774 625	15.11%
Cost of sawdust	113 740	0.97%
Cost of electricity	64 300	0.55%
Transport cost (input market)	113 900	0.97%
Transport cost (output	51 400	0.44%

market)		
Cost of vaccines	188 866	1.61%
Cost of water	23 750	0.20%
Total	**11 747 719**	**100%**
Gross Margin	**712 036**	**-**

Source: Computed by author from survey data (2015)

4.7 Determinants of market participation

Table 4.7 below presents the results of the Logit variables used in determining the market participation by smallholder broiler producers in Mopani District. Logit models are utilized in binary data when there are two possible options indicating failure or success (Rodriguez, 2007). The Logit model was used to check which of the mentioned factors affect the participation of the broiler farmers in the market.

The Cox and Snell R square Indicates that 69.2% of the variation in the model is explained by the significant independent variables. That is, the independent variables explain 69.2% of the probability of smallholder farmers participating in the market. The remaining 30.8% shows the unaccounted change. The independent variables explaining the participation in the market by smallholder broiler farmers were found to be significant at 10%, 5% and 1%, represented by *, **, and *** respectively.

Household size

The household size of broiler farmers in Mopani District was found to be having a negative relationship with market participation, having a coefficient of -7.90. The higher the number of the farmer's household members, the less likely he/she is to participate in the market. This could be because the farmers have more parenting and financial responsibilities at home which require the farmers to spend less time and money in their broiler production and marketing. This explanatory variable was found to be significant at 10%.This is in contrary with a study by Egbetokun and Omonona (2012), which found that family size (household size), had a significant positive relationship with market

participation. That is, when the household size increases, the participation in the market by the broiler farmers also increases. This is because farmers will tend to use the family members as labourers for the broiler enterprises, producing more output to sell in the market (Egbetokun and Omonona, 2012).

Income received per month

The income received per month by the broiler farmers in Mopani District was found to be having a coefficient of -5.45 and a significance level of 1%. This shows that, high income levels for broiler farmers in Mopani Districts are likely to result in farmers not participating in the market. This could be due to the farmers spending the increased income on household expenses rather than investing it in broiler production, and thus leading to farmers not having enough broiler products to sell in the market. These results were found to be contradictory with Abeykoon et al. (2013) who discovered that when farmers earn more monthly income, their probability of participating in the market will tend to increase.

Experience

The experience of the farmers in broiler farming was found to be significant at 1% level and having a coefficient of 1.19. This indicates a positive relationship between the number of years in broiler production and the market participation. As the number of years in broiler production increase, the probability of broiler farmers participating in the market will increase by 1.19. This was opposed by Abeykoon et al. (2013) who found that as the experience of the farmer in poultry production increase, the probability of farmers participating in the market will decline.

Land size

Land size is significant at 1% level and has a coefficient of 3.51. This positive relationship with market participation indicates that when the size of land under broiler production increases by 1 hectare, market participation by the broiler farmers is likely to increase by 3.51. This is because the broiler farmers now have more land to utilize for

broiler production and therefore can expand production and produce more output to sell in the market.

Access to market information

The results found that as access to market information increases, market participation is likely to increase by 0.490, with a significance level of 1%. This is because farmers are now able to understand what is required in the market and where they can sell their produce and at what prices. Therefore, this increases the farmer's probability of participating in the market and making profits for their broiler enterprises. This was confirmed by Abeykoon et al. (2013) who established that at a significant level of 1%, the access to market information was found to have a positive relationship with market access. The probability of farmers participating in the market increases when access to market information increases.

Distance to market

Distance to the output market was found to be having a positive relationship with market participation, with a significance level of 1% and a coefficient of 6.72. This relationship explains that if distance to the market is high in kilometres, the probability of farmers participating in the market will increase by 6.72.This is due to farmers realizing that the distance is too long for consumers to travel to purchase broiler products at the farms; therefore the farmers decide to take the products to the consumers in the market. However, this was in contrary with Mailu et al. (2012) who found that as distance to the market increased, the probability of farmers deciding to participate in the market declined.

