ECONOMIC AND MARKET ANALYSIS OF SMALLHOLDER FARMERS' BROILER PRODUCTION IN THE AMATOLE DISTRICT MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA

by

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DEDICATION

I dedicate this work to my parents Mr C.S. Thibane and Mrs N.B. Thibane who have supported me through this academic journey and have always routed me. I also dedicate it to my entire family who has been patient with me and assisted me during data coding. Finally, I dedicated this work to my supervisors who have imparted knowledge to me and have helped me financially and provided me with a laptop. God bless you all.

DECLARATION 1: PLAGIARISM

I, Zimi Thibane, declare that the findings of this thesis are due to my original efforts and work, except were stated otherwise.

The findings of the thesis have not been previously reported to the University of KwaZulu-Natal or elsewhere, according to my knowledge.

Where assistance is sought, it has been properly stated.

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Date: 25 August 2022

As the candidate's main supervisor, I, **L. Mdoda,** agree to the submission of this thesis.

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As the candidate's co-supervisor, I**, M. Mudhara**, agree to the submission of this thesis.

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DECLARATION 2: PUBLICATION

Author's contribution to publications that form part of the dissertation.

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ABSTRACT

South Africa is a major broiler producer in Sub-Saharan Africa (SSA) accounting for 80% of total broiler production in the region. Broiler production also dominates the agricultural sector in South Africa and remains the cheapest source of protein relative to other animal proteins. The broiler industry has a dual nature, which consists of both smallholder and commercial broiler farmers. Feed is a major cost issue in the broiler sector, accounting for more than 70% of a broiler producer's overall costs. Another obstacle faced by smallholder broiler farmers, especially those in the Amatole District Municipality (ADM) in the Eastern Cape, is the issue of market access.

The aim of the study was to carry out the economic and market analysis of smallholder farmers broiler production in the Amatole District Municipality, Eastern Cape, South Africa .The main objectives of the study, which were used to address the research problem were; to identify and profile broiler farming, determine determinants of market participation among smallholder broiler producers, analyse the factors affecting smallholder broiler farmers' profitability, and analyse the factors affecting smallholder broiler farmers' profitability in the Amatole District Municipality in the Eastern Cape, South Africa. A sample of 150 smallholder broiler farmers was drawn and primary data was collected using a structured questionnaire.

Descriptive statistics were used to profile the broiler farmers in ADM. The average smallholder broiler farmer in ADM was middle-aged and a female. The double-hurdle model was used to analyse factors affecting market participation decisions. The first stage made use of the probit model to analyse factors affecting the probability of market participation. The second stage involves the assessment of factors affecting market participation intensity by the smallholder broiler farmers in ADM. The marketing constraints were also analysed.

Determining the factors affecting the profitability also involved two stages. The first stage made use of the budgetary technique (Gross margin and net farm income) to measure smallholder broiler profits. The results indicated that smallholder broiler production in ADM was profitable, this was indicated by the net farm income of ZAR 996.16 per production cycle. The second stage analysed factors influencing farm profitability. The stochastic production frontier together with the technical efficiency was used to measure the broiler farmers' productivity. The average technical efficiency of farmers was found to be 0.81 indicating that the average smallholder broiler farmer in ADM is

technically efficient. Broiler farmers in the ADM were encouraged to increase their stock size to allow for an increase in their probability to enter markets.

Keywords: broiler market, market participation, productivity, profitability

ACRONYMS/ABBREVIATIONS

ADM	Amatole District Municipality
AGOA	African Growth and Opportunity Act
AGRA	Alliance for a Green Revolution in Africa
BCM	Buffalo City Municipality
BFAP	Bureau for Food and Agricultural Policy
DAAF	Department Agriculture Forestry and Fisher
DALRRD	Department of Agriculture, Land Reform, and Rural Development
DMU	Decision-Making Units
DOC	Day-Old Chicks
ECO	European Consultants Organisation
FAO	Food and Agriculture Organization
FOB	Free On Board
FRC	Feed Conversion Ratio
GDP	Gross domestic product
GM	Gross Margin
HPAI	Highly Pathogenic Avian Influenza
IDC	Industrial Development Corporation
LM	Local Municipality
NAMC	National Agricultural Marketing Council
NFI	Net Farm Income
SACU	The Southern African Customs Union

SAFEX	The South African Future Exchange
SAPA	South African Poultry Association
SFA	Stochastic Frontier Analysis
SHF	Smallholder Farmers
SMMEs	Small, Medium and Micro Enterprises
SSA	Sub-Saharan Africa
TE	Technical Efficiency
T	Tonnes
US	United States
USDA	United States Department of Agriculture

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CHAPTER 1: INTRODUCTION

1.1 Background of the study

The poultry industry is booming all over the world, owing to the increasing human population, rising purchasing power, and urbanization (Mbuza *et al.,* 2017). Poultry production has evolved from a backyard hobby to a commercially focused industry. It is distinguished from other animal production practices because of its high turnover rate and quick returns on investment (Anosike *et al*., 2018). Poultry production offers considerable economic, social, and cultural benefits in developing nations, and it plays an important part in family nutrition. Hinsemu *et al.* (2018) estimated that by 2020, poultry's proportional contribution to global animal protein output is expected to rise to 40%, with the developing world accounting for most of the growth.

The poultry industry in South Africa continues to be the single largest contributor to the agricultural sector (South African Poultry Association (SAPA), 2019), surpassing all other animal sectors as well as all field crop and horticultural sectors (United States Department of Agriculture (USDA), 2020). Poultry production accounted for 20% of the overall agricultural gross value and 41% of animal product gross value in 2019 (SAPA, 2019), with the poultry industry generating R47,9 billion in gross value contributing or 16.5% of total Gross domestic product. The sector also employs about 110 000 people, directly and indirectly, is the world's second-largest consumer of maize, and supports several downstream value-chain firms (such as the feed industry) (SAPA, 2019). Furthermore, poultry products are the most widely produced, accessible, and eaten animal protein in South Africa, helping the country achieve its zero-hunger goals (Nkukwana, 2018).

Domesticated birds, particularly those valued for their meat and eggs, such as chickens, turkeys, ducks, geese, and guinea fowl, are referred to as poultry. Chicken breeds account for 63% of all avian breeds, followed by ducks (11%), geese (9%), and turkeys (5%), while indigenous or heritage varieties account for most of the world's poultry genetic diversity (Nkukwana, 2018). In the South African poultry industry, about 75% of the birds are utilized for chicken meat production, while the remaining 25% are used for egg production (SAPA, 2019). Therefore, this study focuses on chicken meat production, referred to as broiler production. Ettah and Ihejiamaizu (2021) define broilers as simply chickens raised for meat, and that broiler production is the process of growing

broiler birds for meat, with the feed conversion ratio (FCR) as a crucial performance indicator. After two to three months, broilers are said to be marketable, requiring adequate nutrition to maintain their physical weight.

In South Africa broiler meat is produced throughout the country, with 62% of production coming from the North West (22%), the Western and Northern Cape (19%), and Mpumalanga (21%) (Bureau for Food and Agricultural Policy, 2019). Between 2004 and 2008, these broiler-producing provinces led the South African broiler sector through a period of significant development, averaging over 7% per year. From 2009 to 2014, the industry's growth dropped dramatically to less than 1% each year. The industry grew by 4.7% in 2015 (based on tonnes of meat produced, including spent birds and non-commercial production) after that, the industry shrank by 3% in 2016 and then by 0.9% in 2017. Broiler output in South Africa climbed by 5.5% in 2018 due to lower maize prices, and by 3.5% in 2019. From 2009 through 2019, annual growth averaged roughly 1.7% (SAPA, 2019). Even with the increase in broiler production, broiler production in South Africa (and other African countries) is lagging that of other continents such as Asia, the European Union (EU), and the United States (US) (Mbuza *et al.,* 2017). South Africa produces an average of 1,7 million tonnes(T) of poultry meat per year, compared to 2,2 million T required for consumption. This means that, like the rest of Africa, South Africa is a net importer of poultry meat (Goga and Bosiu, 2019) even though it has a large concentration of smallholder broiler farmers.

In the democratic era, demand for poultry products has increased significantly, mainly due to improved incomes among the South African populace (Department of Agriculture, Land Reform and Rural Development (DALRRD), 2019). However, the rising demand has not benefited the local poultry industry. During the first 15 years of democracy, poultry production rose, but then stopped around 2008. Even though demand has increased over the last decade, production has remained constant (SAPA, 2019). Domestic chicken meat production, unlike egg production, has continuously failed to meet the region's expanding demand. As a result, chicken products from the European Union (EU), Brazil, and the United States (US) have flooded the SSA (sub-Saharan Africa). Between 2004 and 2013, chicken meat imports into SSA increased by 209% Etuah *et al*., 2020). In 2013, tariffs were significantly raised, but import growth continued unabated (DALRRD,

2019). Furthermore, the influence of EU, Brazilian, and US imports on local prices has put the local industry under significant financial strain for years. Several large, integrated poultry firms announced downscaling of their operations and concomitant retrenchments at the end of 2016 and the beginning of 2017 (SAPA, 2019). Overall, the policies have failed to fulfill their objectives, as seen by the rising trend of chicken meat imports across the SSA to meet rising demand and the continuous collapse of smallholder broiler farms.

The nature of the South African Poultry industry is a dual and diverse production structure (Bureau for Food and Agricultural Policy (BFAP), 2019), with a large concentration of commercial farmers and a heterogeneous set of smallholder producers. One of the key contrasts between the two farmer groups is the combination of scale advantages and the massive investments in specific assets required for optimal and efficient output levels (BFAP, 2019); with large-scale production being favoured by high capital requirements and clear economies of scale (BFAP, 2019). South Africa's relatively large number of smallholder broiler farmers renders us vulnerable to exporting countries that take advantage of economies of scale (DALRRD, 2019).

Because size is a crucial driver of the efficiency levels in broiler production, smallholder broiler production does not benefit from these economies of scale that commercial farmers can benefit from (Louw *et al.,* 2017). This affects the productivity, profitability, and market access of smallholder broiler farmers as they do not experience economies of scale. With limitations to the size and other resources, several concerns arise: (a) Are the resources and inputs employed in broiler production producing the highest possible yields? (b) How effectively can these restricted resources be utilized to maximize broiler production? and (c) What factors influence production efficiency in the district under investigation? Assessing the profitability of enterprises and the efficiency of production is the greatest way to determine whether resources are being used efficiently. Producers must be aware of the drivers of production efficiency for the businesses in which they are involved early on.

Smallholder household poultry production is the primary method of poultry production in many low-income countries, such as South Africa, and is a significant source of income and nourishment for disadvantaged households (Ezeano and Ohaemesi, 2020). Smallholder broiler production

encompasses 30% of broiler production and is generally characterized by farmers that primarily rely on indigenous fowls for home consumption and profit-generating from broiler production. Smallholder farmers who commercialize their production and marketing operations, according to Agbugba (2020), may be the major vehicle for agricultural development and might be viewed as a vital tool for South Africa's economy-wide growth and development. Smallholder broiler production in South Africa is defined as the production of 40 000 birds per cycle, and roughly 75% of smallholder farmers place roughly 1000 birds per cycle on average (Louw *et al.,* 2017). Yet a small fraction of smallholder broiler farmers in South Africa are active in the poultry markets in South Africa or even internationally. Food security, income generation, and rural development all rely heavily on markets. Agricultural research and development groups have made commendable progress in increasing agricultural output over the years. However, in agriculture, market opportunities must be expanded for productivity-based growth to convert into farmer well-being (Obisesan, 2018). Furthermore, smallholder farmers are concerned about not only agricultural productivity but also increased market access (Obisesan, 2018).

Poor market access is one of the limiting factors experienced by smallholder farmers (Kyaw and Lee, 2018). Farmers in rural locations lack sufficient resources to overcome the high transaction expenses of joining the market. Poor infrastructure and institutions enhance transaction costs, affecting production and market participation decisions significantly. Many smallholder farmers live in distant areas with inadequate transportation and market facilities, which adds to the high transaction costs they confront. Furthermore, they lack accurate market data as well as information on potential trading partners (Mbitsemunda and Karangwa, 2017). Furthermore, the impoverished frequently lack the assets necessary to protect themselves from the market, ecological, political, and social shocks. Private asset accumulation, public infrastructure, and services, according to (Mbitsemunda and Karangwa, 2017), are needed for smallholders to move beyond subsistence cultivation and produce a marketable surplus.

Moreso, smallholder broiler farmers do not benefit from the increased production of meat market requirements. They are impacted because such requirements raise costs, preventing them from competing in marketplaces like commercial farmers (Etuah *et al.,* 2020). All standards of operation must be observed in the commercial poultry production system, from breeding to chick handling

and transportation, processing (feed components and chicken products), and feed manufacturing. For example, manufacturing of animal feed premixes (vitamins and minerals) and complete feeds, broiler genetic production and sale of day-old chicks, and processing plants that produce whole birds, portioned birds, and processed meats are all key activities for Astral and RCL, both leading South African integrated poultry producers (Nkukwana, 2018).

With the local market having a reputation of being a less lucrative market, the local market (such as households, communities, hawkers, seniors, and groups of individuals during special public events) is critical for smallholder farmers in South Africa (National Agricultural Marketing Council, 2020). The enormous number of smallholder producers who largely serve the informal market provides a significant platform for rural development (Nkukwana, 2018). Additionally, smallholder agricultural farmers' proper integration into three tiers of agricultural markets, namely local, national, and worldwide agricultural markets, has been promoted as a viable option for accomplishing the sustainable development goal over time (Olutosin *et al.*, 2019).

Amid high volumes of imports, market constraints, and a huge concentration of commercial farmers that serve as a hindrance to the existence of smallholder broiler farmers, profitability opportunities still exist for the smallholder broiler farmers in terms of the local markets. But to achieve this, smallholder broiler farmers must be efficient producers to compete well in the local market and reap profits. Hence this study investigates the economic and market analysis of smallholder broiler farmers in the Amatole District Municipality. This is done to see if they are efficient producers of the broiler to reap profits in their local markets.

1.2 Problem statement

Poultry meat is the quickest-growing segment of worldwide meat production, consumption, and commerce, with developing and transition economies leading the way (Mottet and Tempio, 2017). The gap between the commercial broiler farmers and the smallholder broiler farmers is too great. The number of commercial broiler farmers is substantially lower than the number of smallholder broiler farmers, yet these smallholder broiler farmers make very little profit, widening the

difference even further (National Agricultural Marketing Council (NAMC), 2020). Imports of poultry meat also pose a problem for smallholder broiler farmers and local poultry production.

South Africa honours different trade agreements that it is part of, and it seems that poultry farmers are drawing the shortest straw. Brazil supplies most of the broiler meat in South Africa and is dumped in the local markets. The AGOA (African Growth Opportunity Act) is one of the agreements that South Africa is part of. This is the United States trade act which aims to enhance market access to the US for qualifying Sub-Saharan African countries. There was a renewal of the AGOA agreement and the approval of the 65 000 metric tons free of antidumping duty import quota for the US (United States Department of Agriculture USDA, 2020). The adjustment caused problems for the local broiler industry. The local poultry industry threw its weight against the quota, which was a red flag during the early stages of negotiation. This quota is expected to grow, as the local production and demand increase (Lombard and Bahta, 2018). The implementation of this agreement saw Rainbow Chicken (RCL Foods) cutting 1350 jobs and repositioning a further 200 staff members who were working in the chicken-producing operation (Lombard and Bahta, 2018). The group is also planning to sell many of its broiler farms, claiming that it is part of its business diversifying model.

With about six million households in South Africa who partake in smallholder agricultural activities (Louw *et al.*, 2017), the shutting down of such a big enterprise as Rainbow chicken poses a question of whether smallholder broiler farmers would be able to survive in the broiler industry. A large portion of smallholders engage in agricultural activities to obtain food, but it is also assumed that the farmers would be inclined to reap the economic benefits that go with surplus production and trade. Since 2010, an increasing share of chicken consumption growth has been matched by increased imports rather than domestic production, making it hard for poultry producers to be profitable. With the closing down of Rainbow Chicken, farmers who are willing to participate in the broiler industry need to look at the profitability and productivity in the industry to ensure that they will be able to reap the economic benefits.

In recent years, the broiler sector's productivity has been questionable because it has struggled to recover production costs in the face of rising feed costs. Feed is a major cost issue in the broiler sector, accounting for more than 70% of a broiler producer's overall costs (USDA, 2020). A rise in the feed price will therefore affect the broiler productivity and, in turn, profitability. Maize prices are set internationally, but they tend to climb for South African farmers during drought years (Department of Agriculture Forestry and Fishery (DAAF), 2019). In October 2019, the Eastern Cape Province was named a drought disaster region, following five years of terrible water shortages (SAPA, 2019). A report conducted by AgriSeta (2020) stated that drought is the biggest contributor to increased feed costs. Therefore, implying that broiler producer in the Eastern Cape will be affected in terms of increased feed costs.

Another obstacle faced by smallholder broiler farmers, especially those in the Amatole District Municipality in the Eastern Cape, is the issue of market access. The Amatole district is categorized as a level C District. According to the European Consultants Organisation (2017), the categories reflect limited institutional capacity, limited SMMEs (Small, Medium, and Micro Enterprises), and market opportunities. The issue of market access continues to be a problem amongst smallholder broiler producers in South Africa as smallholder farmers struggle to access and participate in broiler markets. The length to which they could infiltrate the market differs across provinces and depends on the availability of market information and infrastructure (NAMC, 2016).

Amongst market constraints, there are other constraints facing smallholder broiler producers which include financial constraints, external constraints, and infrastructural constraints. Seladi (2017) specified that smallholder farmers are faced with marketing challenges in their produce, due to inadequate road infrastructure and lack of transport to facilitate the transportation of their produce to the market. Major skills issues also form part of the constraints faced by smallholder farmers, these include Build entrepreneurial skills; Improve animal health skills; and knowledge and technology (AgriSeta, 2022). AgriSeta (2022) also reported an insufficiency of food quality inspectors and food technologists due to the lack of interest to study in this field. This has a serious impact on the broiler industry and is a threat to global competitiveness.

Since market access may influence profitability as well as productivity, this area requires investigation. In the case of smallholder broiler farmers in the Amatole District Municipality, there is lacking literature that addressed issues of productivity, profitability, and market access. Factors that determine market participation, as well as production, are also to be investigated so that policies that improve the determinants can be put in place. NAMC (2016) also reported that smallholder farmers are largely excluded from one of the most lucrative channels, such as direct sales to supermarkets and exports, due to a lack of management skills, little quantities produced, bad quality of the produce, lack of sufficient storage facilities, minimal value addition to their products, transportation constraints, and inadequate information dissemination.

1.3 Aim and Objectives

1.3.1 Aim

The aim of the study is to investigate and explore the economic and market analysis of smallholder broiler farmers in the Amatole District Municipality.

1.3.2 Objectives

Specific objectives are as follows:

i. To identify and profile smallholder broiler farming in the study area.
ii. To analyse the determinants of market participation among smallholder broiler producers in the study area.
iii. To analyse the factors affecting smallholder broiler farmers' profitability in the study area.
iv. To analyse factors influencing broiler farming production efficiency in the study area using a Stochastic Frontier Approach.

1.4 Research questions

i. What is the profile of smallholder broiler farmers in the study area?
ii. What are the determinants of market participation among smallholder broiler producers in the Amatole District Municipality?

iii. What are the factors affecting smallholder broiler farmers' profitability in the Amatole District Municipality in the Eastern Cape, South Africa?
iv. What are the factors influencing broiler farming production efficiency in the Amatole District Municipality?

1.5 Hypothesis

Hypotheses of the study were:

i. There is no profile of smallholder broiler farmers in the study area.
ii. There are no determinants of market participation among smallholder broiler producers in the Amatole District Municipality.
iii. There are no factors affecting smallholder broiler farmers' profitability in the Amatole District Municipality in the Eastern Cape, South Africa.
iv. There are no factors influencing broiler farming production efficiency in the Amatole District Municipality.

1.6 The motivation of the study

There has been minimal study and empirical data on smallholder broiler farmers in South Africa. There are also limited studies conducted on market access as well as production systems used by smallholder broiler farmers in the Eastern Cape Province of South Africa. As a result, accurate data on the actual population of smallholder broiler farmers that exist in the province, as well as their contributions to the country's total chicken population, is lacking. There is also minimal research on broiler production and profitability conducted in the Amatole District in the Eastern Cape Province. In most cases, a lack of proper information makes it impossible to create and implement programs that could help rural households. The study will contribute to the knowledge of smallholder poultry production, specifically broiler farmers in the Amatole District Municipality in the Eastern Cape. The study will also provide information to value chain actors, field officers, and extension officers on the determinants of profitability of smallholder broiler farmers. The identification of the factors that leads to profit maximisation from the farmer's resources is imperative. The information on the profitability of smallholder broiler production will also facilitate decision-making for farmers looking on taking part in the broiler industry. Secondly,

when farmers are being profitable, they are the ones who benefit more from the input use compared to the original investment. Profit maximisation results in a high income which results in a sustainable improvement in the lives of the farmers. Rural development has been of great importance in redressing the past and promoting the reconstruction of rural areas which were previously disadvantaged and marginalised as per the National Department of Rural Development and Agrarian Reform coordinating rural development in the province. The commercialisation of smallholder farmers has also been identified as a key in reducing rural poverty as well as promoting rural economic growth. The information on the determinants of market access will assist in improving the commercialising of smallholder broiler farmers in the Amatole District.

1.7 Definition of terms

Poultry production: This is a type of animal husbandry that involves raising domesticated birds such as chickens, ducks, turkeys, and geese to produce meat or eggs for human consumption.

Broiler: A broiler is a bird that has been bred and kept only to produce meat.

Efficiency: The fundamental reduction in the number of wasted resources utilized to generate a given number of goods or services (output).

Economic analysis: A method for determining the best use of scarce resources by comparing two or more alternatives for achieving a specified goal under certain assumptions and restrictions.

Profitability: This is like profit, but there is one crucial distinction. Profit is an absolute number, but profitability is a relative number. It is a statistic that is used to determine the scope of a company's earnings with its size. Profitability is a measurement of efficiency.

Socio-economic factors: refers to society-related economic factors, which include income, education, employment, community safety, and social supports

Market: A market is a gathering place for two parties, typically buyers and sellers, to exchange products and services.

1.8 Organization of the thesis

This study consists of six chapters. The second chapter is the literature review, which reviews information comprised in other studies on the level of efficiency of smallholder broiler farmers, profitability, and market participation. Chapter three addresses the first objective of the study which is the analysis of factors affecting smallholder broiler profitability in the ADM along with its methodology, empirical results, and policy recommendations. The fourth chapter addresses the second objective of the study; smallholder broiler farming production efficiency, it includes the methodology, empirical results, and policy recommendations. The fifth chapter addresses the third objective of the study which is determinate of poultry market participation decision along with the methodology implemented, conceptual framework and empirical results. The sixth chapter contains the summary, conclusion, and policy recommendations of the study.

The next chapter presents the literature review of the study.

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CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In South Africa and around the world, smallholder farmers are involved in the agricultural sector to grow and consume their produce as well as reap economic benefits. However, their economic growth is constrained by challenges of institutional weakness, lack of lucrative market access, and production issues (Zondi, 2021) This chapter presents a review of literature from previous studies on the marketing, profitability, and product efficiency of broiler farmers in and around South Africa. The chapter firstly provides an insight into the overview of smallholder agriculture and the poultry industry in South Africa. The market share of commercial producers and the proportion of poultry producers around South Africa were further reviewed to better understand the smallholder broiler farmers. The study further reviewed the international trade of broilers in South Africa where it reviewed the role of imports and exports in smallholder broiler market participation. The study further reviewed the broiler value chain, assessing its contribution to the economy. The markets in which broiler is sold were also reviewed together with the factors limiting smallholder farmers' market participation. Finally, the overall constraints faced by the smallholder broiler farmers were reviewed, diving the constraints into financial, marketing, production, and institutional constraints.

2.2 The overview of smallholder agriculture in South Africa

Agriculture is an important sector for the sustained growth of developing countries, especially agriculture-based countries such as those in Sub-Saharan Africa. Rural inhabitants, which comprise 87% of the world's population, still depend on agriculture for nourishment and employment (World Bank, 2017). In South Africa, the agricultural sector is in the process of transformation, decolonizing the sector from years of suppression, neglect, and discrimination towards black farmers through agents that eliminated them from participating in the conventional economy and from legal ownership of land, like that of the 1913 Land Act (Zantsi *et al*., 2019).

South African smallholder agriculture has been seen as the driver of poverty reduction, food security, and rural development. According to Oluwatayo *et al.* (2016), more than six million households participate in smallholder agricultural activities varying from crop production, citrus, vegetable, and wood gathering to livestock husbandry. Over two million of these are women, and

their primary motivation for participating in this type of agriculture is to supplement their food supply in the household (Oluwatayo *et al.*, 2016). They mostly rely solely on obsolete technology for farming and sell mostly at the farm gate as a small portion do access markets. Additionally, smallholder farmers in South Africa are poor, uneducated, and reside in rural settlements with limited infrastructure, placing them in the so-called "second economy " (Oluwatayo *et al.*, 2016).

Smallholder farmers are normally categorized into three categories, which are subsistence, commercial, and emerging farmers. Commercial smallholder farmers are market-oriented and are linked to input suppliers and value chains (Alliance for a Green Revolution in Africa, 2017). Subsistence smallholder farmers produce their products for household consumption and take part in low-input subsistence agricultural production. Emerging smallholder farmers are also referred to as semi-commercial or semi-subsistence as they are identified as being between commercial and subsistence farming (*Zantsi et al.*, 2019). Smallholder farmers in South Africa can also be grouped according to land size, the main reason for farming, commercial orientation, and farm turnover (Mashaya, 2021).

The commercialization of smallholder agriculture is increasingly being identified as a key to economic development and poverty alleviation (Ndoro, 2019). Smallholder farmers in rural Africa, on the other hand, consume many of their farm products, limiting their involvement in output markets (Mujuru and Obi, 2020). Smallholder farmers are typically faced with three important decisions: meeting food security requirements, employment, and producing marketable surpluses. These farmers are noted not only for their subsistence level of output but also for their lack of access to information networks outside of the areas where they live (Akidi *et al.*, 2018). In the Province of the Eastern Cape, smallholder agriculture is primarily subsistence-based, with low production and consequently low revenues. Several government efforts aimed at improving the province's rural livelihoods have failed to deliver the promised results (Mujuru and Obi, 2020).

