Viability of Government-Funded Broiler Production: Lessons from Northern KwaZulu-Natal, South Africa

By

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DEDICATION

This thesis is dedicated to my late grandmother, Busisiwe Mdletshe, who was always encouraging me to do this degree although she had never been to a school environment.

Without faith, it is impossible to please God

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ABSTRACT

Generally, rural areas continue to experience high poverty levels and low incomes, which seem to be occasioned by high unemployment rates, limited educational attainments, and devastating floods and droughts. This situation is further exacerbated by increase in crime rates, making livelihoods even more difficult. To mitigate such adverse situations, rural households employ diverse strategies, including maintaining community gardens, one-home-one-garden schemes, as well as livestock and poultry production. The most prevalent livelihood strategy in South Africa or KwaZulu-Natal is broiler production, since it needs less space and a short production cycle compared to other livestock or crop enterprises. At the same time, income is generated over a short period. Besides, the government of KwaZulu Natal has actively intervened in the sector as part of its broader poverty reduction strategy and farmer support programmes. In KwaZulu-Natal Province, the provincial government has been supporting broiler producers for many years. While substantial research work has been done in the province on livelihood strategies, including livestock production on a province-wide basis, there is no information about how successful the broiler production funded by the government has being. Broader concerns about production problems have not been assuaged based on systematic studies and evidence. It is this wise that this study was initiated. The objective is to assess the economic viability of government-funded small-scale broiler projects in the KwaZulu-Natal Province of South Africa and determine the implications for poverty reduction and food security.

Data were collected from the government-funded small-scale broiler producers that are residing in Northern KwaZulu-Natal districts (uThungulu, Zululand and uMkhanyakude). A total of 75 small-scale broiler projects (25 broiler projects in each district) were selected by probability sampling procedure for the interviews. Questionnaires that combined both close-ended and open-ended questions were used to collect primary data, which include production and marketing, as well as the factors that influence the profitability of the small-scale broiler projects. After collection, data were captured and encoded on spreadsheets in Microsoft Excel and exported to Statistical Package for the Social Science (SPSS) software version 26 and STATA for analyses. Descriptive statistics applied include frequencies and means.

In addition, a gross margin (GM) and gross profit margin (GPM) analysis were employed to assess the profitability of government-funded small-scale broiler projects.

Both profitability and gross margin analyses were used as proxies for farmers' motivation and incentives to participate in broiler production. Further analyses were conducted to determine the model that best explains the underlying relationships. Initially, the Multiple Linear Regression Model was applied to determine the factors influencing the profitability of government-funded small-scale broiler projects. The indication was that while positive profits were revealed, the system seemed to fall short of its potential. In light of that, it was decided to fit another model to estimate the technical efficiency of the system and gain an understanding of the causes of any inefficiency that might exist in the production system. In that regard, the one-step Stochastic Frontier Model was employed to show that the technical efficiency of broiler production systems in the project area was positively and significantly influenced by flock size, the quantity of feeds and labour costs, while medication played no role possibly because of weak extension coverage. An inefficiency model fitted as part of the one-step model suggested that age, gender and educational level were significant influencers of technical inefficiency, with the possibility that the older the farmers, the more technically inefficient the system possibly because of the strenuousness of commercial poultry production. In addition, it was found that the more educated the farmer, the less inefficient the farm, which conversely means that the system becomes more efficient as the farmer receives more education. The negative coefficient of the gender variable also implies that for farms managed by female farmers, the system was less inefficient, which is more technically efficient, and this can be explained by women's propensity to be more gentle, caring and sensitive in managing the chickens than their male counterparts.

Heteroskedasticity tests and corrections were conducted in the one-step estimation technique to show that variations in the inefficiency term (μ) and the stochastic error term were explained by age and educational level for the most part. Clearly, improvements in the broiler industry in KwaZulu-Natal will depend to a large extent on the knowledge and experience of the farmers and substantial enlargement of the flock size of adequately fed birds. Attention to these elements is expected to have important practical implications for sustainable broiler poultry development and food security in the project area, as well as locations possessing identical features and characteristics.