Profitability

The profitability of the broiler farmer is significant at 1% level and has a coefficient of 5.17. This shows that as broiler farmers become more profitable, the probability of them participating in the market increases. When farmers are making profits they are able to expand their production and produce more products for the market. These farmers

realized that selling in the market helps in gaining more profits; therefore they are more likely to increase the produce they take to the market**.**

Land ownership

Land ownership has a negative correlation with market participation, with a coefficient of -1.00. Land ownership was found to be significant at 1% level. When farmers own the land they are producing on, they have one less expense in their cost of production and that is; no rent for the land they utilize in their broiler production. This is likely to give the farmer the perception that his/her cost of production is low and the motivation to produce more may be lacking and the probability of such a farmer participating in the market may be less.

Non-Significant Variables

Age of the farmer

The age of the farmer with the coefficient of -6.44 was found to be statistically not significant. The negative coefficient of -6.44 shows that the age of the farmer is negatively related to the participation of farmers in the market. Thus indicating that, the older the farmer, the less likely he/she is to participate in the market.. This may be due to deterioration of the farmer‘s ability to do more work, and farmers find themselves too weak to produce more products to sell in the market. This could also be due to the fact that the farmers may have been producing for many years and has established a customer base that comes to purchase the broiler products at farm gate. This was confirmed by Egbetokun and Omonona (2012), who found that a unit increase in the age of the farmer leads to a decrease in market participation.

Labour

Labour was found to be statistically insignificant with a coefficient of 3.00. When labour available in broiler production increases, market participation by the broiler producers is likely to increase by 3.00. The more labour that is available allows farmers to produce more broiler products to take to the market. Some farmers hire family members to assist

in broiler production whilst some hire community members, and this increases their labour force and thus their market participation through increased broiler products produced.

Gender

The gender of the broiler farmer was found to be having a negative relationship with the market participation. The study found that majority of the broiler farmers in Mopani District are male, comprising of 51% of the sampled farmers, with the remaining 49% been females. The participation of more male farmers in broiler production may be due to the fact that most males feel responsible for providing a living for their families. This happens mostly to those males who are bread winners with no employment and social grant as the only source of income for their households. These males are mainly producing to make a living, and most may not have any interest in growing their broiler production to a point where it may become commercial, therefore they end up producing less and thus, not participating in the market.

Education level

The results found that when the education level of the broiler farmers increases by one year, the probability of them participating in the market decreases by 3.11. This relationship is indicated by the negative coefficient of the education level, being -3.11. This may occur when these educated farmers gain interest in other economic activities and not pay much attention to their broiler enterprises. This will result in the reduction of total output of the broiler product produced and thus a reduction in the products sold in the market. However, this explanatory variable was found to be insignificant in determining market participation. This was found to be in contrast with Abeykoon et al. (2013) who found that the level education positively affected market participation, however, this factor was also found to be insignificant to market participation.

Sources of income

The Logit results discovered that the variable sources of income has a positive relationship with market participation with a coefficient of 1.06. This means that as

income sources increase, market participation is likely to increase by 1.06. This is because when farmers acquire more sources of income, their monthly income will increase allowing the farmers to spend more of their funds in expansion of their broiler production and producing enough to sell in the market.

Access to storage facilities

Access to storage facilities has a coefficient of 3.57, showing that when farmers have access to more storage facilities, they are likely to participate more in the market. This could be because farmers have storage for the excess produce and the broiler products that were ready for the market but were not bought; and therefore could be slaughtered and stored until it is bought in the market. This will ensure that farmers do not lose out on returns that could be made from those broiler products if they were left to grow for more weeks and get to a point where they were not marketable.

Access to extension services

Farmers' access to extension services has a coefficient of -2.97. This indicates that with an increase in extension services, market participation is likely to decrease by 2.97. Extension services are supposed to assist farmers in the running of their farm business, production of their products and marketing of their products. However, problems may be farm specific, meaning that the problems that one farmer might be facing might not be the problems the next farmer is facing. Therefore, the extension officers may not be providing the services that the broiler farmers need in order to overcome their constraints and this might lead to less participation in the market. This may occur mostly if extension officers practice the top-down approach in farmer interactions. This was in contrary with Kerbaga (2010) whose results found that the more access farmers had to extension services, the higher the probability of them participating in the market. This variable was found significant.