2.3 The overview of the poultry industry in South Africa

The poultry industry continues to pride itself on the fact that it feeds the nation, as more poultry products are consumed every year than all other animal protein sources combined (SAPA, 2019). The South African poultry industry dominates the animal products sector, providing 65.6 % (up

from 65.3 % in 2018) of locally produced animal protein consumed in the country (Department of Agriculture, Land Reform and Rural Development (DALRRD)) (SAPA, 2019). The poultry industry is distinguished, from other major industries, by its greater levels of industrialization, consumption, and commerce (Popoola *et al.,* 2019). Poultry production is the largest product sector in agriculture in South Africa, ahead of all other animal sectors (beef production (R35.5 billion), milk (R16.6 billion), and eggs (R10.3 billion), and ahead of all field crop and horticultural sectors (SAPA, 2019).

Poultry farming is a significant economic, nutritional, and socio-cultural component of nearly every rural, semi-urban, and urban household. According to Nkukwana (2018), broiler production has for many years, provided a pathway to enterprising for smallholder farmers and women, and in ensuring food security for underprivileged households. It also delivers a significant amount of meat, eggs, and other raw items to businesses (Popoola *et al.,* 2019). Broiler meat makes up 93.6% of total poultry meat production, with the rest coming from mature bird slaughter (culls), smallholder and backyard broiler meat production, and other specialty broiler meat products (geese, turkey, ducks, and guinea fowl) (DAFF, 2019). The poultry sector is large and growing, thanks to strong demand both locally and regionally. However, as the demand for chicken in South Africa and the region grows, so does the number of imports (Goga and Bosiu, 2019).

Poultry producers are effectively divided into two groups; a large group of countries that produce at the scale of their domestic market and a smaller group that produce at a greater scale and maximize exports. South Africa has fallen into the former group and has been targeted by countries that are pursuing an export-oriented strategy. Given the fact that we have a large market for poultry and an open economy, we are likely to continue to receive attention from exporters (DALRRD, 2019).

2.3.1 Market share of commercial producers in South Africa

In South Africa, the broiler business is dominated by two main producers, Astral Foods and RCL Foods. In both 2014 and 2018, these two firms contributed 46% of total broiler meat production (Figure 2.1), with the remaining 54% being produced by smallholder farmers (Goga and Bosiu, 2019). In the last five years, key producers' market shares have shifted little. Astral overtook RCL

as the biggest producer, increasing its market share from 22% in 2014 to 27% in 2018 (Ncube, 2018). Due to a reorganization procedure that saw the business sell up some of its poultry operations, RCL's market share fell by 5% in the same period (Ncube, 2018).

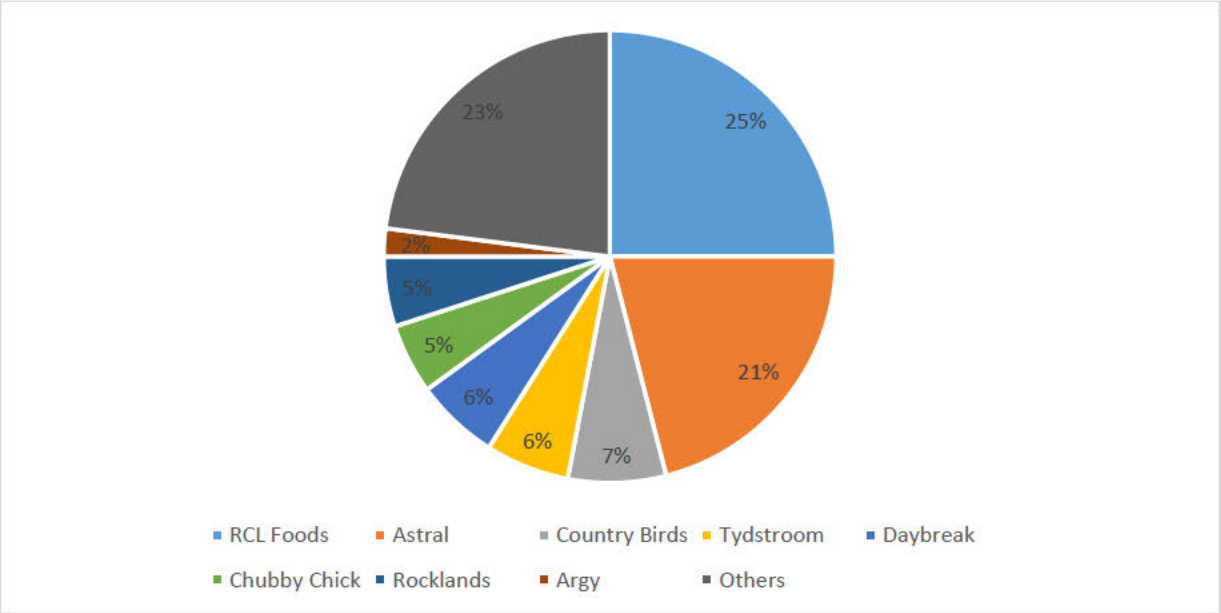


Figure 2.1: Market share of commercial producers in South Africa
Source: Ncube (2018)

The provinces that produce broiler in South Africa are the North West, Western and Northern Cape, Mpumalanga, and the Free State accounting for roughly 74% of total production (DAFF, 2019). North West Province produced 22% of all broiler meat in South Africa in 2018, followed by Mpumalanga Province with 21%, Western and Northern Cape Province with 19%, and Free State Province with 12%. The province of Limpopo produced the least broiler meat in South Africa, accounting for only 3% of total production (DAFF, 2019).

2.4 International trade of broilers in South Africa

One of the least protected markets in the world is South Africa (SAPA, 2020). This allows exporters like Brazil and the EU to flood the market with a large amount of cheap chicken. Nigeria, Kenya, and Swaziland, in contrast, do not authorize any imports; Botswana and Mozambique grant very few import permits; and Namibia places quotas on the importation of chicken (SAPA, 2020). According to SAPA (2019), local production increased by only 16.6 % during the same period while chicken consumption (measured in tonnes) climbed by almost 25%. Between 2009 and 2019,

broiler imports—mostly from the Americas and the EU—rose by 150 %. While local producers complain that imports are driving small producers out of business, eliminating investment, and preventing bigger enterprises from using their full production potential, importers contend that imports are filling a demand that local producers just cannot supply. The South African industry is frequently criticized by the EU as being ineffective and uncompetitive (SAPA, 2019).

2.4.1 Broiler imports

South Africa is a net importer of poultry meat. Import quantity is influenced by world supply, the exchange rate, and import duty (Joubert, 2017). Most of the poultry that South Africa imports comes from Brazil. 52% of the poultry in the first half of 2017 had a Brazilian origin, according to SAPA (2020). Furthermore, 19.5% of South African imports came from the United States (US), while 8.2% came from Belgium. The European Union (EU), which also includes Belgium, imported 19.5% as much poultry as the United States did. Comparing the first half of 2017 to the same period in 2016, chicken import figures for 2017 indicated a 5% decline. Nevertheless, it was still 24% higher than the five-year average for imports from January to June (Lombard *et al.*, 2018). Broiler imports fell by 10% in 2020 compared to the five-year average (2015–2019), and domestic broiler meat output rose by 3.6%. The Minister of Trade, Sector and Competition announced in March 2020 that the ad valorem duty on frozen chicken pieces (bone-in and boneless) will be significantly raised. This was a major triumph for the local broiler industry (SAPA, 2020).

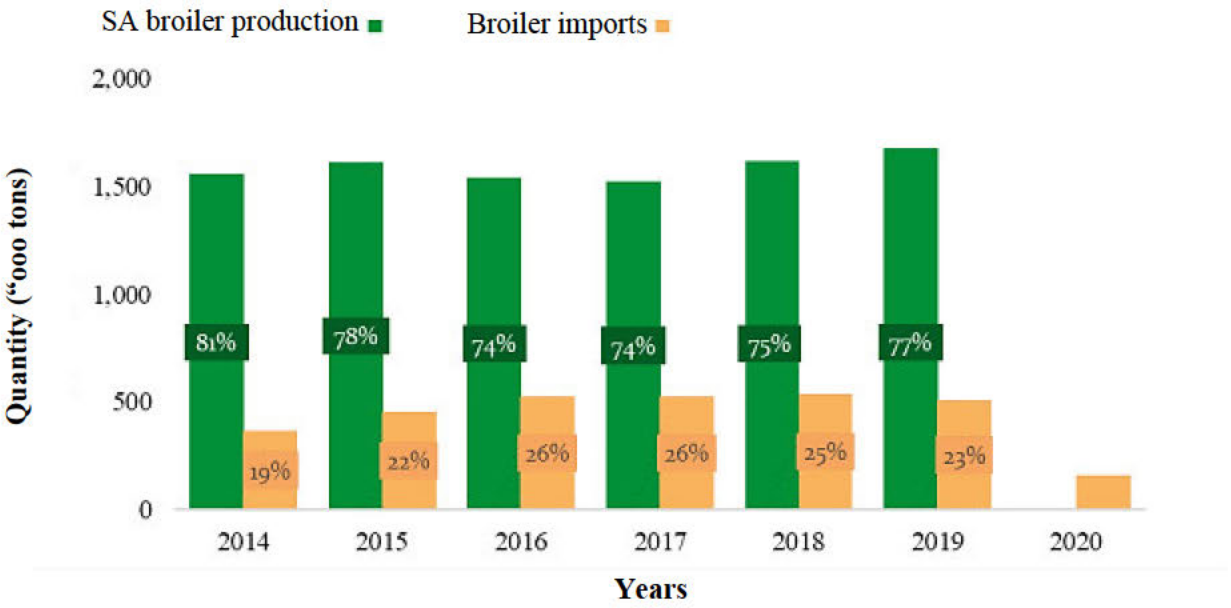


Figure 2.2: Broiler imports compared to local production
Source: National Agricultural Marketing Council (NAMC) (2020)

Figure 2.2 shows the volume of imports from 2014 to 2020 over seven years. The pattern indicates that from roughly 368 thousand in 2014 to 511 thousand in 2019, broiler imports have increased. While within the same period, local broiler output climbed from 1.5 million to 1.67 million (NAMC, 2020). It is important to highlight that between 2014 and 2019, domestic production climbed by 7%, but imports increased at a greater pace of 38%. The latter is made worse by the fact that a significant number of imports is made in the European Union, Brazil, and the United States of America, and that these imports are essentially dumping of cheap meat portions that put pressure on the market for locally produced broiler items (SAPA, 2018).

2.4.2 Broiler exports

Chicken, turkey, ducks, geese, and guinea fowl items totaling 52 578 tonnes (T) were exported in 2020 for a free on board (FOB) value of R 1.249 billion (SAPA, 2020). This represented a 2% reduction from tonnages in 2019. In 2020, broiler exports made up 95.3% of all poultry exports (50 099 T), and 93.3% of all poultry exports' FOB (R1.116 billion) rand value. Exports of broilers fell in 2020 by 0.2%. Turkey exported 1 289 T of poultry in 2020, including 903 T of the mixed product (ducks, geese, or guinea fowl; not defined), 197 T of goose exports, 72 T of duck exports, and 18 T of guinea fowl (SAPA, 2020).

The volume of exports peaked in 2011 at 83 thousand T and hit a new low of 50 thousand T in 2019. The value of exports peaked in 2017, and throughout this time, both the value and quantity decreased, demonstrating the profitability of the chicken export business. The highly pathogenic avian influenza (HPAI) epidemic in June 2017 is what caused a decline in export volume from 2016 to 2019. Moreso, 2019's export volume is unchanged as South Africa continues to battle to reclaim some of the markets it has lost. Most of the broiler meat transported is mechanically deboned, and fresh or cold offal cuts (SAPA, 2020).

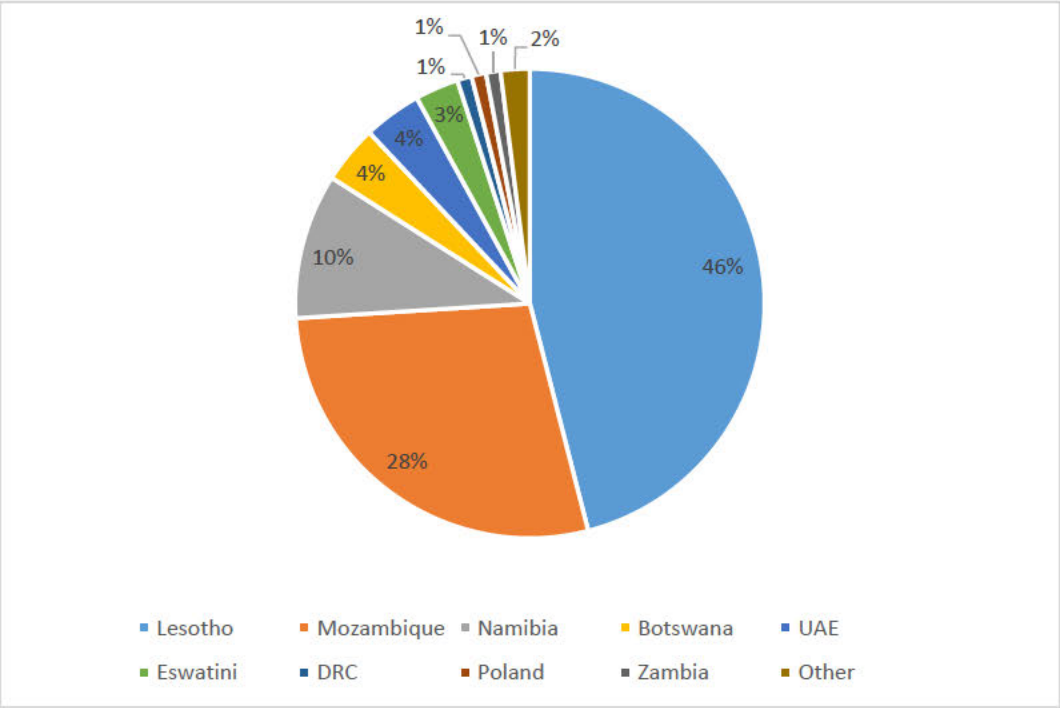


Figure 2.3: Top export market of South African broiler meat in 2019
Source: SAPA (2020)

The primary international markets for South African broiler meat exports in 2019 are depicted in Figure 2.3. Most South Africa's broiler meat exports went to Lesotho, which received 46% of it. Mozambique came in second with 28%, followed by Namibia and Botswana with 10% and 4%, respectively. The share of South African broiler meat exports to the other nations in 2018 was 3% or less. Broiler meat from South Africa is noted to be exported primarily to SADC nations, with (The Southern African Customs Union) SACU members alone accounting for 63%.

2.5 The South African broiler value chain

The value chain of South African broiler meat consists of broiler meat farms and contract growers, feed companies, and other input suppliers and breeders. Some of the feed companies are vertically integrated with the large commercial producers. There are abattoirs, importers, exporters, and retailers in the secondary sector. There are 2.3 million T of domestic consumption with a per capita consumption of 39.89 kg. Production is around 1.76 million T, Imports 510 million kilograms, and Export 50 million kilograms (DALRRD, 2020). Furthermore, there are three main centres of power in the poultry value chain in South Africa. These are grain producers, poultry producers and retailers, while producers additionally exert power through their industry body (Goga and Bosiu, 2019). The poultry value chain in South Africa is significant, generating over 1.7 million T of poultry in 2018. Of the 800,000 persons who worked in agriculture in 2017, it employed about 112,000 and contributed 19.6% of the overall agricultural value (SAPA, 2017). The poultry value chain offers prospects for local and regional industrialization due to the high demand for chicken in South Africa and the region (Goga and Bosiu, 2019). The diagram representation of the South African broiler value chain is indicated in Figure 2.4.

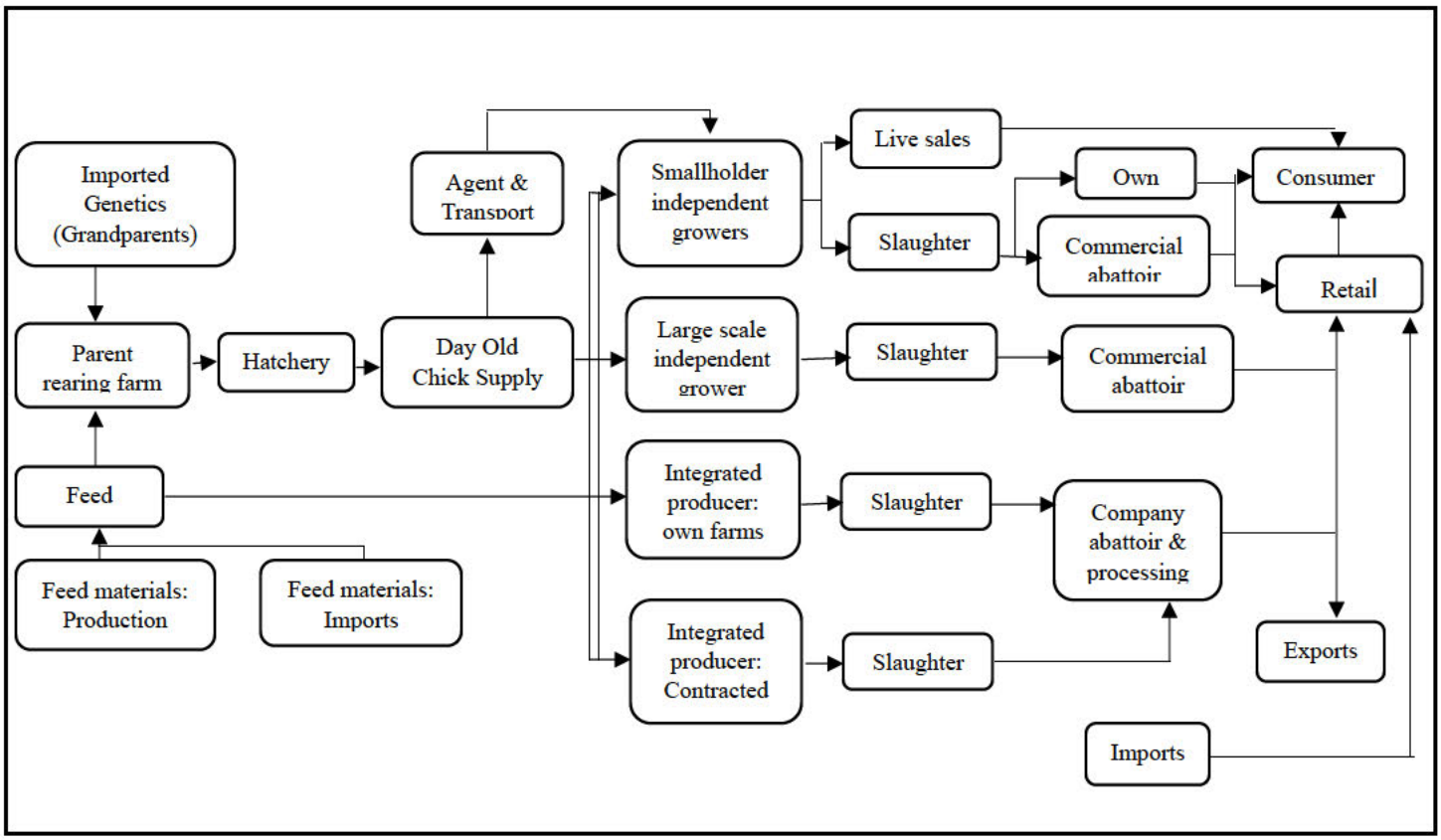


Figure 2.4: The South Africa broiler value chain
Source: NAMC (2020)

2.5.1 Farms, feed companies, and breeders

Animal feed and breeding stock are the two primary inputs in the poultry value chain. Feed makes up roughly 70% of the expense of raising chickens (Goga and Bosiu, 2019). The price of feed has a significant impact on the costs of raising chickens and selling day-old chicks, therefore affecting the cost of production on two different levels (Goga and Bosiu, 2019). Estimates from the AFMA (Animal Feed Manufacturers Association) state that in 2020, its members produced a total of 6.73 million T of animal feed. The amount of feed used by the poultry sector was 4.37 million T, of which 2.791 million T were for broilers, 1.026 million T for layers, 0.536 million T for breeders, and 0.014 million T for ostriches. In total, the poultry business accounted for a staggering 64.9% of AFMA's animal feed sales (SAPA, 2020). Independent businesses are the main providers of day-old pullets to both large and small egg producers. Some are a component of a unified enterprise. Additionally, fertilized eggs and day-old layer pullets are sold to other African

countries. Gauteng, the North West, and the Western Cape currently house most of the day-old layer chick suppliers. (SAPA, 2020).

2.5.2 Contract growers and hatcheries

According to NAMC (2020), contract farming is a legally binding oral or written agreement between the farmer and the contractor with clear obligations and payment for completed tasks, frequently with specifications on production and product properties such as quantity, risk sharing, price discovery, transaction attributes, product quality, and delivery schedule. According to the Industrial Development Corporation (IDC), in 2016 a large portion of South Africa's broiler production is produced by contract growers. Contract farmers frequently receive production inputs including feed, veterinary care, vaccines, day-old chicks, etc. depending on the type or model of contract farming. In exchange, they oversee the feeding process, keep track of mortality rates, feed conversion ratios, weight, and other factors, and produce the finished product under the contract's specifications (NAMC, 2020). The important broiler production stage is frequently leased out within the integrated value chain, allowing for specialization, and thus maximizing efficiency. The contract grower model also suggests that any disease outbreaks would be simpler to control with quarantine measures because it distributes the number of chickens produced in any cycle throughout several farms. A significant factor in biosecurity is that an outbreak on any one farm could be contained to that farm, minimizing the impact on business throughput (IDC, 2016).

2.5.3 Abattoirs and domestic markets

Abattoirs slaughter live poultry as part of the broiler value chain to generate carcasses that are then sold as fresh chicken, frozen chicken, and a variety of other goods to wholesalers, retailers, export markets, and other markets (NAMC, 2020). The commercial value chain in South Africa exhibits high levels of integration and coordination, like top broiler producers worldwide. Due to the significant investment needed in highly specialized assets to produce effectively, the market is extremely consolidated, with a small number of large corporations controlling production. Nearly 70% of the overall production is accounted for by the top 5 producers, and RCL Foods and Astral alone account for almost 50% of the market (Industrial Development Corporation (IDC), 2016).

2.5.4 Import and export markets

Chicken meat production in South Africa is insufficient to meet domestic demand (SAPA, 2019). Imports, therefore, make up the difference in domestic consumption. According to research by Land Bank in 2022, domestic consumption of poultry meat has been declining since 2018. Imports of chicken meat increased from 27% of total domestic consumption in 2018 to 19.8% in 2021 (Land Bank, 2022).

2.5.5 Consumption of broiler meat

Poultry remains the cheapest source of animal protein, but for many lower-income consumers, it has few alternatives and when disposable income declines, it becomes unaffordable, leading to a reduction in meat consumption and a switch back to a more starch-rich diet. Conversely, its relative affordability within the total meat basket implies that mid-income consumers who had been able to afford a more diverse meat basket may end up consuming more poultry (Bureau for Food and Agricultural Policy (BFAP), 2020).

According to DALRRD projections for 2020, 1.873 million T of poultry meat—including that from turkeys, ducks, geese, and guinea fowl—were produced overall, whereas 2.340 million T—including backyard consumption—were consumed. In 2020, poultry meat consumption per person was 38.93 kg annually, down from 39.29 kg in 2018. (SAPA, 2020). According to Post, South Africa's consumption of poultry will drop by 1% to 1.88 million T in 2021. At 1.94 million T, poultry consumption was projected to stay unchanged in 2020. After several consecutive quarters of poor economic growth in the second half of 2019, South Africa already experienced a recession before enacting its coronavirus lockdown (United States Department of Agriculture (USDA), 2020). According to Land Bank (2022), between 2008 and 2021, domestic chicken meat consumption increased more quickly than domestic chicken meat output. According to Land Bank (2022), imports made up the difference in domestic poultry meat consumption (which was about 19.8% of domestic consumption in 2021). The relative cost of chicken meat in comparison to other meat products and population expansion are the main factors contributing to the significant increase in consumption.

2.6 Marketing channels available for broiler farmers

According to Pham *et al.* (2019) access to contemporary marketing channels is regarded as a crucial tool for bringing farmers out of poverty and boosting food security in developing nations. In recent decades, non-traditional marketing chains, such as supermarkets or export markets, have come to coexist with traditional marketing chains through wholesale markets or collectors/wholesalers in developing and transition countries. This has created more profitable opportunities for farmers to sell their products (Pham *et al.,* 2019). Thus, small-scale farmers can choose from among an increasing number of different types of potential buyers. These potential buyers and possible channels are illustrated in Figure 2.5.