Keywords*: Broiler Enterprise; Gross Margin; Northern KwaZulu-Natal; Profitability, Small-Scale broiler producers, Stochastic Frontier Analysis.*

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ACRONYMS AND ABBREVIATIONS

AGE	Applied General Equilibrium
APEC	Asia Pacific Economic Co-operation
APTA	Asia Pacific Trade Agreement
ARC	Agricultural Research Council
ARDL	Autoregressive Distributive Lag
ASGISA	Accelerated Shared Growth Initiative for South Africa
BBC	BRICS Business Council
BCB	Brazil Central Bank
BPFAP	Bureau for Food and Agricultural Policy
BRU	Bio-Resource Unit
BTTC	BRICS Think Tanks Council
CARICOM	Caribbean Community
CBR	Central Bank of Russia
CIS	Commonwealth of Independent States
CMI	Chiang Mai Initiative
CRA	Contingent Reserve Arrangement
DAFF	Department of Forestry and Fisheries
DBSA	Development Bank of Southern Africa
DIPP	Department of Industrial Policy and Promotion
DWAF	Department of Water Affairs and Forestry
EU-CA	European Union- Central Asia
EU-SA	European Union - South Africa
FAO	Food and Agricultural Organization of the United Nations
FDI	Foreign Direct Investment
FMCG	Fast-Moving Consumer Goods
GATS	General Trade in Services
GDFC	Gross Domestic Fixed Capital Formation

GDP	Gross Domestic Product
GDP	Gross Domestic Product
GEAR	Growth Employment and Redistribution
GM	Gravity Model
GMM	Generalised Method of Moments
GVCs	Global Value Chains
HDI	Human Development Index
H-O	Heckscher-Ohlin
HSRC	Human Sciences Research Council
IDC	International Development Cooperation
IDP	Integrated Development Programme
IDZ	Industrial Development Zone
IPEA	Institute for Applied Economic Research
IPI I	Industrial Production Index
IPR	Intellectual Property Rights
ISRDP	Integrated Sustainable Rural Development Programme
JSE	Johannesburg Stock Exchange
KZN	KwaZulu-Natal
KZNDAEA	KwaZulu-Natal Department of Agriculture and Environmental Affairs
NDB	(BRICS) New Development Bank
NEPAD	New Economic Partnership for Africa's Development
NGP	New Growth Path
NRC	BRICS National Committee for BRICS Research
OLS	Ordinary Least Squares
PIDA	Programme for Infrastructure Development in Africa
PLC	Product Life Cycle
PPC	Plant Protection Convention
PPF	Production Possibility Frontiers

PPP	Purchasing Power Parity
RBI	Reserve Bank of India
RDP	Rural Development Programme
RF	Russian Federation
SA	South Africa
SACU	Southern African Customs Union
SADC	South African Development Community
SADC	Southern African Development Committee
SARB	South Africa Reserve Bank
SARS	South Africa Revenue Service
SBSA	Standard Bank of South Africa
SITC	Standard International Trade Classification
SMME	Small, Medium Micro Enterprise
SPS	Sanitary and Phytosanitary Measures
SSA	Sub-Saharan Africa
Stats	SA Statistics South Africa
TBT	Technical Barriers
UECM	Unrestricted Error Correction Model
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNIDO	United Nations International Development Organisation
US	United States
VAR	Vector Auto Regressive
WITS	World Integrated Trade Solution

CHAPTER ONE

INTRODUCTION

1.1 Background

The causes of rural poverty are complex and multidimensional. Among other things, they involve climate, gender, markets and political instability. Likewise, rural poor communities are quite diverse, both in the problems they face and the possible solutions to these problems. Unemployment and income poverty in the province exceed the national average in terms of unemployment and poverty rates (StatsSA, 2021). Over a third of KZN's population lives below the nationally-defined poverty line and more than half of the workforce is unemployed. Over a long-term trend in KZN are not stable which is worrisome (Thurlow *et al.,* 2009; Bhorat and Oosthuizen, 2006; Hoogeveen and Oiler, 2006). The government and development agencies are naturally concerned about the current and prospective socio-economic circumstances and numerous actions have been initiated to address them.