Access to credit

When access to credit increases, the farmers' probability of participating in the market is less. This is shown by the access to credit's coefficient of -1.74, which shows a negative

relationship between access to credit and market participation. Broiler farmers may participate in the market less when they have access to credit because of the funds they have to spend paying back the credit obtained. The funds they use to pay back the credit is an expense that could've otherwise been used for increasing broiler production so enough broiler output can be produced for the market. These results were in contrary to results found by Kerbaga (2010) which indicated that credit access is significant and has a positive relation to the decision of the farmers to participate in the market.

4.7: Logit results for the determinants of market participation

	B	**S.E.**	**Wald**
Age	-6.440	9.330	0.899
Gender	-3.630	2.360	0.016
Education	-3.11	2.60	0.127
Household size	-7.90*	4.110	2.617
Income received per month	-5.450***	2.010	0.019
Sources of income	1.060	5.310	0.054
Experience	1.190***	0.240	0.018
Labour	3.00	7.40	0.111
Land size	3.510***	1.290	1.419
Access to storage	3.570	5.850	1.517
Access to market information	0.490***	0.094	0.000
Distance to market	6.720***	2.800	0.006
Profitability	5.170**	2.570	0.527
Extension	-2.970	4.530	0
Credit	-1.74	9.65	0
Land ownership	-1.00***	0.0004	0

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

Source: Computed by author from survey data (2015)

4.8 Constraints faced by smallholder broiler producers in Mopani District

Table 4.8 presents the descriptive results found of the constraints that smallholder broiler farmers in Mopani District face. The table provides the constraints with the frequency and the percentage of the farmers who said yes they face that constraint and no they do not face that specific constraint.

The results indicate that 58.10% of the broiler farmers in Mopani District experience theft of their poultry by the community whilst 41.90% said they do not experience this problem. These 58.10% of farmers indicated that lack of fencing and proper security leads to theft of their broiler leading to reduced output of the broiler and thus less revenue. Out of the 86 broiler farmers interviewed, 38 farmers said they lack adequate water to farm their broiler chickens and 19 of these farmers explained that their broiler houses are of poor quality. These broiler houses lack the proper curtains to maintain a certain level of temperature required to decrease mortality rate, to which 81.40% of the broiler farmers reported as a major constraint.

It was also found that 47.70% of the interviewed farmers indicated that they lack the funds to grow in their broiler enterprises, and of these farmers in Mopani District, 2.30% said that they lack collateral to acquire credit to overcome their broiler production constraints. Some farmers complained about the prices of the resources they use in production. Resources such as feeds, vaccines and electricity, with the number of farmers having this problem being 34, 5 and 4, for feeds, vaccines and electricity respectively. Fawole (2006) indicated that lack of veterinary services mainly contribute to 66% of farmers' constraints. There are however, a group of farmers who said their major constraint is finding a market for their broiler produce, and out of the 86 farmers interviewed, only 2.30% represented this group of farmers lacking a market for their broiler produce whereas the remaining 97.70% of the interviewed farmers did not seem to have this problem.

Other constraints faced by some small groups of farmers in the study area include lack of training, lack of infrastructure, lack of land, lack of broiler equipment and pest infestation. The number of broiler farmers found to be having these constraints in the study area were found to be 1, 1, 2, 2, and 3, for lack of training, lack of infrastructure, lack of land, lack of broiler equipment and pest infestation respectively. Lack of training and hygiene constraints could be attributed to no availability of extension agents explained (Fawole, 2006).

Table 4.8: Descriptive statistics for constraints faced by smallholder broiler farmers in Mopani District

Constraint	Option	Frequency	Percentage
Theft	Yes	50	58.10%
	No	36	41.90%
Lack of water	Yes	38	44.20%
	No	48	55.80%
Poor quality chicken houses	Yes	19	22.10%
	No	67	77.90%
Lack of funds	Yes	41	47.70%
	No	45	52.30%
Expensive feeds	Yes	34	39.50%
	No	52	60.50%
Expensive vaccines	Yes	5	5.80%
	No	83	94.2%
Lack of electricity	Yes	4	4.70%
	No	82	95.30%
high mortality rate	Yes	70	81.40%
	No	16	18.60%
Lack of collateral	Yes	2	2.30%
	No	84	97.70%