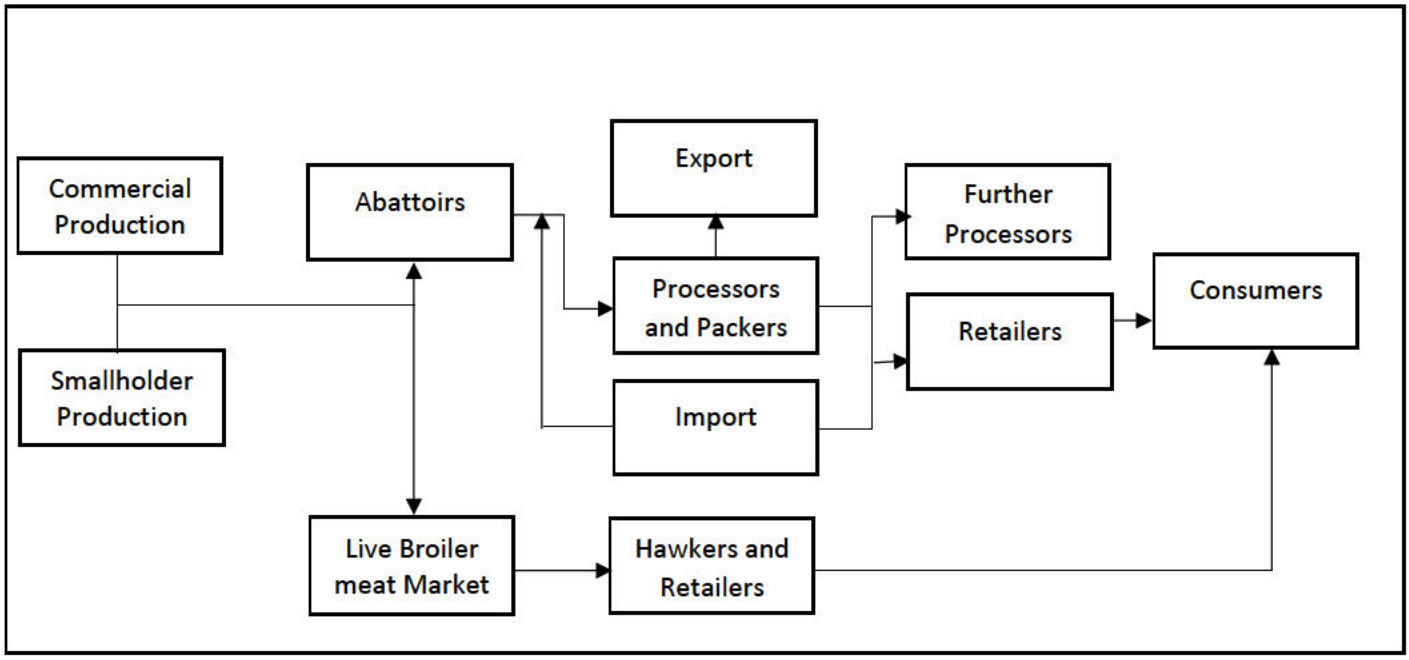


Figure 2.5: Broiler Marketing Channels
Source: DALRRD (2020)

Figure 2.5 depicts the dual nature of the broiler industry which consists of commercial farmers and smallholder farmers. Live broiler meat is marketed mainly through two channels, live broiler meat market, and abattoirs. Most of the broiler meat from commercial is sold through abattoirs while small-scale through live broiler meat markets are sold locally. The live broiler meat market depends on hawkers and small retailers for distribution to final consumers. Abattoirs slaughter broiler meat and sell it as a carcass to processors and packers, who sell chicken fresh, frozen, or

further processed, sell to retailers, or further processors, and export some of the chicken. Processors and packers and further processors also rely on imports for their supplies. Further processors sell to retailers for final distribution to the consumer (DALRRD, 2020)

A large proportion of smallholder broiler farmers in South Africa use the local marketing 'sell on the spot' market channel to abide by those that sell using contractual agreements (NAMC, 2020). Most of those farmers that sell on the spot market are concentrated in the informal market while those farmers selling under contract are concentrated in the abattoir, institutional and retail markets. On the other hand, a larger proportion of the farmers either negotiate the price or become price takers, while the rest (which are the majority when looking at each separately) are price takers. The local market has the highest contribution in all aspects. Sellers in the local market become price takers or negotiate the price in cases where they are selling in crowded places where there are many of them competing. Otherwise, they are usually priced setters based on the individual farmer's cost of production. Whereas prices are mainly set by the market forces (NAMC, 2020).

2.7 Smallholder farmer's market participation

The commercialization of smallholder agriculture through increased participation of smallholder farmers in formal markets is a critical requirement for the economic growth and development of most developing countries relying on agriculture (NAMC, 2020). Market participation of farmers is both a cause and a consequence of economic development. It is a major pathway for rural people in assuring better income and improving food security. The existence of markets and improved market access are important for smallholder farmers since they can draw agricultural and economic development. Improved access to markets has paramount importance in increasing smallholder market participation and the extent of their participation, ceteris paribus (Kyaw *et al.*, 2018).

Poor farmers face steep barriers to participation in different types of markets, including the lack of financing, and the unwillingness of commercial finance organizations to lend to remote, dispersed, smallholder farmers (Poole, 2017). According to DALLRD (2020), in South Africa, 35 producers provide 61% of the total broiler meat market. Imports control 27% of the market. The balance of 12% is being supplied by hundreds of smallholder/emerging farmers. New entrants are free to

enter but are limited in terms of capital, expertise, and the availability of day-old chicks. (DALLRD, 2020). Moreover, Haile *et al.* (2022) found that commercialization is affected by institutional factors, infrastructural and market-related factors, resource factors, and household-specific characteristics that influence production and marketing (Haile *et al.,* 2022).

The decision of a household to consume or market its products, or carry out the two concurrently, is a function of the level of utility derived. According to Adepoju *et al.* (2020), producers maximize utility subject to constraints in the production process on the assumption that they are rational in using available production resources and choosing markets that maximized their utility and by extension of profits. Additionally, Kangile *et al.* (2020) stated that another driver for market participation is heavily determined by the volume of their produce, signifying the availability of surplus for sale. Market participation also depends on the socio-economic factors of the market participants. The transaction costs related to the markets are also key in influencing the market participation of farmers (Kangile *et al.,* 2020).

Confronted with population growth and climate change, it is incumbent on all developing countries to focus policies on production intensification that limits ecological effects and reinforces access to markets for smallholder farmers (Nkukwana, 2018). The truth is, while Africa has experienced high growth rates in the last few years, the strong growth cannot reconcile poverty with inequality reduction, especially if the markets in which the poor and vulnerable interact are not made inclusive (Nkukwana, 2018).

Furthermore, smallholder producers often struggle to gain market access because they lack knowledge of market requirements or the skills to meet them. Furthermore, inadequate information flow and other obstacles prevent them from entering new markets or reduce the benefits they obtained from entry, reducing poverty among small-scale producers, which is often designed to overcome some of these obstacles (Steven *et al.*, 2012). Understanding the factors affecting market participation decisions as well as the extent of participation and how the bottlenecks associated with these factors can be alleviated is fundamental in improving marketing and the smallholder livelihood (Honja *et al.,* 2017). Thus, the question of smallholder participation and level of participation in the vegetable market is of great importance to policymakers seeking to stimulate rural economic growth and poverty reduction (Aliyi *et al.,* 2021).

2.8 Factors limiting smallholder farmers' market participation

2.8.1 Socio-economic factors

In South Africa, most of the smallholder farmers are old and not educated; they rely more on their traditions, which makes them reluctant to adopt modern technologies that will improve their participation in the market. Hlatshwayo *et al.* (2021) reported that participation in the market declines with age, as older farmers are more susceptible to risk aversion and conservative attitudes. Another socio-economic factor is age. Age is sometimes employed as a proxy measure of farmers' experience in production and marketing. A study by Kiprop *et al.* (2019) found a negative relationship between farmers' market participation, whereas Asfaw *et al.* (2016), presented a positive relationship. With this evidence, age can thus be hypothesized to have an indeterminate relationship with market participation.

Kekana and Maponya (2017) found that education is important to farmers because it determines the ability of a farmer to adjust to innovations and education enables a farmer to manage farm operations more effectively and a skilled farmer is more likely to succeed. An unexpected positive relationship between household size and market participation was reported by Hlatshwayo *et al.* (2021) as many studies have found a negative influence of household size on the level of participation in the market. These studies explained that an increase in household size causes farmers to produce more for household production. Hlatshwayo *et al*. (2021) explained that large household size is labour inefficient and produces less output, thereby leaving less surplus for sale.

2.8.2 Market factors

Kekana and Maponya (2017) stated that lucrative markets can change the livelihoods of poor farmers, and if smallholder farmers lack access to these markets, they will not be motivated to produce on a sustainable basis. Amongst the marketing challenges, the farmers faced were high transportation costs. Marketing transport is important as it links the farmers to the markets or consumers on time. The availability of one's market transport influences the delivery time of produce to the markets, unlike the case of farmers who depend on hired transport or public transport to transport their produce. The quality of the delivered produce depends on the availability of transportation. Produce deliveries may be delayed because of unreliable

transportation. When a product is delivered late by new farmers who lack storage facilities, the quality of the product may suffer, making the supplier untrustworthy to the consumer (Khapayi and Celliers, 2016).

2.8.3 Institutional factors

2.8.3.1 Extension Services

One of the most significant agricultural sector interventions for rural development, commercialization, food security, alleviation of poverty, and income generation for beginning farmers continues to be the provision of support services (Khapayi and Celliers, 2016). Without the proper farmer support services, new farmers cannot be commercialized. Emerging agriculture can contribute to greater agricultural growth, rural development, and a favourable influence on farm income with proper access to farmer support services (Khapayi and Celliers, 2016). Extension services further improve the understanding of farmers, which leads to higher production, a higher probability of participating in the market, and the commercialization of indigenous crops (Zondi *et al.,* 2022).

2.8.3.2 Poor Access to Information

According to Khapayi and Celliers (2016), farmers who lack information are less likely to engage in marketing since they are less aware of market trends. The farmers will not be well-informed about market prices, available goods, or desired goods. Khapayi and Celliers (2016) also discovered that most farmers having access to market data depended on their families, their research, and other farmers for market data. Farmers said that the information was out of date, occasionally biased, and unreliable, casting doubt on its utility.

2.9 Productivity of smallholder broiler farmers

Productivity is defined as the rate of production per unit of input, as measured by the effectiveness of productive effort, particularly in industry. Poultry production is unusual among livestock operations in that it has the highest turnover rate and the fastest returns on investment. Poultry

farming is unique in that it has the highest feed conversion rates and generates the most affordable and high-quality animal protein (Olorunwa, 2018).

Several factors influence the efficiency of chicken production, the most important of which are genetics, environment, nutrition, and management. Nutrition should be balanced for improved broiler growth efficiency, as well as increased production quality and safety (Dauksiene *et al.*, 2021). Highly productive poultry farming necessitates the availability of high-quality feed that is both nutritionally complete and free of or low in hazardous and toxic chemicals (Alekseev, 2020). For the time being, maize-based feed is the most expensive commodity for chicken growers. Other feedstuffs (such as cassava root) are utilized in addition to (or as a partial substitute for) maize, but maize is still the most important ingredient. For a good fattening process, high-quality feed is required, and alternative diets that employ less maize can result in lower feed intake, slower weight increase, and a higher feed conversion ratio. Maize output and pricing, on the other hand, are affected by market and weather variations, which can harm poultry producers' profitability and ability to stay in business (Padilla *et al.*, 2019).

In various respects, broiler production varies from other animal production practices. The most crucial is a better rate of return on investment and a high rate of currency turnover. Broilers also have the advantage of being relatively easy to manage, having a short production cycle, a fast growth rate, and a high feed conversion efficiency. Four main elements affecting the efficiency of the broiler sector have been discovered through formal investigations. Production costs, processing, domestic demand, and social considerations were all considered. Age, educational level, community status, the standard of living, finance, labour, farm size, land ownership, and government policy are all socioeconomic elements that affect poultry production (Hassan, 2017).

Broiler farming can be divided into two categories. The first is the commercial system, which is highly integrated and industrialized and involves hybrid breeding while the second is the village/backyard system, which involves indigenous breed breeding (Popoola *et al.*, 2019). However, feed shortages, low chick survival rates, transportation, weather change, poor extension services, locally unimproved birds, high frequency of poultry diseases, insufficient availability of vaccinations and medications, and poor housing management all impede village chicken productivity (Alabi *et al.*, 2020).

Despite these concerted efforts, poultry production in rural areas continues to generate unrewarding returns. Kejela *et al.* (2019), ascribed this to weaknesses in the management and use of traditional production methods. This presents poultry production as a risky enterprise among smallholder farmers in rural areas. The low productivity shows the inability of farmers to fully utilize available technologies hence leading to low yields. Ambetsa *et al.* (2020) argued that improved technology is one of the strategies for increasing agricultural productivity, optimal productivity can only be obtained when the technology is efficiently used. Besides, the high poverty levels entangled with the limitation of factors of production have made it difficult for farmers to increase production using more resources (Asfaw *et al.,* 2019). This constraint implies a need to examine agricultural production, particularly among smallholder farmers. Rasha *et al.* (2018) explain that an analysis of production is vital in selecting cost-effective input combinations and determining gains resulting from improving existing technologies. Increased productivity enables farmers to increase returns without additional inputs and technologies thus better yields. Due to inadequate knowledge regarding the utilization of farm resources, a high risk of uncertainties often characterizes the entire process of production among smallholder rural farmers (Ambetsa *et al.*, 2020).

2.10 Profitability of smallholder broiler farmers

Poultry production is unusual among livestock operations in that it has the highest turnover rate and the fastest returns on investment (Baba, 2016). Poultry production returns investment money faster than any other animal enterprise. When compared to ruminants and other monogastric animals, poultry has the highest rate of development in output and is the cheapest, most common, and best source of animal protein. According to Baba (2016), rolling out batches in a year can boost returns on investment depending on the length of the manufacturing cycle. However, broiler production in parts of SSA is still low due to some problems during its development, as broiler farmers face many input problems. Successful broiler rearing depends on many inputs— such as the availability of quality chicks, supply of quality feed, medicine and vaccine, and other support services. Each of these factors is vital for profitable broiler farming (Mbuza *et al.*, 2017).

Profitability plays an important role in farmers´ decision-making and is also a key aspect of economic efficiency and, as such, is influenced by several factors, which include yield, prices,

farm size and location, production costs, and level of output. It can be argued that profitability is, in fact, the primary objective for producers, and regardless of the different types of economic activities; it must be measured and evaluated. According to Cancino *et al.* (2021), it emerges from the difference between the surplus of total revenue (money generated from sales) and the cost of producing the good, whereas Asqar and Farhod (2022) defined it as the ability of a business to generate profit from its economic activity, by assigning its resources efficiently.

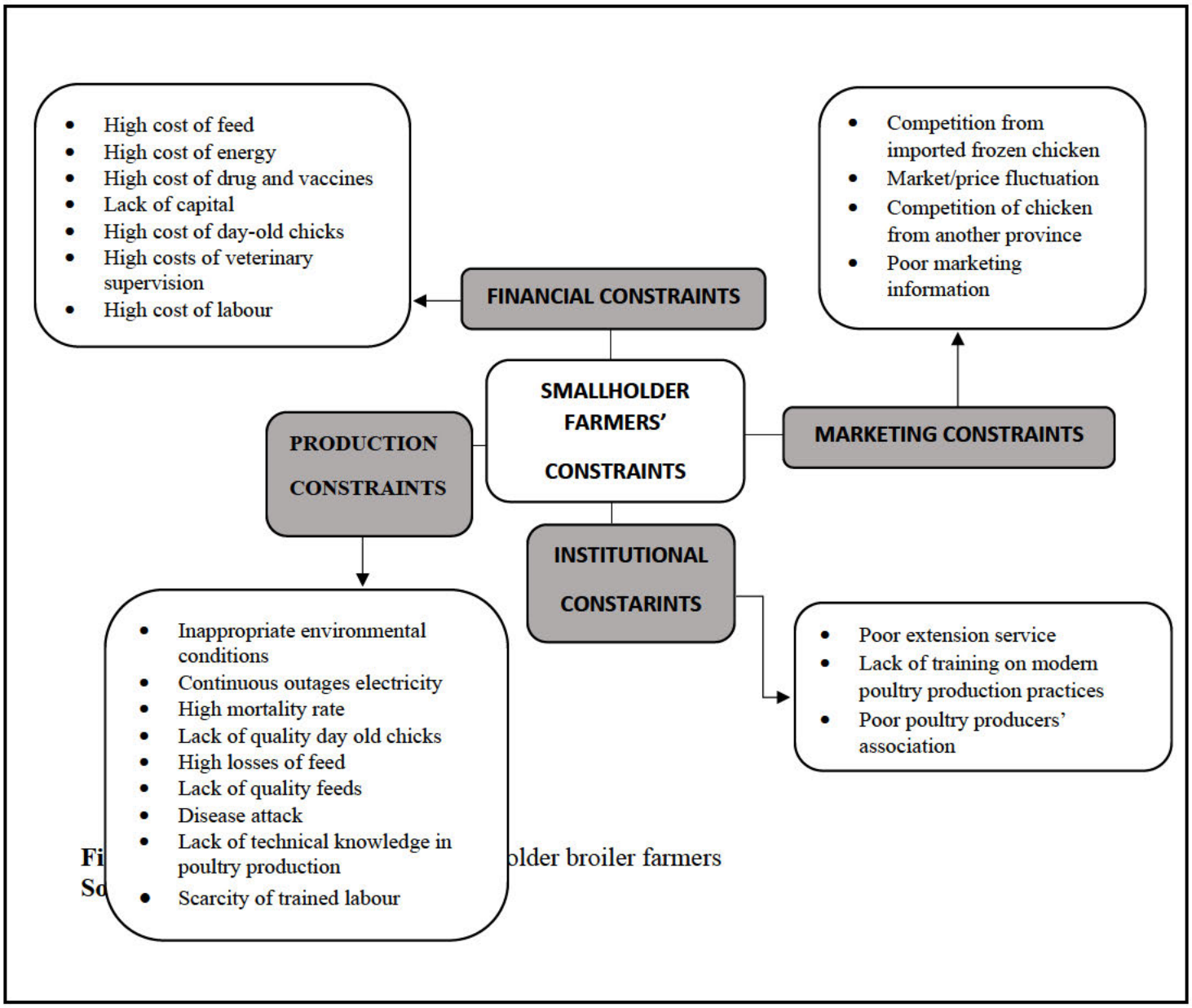
Additionally, Miller *et al.* (2013) stated that a company's financial performance is its profitability as measured by financial indicators. It refers to a company's ability to run efficiently, profitably, survive, and flourish. Firms' financial performance is typically assessed using a combination of financial ratio analysis, benchmarking, performance against a budget, or a combination of all these approaches. The identification of a firm's operating and financial characteristics from accounting and financial statements is known as financial performance analysis (Al-Sharafat, 2017). Financial performance has been a common source of concern among agricultural enterprises performance concerns since it represents the state of their development. According to Wu *et al*. (2022), solid financial performance is a prerequisite for agricultural enterprises to attain sustainability.

Olorunwa (2018) has indicated that smallholder broiler production is profitable. The relationship between the costs incurred in running the farm business and the returns accrued to it can be used to determine the profitability of any business (Chandi and Mujawamariya, 2016). The profitability of broiler production is investigated by analyzing the total average cost of broiler production, average total revenue, and net farm income per bird. If the scale of production is raised and management techniques are improved, the profitability of broiler production can be improved (Baba *et al.,* 2016).

2.11 Constraints faced by smallholder broiler farmers

Smallholder farmers face various problems in developing countries, including a lack of physical infrastructure, a lack of markets, and high transaction costs. Determination of these constraints could be useful in enhancing productivity. Smallholder farmers are finding it difficult to compete in the new market climate. They are significantly limited when it comes to physically reach markets. They also lack market knowledge, business and negotiating expertise, and a collective

organization to give them the authority they need to bargain on an equal footing with larger and more powerful market intermediaries. As a result, they have poor exchange rates and no control over what is given to them. The negative impact on smallholder farmers' production can be attributed to the following factor groups, in Figure 2.6:



Fi older broiler farmers
So

2.11.1 Production constraints

Several limiting factors determine the quantity and nature of output that a producer can achieve within a given period. These are the constraints on production. The constraints on the production of broiler include inappropriate environmental conditions, continuous outages of electricity, high mortality rate, lack of quality day-old chicks, high losses of feed, lack of quality feeds, disease attacks, lack of technical knowledge in poultry production, and scarcity of trained labour (DALRRD, 2019)

The Animal farming system is affected by several climatic factors, but environmental stress has gained special attention in livestock especially in poultry farming, due to public awareness and an abundance of available scientific information. Variations of environmental factors such as sunlight, temperature, humidity, characteristics of animal metabolism, and the mechanism of thermoregulation can cause imbalances in the animal body. An increase in temperature might influence the susceptibility of pathogens (bacteria and parasites) in the environment of chickens. Heat stress negatively affects plant growth (cereal grains) and causes poor feed quality which can affect the poultry growth rate (daily weight gain) due to reduce feed efficiency (Nawab *et al.*, 2018).

The result produced by Olorunwa (2018), on the analysis of constraints on broiler production, revealed the constraints to broiler production in declining order of importance in terms of severity of the challenges. It reveals that disease outbreak, inadequate finance, and high cost of feed were the factors affecting the productivity of the broiler farmers while disease outbreak is valued highest in the list above.

2.11.2 Financial constraints

A financial constraint is any factor that restricts the amount or quality of investment options. The financial constraints in broiler production include the high cost of feed, high cost of energy, high cost of drugs and vaccines, lack of capital, high cost of day-old chicks, high costs of veterinary supervision, and high cost of labour.

According to Olorunwa (2018), financial constraint is one of the most serious constraints identified by the farmers. Inadequate finance could be the reason why farmers could not acquire the necessary inputs especially fixed inputs for large-scale production which attracts higher profit and efficiency. Supporting this assertion, Olorunwa's (2018) study found that Technical Efficiency was highly influenced by financial constraints. Furthermore, (Ismoyowati *et al.,* 2020) found that feed costs are the highest financial constraints for smallholder broiler farmers. With feed accounting for 70% of the total costs incurred in poultry production.

2.11.3 Marketing constraints

Marketing constraints are referred to as factors that hinder an organization's ability to achieve its marketing goals. Competition from imported frozen chicken, market/price fluctuation, competition of chicken from another province, and poor marketing information.

Smallholder farmers in South Africa have limited access to markets (Southern African Food Laboratory, 2016). Smallholder involvement in markets is influenced by access to market information, which is regarded as a major institutional component. Producers can use the information to make economic decisions about market interactions, such as whether to buy or sell, and therefore improve their competitive advantages. Farmers want accurate and timely market information to improve their market knowledge, as this knowledge allows for a more equitable distribution of the anticipated receipts accruable from a more coordinated market price formation for all market actors (Nwafor *et al.,* 2020).

A reason why SHFs with sellable surplus crops stay trapped in poverty is the lack of access to the market. A few national retail stores have risen from 10% market share around 1990 to 60% today and dominate the formal food market in South Africa. Large retailers from this "supermarket revolution" work with non-family, corporate agriculture to develop production systems that, via audits, could claim attributes of environmental sustainability and food safety (Kyaw *et al.,* 2018).

2.11.4 Institutional constraints

Institutional constraint refers to the formation of a certain system and constraints. Institutional constraints in broiler production include poor extension service, lack of training on modern poultry

production practices, and poor poultry producers' association. Hamid *et al.* (2017) found that poor extension service is the most severe institutional constraint facing poultry producers. Extension service is considered an essential input of poultry production as productivity of poultry projects increased when proper and timely services are provided to the producers.

2.12 Chapter summary

The agricultural sector is important for the sustainable growth and development of developing countries, especially those in Sub-Saharan Africa. In South Africa, smallholder agriculture is seen as the driver of poverty reduction, food security and rural development. The commercialization of these smallholder farmers is also identified as a key to economic development and poverty alleviation. The agricultural sector is dominated by the poultry industry, accounting for 65.6% of the locally produced animal protein consumed in the country. Furthermore, the South African poultry industry has a dual nature of smallholder farmers and commercial farmers; with commercial farmers dominating the poultry market. The leading commercial broiler producers are Astral Foods and RCL Foods, contributing 46% of total broiler meat production. The North West, Western and Northern Cape, Mpumalanga, and the Free State account for 74% of total broiler produced in the country; they are the leading provinces when it comes to broiler production. With the poultry industry being so large in South Africa, it still does not meet the country's broiler demand. Imports flood into South Africa to substitute for the lack of broiler production and Brazil is the largest exporter of broiler to South Africa. This flood of cheap broiler exports from countries such as Brazil, lead to a decrease in market opportunities for the broiler producers in South Africa, especially smallholder broiler farmers. Nevertheless, there are still marketing channels that are available for smallholder broiler farmers which include "sell on the spot" markets. These smallholder farmers supply 12% of the broiler consumed in South Africa through their relative marketing channels but some factors limit their market participation. These factors include socioeconomics, market, and institutional factors. The smallholder broiler business is reported to be profitable while its productivity levels amongst smallholder broiler farmers vary. The productivity of broiler farmers is attributed to management skills and access to new technologies. Smallholder farmers also face financial, production, institutional, and marketing constraints. Amid these constraints, they aim to be efficient broiler producers, enter the markets, and reap economic benefits.

Next is chapter 3, where the probability and intensity of smallholder broiler farmers in the ADM was analysed.

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CHAPTER 3: DETERMINANTS OF SMALLHOLDER BROILER FARMERS' MARKET PARTICIPATION DECISIONS IN THE AMATOLE DISTRICT MUNICICALITY, EASTERN CAPE PROVINCE

Abstract

Markets play an important role in strengthening market participation as well as economic development by smallholder farmers, in both the input and output market. These markets are important for the development of smallholder agriculture in South Africa as it faces numerous constraints that restrict its access to markets, which in turn, prevents them from taking advantage of market opportunities. The broiler market in the Amatole District has not been given due attention, which has potential production volume and marketability. Therefore, this study explores the factors affecting the market participation of smallholder broiler farmers in the Amatole District Municipality, Eastern Cape, South Africa. Primary data for this study were collected through a well-structured questionnaire from a broiler producer. Snowball sampling techniques were used to draw an appropriate sample of 150 broiler producer households for this study. The farmers indicated marketing constraints that they face which included high feed costs, bad quality of roads, expensive vaccines, lacking water supply, lack of product training, high mortality rate, and lack of broiler markets. The probit model used to determine participation in the market by broiler farmers showed that gender, education level, household size, marital status, farm experience, membership in farm organization, access to market information, total production of broiler, and the broiler price are the major determinants of the probability of market participation in Amatole District. The intensity of volume sold to the market indicated that extension services, quality of roads access to transportation, distance to markets, and broiler price were the major determinants. Based on the findings, the study suggests that improving communications between farmers and extension services, promoting and empowering youth broiler farming participation, strengthening rural-urban infrastructure, and applying policies that bring down transitional costs are recommended to increase the probability of market participation as well as its intensity.

Keywords: broiler market, double hurdle, poultry

3.1 Introduction

Globally, the poultry industry is the fastest growing agricultural subsector, driven by a combination of push and pull factors (Nkukwana, 2018). Basic factors driving global demand for animal protein (particularly chicken) are increased earning power against a background of falling prices; urbanisation and the resultant shift in consumption patterns; and rapid population growth (Mbuza *et al.,* 2017). On the supply side, the growth of the poultry industry is due to improvements in breeding, nutrition, production and processing technologies, increasing the efficiency of chicken production (Gororo and Kashangura, 2016). However, poultry production in Africa is lagging that of other continents such as Asia (Mbuza *et al.,* 2017).

Poultry production offers considerable economic, social, and cultural benefits in developing nations, and it plays an important part in family nutrition. Hinsemu *et al.* (2018) estimated that by 2020, poultry's proportional contribution to global animal protein output is expected to rise to 40%, with the developing world accounting for most of the growth. Furthermore, there are roughly 500 million smallholder farms in the world, providing livelihood to over 2 billion people (Rabbi *et al.,* 2019). These smallholder farms generate around 80% of the food consumed in Asia and Sub-Saharan Africa and concentrate on subsistence farming; producing simply enough to feed themselves (Rabbi *et al.,* 2019). Low-income countries are defined as those with the highest proportion of smallholder farmers (Kyaw *et al.,* 2018). More than 60% of farm households in South Asia and Sub-Saharan Africa, on average, have less than 1 hectare of farmland, while more than 80% of farm households have less than 2 hectares of farmland (Kyaw *et al.,* 2018).