At the national level, it is now well-established that South Africa is one of the most unequal societies in the world where over 50% of the population remain stuck in poverty (Plagerson, 2021). Despite notable gains in poverty reduction post-apartheid, poverty levels have remained consistently highest among women, black South Africans, people with disabilities, and those living in rural areas (Plagerson, 2021). The apartheid-era legislated exclusion of the black population resulted in what was considered the worst income distribution in any country (Whiteford and McGrath, 1994). The extent of the deprivation suffered by the black population was unspeakable (Blakemore, 2021). While the exclusionary and discriminatory policies that created the conditions for poverty and destitution have been overturned by the majority government, little has changed in the socioeconomic circumstances of the majority of black people, especially those residing in the rural areas of the country.

The ANC-led black majority government that came into power in 1994 drew up a comprehensive programme to make the economy more inclusive and promote greater

black economic participation. One key programme launched in the early days was a land reform programme that aimed at enhancing access to land in the belief, as articulated by the African National Congress in its Reconstruction and Development Programme (RDP), that land is a “basic need” of the people of South Africa (African National Congress, 1994; Machete, 1995). According to Frost (1998), land has both territorial significances as well as symbolic power to the South African black population, whose bitterness about the forced removals from their land during the Apartheid era remains. Therefore, the government committed itself to address poverty, inequality and social exclusion growing out of the country’s dark past. This commitment has been clearly articulated in the Constitution and numerous other documents, including the National Development Plan that was adopted in 2012 as a blueprint for eliminating poverty and significantly reducing inequality by 2030 (Larsson and Nybom, 2006; Plagerson, 2021).

As indicated in the foregoing, the strategies that have been employed by the government to intervene to enhance the livelihoods of the population include the Reconstruction and Development Programme (RDP), Growth Employment and Redistribution (GEAR), the Accelerated and Shared Growth Initiative of South Africa (ASGISA), the National Development Plan (NDP) and the Social Assistance System (Mbuli, 2008; Levisha, 2015). These broad national and provincial strategies have spurred numerous local-level strategies. For instance, rural communities in Northern KwaZulu-Natal use a wide range of strategies to mitigate poverty levels, including community gardens, one-home one-garden schemes, and livestock and poultry production. The Provincial Government of KwaZulu-Natal has provided support for many of these activities, as it strives to support enhanced livelihoods and reduce the high rate of unemployment and under-employment in the province.

The poultry industry is the largest sub-sector of the South African agricultural sector (DAFF, 2013; The Poultry Site, 2020). In 2018, the poultry industry represented 16.6 percent or R47.9 billion of the total gross value of agricultural production of R288.6 billion for that year. Besides, the poultry industry is the largest animal production segment in the nation’s agricultural economy (DAFF, 2013). Within the poultry sub-sector, the most prevalent livelihood strategy is broiler production, since it needs less space and less growing time

compared to other strategies, and income is generated over a short period. Nationally, small/emerging farmers make up some 12% of the market for broilers in the country (DAFF, 2013). In light of these facts, KwaZulu-Natal Provincial Government devotes substantial resources towards supporting small-scale and emerging broiler producers in the province, principally by assisting them with the construction of the needed structures and providing small-scale broiler projects with the first batch of production inputs and marketing.

In the 2011/2012 season, the KwaZulu-Natal Province embarked on a purposeful strategy to accelerate the development and modernisation of broiler production in the province by supporting 134 small-scale broiler projects in the KZN Northern region (Project Office, 2015). Nevertheless, those projects failed to survive, most of them collapsing after the first batch. To date, no assessments have been conducted to determine the reasons for the failure of those projects. It is a fact of enterprise operation that despite the proven economic viability of a livelihood strategy, a particular business focusing on that may fail for various reasons. It is assumed that differences in factors of production, which are largely influenced by both the production and marketing environment and the socio-economic landscape, play an important role in determining both productivity and profitability (Cintina and Pukite, 2018). A systematic analysis is needed to determine which of these factors could have been at play.