No market for output	Yes	2	2.30%
	No	84	97.70%
Lack of training	Yes	1	1.20%
	No	85	98.80%
Lack of infrastructure	Yes	1	1.20%
	No	85	98.80%
Lack of land	Yes	2	2.30%
	No	84	97.70%
Lack of broiler equipment	Yes	2	2.30%
	No	84	97.70%
Pest infestation	Yes	3	3.50%
	No	83	96.50%
TOTAL		**N=86**	**100%**

Source: Computed by author from survey data (2015)

4.9 Chapter summary

The chapter showed the socio-economic results obtained from the study and the factors affecting the farmer productivity in broiler production. The chapter further presented the profitability and the market participation results of the farmers in Mopani District. The constraints that smallholder broiler farmers in Mopani District face were discovered and discussed in this chapter.

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the study, indicating the conclusions drawn from the results of the study. This chapter further discusses the policy recommendations that would be suitable for smallholder production in Mopani District to enhance their productivity, profitability and market participation. Sections included in this chapter are; section 5.2 summary of the study, section 5.3 conclusions of the study and section 5.4 policy recommendations.

5.2 Summary

The aim of the study was to examine the economic and marketing factors affecting smallholder broiler production in Mopani District. The objectives of the study were to describe smallholder broiler producers in Mopani District based on their socio-economic and demographic characteristics, to determine factors influencing productivity among smallholder broiler producers in Mopani District, to estimate the profitability of smallholder broiler production in the study area, to analyse the determinants of market participation among smallholder broiler producers in the study area and to identify the constraints facing smallholder broiler production in Mopani District.

Different analytical techniques were used to address the objectives. The first objective (describe smallholder broiler producers in Mopani District based on their socio-economic and demographic characteristics) and the fifth objective (identify the constraints facing smallholder broiler production in Mopani District) were analysed used descriptive statistics. Stochastic Frontier Production Function and the technical efficiency model were utilized to determine factors that influence productivity and efficiency of the farmers respectively. The Gross Margin Analysis was used to estimate profitability of the smallholder broiler farmers in Mopani District, utilizing the costs of variable costs and total returns; and to analyse the determinants of market participation, the Logit model was used.

The socio-economic results found that the largest group of farmers at 29% were between the ages of 50-59. The maximum age of the group of farmers interviewed in the study area was found to be 81 years of age and minimum age was found to be 26 years. The education level of the farmers was found to be between 0 and 16 years, with minimum number of household members being 1 and maximum being 15 in number.

The Stochastic Frontier Production Function results were established given a set of inputs used to determine productivity in smallholder broiler production in Mopani District. These inputs were found to be labour, feeds, stock size and vaccines. Feeds was found to be significant at 1% level, while stock size was significant at 10% level. However, labour and vaccines were found to be statistically insignificant. Positive correlations were observed between all the inputs and the output level of broiler. These correlations indicated that as the level of these inputs used increases, the level of output will also increase.

The technical efficiency scores were found after analyzing specific socio-economic factors. These factors were age, gender, household size, level of education and experience in broiler production. The results of the technical efficiency indicated that gender and experience were found to be significant at 10% level; age, household size and level of education found to be significant at 1% level. Age and the experience of the farmers were found to have a negative relationship with the technical efficiency; and gender, household size and education level were found to have a positive correlation with the technical efficiency. The average technical efficiency of farmers in Mopani District was found to be at 76.6%, the minimum technical efficiency at 4.2% and the maximum technical efficiency was found to be 100%.

The profitability results of the study used the total revenues and the total variable costs to determine the gross margin of broiler production in Mopani District. The gross margin of the farmers in the study area was found to be R712 036.00. This revealed that smallholder broiler production in Mopani District is profitable. The results also showed that for every R1 spent on production of broiler, the farmers stand to make R16.50 in profits.

The Logit model was used to analyse which factors affect market participation, and the results of the model indicated that household size of the farmers is significant at 10% level; income received per month, experience, land size, access to market information, distance to market, profitability and land ownership significant at 1% level. Experience, land size, access to market information, distance to market and profitability were found to have a positive relationship with market participation. That is, as these factors increase, farmers are more likely to participate in the market. The study also found that as household size, income received per month and land ownership increase, market participation by the farmers is more likely to decline.