Smallholder farmers are defined as those with few assets and less than two hectares of farmland. They are defined as smallholder farmers with features such as reliance on domestic labour for output and a low level of technological use (Otekunrin *et al.,* 2019). Smallholder agricultural households' proper integration into three tiers of agricultural markets, namely local, national, and worldwide agricultural markets, has been promoted as a viable option for accomplishing the sustainable development goal over time (Otekunrin *et al.,* 2019). Otekunrin *et al.* (2019) also stated that, without market-oriented production systems, subsistence broiler production cannot significantly increase rural incomes. To achieve this, agricultural production systems must be intensified, agricultural commercialization expanded, and higher-value broiler specialized. These must be based on the creation of efficient and well-functioning markets and trade systems–ones

that keep transaction costs low, minimize risk, provide information to all players, and do not exclude or work against the poor–especially those living in areas with low productivity and poor infrastructure.

The broiler sector is dominated by a few completely integrated major commercial farmers and a huge number of small-scale producers, who work as contract growers or feed the informal market exclusively (Nkukwana, 2018). Farmers' market participation is critical for obtaining benefits such as income and rural employment in farming. Sorting, grading, and transportation are some of the operations that provide work in rural areas. Farmers have been motivated to transition from subsistence to commercial farming because of market involvement. Commercial agriculture enhances farm output, allowing the farmer to make more profit. Farmers' market involvement, according to Jebesa (2019), is critical for supporting economic growth, food security, and poverty reduction. Many farmers who participated in the market are food secure since the proceeds from the sale of their products allowed them to acquire staple foods.

Improved access to markets has paramount importance in increasing smallholder market participation and the extent of their participation, ceteris paribus (Kyaw *et al.,* 2018). Economic liberalization has given opportunities for smallholder farmers to diversify their products and take their surplus to nearby markets (Jebesa, 2019). Commercialization was categorized into three categories by Rabbi *et al.* (2019): low (30% of output sold), medium (30–75% of output sold), and high (more than 75% of output sold). Significant disparities in welfare outcomes were discovered among the three groups, with higher levels of commercialization being associated with higher levels of welfare and vice versa. Rabbi *et al.* (2019) also discovered that commercialization is dependent on the market for which the product was produced; when it is for the export market, it is positively related to income (not wealth), whereas the effect on welfare as measured by asset holdings and income through the domestic market is limited.

While smallholder farmers still need access to markets, large-scale businesses continue to benefit from rising markets. Smallholder farmers can now choose their markets for both inputs and harvested products after trade barriers were removed and local monopolies were discouraged (Jebesa, 2019). Smallholder farmers are typically faced with two important decisions: meeting food security requirements and producing marketable surpluses (Akidi *et al.,* 2018). Smallholder producers have a big problem due to their reliance on the government for inputs like housing, food,

vaccines, and poultry species (day-old chicks and point-of-lay pullets) as well as marketing (Nkukwana, 2018). Furthermore, due to masses of imported dark chicken meat being dumped in this market by other countries at rates below the cost of production locally, the poultry industry is currently fighting to stay competitive (Nkukwana, 2018). This has harmed both large and small producers, as well as the employment rate.

Farm businesses must make decisions relating to the type of product, timing of sales, pricing, payment, and distribution channels. Several studies have revealed that location of the market, accessibility, age of farmer, education and off-farm opportunities, market structure, market information, and marketing channel members are key determinants of marketing channel choice and commercial behavior (Abdurofi *et al.,* 2017). Furthermore, the nature of the targeted product influences the decision to produce for the domestic or export markets. Because of the rising demand in countries with a large population, the domestic market would be preferable. Non-traditional and high-value commodities, on the other hand, are typically produced for export. If a smallholder wants to sell to the export market, they must consider several factors, including product quality, timely and consistent supply, hygienic packaging, and the amount of the commodity, to be able to compete (Rabbi *et al.,* 2019). Rabbi *et al*. (2019) also claimed that smallholders cannot sell their products in the international market due to regulatory concerns and that there is also a higher risk involved, which may impede the commercialization process.

According to a study titled "A case of smallholder broiler producers in South Africa" (NAMC, 2020), the local marketing channel "sell on the spot" is used by many smallholder farmers in South Africa, followed by those who sell under contractual agreements. Smallholder farmers selling on the spot market are mostly concentrated in the local market, but those selling on contract are mostly concentrated in the slaughterhouse, institutional, and retail sectors (NAMC, 2020). On the other hand, a larger proportion of the smallholder farmers either negotiate the price or become price takers, while the rest (which are the majority) are price takers. The local market has the highest contribution in all aspects. Sellers in the local market become price takers or negotiate the price in cases where they are selling in crowded places where there are many of them competing. Otherwise, they are usually priced setters based on the individual farmer’s cost of production. Whereas prices are mainly set by the market forces.

Amatole is a Category C2 Municipality, which means it has a predominantly rural character, a low pace of urbanization, and limited municipal staff and budget capability. The District also faces a lack of institutional capacity and areas characterized by small centres, limited SMMEs, and market opportunities, reliance on public support, and LED activities primarily at the project level. The nearest market-orientated place for ADM producers is the Buffalo City Municipality (BCM). BCM is the only Category B1 (Secondary City) municipality in the province, reflecting relatively large budgets and staff, a well-developed formal business sector, and enterprises that have market access to supplied business services.

Due to various obstacles, smallholder farmers' market participation remains limited. Many smallholder farmers are in rural areas with inadequate transportation and market facilities, resulting in high transaction costs. Furthermore, they lack accurate market information as well as information on potential trading partners. Smallholders are often exposed to a higher degree of risk and transaction expenses due to their limited output surpluses. Many rural farmers sell their crops at their farm gates and village marketplaces. Marketing information, produce prices, and distance to the market all influence their decisions on how much output to sell (Kyaw *et al.*, 2018). This is all true for Category C2 Amatole District Municipality (ADM). The study aims at investing factors affecting market participation for smallholder broiler farmers in ADM.

3.2 Methodology

3.2.1 Conceptual Framework for Smallholder Broiler Farmers' Market Participation

Market participation and the volume of broiler sold to the market by smallholder broiler farmers in Amatole District Municipality is exampled by the conceptual framework on Figure 3.1. Apart from keeping broiler, some of the farmers studied also grows crops or keep other livestock for both consumption and sales. However, this study focuses on broiler production and sales. The farmers are considered to maximize utility, deriving some form utility from either selling in the nearest output market or selling on-farm or simply not selling their broiler. The assumption was that the market participation decision takes place in two stages. A farmer is said to participate in the market if he/she sells a part of his/her output in the output market. The decision to participate in the market solely depends on the farmer's discretion. At the first stage, the farmers decide whether to sell or not sell their broiler produce in the output market. If they decide not to sell in the output market,

we assume that there is some utility associated with holding on to their broiler or selling it on farm, for example, they may either consume their broiler, or give them to their relatives as a gift, or find it cheaper to sell them on their farmers. Without loss of generality, we normalized this utility associated with not selling to zero. The market participation decision of smallholder broiler farmers, which estimates the probability of farmers participating in the output market can be estimated using the following model:

$$Y_i = \beta X_i + U_i \quad (1)$$

Y_i= a dummy dependent variable (1 = market participation; 0 = no market participation) showing the broiler market participation of i^{th} farmer. If it is 1, it means the farmer sells a part of his/her output in the market, and 0 means otherwise. β is a vector of coefficients of the explanatory variables while X_i is a vector of the explanatory variables that affect market participation measured on the i^{th} farmer, U_i is the i^{th} error term. These explanatory variables include socio-economic factors (age, gender, level of education), institutional factors (extension contacts/services, Quality of roads to market, and membership in the farm organisation), and market factors (distance to market, price of broiler, and market information) which are shown in Figure 3.1.

In the second hurdle, the amount of broiler marketed surplus as a proxy for the degree of market participation was estimated by the following equation by including an estimate of the inverse mill's ratio (λj) as;

$$Y_j = B_j X_j + \lambda j\mu + \mu_j \quad (2)$$

where Yj is the amount of broiler marketed surplus as a proxy for the degree of market participation of smallholder farmers. βj is the unknown parameters to be estimated in the outcome equation and Xj are factors that are expected to affect the amount of broiler sold, and λ is the selection bias correction factor (Inverse mill's ratio). Actual market participation leads to the extent of participation. The extent of participation in turn leads to increased household income there increase food security and overall livelihood.

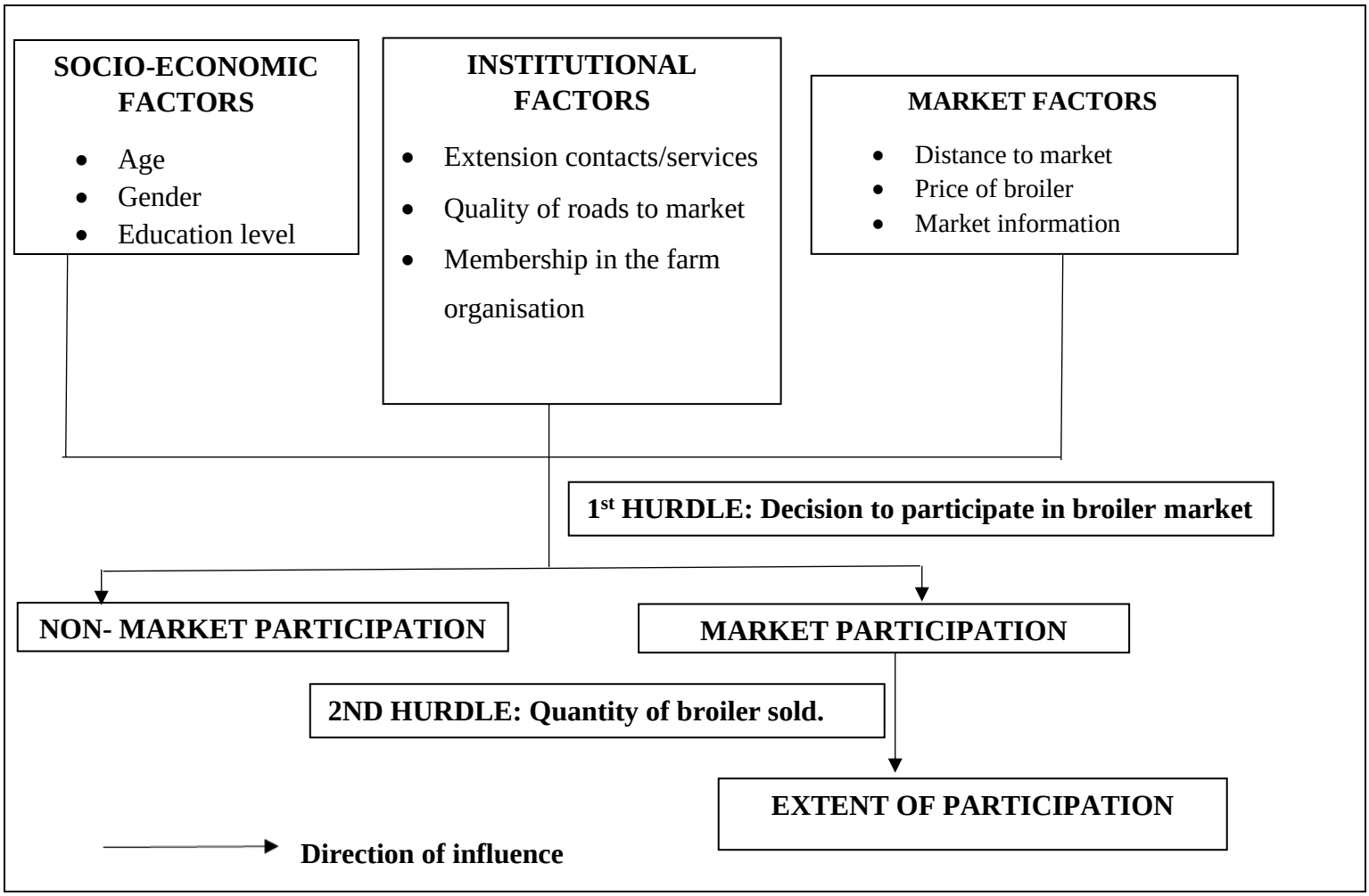

Figure 3.1: Conceptual framework of market participation

Source: Adapted from Mbembe (2020)

3.2.2 Description of Study Area

The research was carried out in Amatole District Municipality (see Figure 3.2). Amatole district is a Category C municipality, suggesting a predominantly rural character and low degree of urbanization, as well as a lack of municipal staff and funding capability (E Cape Amatole Profile final, undated). It is in the central part of the Eastern Cape and falls within latitudes 30˚000 to 34˚150 S and longitudes 22˚450 to 30˚150 E (Famewo *et al.,* 2017) and is 21 595 km² big. The ADM is comprised of six local municipalities: namely Mbhashe, Mnquma, Great Kei, Amahlathi, Ngqushwa, and Raymond Mhlaba. The district has striking views of endless undulating grasslands,

valley bush, pristine estuaries, beautiful beaches, forests, waterfalls, and the Amatole Mountain range from which the Municipality derives its name (Amatole IDP, 2019-2020). The Amatole District Municipality is home to roughly 1.7 million people (Baiyegunhi et *al.*, 2014) including Africans (91%), coloureds (3%) and whites (6%). The area's primary tribes are Xhosa-speaking peoples grouped into various tribes with connected but unique histories (Famewo *et al.*, 2017). Most of the population (68.49%) lives in poverty-stricken homes, and the district accounts for more than a quarter of the province's poverty gap (26.17%).

According to the Eastern Cape Amatole Profile, the district is the most ecologically diverse, possibly in the country, and includes areas of high potential for irrigation, game, beef, dairy, poultry, sheep, goat, and maize farming. Amatole District has a significant presence in agricultural activities which include Cattle (dairy and beef), poultry, maize, horticulture, forestry, and poultry (ECDC, 2015). The Agricultural sector analysis (undated) stated that the poultry industry in the Amatole District Municipality consists of different sub-industries, namely the egg industry, day-old chock supply, and broiler production. The focus of this study is on smallholder broiler farmers. The Agricultural sector analysis (undated) found that about 61 poultry or poultry-related cooperatives were found in the Amatole District Municipality in 2013 were most of these cooperatives were in Raymond Mhlaba (Alice, Fort Beaufort) and Mbashe Local Municipality (Elliotdale).

Figure 3.2: Map showing the Amatole District Municipality
Source: Ngumbela (2018)

3.2.3 Research Design

Research design is a structure of the investigation which is put together in such a way as to attain answers to study questions. There are two types of research design, namely cross sectional, and longitudinal research designs (Mdoda, 2017). This study employed a cross-sectional research design where data was collected at one point in time on several variables such as farmer socio-economic factors, market participation and intensity, profitability and profit determinants, input use and production process, production, and marketing constraints. A subset of broiler farmers in all 6 municipalities were selected to represent the population. Quantitative data were collected on the socio-economic-factors, market potential, marketing costs and margins, production costs and marketing constraints. The study was carried out through a pilot study, thereafter, a questionnaire was used during June and July of 2022. The study mainly focused on smallholder broiler farmers to capture their marketing, profitability, and production decisions.

3.2.4 Sampling Procedure

The sample size and sample selection method should ensure that the population is representative. The method for determining sample size is mathematical. Different criteria such as research cost, time, human resources, accessibility, and availability of transportation facilities were considered in this study to estimate the sample size. A study's target population is the group of people with whom it will conduct research and develop conclusions (Barnsbee *et al.*, 2018). This study's target population was the smallholder broiler farmers in Amatole District who partake in broiler production. The study used a snowball sampling procedure. The snowball technique was used to locate potential subjects with help of extension officers where subjects are hard to locate (Siddiqu *et al.,* 2016). This is the appropriate procedure for the Amatole District where the data for the exact population of smallholder broiler farmers were unknown. The respondents were asked to give referrals to other broiler farmers believed to fit the target population of the study.

3.2.5 Sample Size

The most important component of the research process is determining the sample size for a study because it helps to develop solid results that are more generalizable (Sharma *et al.,* 2020). According to Anyango *et al.* (2016), three methods are used to determine the sample size for a

study; (a) conducting a census for a small population, (b) computation using a formula based on a population, (c) matching the sample size of comparable research. In this study, a formula was used to determine the sample size. Cochran's proportionate to size sampling methodology was used to determine the required sample size.

$$n_1 = \frac{z^2 \hat{p}(1-\hat{p})}{e^2}$$

Where;

n= required sample size

Z = confidence level at 95% (standard value of 1.96)

p = estimate of smallholder broiler farmers which is at 0.89. This was an assumption that 89% of households participates in broiler production in the study area.

q = this is the weighting variable given by 1- p

e^2 = margin of error at 5% (standard value of 0.05)

$$= \frac{1.96^2 \times 0.11 \times 0.89}{0.05^2} = 150.4$$

According to the equation above, the unadjusted sample size is required to be 150. The sample size was chosen since a census would be costly and time-consuming and calculating would necessitate a population whose data was unavailable and unclear.

3.2.6 Data collection

Primary data was the major data used in the study. Data was collected using a structured questionnaire. This questionnaire was pre-tested to increase its reliability. 15 broiler farmers in Alice were used to pretest the questionnaire which was conducted by the enumerators to be trained on how to conduct the interviews. To be able to get the best response from farmers, face-to-face interviews were conducted using the home language, IsiXhosa, to counteract any confusion that

may occur due to language barriers. The questionnaire had four sections, the first section consisted of personal characteristics of farmers (age, gender, educational level, income range, number of dependents, and years in farming); the second section cover input use, costs, and revenues; section three cover marketing factors and the last section had questions on constraints faced by smallholder broiler farmers. The interviews were done in June and July 2022.

3.2.7 Analytical framework

This section of analytical framework is divided into two sections. First section is Double Huddle regression discussion, and second section is the econometric model.

3.2.7.1 Double Huddle regression

The study adopted a double huddle regression to estimate factors influencing market participation of smallholder broiler farmers in the study area. A double-hurdle model was previously used by Aliyi *et al.* (2021) to find determinants of market participation among smallholder vegetable producers in Southwest Ethiopia. The model assumes that smallholder farmers make two separate or sequential decisions about market participation, the size of which is driven by a different set of explanatory variables. Two obstacles must be overcome to see a positive degree of market participation. Each decision process is modelled using a different latent variable. Each hurdle is shaped by the socioeconomic, market, and institutional factors that affect smallholder farmers.

The **first hurdle** in the double hurdle model assesses the decision to participate in the market or not, conditional on market participation. The first hurdle's maximum likelihood estimator (MLE) is estimated using the decision to sell broiler produce (a binary variable), which is supposed to follow a probit model. The continuous variable of quantity sold is assumed to follow a truncated normal distribution in the second hurdle. The MLE is calculated by fitting a truncated normal regression model to the sold quantity (Cragg, 1971). The expected signs and the measurements of hypothesized variables were shown in Table 3.1.

The probit model was used for the first selection. A probit model predicts the probability of whether individual farmers participated in the broiler market or not as shown in Equation (1):

$$Pr\left(Z_i = \frac{1}{W_i}, \alpha\right) = \emptyset\big(h(W_i, \alpha)\big) + \varepsilon_i \quad (1)$$

Where:

Z_i = is an indicator variable equal to unity for smallholder broiler farmers that participated in the marketing

$\emptyset =$ the standard normal cumulative distribution function

$W_i =$ the vector of factors affecting the decision to participate in the broiler market

$\alpha =$ the vector of coefficients to be estimated

ε_i = the error term assumed to be distributed normally with a mean of zero and a variance σ^2

The variable Z_i takes the value of 1 if the marginal utility the household i get from participating in the broiler market is greater than zero, and zero otherwise. This is shown as follows in Equation (2):

$$Z_i = 0 \; if \; Z_{ni} \leq 0$$

$$Z_i = 1 \; if \; Z_{ni} > 0$$

where Z_i^* is the latent level of utility the smallholder broiler farmers get from participating in the market, and with $\mu_i \sim N(0,1)$,

$$Z_i^* = \alpha w_i + \mu_{1i} \quad (3)$$

In the **second step**, an additional regressor in the sales equation will be included to correct for potential selection bias. This regressor is the Inverse Mills Ratio (IMR). The IMR is computed as Equation (4):

$$\frac{\emptyset\left(h\left(\frac{W_i}{\tilde{\alpha}}\right)\right)}{\emptyset(W_i, \tilde{\alpha})} \quad (4)$$

where φ is the normal probability density function. The second-stage equation is given by Equation (5):

$$E = \left(\frac{Y_i}{Z} = 1\right) = f(x_i, \beta) + \gamma \frac{\emptyset(h\left(\frac{W_i}{\tilde{a}}\right))}{\emptyset(W_i, \tilde{a})} \quad (5)$$

Where:

$E =$ is the expectation operator

Y = is the (continuous) proportion of broiler sold

$x =$ is a vector of independent variables affecting the quantity of broiler sold.

β = is the vector of the corresponding coefficients to be estimated

Therefore, Y_i can be expressed as follows:

$$Y_i^* = \beta_0 X_i + \gamma + \mu \quad (6)$$

Where $\mu_i \sim N(0, \sigma_\mu)$. Y_i^* is only observed for those broiler farmers who participate in the broiler market and if $Z_i = 1, Y_i = Y_i^*$.

$$P(0,1) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \ldots + \beta_n X_n + \varepsilon_1 \quad (7)$$

where participation is denoted by 1 and non-participation is denoted by 0.

$\beta_0 =$ is a constant, $\beta_1, \ldots, \beta_n$ are parameters to be estimated

$X_1, \ldots, X_n$ = are the vector of explanatory variables

ε_1 = is an error term.

The second step, which involves a decision on the extent of broiler marketing, is estimated by OLS as follows;

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \ldots + \beta_n X_n + \varepsilon_i \quad (8)$$

where Y_i denotes the broiler sales in percentage (%). β_0 is a constant, $\beta_1, \ldots, \beta_n$ are parameters to be estimated, $X_1, \ldots, X_n$ are the vector of explanatory variables and $\varepsilon_i$is an error term. The two equations for each step are specified as follows: The variables used in the double-hurdle model are shown in Table 3.1.

3.2.7.2 Econometric Model

The model can thus be estimated as follows; the first step of deciding whether to participate in broiler marketing or not can be specified as:

Step 1. (Selection Equation)

$$P(0,1) = \beta_0 + \beta_1 AGE + B_2 GEN + \beta_3 EDU + \beta_3 FEX + \beta_4 ACX + \beta_5 ORG + \beta_6 MS + \beta_7 INFO + \beta_8 AC + \beta_9 PROD + \beta_{10} PROF + \varepsilon_i \quad (9)$$

The second step of choosing the extent of market participation can be specified as:

Step 2. (Outcome Equation)

$$Proportion\ of\ broiler\ sales\ (Y_i) = \beta_0 + \beta_1 AGE + B_2 GEN + \beta_3 EDU + \beta_3 HSZ + \beta_3 FEX + \beta_4 ACX + \beta_5 QR + \beta_6 ORG + \beta_7 ACT + \beta_8 DM + \beta_9 INFO + \beta_{10} BP + \varepsilon_i \quad (10)$$

where AGE denotes the age of the broiler farmer, GEN denotes the gender of the broiler farmer, EDU is the education level of the broiler farmer, HSZ is the household size, FEX is the farm experience, ACX is access to extension services, QR is the quality of the roads, ORG is the membership to farm organization, ACT is the access to transport, AC is access to credit, DM distance to markets, AMI access to market information, MS is the marital status of the broiler farmer, PROD is the total broiler produced, PROF is broiler profit, and BP is the broiler price.

Table 3.1: Factors influencing market participation for smallholder broiler farmers by using the Double Hurdle Model.

Dependent Variables

Variables	**Variables**	**Description measurement**	**Hypothesized Effect**

$Prob(Y)$	Type of household (market participant/Non-market participant)	Dummy (1 = market participant, 0 = non-market participant)	±
$Broiler\ sold$	The volume of broiler sold in the market (%)	The proportion of Broiler sale	±

Independent Variables

Variables	**Variables**	**Description measurement**	**Hypothesized effect for participation decision**	**Hypothesized effect for the intensity of participation**
Socio-Economic Factors				
Age	AGE	Continuous Actual years (Continuous)	−	−
Gender	GEN	Dummy male = 1, female = 0	+	+
Household size	HSZ	Actual number of people in the house (continuous)	±	±
Marital status	MS	Dummy (1=Yes; 0= No)	+	
Education level	EDU	actual years spent in school (Continuous)	±	+
Farming experience	FEX	Actual years of farming	+	+
Institutional Factors				
Access to extension services	ACX	Dummy (1 = Yes, 0 = No)	+	±
Farm organisation membership	ORG	Dummy (1 = Yes, 0 = No)	±	±
Market Factors				
Access to transport	ACT	Own transport = 1, 0 otherwise		+
Distance to market	DM	Actual Km (Continuous)		−

Quality of roads to market	QR	Dummy (1= Good; 0= No)		+
Access to market information	INFO	Dummy (1= Yes, 0 = No)	+	+
Access to credit	AC	Dummy (1= Yes, 0= No)	+	
Price of broiler	PRICE	The actual amount (Rands)		+
Total production of broiler	PROD	Number of broiler output (Continuous)	±	
Broiler profit	PROF	Continuous (Actual amount in Rands)	+	

"+ "indicates a positive relationship; "−" negative relationship, "±" uncertain relationship between the independent variables and market participation decision or market participation intensity.

3.2.7.3 Justification for the use of the Hypothesized Variables

Age of the Broiler Farmer

The age of the broiler farmer was expected to harm the volume of broiler meat sales. It is hypothesised that old-aged households' heads are slow to adapt to changing market conditions and new technologies, and therefore do not respond quickly to market incentives to increase broiler supply to the market. The descriptive results generated by Anumudu *et al.* (2020), indicated that generally, the mean age of the household head for market participants was lower than that of non-market participants. This, therefore, indicates that old-aged households are not as market-oriented compared to young-aged households.

Gender of Farmer

The Gender of the farmer is expected to positively affect broiler market participation as well as the extent of market participation. This is because of the labour-intensive nature of broiler production and males are expected to be able to handle more labour-intensive work which will help with the volume of broiler production. This hypothesis is consistent with the findings of Anumudu *et al.* (2020).

Household Size

The household size is written as a continuous variable, which depicts the actual number of people leaving at the investigated home. The household size is expected to positively or negatively influence market participation by the broiler farmers; its effect on the extent and the profitability of market participation is also not clear. It may either increase or decrease the extent of market participation. Abera *et al*. (2016) found that household size had a negative relationship with the probability of market participation. Anumudu *et al.* (2020) also found household size to negatively affect the volume of produce sold to the market.