The consumption of livestock-derived foods has undergone some significant transformations, globally. Between 1961 and 2011, global average meat consumption per capita increased by 75% (FAO, 2016). Population growth, urbanisation, and higher incomes have been cited as responsible for driving the increase in the demand for foods of animal origin in most countries. Erasmus (2019) argues that the global population has grown from seven billion in 2010 and is projected to reach 9.8 billion in 2050, and incomes are continuously growing across the most developing world. Thus, this implies that overall food demand is on course to increase. Erasmus (2019) estimates that the demand for animal-based foods will increase by nearly 70% by 2050. According to Nassar *et al*. (2019), matching the increase in the consumption of meat products with the growing human population will require efficient management and feeding conditions that best fit the needs of livestock. In South Africa, there has been a marked increase in the consumption of

poultry products, especially poultry meat. One estimate by the Department of Agriculture, Forestry and Fisheries (DAFF, 2013) revealed that consumption per capita was 36 kg per person in 2012 and Statista (2022) hints that there is evidence that this has been growing ever since. For instance, according to statistics analysed by Shahbandeh (2020; 2022) in 2016, per capita consumption of poultry meat was 40 kg/person, growing to 41.2 kg/person in 2017. On an overall national basis, it was revealed that in 2018 and 2021, domestic consumption of broiler meat amounted to 1.88 million metric tonnes and 1.9 million metric tonnes, respectively (Shahbandeh, 2022). Therefore, evidence of high potential for viability and profitability of broiler enterprise exists and thus raises serious concerns about the failure of such undertakings in the KwaZulu-Natal Province or anywhere else in South Africa for that matter. There is, therefore, a need to explore and manage production efficiencies in the broiler sub-sector and determine the reasons for any deviations from the frontier.

This study is undertaken to determine the economic viability (profitability) of the government-funded small-scale broiler projects in Northern KwaZulu Natal of South Africa. Thus, the results are expected to generate vital information about the constraints of farmers in their efforts to enhance their livelihoods through broiler production and to identify steps that can be taken to introduce improvements that will be beneficial to the farmers. Such an understanding or information can be crucial and helpful in the design of viable or sustainable small-scale broiler projects and this could go a long way in addressing or improving the small-scale rural livelihoods in the long run. Benefits to the wider economy are also anticipated to the extent that improvements in domestic poultry production may lead to the substitution of the large volumes of imports of poultry products into South Africa and contribute to significant foreign exchange savings for the economy.

1.2 Problem Statement

The current and prospective levels of poverty arising from high unemployment and underemployment in KwaZulu-Natal are sources of deep concern to the government. Based on the lower-bound poverty line, it is estimated that about 52% of the population of KwaZulu-Natal is poor (StatsSA, 2021). Unemployment remains one of the most formidable challenges for the province with as many as 34.5% of the population being without jobs in 2022, having fallen from 35.3% in 2021 (StatsSA, 2022). Another much wider indicator

used is NEET (not in employment-education-or-training). According to Statistics South Africa (StatsSA) (2022) and Nkanjeni (2022), about 3.8-million (37%) out of 10.2-million young people in KwaZulu-Natal aged 15-24 were not in employment, education or training (NEET). It was also estimated that the overall NEET rate increased by 4.6% in the first quarter of 2022 compared to the first quarter of 2021. The need for urgent action to improve the situation has therefore always been high.