The study also found that there are different constraints faced by the smallholder broiler farmers. Some of these constraints were found to be: theft of the broiler chickens, lack of funds, mortality rate and lack of proper housing. The results showed that 58.7% of the farmers in Mopani District are experiencing theft of their broiler, 47.7% lack funds and due to poor housing of their chicken houses, 81.4% of the farmers experience high mortality rates.

5.3 Conclusion

Research questions were asked in this study. The first research question asked what the socio-economic characteristics of smallholder broiler producers in Mopani District are. The results of the study found that farmers in the study area can be characterized by their age, gender, level of education, household size, income received per month, what their sources of income are and their experience in broiler production.

The second research question asked what the production and marketing factors influencing productivity among smallholder broiler producers in Mopani District are. The results of the study found that the production and marketing factors that influence productivity include labour, feeds, stock size and vaccines. These factors indicated what happens to the broiler output when they are increased. More factors were found to be affecting efficiency of the smallholder broiler farmers in the study area and these factors were found to be age, gender, household size, level of education and experience of the farmers in broiler production. The results of the study further indicated that these factors

affect the productivity of broiler farmers in Mopani District. These factors affect productivity positively, and the technical efficiency factors have both positive and negative effects. The positive factors on technical efficiency are gender, household size and level of education, whereas the negative factors affecting technical efficiency were found to be age and the farmers' experience in broiler production.

The third research question asked what the determinants of market participation among smallholder broiler producers in the study area are. The results of the study showed that there are 8 significant factors that affect market participation. These factors include household size, income received per month, experience of the farmers in broiler production, land size, access to market information, distance to the market, profitability and land ownership. Out of these factors, 5 of them were found to be affecting market participation positively and the remaining 3 were found to affect market participation negatively. The factors that affect market participation positively were found to be experience, land size, access to market information, distance to market and profitability; and those factors that affect market participation negatively were found to be household size, income received per month and land ownership.

The fourth research question asked if the smallholder broiler production in the study area is profitable. The study found that smallholder broiler production in Mopani District is profitable with the recorded profit at R712 036.00 per annum.

The fifth research question asked what the constraints facing smallholder broiler production in Mopani District are. The results of the study revealed that different farmers in the study area face different constraints. Such constraints included theft of their broiler chickens, lack of water, lack of funds, lack of proper houses and high mortality rates.

5.4 Policy Recommendations

- The study recommends that farmers be provided with security measures in their broiler production to reduce theft of their broiler chickens as this is one of the constraints faced by broiler farmers in Mopani district.

- The study recommends that there be linkages established between the formal markets and the smallholder farmers. Some farmers in the study do not participate in the market because they do not know where to take their products for sale. Therefore, there should be an establishment of an information system that allows the smallholder farmers to acquire such information as to where they can sell their products and the quality standards required to ensure that farmers have access to market information at all times.
- Farmers who are making profit and have more experience in broiler production should be provided with a platform to grow into commercial farming. This could be through subsidies or provision of major resources that are key to enhancing expansion, such as land and funds.
- Government should find ways of linking the smallholder farmers in the study area with other stakeholders, governmental and private, to allow smallholder farmers opportunities to network and get to know how the commercial successful farms operate and see where they can improve their production and marketing of products. This will help the smallholder broiler farmers address some of their constraints, such as poor quality chicken houses, high mortality rates, how to find markets for their produce and pest infestations.
- Current programs that are set in place to assist smallholder broiler farmers should be reviewed due to the fact that some disadvantaged farmers do not get the assistance of such programs and hence they do not have many opportunities for improvements. These programs may assist farmers become more efficient in their broiler production, such programs that provide land, training and broiler equipment for the farmers.

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Annexure A: Questionnaire – smallholder broiler farmers in Mopani District

UNIVERSITY OF LIMPOPO (Turfloop Campus)

Faculty of Science and Agriculture

School of Agricultural and Environmental Sciences

Department of Agricultural Economics and Animal Production

ECONOMIC AND MARKETING ANALYSIS OF SMALLHOLDER BROILER PRODUCTION IN MOPANI DISTRICT OF LIMPOPO PROVINCE, SOUTH AFRICA.