Marital Status of the Farmer

The marital status was captured as a dummy variable, with a married farmer reporting a one and a non-married, divorced, or widowed reporting a zero. The marital status of the farmers is expected to positively affect market participation. Achandi and Mujawamariya (2016) found that majority of market participants and non-participants were married, which does not give a clear indication of whether marital status of farmers negatively or positively affect the probability of market participation and its intensity.

Education Level of the Broiler Farmer

The education level of the farmer was captured as a continuous variable, indicating the number of years spent in formal school. The education level of the household head has been found to influence market participation because household heads with a high level of education may have better abilities to negotiate and acquire more information than those with a low level of education (Chamboko *et al.*, 2017). Thus, it was assumed that the education level of household heads would have a positive impact on determining both market participation and the volume of market sales among smallholder farmers.

Farmer Experience of the Broiler Farmer

The experience was expected to positively determine the decision on the sale of broiler meat as well as the extant of market participation by broiler farmers. This is because more experienced farmers are expected to have more knowledge of better production mechanisms, which in turn increases their marketable surplus (Mbembe, 2020)

Access to Credit

Access to credit is reported as a dummy variable, with one indicating access and a zero representing a lack of access. Credit access is expected to positively influence market participation. Access to credit is expected to offer farmers a way to purchase assets that will benefit the business in terms of growth and long-term sustainability. Giziew (2018) found a positive relationship between market participation and access to credit.

Access to Extension Services

Access to extension services was captured as a dummy variable in Amatole District. Smallholder farmers who have contact with the extension services may have a better understanding of new technologies such as high-yielding varieties and other new farming practices, which encourage them to produce more and improve their livelihood (Kyaw *et al.,* 2018). Access to extension training is expected to positively influence the intensity of market participation among broiler producers.

Membership in a Farmer Organization

This variable was included as a dummy variable if any of the household members had a membership in the farmers' organization. In this study, we assumed that membership in a farmer organization positively influenced both the probability of market participation and the extent of market participation of farmers in Amatole. This means those who are members of the cooperative could have better access to market information, inputs, extension services and technical advice. Abera *et al.* (2016) found that membership to market organisation positively related to market participation.

Access to Transport

Access to transport is a dummy variable in this study. Being able to hire or own appropriate transportation for broiler products was assumed to positively influence the level of market participation. Mdoda, (2017) found transportation access to negatively influence market participation due to the transactional costs involved.

Distance to Market

The distance to the market was measured in kilometres. Distance to the market was hypothesized to negatively influence the decision to participate and the quantity of broiler sold to the market among smallholder broiler farmers in the Amatole District. Irene *et al.*, (2018) found that distance to the preferred marketing channel was negatively correlated to the probability of selling indigenous chicken. This finding suggested that households that are closer to market outlets are more likely to sell their indigenous chicken than those households living further away.

Quality of Roads to Market

The quality of market roads was used as a dummy variable in this study area. It is assumed that the better the quality of roads to the market, the better the farmers' access to market information and transportation. The findings by Ingabire *et al.* (2017) also reveal that farmers would be more commercialized if they could have access to good roads that are practicable throughout the year and connect to local markets. Long distances to these roads increase transaction costs, which discourages farmers' participation in markets. The increased transaction costs reduce the profitability of farm production, leading to more subsistence farming.

Access to Market Information

Access to market information was included as a dummy variable whether the household received information on the market prices before selling. Chamboko *et al.* (2017) measured access to market information based on whether one of the household members owned a mobile phone, and whether the mobile phone was used to access enterprise information. Access to market information is important because it enables farmers to make more appropriate decisions on which market to sell to and when to sell the commodity. Therefore, this study hypothesized that access to market information positively influenced the decision of farmers to participate in the market.

Broiler Profit

Broiler profit was reported as a continuous variable with the actual profits incurred by the broiler farmers in the study area being recorded. It is expected that broiler profits motivate the farmers to participate in the market, hence a positive relationship between the two is expected.

Price of Broiler

The price of rice was included in the regression as a continuous variable (Rands) in South African currency. It is hypothesized that farmers that receive a high market price for broiler are likely to produce more and increased market surplus. According to Worku *et al.* (2021) significantly influence market participation. It was also concluded that higher prices provide a greater opportunity for farmers to participate in the market. Thus, we postulated that broiler prices were a factor that positively influenced both the decision to participate in the market and the volume of broiler sold to the market among smallholder farmers.

Total Production of Broiler

The total production of broiler meat was measured by the number of broilers produced. Smallholder farmers try to increase production and receive more income by selling surplus amounts of produce. This is because smallholder farmers first produce for household consumption and sell the surplus. According to Irene *et al.* (2018) output is expected to positively influence the farmers' decision to participate in the market. The more output the more the farmer can generate a marketable surplus for participation in the market.

3.2.8 Ethical Considerations

Ethical clearance was obtained from the University of KwaZulu-Natal under the Research Committee (insert Ethical clearance number). During the study, the researcher maintained high professional ethics of conduct and ensured that respondents were well informed of voluntary participation, risk of harm, and anonymity and confidentiality were considered. The respondents participated based on informed consent. Sufficient information and assurance on the goals of the study were communicated to the respondents. This allowed individuals to fully comprehend the ramifications of involvement and make an informed, deliberate and freely given decision about whether to participate, without the use of coercion or pressure. Relevant information was disclosed and any other possible risks of participation and issues around what will happen to the data obtained were addressed.

All research respondents voluntarily and formally consented to participate in the research after having been informed of the potential risks and benefits of their participation. They were able to

withdraw from the research at any time. The participants who were not willing to participate at first were further explained the objectives of the study, as well as its objectives. While collecting, analysing, and reporting data, confidentiality and anonymity were ethical procedures aimed to protect the privacy of human subjects. This study only incorporated quantitative data, but both confidentiality and anonymity of the smallholder broiler farmers were protected. By not revealing the participants' names and identities during data collection, analysis, and publishing of the study findings, the participants' anonymity and confidentiality were kept. During telephone communication, the interview session, data processing, and dissemination of the findings, the privacy and confidentiality of the interview setting were properly controlled.

3.3 Results and Discussion

The major findings of the study are presented in this section. A description of the socio- economic factors affecting smallholder broiler farmers' market participation in ADM is presented. The findings from the double hurdle model are also presented along with the discussion for each econometrics finding.

3.3.1 Socio- economic characteristics of smallholder farmers in Amatole District

Market participation was measured by the smallholder broilers farmers' ability to sell their broiler produce in their nearest output market. The sampled 150 broiler farmers revealed that 129 farmers had participated in the broiler market and 21 of the farmers did not partake. Table 3.2 shows the socio-economic characteristics of the market participants and non-market participants. The socio-economic characteristics include age, gender, education level, access to extension services, household size, farm size, farming experience.

Table 3.2: Socio- economic characteristics of smallholder farmers in Amatole District market participants and non- market participants

Characteristics	Market participants (n= 129)	Non- market participants (n= 21)	Overall (n= 150)
	Mean	**Mean**	**Mean**
Age	0.41	0.45	0.41
Gender (female)	0.55	0.76	0.64

Education level	12	10.86	12
Access to extension services	0.67	0.67	0.62
Household size	5.00	6.00	5.86
Farm size	0.83	0.65	0.77
Farming experience	14.59	3.53	13.12

Source: Field Survey (2022)

According to Table 3.2, the average age of smallholder broiler farmers in the ADM is 41 years. This means that most farmers in the ADM are middle-aged farmers and possess much knowledge that will help with making informed marketing decision and are well experienced in the broiler industry. They are not pensioners level of age (65 years) meaning that they still have the energy to run their broiler business efficiently. The COGTA (2020) reported the older working age category in ADM is between the ages 45-64 years, with the average of 41 years amongst the broiler producers, efficiently levels are not expected to decrease. Therefore, the volume of broiler sold to the market is expected not be negatively affected by age. These results agree with Egbetokun *et al.* (2017) who found similar results of smallholder farmers' market participation. These results contradict Haile *et al.* (2022) and Irene *et al.* (2018) who found that majority of the market participants were of younger farmers and negatively affecting market participation; the diminishing marginal effect on production was highlighted which results in a low market participation and intensity.

On average, broiler farmers in ADM were found to be female with 64% compared to male with 36%. This implies that broiler farming is dominated by female farmers in the study area. This may be a result of the population proportion of Amatole District. COGTA (2020) reported that the female population of ADM is 52.7% while the male population is 47.3%. This is because male migrate to other major urban areas in search of work opportunities. With broiler production being dominated by females in ADM, market participation and intensity of participation is expected to be high. This is because of the low level of labour intensity when it comes to broiler production and that the female farmers are likely going to participate in the market to earn income to feed their families. These results contradict Mirie and Zemedu (2018) who found that male farmers are

dominating broiler and are participating in markets as compared to female broiler farmers. The study found that smallholder broiler farmers were literate as they have spent 12 years in school, which is equivalent to secondary education. This is very beneficial to broiler farming as reveals that farmers were knowledgeable and able to access agricultural information which enhance their farming. Additionally, farmers were able to apply their knowledge obtained from school on their business and this contributed positively on market participation by smallholder broiler farmers. The average household size was 5 people per household and was used mostly as a family labour. The household size was used as a proxy of family labour for this study. These results agree with Mdoda *et al.* (2022) that smallholder farmers have an average family size of 5 people, and it is mostly used as family labour as farmers do not have financial support to hire contract labourers for the farm. The average land size of smallholder broiler farmers in ADM was 0.774 hectares. With a land size that is less than a hectare, broiler farmers used the land to house the family and used for broiler production.

From the results, 62% of the broiler farmers in ADM had access to extension services. Effective access to extension services provides farmers with production and market information. This therefore implies that 62% of the broiler farmers in ADM have access to production and marketing information which was beneficial for participating in markets and enhancing production. These results concur with Degefa *et al*. (2022) who found that having access to extension services was an important factor in production and marketing through the mastery of skill and knowledge of the farmers in using recommended input and management as these services Enhances production through training and the used recommended technologies.

3.5.2 Factors affecting farmers' decision to participate in broiler markets

Factors affecting smallholder farmers' market participants are divided into two parts; mainly determinants of broiler market participation and the factors affecting the volume sold. The probit model is used to analyze factors affecting market participation and the Ordinary Least Square is used to examine factors influencing the volume of broiler sold by smallholder broiler farmers in the ADM. The constraints that hinder market participation amongst broiler producers are also examined and ranked according to their dominance amongst the broiler farmers in ADM.

3.5.2.1 Determinants of broiler farmers' market participation

The determinants of broiler market participation by farmers in the Amatole District are analyzed in this section. The probit model was used with 8 explanatory variables which are illustrated in Table 3.3. The decision to participate in the broiler market was a binary choice that was built on utility maximization theory (Tarekegn and Yosefe, 2017), hence the use of the probit model. This model was used to analyze which of the 8 variables affects the participation decision of the smallholder broiler farmers in the market. Table 5 below indicates the significant likelihood ratio statistic indicted by the chi-square as P<0.0000, suggesting that all the model parameters were cohesively significant in explaining the dependent variable. The Pseudo R^2 were 0.72 suggests that the specification fits the model well and the explanatory variables used in the model explain 72% of the variation in the market participation decision, showing the goodness of fit of the model. The remaining 28% shows the unaccounted change. The explanatory variables for broiler market participation by smallholder broiler farmers were found to be significant at 10%, 5% and 1%.

Table 3.3: Determinants of smallholder broiler market participation in the study area

Variables	$\boldsymbol{\beta}$	Std. Error	Z	P > |z|
Gender (Female)	2.022	1.091	1.85	0.064*
Education level	0.184	0.099	1.87	0.062*
Household size	0.415	0.231	1.80	0.072*
Marital status	-0.874	0.468	-1.87	0.062*
Farmer's experience	0.122	0.073	1.67	0.095*
Membership in the farm organization	-2.116	1.026	-2.06	0.039**
Access to market information	2.063	1.082	1.91	0.057*
Total production of broiler	0.023	0.007	3.08	0.002***
Profitability	0.0004	0.0001	3.41	0.001***
Constant	-3.386	1.974	-1.72	0.086

Number of observations = 150

LR chi2 (8) = 99.40

Prob > chi2 = 0.0000

Pseudo R2 = 0.7185

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

Source: Field survey (2022)

The probit results indicated that the gender of the broiler farmers is statistically significant at a 10% level and has a positive coefficient. This implies that an increase in the number of female participants increases the probability of broiler market participation. Market participation is time-consuming because farmers spend all day in the output market selling their broilers. Female farmers are therefore expected to not be beneficial as they normally have household responsibility. This is not true for smallholder broiler farmers in ADM as they are more economically involved and positively affect market participation. This was in line with the findings of Egbetokun *et al.* (2017) where male farmers caused a decrease in the probability of market participation and female farmers had a positive relationship with market participation.

The education level was found to be statistically significant at a 10% level of significance with a positive coefficient. This implies that the education level and the probability of market participants have a positive relationship, an increase in the educational years is expected to increase the probability of market participation. This may be caused by the fact that educated farmers will be able to comprehend market information better and find other innovative ways that they can enter the market and differentiate their products. These findings were in line with the findings of Mdoda (2017) that farmers with secondary and tertiary education were important as such farmers can easily understand farm business dynamics and are easily trained, unlike those farmers with primary and no education at all. Therefore, the highest level of education by smallholder broiler farmers positively influences the probability of market participation.

Household size showed a positive and significant coefficient, indicating a positive relationship between household size and the probability of market participation of broiler framers. This implies that an increase of one additional member of the household will increase the probability of market participation by broiler farmers. Large household size is expected to contribute to labour and thereby increase productivity while decreasing costs in terms of labour. An increase in farm productivity allows for surplus produce to be available for market sales. These findings were in line with those of Hlatshwayo *et al*. (2022) who found that household size had a positive and significant relation with market participation.

The broiler farmers' experience was found to be statistically significant at a 10% level and had a positive coefficient. This implies a positive relationship between the years of broiler experience and the probability of participating in markets. An increase in the years of broiler farming experience will increase the probability of broiler farmers' market participation. A high level of farming experience amongst the smallholder broiler farmers implies years of navigating the broiler industry through building customer relations and acquiring and implementing marketing information. Therefore, smallholder broiler farmers are most likely aware of when and where to sell to gain the most profits resulting in them being most likely to participate in the broiler market. This was in line with the findings of Tarekegn and Yosefe (2017) who found that the years of farming experience positively affect the probability of market participation.

The results illustrate a marital status with a negative coefficient which is statistically significant at the 10%. The negative coefficient indicated a negative relationship between marital status and the probability of broiler farmers' market participation. The negative relationship may be attributed to that married male farmers are expected to be depending on non-farm income to support the family meaning that less attention is given to broiler production and its market participation, leading to a decrease in the probability of participating in the broiler market. The married female farmers were expected to be taking care of their families and need "fulfilling their wifely duties"; resulting in less time spent on broiler production and learning more about the broiler output market. These findings contradict those of Dlamini and Huang (2019) who found that farmers with marital status were more likely to participate in markets.

The probit model indicated a negative coefficient for membership to farm organisation, which implies a negative and statistically significant relationship (at a 5% level) between membership in farm organization and the probability of the broiler farmer participating in the output market. The negative coefficient indicates that an increase in the level of farm organization participation is likely to decrease the probability of market participation. Farm organizations offer farmers production and market information. It is where farmers get new networks and may get an easy way to sell their produce. The farmers may be getting connections to sell to their rural community and end up selling their produce locally (on-farm) and ending up seeing on-farm sales as being more convenient and easier. This results in a decrease in market participation by the farmers. This result contradicts those of Lefebo *et al.* (2016) that say that membership in farm organizations increases the probability of market participation. Meanwhile, access to market information, often provided by the extension service, had a positive coefficient indicating a positive and statistically significant relationship (at a 10% level) between access to market information and the probability of market participation. Market information provides farmers with information about the prices and produces demand areas available for farmers in the ADM. This information, therefore, increases the likelihood of farmers' participation in the market. This was in line with the finding of Lefebo *et al.* (2016) who established that access to market information had a positive and significant relationship to the profitability of market participation.

The results indicated the total broiler produced had a positive and statistically significant relationship (at a 1% level) with the probability of market participation by the broiler farmers ($p=0.002$). Therefore, an increase in the total production of broiler will increase the probability of market participation. Market participation comes with transitional costs that include time and transportation costs. Sending a large quantity to the output market allows for the likelihood of covering the transitional cost with sales income to increase. Therefore, making total broiler production a driver of market participation. This was consistent with the findings of Mbitsemunda and Karangwa (2017) who observed that the relationship between the total production of products and the probability of market participation is positive and significant.

Finally, the probit results indicated that the coefficient for profitability was positive indicating a positive and statistically significant relationship (at a 1% level) between profitability and the probability of market participation. This indicates that as broiler farmers become more profitable,

they are more likely to participate in the output market. Farmers can increase output and supply the market with more goods when they are profitable. These broiler farmers understood that selling in the market increases profits, therefore they were more inclined to participate in the market. These results were like those of Machethe (2016) who found that profitability has a positive and significant relationship with the probability of participating in the market.

3.3.2.2 Marketing constraints faced by smallholder broiler farmers

The broiler farmers in ADM were asked to write constraints that hinder them from participating in the market. The marketing constraints faced by the smallholder broiler farmers in ADM are shown in Table 3.4 and ranked according to their frequency amongst the farmers. These constraints include high feed costs, bad quality of roads, expensive vaccines, lacking water supply, lack of product training, high mortality rate, and lack of broiler market.

Table 3.4: Marketing constraints faced by smallholder broiler farmers in the study area

Constraints	Number of farmers facing constraints (Respondents = 150)	Percentage (%)	Ranking
Bad quality of roads	134	89.33 %	1
Lack of extension services	98	65.33%	2
Lack of production training	74	49.33%	3
Lack of access to market information	64	42.67%	4
Lack of broiler output market	35	23.33%	5
Lack of access to transport	18	12%	6

The ranking numbers from 1-6 indicated the frequency of the constraint, with 1 being the most frequent and 6 being the least frequent amongst the farmers.

Source: Field Survey (2022)

Table 3.4 above indicated that bad quality of roads was the constraint faced by most broiler farmers in ADM with 89.33% of the farmers reporting it as a constraint. The bad quality of roads affects the quality of broiler by the time it gets to the market. Transportation damage is possible if the quality of the road is not good and that will result in the quality of the broiler being unmarketable and sometimes the death of the broiler. The possible loss and damage of the broiler production is

an incentive that leads farmers not to participate in the output market and rather sell at farm gate price because of bad quality of roads. These findings were in line with those of Adeyonu *et al.* (2021) who concluded that poor road quality prevents the farmers, located in remote areas, from accessing the output market.

Lack of extension services was ranked as the 2nd most prominent constraint amongst the farmers with 65.33% of the broiler farmers in ADM reporting it as a constraint. Extension services provide farmers with the market, production, and management information. Extension officers are familiar with the marketing structure and production strategies that are used in a specific area. Lacking extension services may result in farmers encountering misinformation, from the internet, that is not suitable for that specific area. Farmers that do not possess market information seldom participate in the output market. Kshash and Oda (2019) found that poor extension services are the most severe constraint faced by poultry producers in Babylon province. Hamid *et al.* (2017) considered extension services as an essential input of poultry production as productivity of poultry projects increases when proper and timely services are provided to the producers. Furthermore, a lack of market information was reported by 42.67% of the smallholder broiler farmers in ADM. The broiler producers need to know who needs which product at what cost. Mgbenka *et al*. (2016) stated that the farmer's market information needs are those that enable the farmers to make rational and relevant decisions.

Lack of production training was another constraint faced by the smallholder broiler farmers in ADM. About 49.33% of the smallholder broiler farmers reported lacking production training. Such services are usually provided by extension officers and farm organisations. Production training provides smallholder broiler farmers with skills to improve production efficiency. The improvement in production allows for high volumes of the broiler to be produced and then sold on-farm and in the output market. The findings were in line with those of Yemane *et al.* (2016) who found that poultry producers lacked adequate training.

The results in Table 3.4 show that 23.33% of the smallholder broiler farmers reported lacking a broiler output market for their produce. This means that the broiler farmers do not know where to sell their products to make profits. These farmers are likely to sell their produce on-farm and do not participate in the broiler output market. Oluwatayo *et al*. (2016) found that smallholder broiler

farmers in Mopani District Limpopo stated that 2.3% of the broiler farmers reported that their major constraint is finding a market for their broiler produce. Furthermore, 12% of the smallholder broiler farmers reported not having access to transport to the output market. Access to transport is important as broiler outputs in ADM are located far. A lack of transportation means that the broiler produce cannot be taken to the output market, therefore, hindering farmers from participating in the broiler output market. Islam *et al.* (2016) also identified that transportation is one of the serious constraints in marketing agricultural produce by smallholder farmers.

3.3.3 Factors influencing the volume of broiler sold

The second hurdle, the investigation of the factors affecting the volume of broiler sold in the market, was estimated using the OLS regression model. Table 3.5 displays the results of volume sold by broiler producers. Extension contract, quality of roads, quality of roads, access to transportation, and broiler price were found to be statistically significant at either 1%, 5% and 10% levels.

Table 3.5: Factors affecting the volume of broiler sold in the study area

Variables	Coefficient $\boldsymbol{\beta}$	Std. Error	Significance
Extension services	9.0905	4.9646	0.069*
Quality of roads	26.474	6.7582	0.000***
Access to transportation	17.2168	9.1188	0.061*
Distance to markets	0.2383	0.10564	0.026**
Broiler price	0.5601	0.0665	0.000***
Constant	1.234	14.1495	0.931

Number of observations = 150

F-value = 33.68

Prob > F = 0.0000

R- squared = 0.7468

Adjusted R-squared =0.7247

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

Source: Field survey (2022)

The ordinary least squared regression indicated that access to extension services has a positive and significant relationship (at a 10% level) with the extent of broiler market participation. The results also indicate that access to extension services by the broiler farmers increases the volume of broiler sold. This could be explained by the fact that access to extension services would provide access to current information on agricultural technologies that could boost output and, as a result, raise the volume of broiler sold. The findings were in line with those of Lefebo *et al.* (2016) who indicated that access to extension services is likely to increase the volume of broiler sold in the market.

Access to transportation to the market was found to be statistically significant at a 1% level with a positive coefficient. This implies a positive relationship between access to transport and the volume of broiler sold to the market. A unit increase in the accessibility of transport to the market increases the volume of broiler sold. Access to transport provides a means to take the broiler to produce to the market meaning that greater volumes can be taken to be sold to the output market. Most of the farmers in ADM either hired the transport as a group or hired as individuals. Ayodele *et al.* (2021) shared the same sentiments that having access to transportation positively affected the intensity of market participation. This was attributed to the fact that having access to transport allows for produce to be transported to the output markets for sale. Moreover, the quality of road on which the transportation will be travelling is also important.

The quality of roads was found to have a positive coefficient which is statistically significant at a 1% level. This implies the good quality of a road will increase the volume of broiler sold to the market. This may be a result of the fact that good quality roads to the market make it easy for broiler producers to transport their produce to the market and fewer transportation deaths will be experienced; therefore, more volumes may be sold.

The distance to the market was statistically significant at 5% with a positive coefficient. The coefficient depicts a positive relationship between the intensity of market participation and

distance to the market, where a kilometre increase in market distance increases the intensity of market participation. Noting that the further the situation of the farmers to the output markets, the easier it is to access land for broiler farming, therefore the high the broiler produced and the greater the volume of broiler that may be sold to the market. These findings were in line with those of Dlamini and Huang (2019) who found the distance to the market positively affected the intensity of market participation. contradicting results were reported by Tura *et al*. (2016) who found that distance to the nearest market negatively and significantly influences the intensity of marketed surplus. Tura *et al*. (2016) implied that as the distance from the nearest market increases, variable transport costs increase, and this discourages smallholder farmers from selling high volumes of produce.

The broiler price had a significant (p=0.000) effect on the volume of broiler sold. The positive coefficient indicated that an increase in the broiler price will increase the volume of broiler sold in the output market. Higher market prices will encourage farmers to produce more, boosting the amount of broiler sold in the market by smallholder farmers, according to the study's findings. Kyaw and Lee (2018) also showed that rice farmers tend to sell more of their products when the market price is higher. This is true for broiler farmers in ADM as they aim to sell high volumes of their broiler produce in the market rather than on-farm where they earn farm-gate prices.

3.4 Conclusions and policy recommendations

The study was conducted to investigate the determinants of market participants of market participation intensity in Amatole District Municipality. Primary data was used to collect data from 150 smallholder broiler farmers using structured questionnaires. The study results indicated that the average age of smallholder broiler farmers was 41 years and was dominated by female farmers. Broiler farmers had 12 years of farm experience which contribute to their active participation in markets. Smallholder broiler farmers were constrained by the quality of roads, lack of extension services, lack of product training, lack of access to market information, lack of broiler output market and lack of access to transport. The econometric analysis showed that the increase in the probability of broiler market participation was mainly attributed to the socio-economic and market factors of the broiler farmers, with most of the explanatory variables belonging to these two categories. The socio-economic factors were gender, education level, household size, marital

status, and farming experience while institutional factors were membership in farm organisation, access to market information, total production of broiler, and profitability were found to affect market participation. The explanatory variables influencing volume sold to the market were access to extension service, quality of roads, access to transportation, distance to market, and broiler price. Based on the findings of this study, improving communications between farmers and extension services is recommended to increase the probability of market participation amongst the smallholder broiler farmers. Extension services provide smallholder broiler farmers with market information, information on new and modern production processes, tools, and technology that majority of the farmers are not aware of. Also, broad-based policies aimed at organizing farmer's cooperatives, promoting, and empowering youth broiler farming participation, and strengthening rural urban infrastructure are recommended. Broiler price was found to positively affect the intensity of market participation. The output price is an incentive for broiler farmers to supply more produce for sale. Therefore, to increase the quantity supplied by smallholder broiler farmers, policies which bring down transitional costs which increase the price received by farmers and encourage farmers to form group marketing arrangements should be applied.

3.5 Future areas of research

This study focused on one District in the Eastern Cape, South Africa. There is a need to expand research to cover all districts, as well as to compare market participation across districts to draw lessons from one district to another; so, to grow the Eastern Cape economy. The current study was conducted to establish the probability and the extent of smallholder farmers' participation in the market. Further studies could be done to assess the effect of farmers' participation in the market on household food and nutrition security and on income.

Next is chapter 4, where the profit determination along with its determinant was investigated.

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CHAPTER 4: AN ANALYSIS OF PROFITABILITY AND FACTORS AFFECTING SMALLHOLDER BROILER PROFITABILITY IN AMATOLE DISTRICT MUNICIPALITY IN THE EASTERN CAPE, SOUTH AFRICA

Abstract

The poultry industry is booming all over the world, owing to the increasing human population, rising purchasing power, and urbanization. South Africa saw the shutdown of Rainbow Chicken enterprises which was one of the biggest poultry producers in South Africa. With the collapse of such a big commercial enterprise, smallholder broiler producers who are willing to participate in the broiler industry need to look at the profitability and productivity in the industry to ensure that they will be able to reap the economic benefits. The analyses of the income leftover from the capital after all overhead costs have been deducted will assist in evaluating the business' success. Feed cost accounts for up to 65% of the cost of a live broiler in poultry operations, making it the most critical factor in profitability. The study examined the profitability and its determinants of smallholder broiler framers in the Amatole District Municipality, Eastern Cape, South Africa. The study made use of snowballing to collect data from broiler farmers. Primary data was collected from June to July 2022 from a total of 150 smallholder broiler farmers by direct interviewing using a semi-structured questionnaire. Descriptive statistics, budgetary technique, and multiple regression model were used for data analysis. The descriptive results indicated that 64% of the smallholder broiler farmers were female with an average age of 41 years old. Smallholder broiler farmers spent 12 years in school which is equivalent to secondary school in South Africa and had a farm experience of 13 years. The budgetary technique showed a net farm income of ZAR 996.16 and a rate of return on investments of 0.26 per production cycle. These results indicated that broiler production is profitable. The empirical results showed that age, household size, farming experience, access to transport, cost of labour, cost of water, cost of feed, and quantity of broiler produced were significant determinants of the profitability of smallholder broiler farmers. The study recommended that the extension officers should be involved in broiler production and assist the farmers in terms of feed cost supplementations. This may encourage new entry into the broiler industry because of its profitability and supplement of feed costs. Government should support broiler farmers through allocating funds for projects that offer broiler production training and market information as to promote more broiler farming. The study recommends formation of extra

marketplaces for selling and development of nearby markets in farming areas around the broiler farmers is crucial to decrease transportation expenses and distance to markets to promote market participation.

4.1 Introduction

Agriculture has a crucial role in developing country economies, particularly in Sub-Saharan Africa (SSA). South Africa continues to be the region's leading broiler producer, accounting for 80% of total broiler production. Broiler production dominates the agricultural sector, and it continues to be the cheapest source of protein among all other animal proteins, with beef coming in second. Broiler meat accounts for approximately 93.6% of all poultry meat produced (DARRLD, 2020). The grain and chick industries both benefited from the expansion. Animal biologists and veterinarians are concerned about the requirement to provide enough animal protein for human use. Animal protein is necessary for man's regular physical and mental development, in addition to being profitable for farmers (Rabbani and Ahmad, 2021).

Broiler farmers, like all other farmers, use profitability ratios to measure and evaluate their farm's ability to generate income relative to their revenue and operating cost during a particular period. This is because it is a well-known fact that the overall essence of venturing into the broiler business is to make a profit. This is in line with the assertion of Ettah *et al.* (2018) that the growth of a business can only be successfully appraised by studying the profitability of the business. While Ettah *et al.* (2021) emphasized that analysing the income leftover from the capital after all overhead costs have been deducted will assist in evaluating the business' success. Feed cost accounts for up to 65% of the cost of a live broiler in poultry operations, making it the most critical factor in profitability (SAPA, 2020).

SAPA (2019) claim rising feed costs as one of the primary reasons why the sector cannot perform better and relies heavily on the price trend of the main feed ingredients. They suggest that high feed costs, as well as a lack of understanding about disease control, outbreaks, selection, and mating processes, are important issues in broiler production. The feed cost in broiler production is a major cost that accounts for around 70% of the overall variable cost, with day-old chicks (DOC) accounting for about 22% and labour, vitamin, and equipment accounting for the rest (SAPA,

2019). The corn harvest in 2018/2019 was 10% lower than the previous year. Even though the crop is still good, the South African Future Exchange (SAFEX) yellow maize prices jumped by an average of 27% between July 2018 and July 2019. Broiler feed prices rose in lockstep with maize prices from August 2018 to April 2019, before levelling out for the rest of the year, 2.9% higher than prices at the height of the drought (2016). As input prices continue to grow, producers are once again under pressure (SAPA, 2019). Furthermore, conventional wisdom holds that smallholder farmers participating in market-oriented production can diversify their income and raise agricultural output, resulting in increased profitability, food security, and poverty alleviation (Mdoda and Obi, 2019). However, many constraints hinder the participation of smallholder broiler farmers in high-value markets. One of these constraints is the high levels of low-priced broiler which is dumped into South Africa.

South Africa consumes more broiler meat than it produces, implying that the country is not self-sufficient and must rely on imports to meet demand. With about 6 million households in South Africa who partake in smallholder agricultural activities (Louw *et al.*, 2017), the shutting down of such a big enterprise as Rainbow chicken poses a question of whether smallholder broiler farmers would be able to survive in the broiler industry and meet the South Africa poultry demand. According to the Department of Agriculture, Land Reform and Rural Development (2020), South Africa produced 1.76 million tons of broiler in 2018/19, but its consumption was 2.3 million tons in the same year. South Africa is becoming a net importer of broiler meat as the gap between use and supply continues to expand (DALRRD, 2020). While low-cost imports may help consumers if the low-cost import prices are passed on to them (which does not always appear to be the case), they can hurt domestic companies' capacity to earn profits at acceptable rates of return. As a result, these manufacturers are unable to maintain the level of investment required to expand their operations (SAPA, 2020). According to DALRRD (2020), increasing local chicken production has recently been a consensus in South Africa. In the same breath, DALRRD (2020) also reported that broiler meat output increased from 2010 to 2015, then declined till 2017. This could be attributed to rising input prices, which puts profitability under strain, as well as the 2015/16 drought.

Local producers highlighted the detrimental effects of high import levels after reporting significant drops in operating profit for the 2018/2019 year (SAPA, 2019). Sales volumes have been slashed, input costs have risen, municipal infrastructure has crumbled, electrical supply has faltered, and

strike action has escalated (SAPA, 2019). All of this contributes to a hostile trading environment, limiting consumer expenditure. Meat importers' statements that broiler producers are making a lot of money are obsolete and do not consider a company's long-term financial status. Recent research (such as Oluwatayo *et al.,* 2017) have shown that broiler production is a successful farming technique in various parts of South Africa (namely Limpopo). However, important challenges such as production accessibility, sustainability, and non-optimal resource utilization may occur. Furthermore, these factors affecting chicken farming can differ from one region to the next, and the farmers were compelled to accept relatively lower earnings due to a small gap between cost and revenue (Kamruzzaman and Rana, 2021). Given the anticipated unstable profit in the broiler industry necessitated largely by the high cost of production, an economic analysis aimed at revealing the status of broiler production in terms of costs and benefits through various performance indicators is indeed important for newcomers and policy formulation in the Amatole District Municipality, Eastern Cape, South Africa. Therefore, the objective of the study is to analyse the profitability as well as to determine the profitability determinants of smallholder broiler farmers in Amatole District Municipality.

4.2 Methodology

4.2.1 Theoretical and analytical framework

Economists agree that profit maximization is one of the major objectives of firms (Olorunwa, 2018). For firms to make a profit (an indicator of productivity) they need to consider their costs when making pricing decisions. Production costs and efficiency are primarily determined by the prices of inputs including time, labour, capital, and technological advances (Olorunwa, 2018). Costs can be broadly categorized as fixed and variable. Fixed costs do not vary with the level of production. Rents, insurances, the salaries of administrative staff and depreciation on capital equipment are all examples of expenditures which do not directly vary with the level of production. If the production of an organization in each period were zero, these costs still must be met. In contrast, variable costs are those expenditures which vary in direct relation to volumes of production. Examples of this class of cost include raw material costs, hourly labour rates and packaging costs. This work benefits from other economic theorists who applied and recommended the use of the unit output profit model and a Cobb-Douglass production function to test the

productivity of firms. Yotopoulos and Lau specifically tested for equal technical and pricing efficiency; equal economic efficiency, and absolute pricing efficiency for each type of firm using the profit model. Their model uses data readily accessible from firms such as input prices, output prices and fixed capital service flow. Tests can be run to determine if the firms are profit maximizers and if technological progress is neutral. Net farm income (NFI) and gross margin (GM). NFI, is derived after obtaining the gross margin (GM). GM is the amount of money realized after deducting variable expenses or costs from total sales or income. NFI is obtained by adjusting net cash farm income for total depreciation, net inventory changes and value of products consumed at home. NFI is the only true measure of profit for the accounting period since it includes the above adjustment which could be quite large. NFI is the profit from the year's operation and represents the return to the rice farm owner for personal and family labour, management and equity capital used in the rice farm. Gross margin= Total income (TI) – Total variable costs (TVC). NFI = GM – Total fixed cost (TFC).

4.2.2 Target Population, Sample Size and Technique

The target population for this study were smallholder broiler farmers in the Amatole District municipality, who kept their broiler to generate a profit. Snowball sampling techniques were used to select 150 smallholder broilers. The first stage involved the purposive selection of the broiler-producing municipalities in the Amatole District Municipality. This was conducted to meet the study requirements of getting in contact with smallholder broiler farmers. A second stage involves community selection within the selected local municipality (must specify how many communities were selected in each municipality and why). The smallholder broiler farmers are not evenly distributed within the communities in the district and extension officers do not have contact with all the broiler farmers. In the last stage, the snowball sampling technique was used to select the desired sample size for the study. A sample size of 150 smallholder broiler farmers was obtained. The broiler farmer found in the database of the extension officer was interviewed and then asked to refer another smallholder broiler farmer. The required sample size was calculated using Cochran's proportion to size method. According to the equation below, the unadjusted sample size is required to be 150.

$$n_1 = \frac{z^2 \hat{p}(1-\hat{p})}{e^2}$$

Where;

n= required sample size

Z = confidence level at 95% (standard value of 1.96)

p = estimate of smallholder broiler farmers which is at 0.89. This was an assumption that 89% of households participates in broiler production in the study area.

q = this is the weighting variable given by 1- p

e^2 = margin of error at 5% (standard value of 0.05)

$$= \frac{1.96^2 \times 0.11 \times 0.89}{0.05^2} = 150.4$$

4.2.3 Empirical model

This section looks at the analytical frameworks applied in this study. This section is divided into three sections, namely: first section is Budgetary technique (gross margin, Net farm income) used to estimate broiler profitability and the second section is Multiple regression used to estimate profit determinants. Several researchers including Rabbani and Ahmad (2021); Ezeano and Ohaemesi (2019); Baba (2016) used this approach.

4.2.3.1 Budgetary technique:

Farm budgetary techniques involving gross margin and net farm income were used to estimate the profitability of smallholder broiler farmers in the Amatole District, Farm budgetary techniques have been widely used in estimating costs, returns, and net farm income of farm enterprises to facilitate production decisions based on worthiness. A farm budget is the detailed physical and financial plan for the operation of a farm for a certain period. The farm budgetary analysis helps to determine the total cost and total revenue that accrued to the enterprise within a specific

production period (Okon *et al.*, 2021). Different tools can be adopted in reaching farm enterprises' decisions including Gross margin (GM), Net farm Income (NFI), Profitability Index (PI), Returns on Investment (RRI), and Rate of returns on Variable Cost (RRVC) and Capital Turn over (CTO).

NFI is derived after obtaining the gross margin (GM). GM is the amount of money realized after deducting variable expenses or costs from total sales or income. NFI is obtained by adjusting net cash farm income for total depreciation, net inventory changes and value of products consumed at home. NFI is the only true measure of profit for the accounting period since it includes the above adjustment which could be quite large. NFI is the profit from the year's operation and represents the return to the broiler farm owner for personal and family labour, management and equity capital used in the broiler farm.

$$\text{Gross margin (GM)} = \text{GrossIncome (GI)} - \text{Total variable costs (TVC)} \quad \ldots\ldots\ldots\ldots (11)$$

$$\text{Net Farm Income (NFI)} = \text{GM} - \text{Total fixed costs (TFC)} \quad \ldots\ldots\ldots\ldots\ldots (12)$$

Where:

TFC = Total Fixed Costs

NFI = Net Farm Income / Profit

GM = Gross Margin

$$= \sum_{i=1}^{n} P_i Q_i - \sum_{j=1}^{n} P_i X_i \quad \ldots\ldots\ldots\ldots\ldots (13)$$

GI = Gross Income

$$= \left(Price\ of\ Output(P_i) \times Quantity\ of\ Output\ (Q_i)\right) + Other\ Income \quad \ldots\ldots\ldots\ldots (14)$$

TVC = Total Variable Costs

$$= \sum_{j=1}^{n} P_j X_j = Price\ of\ input\ (P_i) \times Quantity\ of\ Input\ (X_j) \quad \ldots\ldots\ldots\ldots (15)$$

i is the number of responses ($i = 1,2,3, \ldots n$)

$$\sum_{j=1}^{n} P_j X_j = C_{cj}Q_{cj} + C_{fj}Q_{fj} + C_{lj}Q_{lj} + M_j + T_j + E_j \text{ ....} (16)$$

Where:

C_{cj} = average cost of chicks

Q_{cj} = average quantity of chicks

C_{fj} = average cost of feed

Q_{fj} = average quantity of feed

C_{lj} = average cost of labour

Q_{lj} = average quantity of labour

M_j = average cost of medication/ veterinary service

T_j = average cost of transport

E_j = average cost of electricity

4.2.3.2 Multiple Regression Analysis for Gross Margin

Regression analysis is a statistical approach for examining and modelling the relationship between two or more variables, which can be linear or nonlinear (Mdoda and Obi, 2019). Madushanka and Jathurika (2018) further stated that regression analysis describes the mathematical equation that "best fists" the value recorded for the two variables. The direction of the link between the independent and response variables is shown by the sign of each coefficient. A positive sign shows that there is a direct link between profitability and the sign. A negative sign indicates that broiler production costs are higher, which affects farmer profitability (Cancino *et al.*, 2021). The expected signs are indicated in table 4.1. As used by Aminu and Hermanns (2021), this study also uses a multiple regression model to estimate factors that influence the profitability of smallholder broiler farmers in the study area.

Model specification:

$$Y = \hat{a}_0 + \hat{a}_1 X_1 + \hat{a}_2 X_2 + \hat{a}_3 X_3 + \hat{a}_4 X_4 + \hat{a}_5 X_5 + \hat{a}_6 X_6 + \hat{a}_7 X_7 + \hat{a}_8 X_8 + \hat{a}_9 X_9 + U_i \ldots\ldots (17)$$

Farm profitability is defined as a function of farmer and farm characteristics. The farmer and farm characteristics of interest in this research are presented in Table 4.1.

Table 4.1: Independent variables in the regression model, as well as expected signs

Variables	Measurement type	Expected sign
Farmer characteristics		
X_1 = Age of farmer	Actual years	+
X_2 = Gender	Dummy (1=male; 0= female)	±
X_3 = Educational level	Actual years (Continuous)	+
X_4 = Experience of the farmer	Actual years (Continuous)	+
X_5= Household size	Actual number (Continuous)	±
Farm characteristics		
X_6 = Flock size	Actual units (Continuous)	±
X_7 = Cost of water	SA Rands ZAR (Continuous)	±
X_8 = Cost of electricity	SA Rands ZAR (Continuous)	±
X_9 = Cost of labour	SA Rands ZAR (Continuous)	±
X_{10} = Cost of vaccine	SA Rands ZAR (Continuous)	±

X_{11}= Cost of transportation	SA Rands ZAR (Continuous)	±
X_{12} = Cost of feed	SA Rands ZAR (Continuous)	±
X_{13} = Membership to the farming organization	Dummy (1= Yes; 0= No)	+

"+" indicates a positive relationship between the independent variables and profitability." ±" Indicates and uncertain relationship between profitability and the independent variables. ZAR indicated the South African rand.

Table 4.1 shows the expected indications of the independent variables based on their projected relationship with broiler farmer profitability. Logically, a farmer with more education and experience will be able to accomplish his or her work properly. The educational level of farm owners is critical in broiler bird management, and it is recognized to influence their farming activities (Olorunwa, 2018). The respondents' high literacy level will enable them to comprehend and implement current farm practices, hence increasing productivity and profitability. This means that a farmer's level of education improves his farm's productivity and his ability to grasp and assess new production technology.

The number of years that farm owners or managers have been involved in poultry production could be used to assess the farmers' poultry farming experience (Ahamefule *et al.,* 2020). Experience is predicted to have a considerable favourable impact on a farmer's or farm manager's managerial competence. As a result, the more experienced a poultry farmer is, the more efficient he will be in farm management because the knowledge he has gained through the years will be applied to the production activities. Depending on the age and active members of the home, the size of the household may or may not be helpful.

On the other hand, the farmer's age is projected to have a positive association with his or her overall productivity, resulting in improved profitability. Age is a significant aspect of traditional agriculture, according to John *et al.* (2020). It determines a farmer's ability to produce and, as a result, his production. This is because farming in this part of the world is still labour intensive, with conventional agriculture production systems reliant on rudimentary instruments powered by

human muscle. Flock size may or may not have a favourable impact on a farmer's bottom line. This is owing to the uncertainty surrounding the flock's death rate, which can be unpredictable in many circumstances due to disease outbreaks.

Operational expenditures (cost of water and electricity) and feed costs are also difficult to predict. If the income earned covers the expenses incurred, the relationship is positive, indicating that the broiler farmers are efficient producers. The profitability of a farmer is projected to be positively correlated with his or her membership in an organization. Farmers' contact with various extension media is intended to aid them in gathering up-to-date information on broiler production, which could help them reduce certain limits in broiler farming and increase production.

4.3 Results and discussion

This section is dived into two. The first section profiles smallholder broiler farmers with the use of the socio-demographic profile mean. The second section analyses profitability as well as its determinants using the Budgetary technique as well as the OLS regression model, respectively.

4.3.1 Measuring Profit of smallholder broiler farmers in ADM

One of the main goals of any enterprise is to be sustainable in any competitive environment. To do so, the enterprise needs to develop, implement, and maintain strategies that can enhance its performance. This can be done by investigating the internal and external factors that may have an impact on the enterprises' profitability (Alarussi and Alhaderi, 2018). Profitability is the difference between the cost of resources used in production and the value of monetary goods. The profit is important because it determines farm loss or gains from the amount of revenue realized and the cost of operating a farm venture achieve within a certain period (Mdoda, 2017). Table 4.2 gives an outline of the performance of broiler production (in a single production cycle) in terms of total average revenue, total average variable cost, gross margins attained and return per rand invested. Total average revenue is the average income from broiler sales and gross margins were calculated as total average revenue less total average variable costs. For this study, a positive gross margin reflects a profit, and a negative gross margin reflects a loss. Table illustrates the profitability analysis of smallholder broiler farmers in the sampled study area.

Table 4.2: Profitability of smallholder broiler production in Amatole District Municipality

Costs and Revenue	Amount (in Rands, ZAR)	Percentage
Average Gross Revenue $\sum_{i=1}^{n=150}(\boldsymbol{broiler\ price_i} \times \boldsymbol{quantity\ of\ broiler\ sold_i})/150$	**13011.49**	-
Average variable costs:	-	-
Costs of feed	5136	62.32 %
Cost of day-old chicks	1540	18.69 %
Cost of vaccine	101.22	1.23 %
Cost of water	44	0.53 %
Cost of electricity	352.53	4.28 %
Transportation costs (input market)	354.5	4.3 %
Transportation costs (output market)	285.48	3.46 %
Cost of labour	428	5.19 %
Total average variable costs	**8241.73**	100
Gross margin	**4769.76**	-
Gross Margin per rand	**1.73**	-

Source: Field survey (2022)

The cost of feed is the highest cost of production incurred and contributed 62% of the total variable costs of broiler production in ADM. These high costs of feeds lead to some smallholder broiler farmers being unable to realize significant profits or having to raise the prices of their output. These results agree with Abdurofi *et al*. (2017) who found similar results in their study that feed costs contributed the highest to total variable costs in Peninsular Malaysia. The cost of day-old chicks (DOC) accounted for 18.69% of total variable costs, and these day-old chicks are bred to become chickens that are sold. The cost of DOC was ranked second out of all the variable costs. The high

costs are caused by the monopolistic supply called Umtiza which is located all around the Eastern Cape Province. The broiler farmers have reported a fluctuation in the DOC costs and have nowhere else to purchase the DOCs. These findings were like those findings of Ettah *et al.* (2021) who found that DOC costs in Cross River State in Nigeria were ranked second out of all variable costs incurred in broiler production. Ettah *et al*. (2021) attributed these findings to the few producers of day-old chick, because of the high technology and expertise involved in its production.

The broiler farmers spent an average of ZAR 101.22, ZAR 354.5, and ZAR 285.48 on the vaccine, transport to input market, and transport to output market respectively, per production cycle. This may be because smallholder broiler farmers hardly spend any money on water costs, transportation costs to the output market and supplement feed for crushed maize to help decrease feed costs. The less money spent on costs the greater the gross margin achieved by the broiler farmers. The lowest cost at ZAR 44, per production cycle, was found to be the cost of water. Farmers in Amatole District do not spend a lot of their funds on water because most of the farmers have access to communal taps and dams where they fetch their water to use in their broiler production. These findings agree with Oluwatayo *et al*. (2016) who found water to be the lowest cost in broiler production. The cost of electricity accounted for 4.28% of the total variable cost incurred the broiler production. Smallholder broiler farmers in ADM used paraffin heaters to maintain the required temperature in chicken houses thereby reducing the cost of electricity and this use is encouraged by the constant load shedding the country is experiencing. The study findings agree with Jamtsho *et al*. (2021) that electricity costs as being amongst the least variable costs. Cost of labour contributed 5.19% of total variable costs. The cost of labour amounted to ZAR 64 200 per production cycle. This is the third highest cost incurred by smallholder broiler farmers in ADM. This is due to most of the additional labour employed being expected to work every day of the week. These findings were in line with those reported by Oluwatayo *et al.* (2016).

Broiler farming is profitable in the study due to positive average gross margin and farmers were generating farm returns (ZAR 4769.76 per production cycle). Table 4.2 above indicated that the return per rand is 1.73 and this implies that the returns on the business are greater than the expenses that are incurred for the broiler business. The ratio of total average variable cost to gross margin of 1.73 means that for every R1 spent on broiler production by smallholders, farmers are estimated to make returns of ZAR 1.73 in profit. The broiler farmers can cover the costs of their products

and make a profit from the sales of their products. Therefore, the gross margin analysis shows that broiler farmers in the Amatole District are making a profit in their broiler production. These findings were in line with Oluwatayo *et al.* (2016); Ettah *et al.* (2021); Ifeanyichukwu *et al.* (2016) who also found similar results that broiler production is profitable and feasible to invest on.

Net Farm income as a measurement of profit

The profit is depicted as NFI which is incurred from the operations from the previous production cycle which is estimated to take an average of 6 weeks. The calculation of the net farm income is shown in table 4.3. The gross margin and the net farm income are represented by:

$$Gross\ Margin\ (GM) = Total\ Revenue\ (TR) - Total\ Variable\ Costs\ (TVC) \quad \ldots\ldots\ldots\ldots\ldots\ldots (18)$$

$$Net\ Farm\ Income\ (NFI) = Gross\ Margin\ (GM) - Total\ Fixed\ Costs\ (TFC) \quad \ldots\ldots\ldots\ldots\ldots\ldots (19)$$

$$Return\ on\ Investment = \frac{NFI}{TC} \quad \ldots\ldots\ldots\ldots\ldots\ldots (20)$$

$$\text{Total Costs } (TC) = Total\ Variable\ Cost\ \ (TVC) + Total\ Fixed\ Costs \quad \ldots\ldots\ldots\ldots\ldots\ldots (21)$$

Table 4.3: Net Farm Income of smallholder broiler farmers in ADM

Description	**Rands (R)**
Gross margin (computed in table 4.3)	4770.23
Total Fixed Costs	3774.07
Cost of housing	3774.07
Net farm income	996.16
Return on Investments ($\frac{NFI}{TC}$)	0.26

Source: Field survey (2022)

The above Table 4.3 shows that the net farm income of smallholder broiler producers in ADM is ZAR 996.16 per production cycle. This implies that broiler production is profitable, and farmers were yielding advantageous returns on their broiler production business. In terms of sustainability,

the 150 broiler farmers' profitability was anticipated to be a key factor in motivating them to continue raising chickens, while those who were aware of the profitability associated with this farming practice can participate in the broiler industry and use it as means of making a living and improving their standard of living. The study findings concur with the findings of (Oluwatayo *et al.,* 2016) that broiler production in the Mopani District, Limpopo was profitable and sustainable. The net return on investment value of 0.26 implied that ZAR 0.26 was returned as profit on every ZAR1 invested in the broiler enterprise. This shows that broiler production in the study area was profitable. These findings were consistent with Ettah *et al.* (2021) who reported various levels of profitability and a positive return on investment in broiler production in their study. The profits obtained in the broiler production per cycle in ADM are higher than the R350 (per month) unemployment grants that were received by South Africans during the COVID-19 pandemic, implying that a broiler production is a viable option for the unemployed youth. Moreover, the profitability of the broiler enterprise has the potential to create jobs and promoted food security in the Amatole District. The NFI results show that the province's broiler enterprise is suitable for the agricultural sector.

4.3.2 Factors influencing farm profitability of smallholder broiler farmers

Table 4.4, illustrates the multiple regression results of the factors affecting smallholder broiler production profitability in ADM. The equations in chapter four above are estimated by the Ordinary Least Square technique. A single multiple regression model was used to get the regression parameters, and the variables included in the model were consistent with the theoretical and empirical research presented in chapter four. The variables used in the regression model were age, gender, education level, farming experience, household size, membership in farm organization, access to transport, the quantity of broiler produced, cost of labour, cost of water, cost of electricity, cost of the vaccine, and the cost of feed. The R^2 and the adjusted R^2 of 0.7378 and 0.7128 respectively. This indicated that 73.8% of the variation in the farmers' profitability is explained by the input variables of the smallholder broiler farmers. The significance values demonstrate whether a change in the independent variable significantly influences the dependent variable at a given level. In this study, the variables were tested at 1%, 5% and 10% levels of significance. The variables which were found to significantly influence smallholder broiler farm profitability were age, gender, operating expenses, and cost of feed. The farmers' characteristics

described are in line with the model specification in the previous sections above. The statistically significant farmer's characteristics include age, household size, and farming experience. These characteristics are significant at either 1%, 5% or 10%.