Name of researcher : Machethe T.A.
Name of enumerator : …….....
Name of Municipality : .....
Name of village : .....
Questionnaire no : .....
Name of respondent : …….....
Respondent signature : .....
Date of interview : …… …….....

Section 1: Socio-economic characteristics of farmers

1.1. Age of farmer: ……
1.2. Gender: Male ☐ Female ☐
1.3. Marital status: Single ☐ Married ☐ Widowed ☐ Divorced ☐ Separated ☐
Other ☐ Please specify,.....
1.4. Household size: …….....
1.5. Education (years in school): …….....

1.6. What is your primary economic activity? Farming ☐ Trading ☐ Public salaried job ☐ Private salaried job ☐ Domestic worker ☐ Craftsman ☐ Other ☐ Please specify,.....

1.7. Household sources of income: Broiler income ☐ Other agricultural income ☐ Non-agricultural wages ☐ Remittance ☐ Self-employed ☐ Other income sources ☐ Please specify,.....

1.8. How much income do you receive per month (from all other income sources except broiler production)? >R1000 ☐ Between R1001 – R5000 ☐

Between R5001 – R10 000 ☐ <R10 000 ☐

1.9. Number of years in Broiler production: …….....

1.10. Are you a member of any farmer organization? Yes ☐ No ☐

Section 2: Input use, costs and revenues

2.1. How many production cycles do you have per year? .....

2.2.Do you hire labour for your production of broiler? Yes ☐ No ☐

2.2.1. If yes to question 2.2., how many people did you hire? ……..

2.2.2. Is the labour you hire permanent or temporary?.....

2.2.3. How many days a week/month (specify) do these people work? …….

2.2.4. How much do you pay your labourers per day/week/month (specify)? ……

2.3. How much feeds (in Kgs) did you use in each production cycle for your broiler production in the previous year? …….....

……

…….....

2.4. What is the price of your feeds per Kg? ……

2.5. How many day old chicks did you use in each production cycle for your broiler production in the previous year?.....

……

……

2.6. How much do you spend per chick? ……

2.7. How much did you spend on vaccines in each production cycle for your broiler production in the previous year?.....

…….....

.....

2.8. Are there other variable costs that you incur in your broiler production per year?

Yes ☐ No ☐

2.8.1. If yes to 2.8., please specify the other variable costs and the amount incurred (Rands)……

……

……

……

……

……

2.9. What is your land size?.....

2.10. Do you own the land you are producing on? Yes ☐ No ☐

2.10.1. If no to 2.10., what type of ownership arrangement exists between you and the land owner?.....

2.11. How many chicken houses do you have?.....

2.12. How many broiler chickens does each house carry?.....

2.13. Do you process your broiler? Yes ☐ No ☐

2.13.1. If yes to 2.13., how do you process your broiler?.....

……

2.13.2. Do you have storage facilities for your processed produce? Yes ☐ No ☐

2.14. What is the distance in Kms from your chicken houses to the input market?.....

2.15. How much quantity of your output did you produce in each production cycle?.....

.....