The presence of multicollinearity and heteroscedasticity was detected through carrying statistical tests. The results showed a mean VIF value of 3.16 which ranged between 1.08 and 7.33 depicting the presence of multicollinearity amongst some of the explanatory values. However, the Breusch Pagan test for heteroscedasticity shows an s-statistic value of 2.98 and a p-value of 0.0007. Since the p-value is below 1%, the model shows the presence of heteroscedasticity.

Table 4.4: Factors influencing smallholder broiler profitability in Amatole District Municipality

Variable	Coefficient	Significance
Age	-173.09	0.025**
Household size	474.45	0.049**
Farming experience	229.44	0.044**
Access to transport	6588.28	0.000***
Cost of labour	1.46	0.079*
Cost of water	-2.12	0.058*
Cost of feed	-1.35	0.000***
Quantity of broiler produced	87.73	0.000***
Consent	-6645.12	0.034
F-value	**29.44**	
Prob > F	**0.0000**	
R-squared	**0.7378**	
Adjusted R-squared	**0.7128**	
Observations	**150**	

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

Source: Computed by Author from survey data

The farmers' age has a negative coefficient and was statistically significant at a 5% level. The negative coefficient implies an inverse proportional relationship with profitability. Also, it suggests that middle-aged people tend not to participate in markets to the same extent as younger

farmers. These results were in line with the findings of Adeyonu and Odozi (2022). Household size was found to be statistically significant at a 5% level and household size was used as a proxy for family labour. It had a positive coefficient implying that a unit increase in household size, induces an increase in the broiler farmers' profit. This may be attributed to an increase in family labour which will positively affect productivity and thereby increase profits. These results were identical to those of Obayelu *et al.* (2017) who found that household size contributes to family labour which increased farm profits.

Farm experience had a positive coefficient and is significant at 5% level. The positive coefficient implies a direct relationship with profitability. Implying that the more experience the smallholder broiler farmers has the higher the profits. This means that smallholder broiler farmers with the most experience are likely to have mastered their production systems resulting in less wastage and a higher productivity level. They are also expected to have a higher understanding of the market dynamics thereby resulting in increased profit generation. These findings were in line with Mdoda (2017) who concluded that an increase in the farm experience would result in an increase in profit or returns of a farmer. It was attributed that farmers who have higher farming experience are expected to be more knowledgeable in the combination of resources. The more experience the farmers are, the more understanding of market dynamics, which subsequently increases and generates farm profit as well as knowing how the profit is generated.

The cost of labour has a positive coefficient which is statically significant at the 10% level. This depicts a positive relationship between the cost of labour and the profitability of the broiler farmers. This implies that hiring labour results in an increase in broiler productivity consequently increasing profits. This finding was in line with that of Okon *et al.* (2021) who observed that labour is one of the most important factors of production contributing to profits. Whereas the cost of water has a negative statistically significant relationship with broiler profitability at a 10% level of significance, owing that an increase in the cost of water will reduce the profit level of the broiler farmers. This was in line with the finding of John *et al.* (2020) where it was found that water costs are inversely related to the profit level of the farmers. These costs are hardly faced by most of the smallholder farmers in the ADM because the farmers receive free water from the municipal taps and fetch water from the river. The OLS regression results showed access to transport to be positive and statistically significant at a 1% level. The positive results imply that an increase in the

accessibility of transport will increase broiler farmers' profitability. Transportation offers a way to get goods to the nearest output market and it is a need for farmers in the ADM as farmers are situated far from the output market. The output market offers higher prices and customers which results in higher profits.

The cost of feed has an inverse relationship with the profitability of smallholder broiler farmers, and it is statistically significant at 1%. The negative coefficient implies that a unit increase in the cost of feed is going to decrease the profit level. Feed was found to be the most expensive production cost incurred by the farmers in ADM but some of the farmers substituted feed with crushed maize that they grow themselves. The expensive feed raises costs and results in a decrease in profits. Abdurofi *et al*. (2017) also suggested that feed account for 70% of total variable costs which in turn means that it's a large determinant of profit levels. The quantity of broiler produced was found to have a positive coefficient, indicating a positive and significant (p=0.000) farm profitability. This implies that a unit increase in the quantity of broiler produced increases farm profitability. Producing a higher broiler quantity allows for a greater stock of broiler to be sold and therefore higher profits will be realized.

4.4 Conclusion and policy implications

This study investigated the determinants of broiler profitability in the Amatole District Municipality Eastern Cape, South Africa using quantitative primary data through interviewing 150 smallholder broiler farmers. The study made use of descriptive statistics, budgetary techniques, and multiple regression for analysis. The budgetary technique (gross margin and net farm income) was used to calculate whether broiler production in ADM was profitable. The descriptive results reveal that farming is dominated by female farmers with an average age of 41 years. The average household size was 5 people in a household and had farm size of 0.774 hectares. The budget technique analysis revealed that broiler production is profitable with a value of average net farm income equaling ZAR 996.16 per production cycle. The OLS regression shows that age, household size, farming experience, cost of water, cost of feed, cost of labour, access to transport, and quantity of broiler produced were factors influencing smallholder broiler profitability. Feed prices was found to be the strongest determinant of smallholder broiler profitability. Therefore, the study recommends that government and Department of Agriculture to invest more on agricultural

extension officers so that they can train broiler farmers and disseminate crucial information required for broiler production. This may encourage new entry into the broiler industry because of its profitability and supplement of feed costs. The study further recommends financial support for broiler production from government and NGOs as farmers struggle to access finances to purchase broiler inputs and transport their production as this will encourage young people to join the broiler farming.

4.5 Future areas of research

This study focused on one District in the Eastern Cape, South Africa. There is a need to expand research to cover all districts, as well as to compare profit levels and profit determinants in the broiler industry of each district in the Eastern Cape, to draw lessons from one district to another. Further studies could be done to assess the understanding of the importance of profit generation in business, amongst the smallholder broiler farmers.

Next on the study is chapter 5, where the productivity and efficiency of the smallholder broiler farmers is investigated.

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CHAPTER 5: SMALLHOLDER BROILER FARMING PRODUCTION EFFICIENCY IN AMATOLE DISTRICT: A STOCHASTIC FRONTIER APPROACH

Abstract

South Africa is the African continent's top commercial chicken producer, followed by Egypt, Morocco, Nigeria, and Algeria, in that order. Poultry products are the most widely produced, affordable, and eaten animal protein in South Africa, helping the government achieve its zero-hunger targets. The broiler industry in South Africa saw its largest broiler producer, Rainbow Chicken, collapse raising the question of whether smallholder broiler farmers will be able to produce efficiently in such a climate. Size is a crucial driver of the efficiency levels in broiler production and smallholder broiler production does not benefit from these economies of scale that commercial farmers can benefit from. Therefore, emphasises the question of whether smallholder broiler farmers will be able to efficiently produce to generate profit. The study was conducted in the Amatole District Municipality of the Eastern Cape province, where the broiler farmers' production efficiency was estimated using the stochastic production frontier. It aims to determine the input variables affecting broiler production and the level of technical efficiency achieved. The snowball sampling technique was used to collect data using a semi-structured questionnaire from 150 broiler farmers. The data collected was analysed using relevant econometric techniques. The study results reveal that the smallholder broiler farmers had an average technical efficiency of 81% and the average land holdings of 0.77 hectares. The stochastic production frontier indicated that stock size, the quantity of feed administered and the land under broiler production were the significant determinants of broiler production. The results for the technical inefficiency indicated that quantity of feed, land size, and stock size were the significant determinants of technical inefficacy of smallholder broiler farmers in ADM. With broiler production being technical efficient, programs that promote broiler production amongst rural communities should be promoted. Funding to promote an increase in stock size should be offered to farmers so they can slowly move from being smallholder producers to commercial producers. Based on the farm stochastic production frontier analysis, the study recommends the implementation of policies that aim to reduce the costs of broiler production so that locally produced chicken meat can compete with imports in terms of prices.

Keywords: broiler production, productivity, technical efficiency

5.1 Introduction

Agriculture's importance in the economy is shown in its distribution of jobs, contribution to the nation's Gross Domestic Product (GDP), foreign exchange earnings, savings, and provision of food and fibre for local consumption as well as raw materials for agro-allied businesses (Ahiale *et al.,* 2019). World agriculture will need to evolve dramatically in the coming decades to meet the future food demands of a growing, increasingly wealthy, and urbanized population (Paloma *et al.,* 2020). Smallholder farmers in developing nations are an important part of the global food security equation. More than 80% (475 million) of the world's farms operate on less than two hectares of land. Despite accounting for only 12% of the world's agriculture, these farms generate an estimated 80 per cent of the food produced in Asia and Sub-Saharan Africa (Gomez *et al.,* 2020). Despite the critical role smallholder farms play in global food security and nutrition, they are a vulnerable population that is frequently overlooked by development policies, and they account for the majority of the world's poor and hungry (Paloma *et al.,* 2020).

South Africa is the African continent's top commercial chicken producer, followed by Egypt, Morocco, Nigeria, and Algeria, in that order. Poultry products are the most widely produced, affordable, and eaten animal protein in South Africa, helping the government achieve its zero-hunger targets. The industry is the most important part of the country's agricultural economy, accounting for more than 16% of total GDP (Nkukwana, 2018). According to SAPA (2019), roughly 74% of the birds in the South African poultry sector are utilized for meat production, with the remaining 26% for egg production. Between 2004 and 2008, the South African broiler sector had a significant expansion, averaging more than 7% each year. From 2009 to 2014, the industry's growth dropped dramatically to less than 1% each year. The sector rose by 4.7% in 2015, including spent birds and non-commercial output, before contracting by 3% in 2016 and a further 0.9% in 2017. Broiler output in South Africa increased by 5.3% in 2018, 3.9% in 2019, and 3.7% in 2020, resulting in lower maize costs. Growth has averaged roughly 1.6% per year during the last ten years, from 2010 to 2020. To put these figures in context, the yearly population increase between 2004 and 2008 was 1.4%, and the annual population growth between 2010 and 2020 was roughly 1.58% (SAPA, 2019).

South Africa consumes around 3.6 million tons of poultry, beef, lamb, and pork meat each year, with poultry meat accounting for more than 60% of total meat consumption. Poultry meat has become the most important protein source in the diet of the majority of South Africans due to its low cost and availability (AgriSeta, n.d.). The growing consumption of poultry worldwide has incentivized the development of chicken breeders (Caldas *et al.,* 2018). One of the reasons for the increase is that poultry provides relatively low-cost animal protein (Mueller *et al.,* 2018). The most prevalent classifications for major poultry production systems are egg and meat production systems (Ren *et al.,* 2020). The importance of broiler is further noted by Ezeano and Ohaemesi (2020) to include: offers high productiveness, fast growth rate, short generation interval, and unparalleled competence in the nutrient transformation to high-quality animal protein. Despite these positive characteristics, Ettah *et al.* (2021) report that the industry still faces challenges such as poor reproductive performance, low growth rates, diseases, mortality, predation, and low literacy among farmers, as well as a poor market for the product in smallholder broiler production.

Smallholder broiler farmers in South Africa are finding it difficult to meet local market demand and export broiler products because of obstacles such as lack of access to markets, high production costs, and low quality of finished products in packaging and standards. As a result, efforts to overcome these limits must be stepped up through research, policy formulation, and help from the public sector and other stakeholders. These factors, as well as others, prompted the need to conduct this research and identify ways to aid smallholder broiler farmers in their production and sale of their goods.

Moreso, according to DAFF (2018), there are eight (8) commercial producers responsible for over 70% of the total broiler production. Louw, *et al.* (2017) cited that the production of 40 000 birds per cycle is small-scale production in South Africa, and that about 75% of smallholder farmers often place about 1000 birds per cycle on average. The 30% of broiler production falls under this category, often characterized by constituting those farmers who largely rely on indigenous fowls for home consumption and profit generation from the surplus. This is one of the key challenges associated with poor efficiencies as size is a key determinant of efficiency levels that can be achieved (Louw *et al.,* 2017). Furthermore, the limited ability to buy inputs in bulk due to the operation's small scale tends to raise input costs in comparison to larger industry competitors. As

a result, in such an environment, integrated operations with economies of scale are likely to dominate (NAMC, 2020).

Many smallholder poultry operators have been forced out of business in the past owing to issues such as feed shortages and high costs of other inputs. Tesfaw *et al.* (2021), reported that broiler producers could sell their products at a competitive price to make more profit if the cost of broiler production is reduced. On the other hand, SAPA (2019) reported that many new farmers have been unable to maintain their enterprises in the face of challenging trade conditions, putting rural food security at risk. Small producers are especially susceptible since they can't withstand market shocks and rely on an enabling environment to succeed. The collapse of the chicken sector would have major implications for maize and soya producers, as well as the full food and grain value chain, which includes fertilizer and seed providers, as well as storage and processing facilities.

To reduce dependency on imports and allow broiler production to effectively contribute to food security and poverty reduction, it is imperative to optimize broiler production systems by improving the productivity of production factors. Furthermore, as agricultural land cannot be increased indefinitely, there is a need for improvements in the efficiency of existing production factors to foster broiler production. Growth and development in the agricultural sector can be achieved if farmers strive to increase their resource utilization efficiency. Most policies that have been adopted in the past have tried to address growth through increased use of agricultural inputs and expansion of agricultural enterprises by bringing more land under cultivation without really focusing on maximizing efficient utilization of the already available resources. In sub-Saharan Africa, development practitioners are now realizing that improving the efficiency of agricultural production is a necessary strategy for economic growth and the alleviation of rural poverty (Dube and Mugwagwa, 2017).

The concept of agricultural resource efficiency is concerned with the relative performance of the processes utilized to convert given inputs into outputs. Technical, allocative, and economic efficiency are the three primary categories of efficiency (Ahiale *et al.*, 2019). Technical efficiency refers to a company's capacity to adopt best practices in the manufacturing process to ensure that just the minimum quantity of a given set of inputs is required to produce the "optimal" level of output. Allocative efficiency refers to the selection of the best input combination given the relative

factor prices. Economic efficiency, on the other hand, refers to a farm's capacity to maximize profit.

The effectiveness and quality of farm management are reflected in agricultural output efficiency. Some claim that expanding production and productivity through technological adoption and area expansion (Getahun and Geta, 2017). However, the first alternative requires significant funding for technology development and diffusion, while the second option is improbable due to land scarcity and excessive subdivision into small units, resulting in highly fragmented production systems.

As a result, enhancing agricultural production and productivity among smallholder farmers through efficiency necessitates a thorough understanding of the present efficiency level in the area, as well as the factors that influence efficiency levels. There have been small empirical studies conducted to estimate the level of efficiencies and identify their determining factors for major crops such as barley (Getahun and Geta, 2017), which reported a significant level of inefficiencies, but no studies computed and highlighted the output loss due to inefficiency. There are no similar investigations underway in the study area, to the best of the author's knowledge. Furthermore, current inputs and technology must be used to update the information. As a result, this research was conducted to estimate smallholder barley production technical efficiency, identify variables impacting technical efficiency, and compute frontier output and the amount lost by an average efficient producer.

In terms of production efficiency, there is little doubt that South African producers outperform worldwide competitors. Over the years, the University of Wageningen has shown this. Our competitiveness is harmed by production expenses, mainly feed costs. In most countries, feed expenses account for 65% to 73% of total live broiler production costs. Any rises in global maize and soya prices have an influence on South African feed costs due to the country's relatively high levels of protein imports and a free market for maize exports. Even for non-dumped tariff lines, high feed prices keep the domestic broiler price over import parity, making South African producers vulnerable to imports. Even a declining and cannot safeguard the local market against inexpensive poultry imports when global feed prices are high, or the local maize harvest fails (SAPA, 2019).

Rainbow Chicken, one of the largest enterprises, says it retrenched 1200 workers (in January 2017) and that this will increase inside Rainbow and other chicken establishments throughout the country," according to Karodia (2017). The situation is insecure and generating great difficulty for workers, and it is only going to become worse in the current economic climate. To stay afloat, Rainbow has sold 15 of its 25 chicken farms. It is nothing short of a calamity for thousands of individuals to lose their employment at a time when economic growth is stagnating and job losses across the country are at an all-time high. The South African poultry industry is in dire stress and an absolute crisis (Karodia, 2017). Following the declaration of the poultry business as a distressed industry, there have been numerous requests for intervention in recent years, raising the question of how competitive South African producers are globally and what the basic elements are that drive that position (BFAP, 2019).

Because size is a crucial driver of the efficiency levels in broiler production, smallholder broiler production does not benefit from these economies of scale that commercial farmers can benefit from (Louw *et al.*, 2017). This affects the productivity, profitability, and market access of smallholder broiler farmers as they do not experience economies of scale. With limitations to the size and other resources, several concerns arise: (a) Are the resources and inputs employed in broiler production producing the highest possible yields? (b) How effectively can these restricted resources be utilized to maximize broiler production? and (c) What factors influence production efficiency in the district under investigation? Assessing the profitability of enterprises and the efficiency of production is the greatest way to determine whether resources are being used efficiently. Producers must therefore be aware of the drivers of production efficiency for the businesses in which they are involved early on.

With the size limitation and the stiffer competition faced by poultry producers from imported poultry products that tend to be about 30–40% cheaper than chicken from domestic producers (FAO, 2014). This has further aggravated the production challenges of the local poultry industry and has dimmed the sector’s potential role in the socio-economic development of the country. Farmers in the poultry sub-sector have consistently called for input subsidies and other import regulations to enable them to compete fairly with imported ones. The growing concern is whether the poultry sub-sector is economically vibrant and has better returns on investment. The purpose of this study is to estimate the technical efficiency of smallholder broiler farmers in the Amatole

District Municipality using the stochastic production frontier. Recommendations for improving smallholder broiler productivity in Amatole District Municipality are included in this study.

5.2 Methodology

5.2.1 Theoretical Framework

Efficiency concerns the relative performance of the processes used in transforming a given input into output (Otieno *et al.,* 2012). Agricultural productivity can be defined as the index of the ratio of the value of total farm output to the value of the total inputs used in farm production. Since one of the main objectives of any society is the attainment of an optimally high level of living with a given amount of effort, any increase in the productivity of resources employed in farm production will amount to progress. Increasing agricultural productivity will contribute to the well-being of the economy. From a general perspective, any increase in farm output will result from one of the following forces: First it would result from an increased quantity of inputs with no change in output per unit of input; second, it will result from the increased productivity of inputs with no change or a decrease in the quantity of input; finally, it will result from a combination of changes in inputs and productivity. This situation makes the concept of efficiency a central issue in production economics.

Economic theory distinguishes two measures of efficiency: technical and allocative efficiency. Any firm that achieves both are described as being economically efficient. Several attempts have been made to define economic efficiency and measure it empirically. Farrel (1957) defined economic efficiency in an admirable and accepted form, but his definition defies precise measurement. His definition of efficiency is couched in three-related terms. Firstly, he defines technical efficiency as the measure of a firm's success in producing a maximum output from a given set of inputs. It indicates all those undisputed gains that can be obtained by simply gingering up management. Secondly, he defines price or allocative efficiency as the measure of a firm's success in choosing an optimal set of inputs. This is an indication of the gains that can be obtained by varying the input ratios on certain assumptions about the future price structure lastly, he defines overall efficiency as the simple product of technical and price efficiencies.

The frontier measure of efficiency implies that efficient firms are those operating on the production frontier. The amount by which a firm lies below its production frontier is regarded as the measure of inefficiency (Chaovanapoonphol and Somyana, 2020). Efficiency cannot be easily measured since precise measurements rest on the assumption of an efficient isoquant. However, research has established two approaches to measure Efficiency. Farrell (1957) categorized these approaches into parametric and non-parametric measures. The non-parametric approach is a deterministic technique that employs mathematical programming to evaluate relative efficiency. The commonly employed non-parametric technique in literature is the Data envelopment analysis which assumes no random mistakes and is mainly used to measure the technical efficiency of decision-making units (Fadzima, 2016).

Srinivasulu *et al*. (2015) further opined that the Data envelopment analysis is more appropriate for the industrial, rather than the agricultural sector. The major setback of this approach is its inability to estimate model parameters and allow for hypothesis testing of the fitness of the model (Kavoi *et al.*, 2016). In addition, it does not separately specify efficiency scores from unknown variations (noise). The parametric approach on the other hand makes use of a stochastic frontier production which is based on the Cobb-Douglas production function incorporated into various estimation methods such as ratio analysis, Ordinary Least Square (OLS), Total Factor Productivity (TFP) and Stochastic Frontier Analysis (SFA) (Fadzima, 2016)

This study uses the stochastic frontier production function. The stochastic frontier function is useful, according to Abate and Mekie (2019); Bairagi and Mottaleb (2021); Pudaka *et al* (2018) since it helps to measure both technical efficiency sources and the impact of measurement mistakes or factors that are not inherently related to production. The error term ($\boldsymbol{e_i}$) is used to estimate the technical efficiency when using the stochastic frontier model. The error term has two components, $\boldsymbol{e_i}$ which factors a random error term $\boldsymbol{v_i}$ with a zero mean ($\boldsymbol{0, \sigma\, v^2}$) that is related with random or statistical disturbance term which describes the impact of weather, diseases, and other events outside the farmer's control; and $\boldsymbol{u_i}$, the non-negative random variable related to an individual ith farmer's inability to attain maximum efficiency of production. This study defines $\boldsymbol{u_i}$ to represent the technical inefficiency of the broiler farmer which lies between zero and one. The stochastic model is specified as:

$$Y_i = f(X_i;\beta)\ exp(\varepsilon_i) \qquad = f(X_i;\beta)\ exp(v_i - u_i), i = 1, \dots, N \qquad (18)$$

Where Y_i is the weight of birds at the sale of the i[th] poultry farmer, $f(X_i, \beta)$ represents a production functional form (such as Cobb-Douglas or Translog functional form) and $(\varepsilon_i = v_i = u_i)$ denotes the composite error term. Normally, the v_i captures random factors which are beyond the control of the poultry farmer and are assumed to be identically and independently distributed (iid) with zero mean and a constant variance as $(0, \sigma v^2)$. The two error terms are also assumed not to be correlated with each other and with the input variables (X_i). On the contrary, the inefficiency error component u_i although has similar characteristics, differs slightly by having a non-zero mean (Chandio *et al.,* 2019). The error term u_i is assumed to have a truncated normal distribution $\left(u_i \approx iddN^{+}(\mu, \sigma u^2)\right)$ and the technical inefficiency effects are expressed as:

$$u_i = Z_i\delta + w_i \qquad (19)$$

In this case, Z_i is a $(P \times 1)$ vector of explanatory variables meant to capture the technical inefficiency effect including socioeconomic and poultry farm management factors; δ is a $(P \times 1)$ vector of unknown parameters to be estimated and wi represents the unobserved random variables which are assumed to be independently distributed and normally distributed with zero mean and constant variance. The technical efficiency of the i[th] poultry farmer, denoted by TE_i, is defined to be the ratio of the mean production of the i[th] poultry farmer, given the value of the inputs X_i , and its corresponding technical inefficiency effect u_i to the corresponding mean of production if there were no inefficiency of production. The technical efficiency is empirically measured by decomposing the deviation into a random component (V_i) and an inefficiency component (U_i). The technical efficiency of an individual farm is defined in terms of the observed output (Y_i) to the corresponding frontier output (Y^*) given the available technology (Battese and Coelli, 1995), that is,

$$TE = {Y_i}/{Y_i^*} = \frac{f(X_i;\beta)\ exp(v_i - u_i)}{f(X_i;\beta)\ exp(v_i)}$$

$$TE = exp(u_i) \qquad (20)$$

Such that, $0 \leq TE \leq 1$. An estimated value of technical efficiency for each observation was calculated as in equation (3). A $TE = 1$, means the firm is technically efficient and its output level is on the frontier. Otherwise, a $TE < 1$, the firm is technically inefficient because it could have produced more outputs with the given level of inputs irrespective of input prices.

5.2.2 Data collection methods and sampling techniques

The survey design for this research was cross-sectional, where data from smallholder broiler production were collected at a single point in time without repetition from the sample. The design is appropriate for descriptive study and determination of the relationships between and among each participant's characteristics. It is also economical in terms of time and financial resources (Saqiba *et al.*, 2018). Mdoda (2017) defines a sampling frame as a list of all units from which a sample is to be drawn. Information with regards to the operation status of the smallholder broiler farmers in Amatole District was accrued through communication with the extension officers in Amatole District. In this research, smallholder broiler farmers were selected based on their voluntary participation. Based on the information gathered, the municipalities where broiler production took place were identified and the communities with the most broiler producers were further identified. The research team relied on the support from extension officers who assisted in identifying smallholder broiler framers in the different communities in the study area. Enumerators made up of residents were involved in the study of productivity analysis in the Amatole District. No farm records were being kept and provided by farmers regarding income and expenditure, which resulted in the research using discretion. These yields aggregated results.

A snowball sampling technique was used in selecting the study participants. A sample of 150 households was selected and was trusted to yield unbiased results. Areas, where broiler farming took place, were identified then the previously interviewed farmer was asked to identify a fellow broiler farmer until all 150 broiler farmers were interviewed. Primary data were collected using well-structured questionnaires administered by three enumerators, who knew how to communicate with the farmers in their local language. A Pilot test was administered to 10% of the sample size, to train the enumerators as well as ensure the viability of the questionnaire. The data were collected between June and July 2022.

5.2.3 Empirical Model Specification

As mentioned above, the stochastic frontier production model that comes with technical efficiency effects was utilized for this study (Abate and Mekie, 2019). The Cobb-Douglas stochastic frontier production function, which assumes broiler farmers' production technology, is as follows:

$$InY_i = B_0 \sum_{j=i}^{4} B_j \, In \, X_{ij} + v_i + u_i \quad (21)$$

$$InY_i = \beta_0 + \beta_1 InX_{i1} + \beta_2 InX_{i2} + \beta_3 InX_{i3} + \beta_4 InX_{i4} + \beta_5 InX_{i5} + v_i + u_i \quad (22)$$

$In =$ Natural logarithm

$B_0 =$ Constant term

$B_j =$ Production coefficient

Y_i = Broiler output (kgs)

X_1 = Labour (in man-days)

X_2 = Feeds (kgs)

X_3= Stock size (units)

X_4 = Vaccines (rands)

$X_5 =$ Land area under poultry production (ha)

$X_6 =$ Total variable costs such as electricity, water, and petrol costs (rands)

$V_i =$ Statistical noise

$U_i =$ Technical inefficiency

Technical Efficiency:

A smallholder broiler farmer is deemed technically efficient when it produces as much output as possible from a given set of inputs or if the farmer uses a minimal number of inputs for a given level of output. This will assist the smallholder broiler farmers in being competitive in the broiler market. Technical efficiency is calculated as follows (Onyewuchi, 2019):

$$TE_i = a_0 + a_1W_1 + a_2W_2 + a_3W_3 + a_4W_4 + a_5W_5 \quad (23)$$

Where:

TE_i = Technical efficiency effect of the i-th farmer

W_i= Explanatory variable representing socio-economic characteristics of farmers to explain technical inefficiency

a_i = Unknown parameters

a_0 = Constant term

W_1 = Age (years)

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

W_3 = Household size (in numbers)

W_4 = Education Level (in years)

W_5 = Farming experience (in years)

Table 5.1: Stochastic production variables and technical efficiency of broiler farmers' determinants.