2.16. How much transportation cost did you incur in each production cycle to the input market?.....
.....

Section 3: Marketing factors

3.1. How much do you sell your products (broiler chickens and/or the processed broiler) for in the output market?.....

3.2. What motivated you to start broiler production?.....
.....
.....

3.3. Do you keep records of your activities (such as records on sales and production)? Yes ☐ No ☐

3.4. Who do you sell your products to? Local community ☐ Formal market ☐ Informal market ☐ Other ☐ Please specify…….....

3.5. Do you transport your products to the market? Yes ☐ No ☐

3.5.1. If yes to 3.5., what mode of transport do you use?.....

3.5.2. Do you hire or own the transport you use to transport the products to the market?.....

3.5.3. How much costs do you incur in transporting your products to the market?.....
.....

3.6. Do you have access to credit? Yes ☐ No ☐

3.6.1. If yes to 3.6., how much credit did you receive in each production cycle (Rands)?.....
.....

3.6.1.1. When was the credit obtained?.....

3.6.1.2. What was the purpose of the credit?.....

3.6.1.3. Who was the source of the credit?.....

3.6.1.4. Have you finished paying off the credit? Yes ☐ No ☐

3.7. Do you have access to extension services? Yes ☐ No ☐

3.7.1. If yes to 3.7., how frequent were the extension services received?.....
.....

3.7.1.1. What were the services received? .....
……
……
3.8. Do you have access to market information? Yes ☐ No ☐
3.9. What is your source of the market information? Extension officers ☐
Television/Radio ☐ Internet ☐ Other farmers ☐ Other ☐ Please specify…….
3.10. What infrastructures are available for your use? Roads ☐ Electricity ☐
Value adding facilities (such as packaging facilities) ☐ Other ☐ Please specify,……..
3.11. What is the distance in Kms from your chicken houses to the output market?.....
3.12. What other factors influence (positively or negatively) your participation in the market?.....
.....
.....
.....

Section 4: Constraints

4.1. What are the constraints that you face in your broiler production?
i. .....
ii. .....
iii. .....
iv. .....
v. .....
4.2. What have you done on your own so far to overcome these constraints?
i…….
ii……
iii……
iv……
v……..

4.3. How do you think the government can assist you in your broiler production?

i.....

ii.....

iii.....

iv.....

v.....

4.4. What are the opportunities available to you in your broiler production?

i.....

ii.....

iii.....

iv.....

v.....

Annexure B: STATA 11 output

Stochastic Frontier Production Function results

```
. insheet using "D:\STOCHASTIC-data.csv"
(5 vars, 86 obs)

. . frontier   broiler vaccines labour stock feeds

Iteration 0:   log likelihood = -6.1008961
Iteration 1:   log likelihood = -4.7883993
Iteration 2:   log likelihood = -3.4082443
Iteration 3:   log likelihood = -3.1913355  (not concave)
Iteration 4:   log likelihood = -2.3316273  (not concave)
Iteration 5:   log likelihood =  -1.497161
Iteration 6:   log likelihood = -1.2485639
Iteration 7:   log likelihood = -1.0943445
Iteration 8:   log likelihood = -.87826298
Iteration 9:   log likelihood = -.86451387
Iteration 10:  log likelihood = -.83720855
Iteration 11:  log likelihood = -.80317947
Iteration 12:  log likelihood = -.79134205
Iteration 13:  log likelihood = -.78136665
Iteration 14:  log likelihood =  -.7772697
Iteration 15:  log likelihood = -.77363526
Iteration 16:  log likelihood = -.77308372
Iteration 17:  log likelihood = -.77256207
Iteration 18:  log likelihood = -.77202615
Iteration 19:  log likelihood = -.77171412
Iteration 20:  log likelihood = -.77152943
Iteration 21:  log likelihood = -.77141604
Iteration 22:  log likelihood = -.77134992
```

```
Iteration 23:  log likelihood = -.77130301
Iteration 24:  log likelihood = -.77128353
Iteration 25:  log likelihood =  -.7712639
Iteration 26:  log likelihood =  -.7712515
Iteration 27:  log likelihood = -.77124299
Iteration 28:  log likelihood = -.77123846
Iteration 29:  log likelihood = -.77123523
Iteration 30:  log likelihood = -.77123294
Iteration 31:  log likelihood = -.77123127
Iteration 32:  log likelihood = -.77123011
Iteration 33:  log likelihood = -.77122913
Iteration 34:  log likelihood = -.77122838
Iteration 35:  log likelihood = -.77122803
Iteration 36:  log likelihood = -.77122772
Iteration 37:  log likelihood = -.77122751
Iteration 38:  log likelihood = -.77122732
Iteration 39:  log likelihood = -.77122716

Stoc. frontier normal/half-normal model          Number of obs   =         86
                                                 Wald chi2(3)    =   1.08e+12
Log likelihood = -.77122716                      Prob > chi2     =     0.0000

------------------------------------------------------------------------------
broiler |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
vaccines |   .8135674   .0906307     8.98   0.000     .6359346    .9912002
labour |    2.151161   1.603091     1.34   0.180    -.9908406     5.293162
  stock |    .0740606   .0181324     4.08   0.000     .0385217     .1095995
  feeds |     .017966   .0107366     0.14   0.889    -.0195468      .02254
_cons |   657.9582   7370.646  -3.3e+04   0.09  -13788.24     15104.16
-------------+----------------------------------------------------------------
   /lnsig2v |  -41.21339   1413.876    -0.03   0.977    -2812.36    2729.933
   /lnsig2u |  -1.396495   .2672612    -5.23   0.000    -1.920317   -.8726726
-------------+----------------------------------------------------------------
    sigma_v |   1.12e-09   7.94e-07                           0           .
------------------------------------------------------------------------------
```