Variables	Units	Description
	Stochastic Production Frontier	
$\boldsymbol{Y_i}$	Kilograms	Broiler output
FARMERS INPUTS		
$\boldsymbol{X_1}$	Kilograms	Feeds
$\boldsymbol{X_2}$	Units	Stock size
$\boldsymbol{X_3}$	Rands	Vaccine
$\boldsymbol{X_4}$	Hectares	Land area under poultry production
FARMERS' VARIABLE OVERHEAD COSTS		
$\boldsymbol{X_5}$	Rands	Cost of electricity
	Determinants of technical efficiency	
$\boldsymbol{W_1}$	Years	Age
$\boldsymbol{W_2}$	Dummy	Gender
$\boldsymbol{W_3}$	Units	Household size
$\boldsymbol{W_4}$	Years	Education level
$\boldsymbol{W_5}$	Years	Farming experience
$\boldsymbol{W_6}$	Dummy	Access to extension services

Yi is the dependent variable of the stochastic production frontier; Xi are the independent variables of the stochastic production frontier. Wi are the independent variables of technical efficiency.

5.3 Results and discussion

5.3.1 Stochastic Production Frontier and Technical Efficiency Results

5.3.1.1 Estimating stochastic Production Frontier of broiler producers

The productivity of broiler farmers in the study area was determined using the Stochastic Production Frontier Function. The variables that were determinants of broiler productivity were

quantity of feed, stock size, and land size which were all significant at 1%. They all had a positive coefficient depicting a positive relationship between the variables and productivity. An increase in the quantity of feed, stock size and land size will increase the productivity of smallholder broiler farmers. The estimated stochastic frontier showed a significant Wald chi-square value of 218.01 and an overall sample with a statistically significance at 1%, 5% and 10% levels. The diagnostic statistics show a log-likelihood ratio of -29.3209 and a lambda value of 0.0875. The value of lambda, which is the variance ratio indicates that 8.75% of the variation in broiler productivity is due to inefficiency. This indicates a good fit of the model and considers the composite random errors. The overall average technical efficiency for potatoes in the study area is 81%.

Table 5.2: The stochastic production frontier function for smallholder broiler farmers in ADM.

Independent variables (natural logarithm)	Parameters ($\boldsymbol{\beta}$)	Broiler Output (Y) = Dependent Variables		
		Coefficient	**Std Err**	**P> | t |**
Quantity of feed	β_1	0.407	0.108	0.000***
Stock size	β_2	0.498	0.140	0.000***
Land size	β_4	0.056	0.034	0.000***
Constant	β_0	2.248	0.00943	0.000***
Sigma v		0.0689	0.0126	
Sigma u		0.6023	0.0367	
Lambda		0.0875	0.0367	
Log likelihood = -29.3209 Prob > chi2 = 0.0000 Wald chi2 (4) = 218.01 Number of Observation (n=150) Average Technical Efficiency = 0.81				

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

Source: Results generated from STATA 17 from survey data (2022)

The stochastic production frontier (Table 5.2) revealed that quantity of feed used had a positive and was statistically significant at 1% level. This indicated a positive relationship between the quantity of feed used and the productivity of the broiler farmers. When broiler feed is increased, broiler output will also increase. This shows that the broiler chickens are using and consuming their feeds effectively. These findings were consistent with those of Oluwatayo *et al*. (2016) where

a positive relationship was observed between the quantity of feed and broiler production. The stock size was statistically significant at a 1% level and had a positive coefficient. This implies that when stock size is increasing by 1% addition, the broiler output produced will also increase. These results agree with Olorunwa (2018) that broilers production increases with an increase in the number of birds and that the larger the flock size, the less inefficient a farmer becomes.

The land size under broiler production had a positive coefficient and was statically significant at a 10% level. The results imply that an additional land size, will result in an increase in the broiler production. This indicates that high levels of broiler produce were recorded amongst farmers with a larger land size compared to those with a small portion of land. Larger farm sizes allow a larger space that can occupy a bigger stock size than those with a small land holding. The results contradicted those of Evans *et al.* (2021) who recorded a high level of output amongst farmers with a small portion of land. The plausible defense, by Evans *et al.* (2021), is that farmers with small areas of land may be among those who depend on their farms for employment.

5.3.1.2 Technical Efficiency of broiler producers

The focus of this study was to find determinants of technical efficiency amongst the smallholder broiler farmers in Amatole District Municipality. Merely having knowledge that farmers were technically inefficient might not be beneficial unless the determinants of the inefficiency are identified. Therefore, in the second stage of this analysis, the study investigated farm and farmer-specific determinants that had an impact on smallholders' technical efficiency. The results show that gender, household size, and farm experience have a significant influence on the level of technical inefficiency attained by smallholder broiler farmers in the ADM. Accordingly, the negative and significant coefficient of gender and household indicate that improving these factors contribute to reducing technical inefficacy. Whereas the positive and significant variable of farming experience affects the technical inefficiency positively.

Table 5.3: Determinants of technical inefficiency of broiler producers

Technical inefficiencies				
Independent Variable	**Parameters**	**Coefficient**	**Std Err**	**P> | t |**
Gender (female)	W_2	-2.348	0.876	0.007***
Household size	W_4	-0.647	0.134	0.000***
Farmer experience	W_5	0.177	0.101	0.078*
Constant	W_0	0.659	2.030	0.747
Sigma v		0.112	0.017	
Sigma u		0.396	0.033	
Lambda		3.534	0.041	

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

Source: Results generated from STATA 17 from survey data (2022)

The results for gender showed a negative coefficient for broiler production and was statistically significant at 1% level. This suggests that there is an inverse relationship between gender and broiler productivity. This implied that an increase in female broiler farmers results in a decrease in inefficiency, therefore, concluding that male broiler farmers were more technically efficient than female farmers. This may be attributed to the labour intensiveness of broiler production. These findings contradict with Hassan (2018) who found female farmers to be more technically efficient than their counterparts. Household size had a negative and was statistically significant level at 1%. This implies that an increase in the household size will induce a decrease in the technical inefficiency of broiler production. This may be attributed to the fact that larger households were more likely to employ family labour to assist with broiler production, resulting in a decrease in technical inefficiency. Hassan (2018) found that big family sizes attest to be a constraint to the success of higher production as the product is used in meeting the needs of the big household size.

Farm experience had a positive coefficient and was statistically significant at 10% level. This suggests a directly proportional relationship between farming experience and the technical inefficiency of the broiler farmers. An increase in farming experience will induce an increase in technical inefficiency. This implies that broiler farmers in ADM with high farm experience were technically inefficient. This contradicts those of Olorunwa (2018) who states that farmers with

more years of farming experience tend to be more technically efficient. The technical inefficiency observed from the broiler farmers, as farm experience increases, may be attributed to diminishing returns to scale. Experience comes with age, therefore the more experienced the broiler farmers are, hence older, the less efficient they become

5.4 Conclusions and policy recommendations

The main aim of the study was to identify factors affecting smallholder broiler farmers' productivity in the Amatole District Municipality in Eastern Cape South Africa. The study indicated that even though smallholder farmers do not benefit from the economies of scale and face cheap broiler imports, smallholder broiler farmers in South Africa continue to produce. The descriptive statistics indicated that smallholder broiler farmers were middle-aged and predominantly female. They also spent 11 years in school and had a farming experience of 13 years. The Stochastic Production Frontier showed that stock size, the quantity of feed and land size significantly influenced smallholder broiler production. The technical efficiency results showed that gender, household size and farming experience are the significant factors affecting the level of technical efficiency of broiler farmers. The results also showed that the average technical efficiency level of smallholder broiler farmers was 81% and meaning that, on average, the broiler farmers in Amatole District can save up to 19% in production costs. With broiler production being technical efficient, programs that promote broiler production amongst rural communities should be promoted. Funding to promote an increase in stock size should be offered to farmers so they can slowly move from being smallholder producers to commercial producers. It is recommended that the implementation of policies that aim to reduce the costs of broiler production in ADM so that locally produced chicken meat can compete with imports in terms of prices. With the decrease in feed costs, farmers can buy a larger quantity of feed which positively affects the level of productivity of the broiler farmers.

5.5 Future areas of research

This study focused on one District in the Eastern Cape, South Africa. There is a need to expand research to cover all districts, as well as to compare productivity levels in the broiler industry of each district in the Eastern Cape, to draw lessons from one district to another. Further studies could

be done to assess the input drivers of productivity in the broiler industry of Amatole District Municipality.

The next chapter is chapter 6, where the summary, conclusion and the policy recommendations of the study are found.

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CHAPTER 6: SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

6.1 Introduction

The study is summarized in this chapter, along with the conclusions. This chapter also analyzes appropriate policy solutions that may enhance productivity, profitability, and market participation for smallholder broiler farmers in Amatole District. The summary, results and policy recommendations are all provided in this chapter.

6.2 Summary

The poultry industry is booming all over the world, owing to the increasing human population, rising purchasing power, and urbanization Furthermore, the poultry industry in South Africa continues to be the single largest contributor to the agricultural sector, surpassing all other animal sectors as well as all field crop and horticultural sectors. But the gap between the commercial broiler farmers and the smallholder broiler farmers is too great. The number of commercial broiler farmers is substantially lower than the number of smallholder broiler farmers, yet these smallholder broiler farmers make very little profit, widening the difference even further. Imports of poultry meat also pose a problem for smallholder broiler farmers and local poultry production. To address these issues the study poses the question: what are the determinants of market participation among smallholder broiler producers in the Amatole District Municipality; what are the factors affecting smallholder broiler farmers' profitability in the Amatole District Municipality in the Eastern Cape, South Africa? and what are the factors influencing broiler farming production efficiency in the Amatole District Municipality? It was then hypothesised that smallholder broiler farmers in Amatole District efficiently use farm resources to secure a profit. The conduction of the study is beneficial as there has been minimal study and empirical data on smallholder broiler farmers in South Africa. There are also limited studies conducted on market access as well as production systems used by smallholder broiler farmers in the Eastern Cape Province of South Africa.

Literature was then reviewed to assist in answering the research questions posed in the first chapter. It was reviewed that agriculture was found to be an important sector for the sustained growth of developing countries, especially agriculture-based countries such as those in Sub-Saharan Africa.

Rural inhabitants, which comprise 87% of the world's population, still depend on agriculture for nourishment and employment. In South Africa, the agricultural sector is in the process of transformation, decolonizing the sector from years of suppression, neglect, and discrimination towards black farmers through agents that eliminated them from participating in the conventional economy and from legal ownership of land, like that of the 1913 Land Act. The poultry industry was reviewed to continue to pride itself on the fact that it feeds the nation, as more poultry products are consumed every year than all other animal protein sources combined (SAPA, 2019). The South African poultry industry was found to dominate the animal products sector, providing 65.6 % (up from 65.3% in 2018) of locally produced animal protein consumed in the country. It was found that in South Africa, the broiler business is dominated by two main producers, Astral Foods and RCL Foods. The provinces of the Northwest, Western and Northern Cape, Mpumalanga, and the Free State accounted for roughly 74% of total production. But the broiler industry is flooded with imports from countries such as Brazil limiting broiler market access for smallholder broiler farmers in South Africa. The marketing channels available for smallholder broiler farmers include live sales and abattoirs. Poor farmers face steep barriers to participation in different types of markets, including the lack of financing, and the unwillingness of commercial finance organizations to lend to remote, dispersed, smallholder farmers. The hindrance in market participation affects the broiler farmers' level of profitability and productivity.

The third chapter aimed at answering the question of what the determinants of market participation among smallholder broiler producers in the Amatole District Municipality are. The target population for the study is smallholder broiler farmers in ADM who partake in broiler production, and the snowball technique was used to attain a sample size of 150. The study used the double-hurdle to assess the decision of market participation and the decision on the extent of broiler market participation. The Probit model was used to access the determinants of the decision of market participation. The results found that gender, education level, household size, farming experience, access to market information, total production of broiler, and profitability positively affected the decision to participate in the output market. While marital status and membership in farm organisations negatively affected market participation decisions. The results for determining the factors affecting the extent of market participation were extension services, quality of roads, access to transportation, distance to markets, and broiler price. Marketing constraints were also analysed with substandard quality of roads being the common constraint amongst the smallholder broiler

farmers in Amatole District Municipality. The government should assess the road quality in Amatole District and improve it, as this hinders market participation of broiler farmers.

The fourth chapter aims at answering the question of what the factors are affecting smallholder broiler farmers' profitability in the Amatole District Municipality in the Eastern Cape, South Africa. This study employed a cross-sectional research design. A well-structured questionnaire was employed to collect data from 150 broiler farmers. The budgetary technique was used to determine which smallholder broiler farmers make a profit while the OLS regression model was used to investigate factors affecting the profitability. Smallholder broiler farmers were found to make ZAR 996.16 in broiler profits. The factors affecting smallholder broiler farmers' profitability included age, household size, farming experience, access to transport, cost of labour, cost of water, cost of feed, and quantity of broiler produce. The extension service should be provided with finances to encourage new entry into the broiler industry so that the economy of Amatole District Municipality may be improved.

The fifth chapter of the study addressed the question of what the factors are influencing broiler farming production efficiency in the Amatole District Municipality. A multistage sampling procedure was used to collect primary data using a well-structured questionnaire from 150 broiler farmers. The productivity of broiler farmers in the Amatole District was determined using the Stochastic Frontier Production Function and the frontier also measures technical efficiency. The results showed that the determinants of productivity for smallholder broiler farmers in ADM were the quantity of feed, stock size, and land size. The technical efficiency results showed that gender and household positively affected technical efficiency while farm experience negatively affected technical efficiency. The results further showed the average technical efficiency level for smallholder broiler farmers was 81% alluding that smallholder broiler farmers in ADM are efficient producers. Programs to train smallholder broiler farmers to handle larger stock sizes should be implemented to grow their enterprises.

6.3 Conclusions

Though smallholder farmers play a crucial role in contributing to food security in South Africa, especially at the household level, they account for a considerable portion of the food insecure. So, investigating factors that affect the market participation, profitability and productivity help provide

an opportunity to find the cause of the remaining food insecure, but also the likelihood of finding possible pathways to enhance their status of food security. The pilot study administered assisted in improving the questionnaire in terms of the inputs used together with the costs of broiler farmers. The enumerators were also able to get familiar with asking the questions and adjusting the language when asking the questions. The study concludes that the determinants of broiler market participation in ADM were gender, education level, household size, farming experience, access to market information, total production of broiler, profitability, marital status, and membership to farm organization. The determinants of the extent of broiler market participation were quality of roads, extension services, access to transportation, distance to markets, and broiler prices. The study also concludes that smallholder broiler production in Amatole District is profitable. While the determinants of the profitability were age, household size, farming experience, access to transportation, cost of labour, cost of water, cost of feed, and quantity of broiler produce. The factors that influenced productivity include stock size, the quantity of feed, and land size. Whereas the determinants of productivity of the smallholder broiler farmers in the study area were gender, household size and farming experience. The factor affecting technical inefficiency was a family experience, gender, and household size.

6.4 Policy Recommendation

- Total production of broiler was found to positively affect the probability of market participation by the broiler farmers in ADM. Broiler farmers in the ADM can be encouraged to increase their stock size to allow for an increase in their probability to enter markets.
- This increase in the stock size will need an extension officer to train and assist farmers in informing them about the best production practices that can reap the highest level of the total production of broilers.
- South Africa faces many economic issues and many waits on the government to provide solutions. With regards to market participation by the smallholder broiler farmers, they should look for ways to be innovative and create markets for themselves where they will thrive in the face of a broiler industry which favours commercial producers. The free rage

market is still new and with easy access to land in the rural communities, they can specialize in free-range chicken production.

- It is recommended that farmers and investors are hereby encouraged to invest more in broiler production to harness the profit potentials of the enterprise which would, in turn, increase the supply of poultry meat and animal protein in the area.
- The extension officers in all the municipalities in the ADM should be involved in broiler production and assist the farmers in terms of feed cost supplementations. This may encourage new entry into the broiler market because of its profitability and supplement of feed costs.
- Farming experience is another driver of broiler farming profitability. Programs can be set where experienced farmers can mentor and train new entry farmers so they can also achieve profits and have the capital to expand their enterprises.
- The efficiencies of the farmers in ADM can be increased by the constant and regular introduction of new techniques and innovations in poultry farming. This can only be made possible, however, by an efficient and effective government-driven extension system which will propel regular training and retraining.
- Implementation of policies that aim to reduce the costs of broiler production in ADM so that locally produced chicken meat can compete with imports in terms of prices is recommended. With the decrease in feed costs, farmers can buy a larger quantity of feed which positively affects the level of productivity of the broiler farmers in ADM.
- An effective and efficient vaccination programme in broiler production should be encouraged to minimize mortality and losses from many dreadful poultry diseases such as gumboro, newcatle.

6.5 Limitation and delamination of the study

The study's limitation was that it is limited to a specific district. Its conclusion must be interpreted in this light. The results of this study may not be generalised and universally applicable for smallholder farmers in other Districts or other Municipalities in South Africa. This is because, while smallholder broiler farmers share some characteristics, their scope of operations, access to markets, and other aspects differ. Also, the investigation of all the areas in the district is not

attainable due to the distance of the villages/areas. Lastly, it would have been great to employ panel data to capture time-variable profitability variables including production, price, and costs, allowing for a better understanding of profitability difficulties. However, due to a lack of funding, time, and other resources, the study can only use cross-sectional data. Delimitations are the boundaries that the researcher voluntarily impose on themselves. They are concerned with the definitions that the researchers choose to designate as the boundaries or limits of their work to keep the study's aims and objectives from becoming unattainable. This study focused on smallholder broiler farmers in the Amatole District Municipality that desire to participate in market activities (which has six municipalities). The study addressed 15 market and production constraints due to time constraints and the scope of the research. Lastly, the data collection process took on the assumption that all the smallholder broiler farmers would answer the questionnaire honestly and will remember all the variable costs incurred during the production cycle before the questionnaire.

6.6 Future Research

The study focused on the Amatole District Municipality. Future studies can investigate the market participation, profitability, and productivity of smallholder broiler farmers in the whole province of the Eastern Cape. Comparative studies with other districts can also be conducted to assess smallholder broiler farmers' market participation, profitability, and productivity.

APPENDICE A: QUESTIONNAIRE

DISCIPLINE OF AGRICULTURAL ECONOMICS

SCHOOL OF AGRICULTURAL, EARTH AND ENVIRONMENTAL SCIENCE

UNIVERSITY OF KWA-ZULU NATAL, PIETERMARITZBURG CAMPUS

ECONOMIC AND MARKET ANALYSIS OF SMALLHOLDER BROILER FARMERS IN THE AMATHOLE DISTRICT MUNICIPALITY

QUESTIONNAIRE

GENERAL INFORMATION

Name of farmer: ……

Name of Municipality: ……

Name of village: ……

Date of interview: ……

Do you engage in broiler production? 1=Yes ☐ 2= No ☐

How long have you been farming chickens? ……

PART A: SOCIO-ECONOMIC ECONOMIC CHARACTERISTICS OF FARMERS

1.1 Gender of farmer: 1= Male ☐ 2=Female: ☐

1.2 Age: …….

1.3 Education level (in school years):……

1.3.1 If you chose another, please specify: ……

1.4 Current occupation: …….

1.5 Household size (numbers): …….

1.6 Farm size (ha):……..

1.7 Broiler farming experience: …….

1.8 What is your main source of income? 1= Broiler farming ☐ 2= Remittances ☐ 3= Other agricultural activities ☐ 4= Non-agricultural activities ☐ 4= Wages/ Salary ☐

1.9 Please estimate your average income per production cycle (rands) from the sources below

Broiler production income	Remittances from friends & family	Income from other agricultural activities	Income from non-agricultural activities	Wages/ Salary

1.10 Do you belong to any farming organizations? 1= Yes ☐ 2= No ☐

1.11 Marital Status of household head: 1 = Married ☐ 2 = Single ☐

PART B: BROILER PRODUCTION INFORMATION, INPUTS, COSTS AND COSTS

2.1 How long have you been producing broilers: ……

2.2 What was the main reason for going into broiler production: 1= Income source ☐ 2= Food source ☐ 3 = Hobby ☐ 4= Other ☐

2.2.1 If other in 2.2 please specify. …….....

2.3 Do you hire people to help you with your broiler production? 1= Yes ☐ 2= No ☐

2.3.1 If yes to 2.3, what is the total number of persons hired?.....

2.3.2 What is the source of your labour? 1=Hired labor ☐ 2= Family labor ☐

2.3.3 How many labour days are employed a week? ……..

2.4 What is the number of production cycles you have per year? ……

2.5 How long is each production cycle? …….

2.6 How many breeds of chickens do you currently have on your farm? ……

2.7 How many chickens are produced, on average, in a production cycle?

…….....

2.8 What type of feed do you give to your chickens? 1=Starter ☐ 2= Grower mash ☐ 3= Finisher ☐

4= Other ☐

2.8.1 If other in 2.8, please specify: ……

……

2.9 Do you administer preventive vaccines to your chickens? Yes = ☐ No = ☐

2.9.1 If yes to 2.9, what vaccine do you administer?

i. ……
……

ii. ……
……

iii. ……
……

2.10 Do you keep your broiler warm? 1=Yes ☐ 2=No ☐

	Day old chicks	Vaccine	Feed		
			Starter	Grower mash	Finisher
Where do you source the input?					

1. Government agencies:					
2. Market:					
3. Other: If others specify:					
How is it transported to the farm?					
1. Own transport					
2. Hired (Individual)					
3. Hired (Group)					
4. Supplier transport					
5. Public transport					
6. Other If Other specify:					
What are the constraints faced in sourcing these inputs?					
1. High prices					

2. Supplier located far					
3. Limited varieties supplied					
4. Other If Other specify:					

2.10.1 If yes to 2.10, how do you keep them warm? 1=Heat lamp ☐ 2= Keep in crowds ☐ 3= Infrared bulbs ☐

2.11 On average, how many chickens/ chicks die during each production cycle?……

2.12 Is the land used 1= Owned ☐ 2= Rented ☐

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

2.14 How much do the chicken houses cost? …….....

2.15 Do you process your chicken? 1=Yes ☐ 2=No ☐

2.16.1 If Yes to 2.16, how does your broiler get processed?……...……

2.17 What are your products? 1= Live chicken ☐ 2= Culled whole chicken ☐ 3= Culled chicken pieces ☐ 4= Other ☐

2.17.1 If Other in 2.17 please specify:

i. ……..

ii. ……..

iii. ……..

PART C: MARKET INFORMATION

3.1 Do you sell your broiler produce? 1=Yes ☐ 2= No ☐

3.2 Do you keep a record of the sales made? 1=Yes ☐ 2= No ☐

3.3 Where do you sell your product? 1=Local community ☐ 2= Formal market 3=Informal market ☐ 4=Other ☐

3.6 Are their seasonal variations in your pricing? 1=Yes ☐ 2= No ☐

3.7 Do you have a way to get your goods to the market? 1= Yes ☐ 2= No ☐

3.7.1 If yes to 3.7 what mode of transport do you use? 1= Truck ☐ 2= Van ☐ 3=Other

3.7.1.1 If other please specify …….

3.7.2 Is the mode of transportation to the market 1= Owned ☐ 2= or Hired ☐

3.8 How would you rate the quality of the road to the market? 1= Good ☐ 2= Bad ☐

3.9 Do you have access to market information? 1= Yes ☐ 2= No ☐

3.10 Where do you get your market information from? 1= Extension officers ☐

2= Internet 3= Television/Radio ☐ 4= Other farmers ☐ 5= Newspaper ☐ 6= Other sources ☐

3.10.1 If other than 3.10 please specify ……

3.11 What is the distance to the output market? .....km

3.12 Estimation costs for the broiler enterprise in a single production cycle:

Inputs	**Quantity**	**Cost/unit**	**Total cost**
DOCs (day-old chicks)			
Starter feed			
Grower mash			
Finisher			
Vitamins and Vaccines			
Water costs			
Electricity			
Vet cost			
Transportation inputs			
Transportation output			
Catcher costs			
Labour			
Repairs and maintenance			
Slaughtering costs			
Miscellaneous costs			
Total production cost			
Price per boiler			
Boiler sold batch			
Total income			

Others			

PART D: CREDIT AND EXTENSION SERVICES

4.1 Do you have access to credit facilities? 1=Yes ☐ 2=No ☐

4.1.1 If no to 4.1, specify? ……

4.1.2 If yes to 4.1., how much credit did you receive (Rands)?.....

4.1.2.1 Where was the credit obtained?.....

4.1.2.2 Why was the credit obtained?.....

4.1.2.3 How much was the credit?.....

Types of constraints	No	Sometimes	Yes
Do you experience theft of your chicken?			
Do you face lacking water supply?			
Is it hard to access funding?			
Is the vaccine expensive?			
Is it difficult to access electricity in the area?			
On average, is there a high mortality rate per cycle?			
Do you have a market for your broiler output?			
Is there broiler production training that is available?			

Is the infrastructure in the area good?			
Is it easy to access land for production in your area?			
Do you face problems with a pest infestation?			
Is the feed expensive?			

4.1.2.4 Have you finished paying off the credit? 1=Yes ☐ 2=No ☐

4.1.2.5 How much interest was charged for the credit? ……

4.2 Do you have access to extension services? 1= Yes ☐ 2= No ☐

4.2.1 If yes to 4.2 Please rate the quality of the extension service (1= poor; 5 = excellent): ☐

PART E: CONSTRAINTS

5.1 What have you done on your own to overcome the above-mentioned problems?

a. ……..
b. ……..
c. ……..
d. ……..
e. ……..

APPENDIX B: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

17 May 2022

Zimi Thibane (217008329)
School Of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear Z Thibane,

Protocol reference number: HSSREC/00003885/2022
Project title: Economic and market analysis of smallholder broiler farmers in the Amatole District municipality
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 22 February 2022 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 17 May 2023.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee
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