sigma_u	.4974563	.0664754	.3828321	.6464003
sigma2	.2474628	.0661372	.1178362	.3770893
lambda	4.43e+08	.0664754	4.43e+08	4.43e+08

Likelihood-ratio test of sigma_u=0: chibar2(01) = 12.79 Prob>=chibar2 = 0.000

Technical efficiency results

```
. insheet using "E:TE.csv"
(6 vars, 86 obs)
. gen lny=ln(output)
. gen lnw1=ln(age)
. gen lnw2=ln(gender)
. gen lnw3=ln(household size)
. gen lnw4=ln(education)
(13 missing values generated)
. gen lnw5=ln(experience)
. frontier  lny lnw1 lnw2 lnw3 lnw4 lnw5

Iteration 0:   log likelihood = -103.29298
Iteration 1:   log likelihood = -103.29277
Iteration 2:   log likelihood =  -103.2926
Iteration 3:   log likelihood = -103.29246
Iteration 4:   log likelihood = -103.29244
Iteration 5:   log likelihood = -103.29241
Iteration 6:   log likelihood = -103.29241

Stoc. frontier normal/half-normal model          Number of obs   = 86
                                                 Wald chi2(5)    = 5.40
Log likelihood = -103.29241                      Prob > chi2     = 0.3689
 lny |      Coef.          Std. Err.      z          P>|z|     [95% Conf. Interval]
 lnw1 |  -.8378886    .0325932     -0.63    0.001    -1.381752     .705975
lnw2 |   .5392858    .2843158      1.57    0.107    -.1355607    1.214132
```

lnw3	.2142699	.2418953	0.89	0.004	-.2598362	.688376
lnw4	.839527	.2050117	0.41	0.01	-.3178628	.4857683
lnw5	-.2854079	.156343	-0.74	0.061	-.4218345	.1910187
_cons	8.100347	2.457853	3.30	0.095	3.283043	12.91765
/lnsig2v	-.0080554	.1659718	-0.05	0.961	-.3333542	.3172434
/lnsig2u	-8.023499	100.2352	-0.08	0.936	-204.481	188.434
sigma_v	.9959804	.0826523			.8464729	1.171895
sigma_u	.0181017	.9072141			3.96e-45	8.28e+40
sigma2	.9923046	.1655515			.6678297	1.31678
lambda	.0181748	.9168725			-1.778862	1.815212

Likelihood-ratio test of sigma_u=0: chibar2(01) = 0.00 Prob>=chibar2 = 1.000

Annexure C: Technical efficiency scores from Frontier 4.1 output

1	100
2	100
3	100
4	81.9
5	79.6
6	64.3
7	62.4
8	43.8
9	25
10	100
11	100
12	100
13	93.3
14	94.6
15	81.2
16	100
17	100
18	100
19	100
20	72.7
21	100
22	100
23	100
24	87.9
25	100
26	100
27	100
28	76.1
29	100
30	100

31	100
32	81.1
33	61.3
34	100
35	73.4
36	100
37	100
38	100
39	100
40	84.4
41	54.7
42	100
43	40.3
44	100
45	75.4
46	95
47	100
48	100
49	100
50	62.7
51	73.3
52	33.2
53	44.7
54	19.6
55	100
56	39.3
57	100
58	100
59	68.1
60	64.4
61	47.3

62	100
63	100
64	100
65	100
66	58.9
67	89.6
68	100
69	81.8
70	47.4
71	100
72	45.5
73	100
74	81.6
75	77.8
76	5.1
77	8.8
78	100
79	100
80	6.2
81	4.2
82	11.8
83	25.4
84	12.9
85	17.8
86	32.5
Average	76.60814
Min	4.2
Max	100