In the 2011/2012 financial year, the KwaZulu-Natal Provincial Government embarked on a purposeful strategy to accelerate the development and modernisation of broiler production in the province by supporting 134 small-scale broiler projects in the KZN Northern region. Agriculture is an important livelihood strategy in the province. According to StatsSA (2021), KwaZulu-Natal Province has the third highest proportion of agricultural households in the country. The official statistics show that agricultural activities in the province focus on crops (sugarcane, maize), horticulture as in sub-tropical fruits, especially pineapples, bananas, cashew nuts, potatoes, soya and other vegetables, and livestock like beef and sheep for mutton and wool, pork and poultry (Trade & Investment KwaZulu-Natal, 2022). The local people have traditionally kept chickens that they raise by extensive and free-range techniques. Thus, making broiler production an important poverty reduction strategy has been an acceptable option for the provincial government. A large body of academic literature has established the crucial role played by livestock in the rural and household economies of developing countries, particularly in Africa and Asia (Birol and Asare-Marfo, 2018). These roles include their significant contributions to employment creation, food and nutrition security and intra-household gender equality (Birol and Asare-Marfo, 2018; Babatunde, Adekunle and Olagunju, 2012). Poultry has stood out as the most accessible to the poor and vulnerable population in those regions, where livestock has proved a formidable poverty fighter (Babatunde, Adekunle and Olagunju, 2012; Rabby, Fredericks and Alam, 2013). Without questions, the consensus in the literature is that broiler production at the small-scale level is an economically viable activity.

Despite the international consensus on the role that broilers can play in the smallholder sector, to date, debatably, the economic viability of those broiler production enterprises in the South African rural landscape has not been systematically evaluated. Studies that have

traditionally focused on the large-scale commercial sector are not in short supply, just as they have been in the crop sector of the country. Commercial broiler producers cannot be weaned of government support as they also a part of community but this study is focusing on small scale broiler producers. However, it is a fact that government resources are themselves dwindling and sometimes such support may not be sustainable. Much of this has been influenced by the legacy of the past policies that were skewed towards large-scale commercial agriculture. With the changing political situation in the country culminating in the dismantling of apartheid-inspired discrimination against black entrepreneurial successes, the emphasis of research should shift to promote greater insights into the economic relationships in the small-scale sector dominated by the black population.

The assumption is that there might be differences in factors of production, which are largely influenced by both the production and marketing environment, poor entrepreneurship skills and socio-economic landscape in light of limited capital availability in a poor community. Preisendorfer, Bitz and Bezuidenhout (2012) attempted some explanations for the low rate of black participation in entrepreneurial activities, and they mentioned the historical role of apartheid, missing financial resources within the black community, a shortage of human capital, differences in mindsets and traits, and social capital and network insufficiencies. It is considered that missing financial resources and human capital shortage are quite serious and a call for urgent intervention (Preisendorfer, Bitz and Bezuidenhout, 2012). For this reason, government funding will remain important in South Africa to speed up the integration of the black population into the nation's agricultural economy (Cintina and Pukite, 2018). It is, therefore, necessary to find out why the high failure rate of the small-scale broiler projects happened despite generous financial support from the government. Thus, the present study is a means of investigating the economic viability (profitability) of the government-funded small-scale broiler projects. The results are expected to help generate crucial insights into demonstrating what farmers and developmental agencies need to know in order to be in a position to implement appropriate innovations for broiler production improvement. Such an understanding or information can be crucial and helpful in the design of viable or sustainable small-scale broiler projects to address whatever shortcomings the present system might have. South Africa, especially KwaZulu Natal province, provides an excellent location for this study because of the existence of a large

number of supported small-scale broiler farmers, substantial amounts of poultry product imports and a high consumption of poultry products. Overall, the thesis tests the hypothesis that government intervention in private enterprise adds value to the viability of the enterprise and contributes to livelihoods and food security.

1.3 Objectives

1.3.1 Main objective

The broad objective of this study is to test the hypotheses that government-funded small-scale broiler projects are not viable based on the lessons from the KwaZulu Natal Province of South Africa.

1.3.2 Specific objectives

1. To describe the poultry production systems in the farming systems of South Africa
2. To analyse the pattern of investment in the poultry industry in the area of study
3. To determine the relative viability of private and public-funded enterprises
4. To estimate the technical efficiency of the broiler producers and the entire industry in the project area
5. To analyse the factors that affect the technical efficiency of small-scale broiler producers and determine the factors that prevent small-scale farmers from improving the productivity of their enterprises

1.4 Research Questions

The economic viability of government-funded small-scale broiler projects in KwaZulu Natal Province of South Africa remains unstable in light of the high failure rate of schemes in recent years. This raises the following research questions:

1. What is the poultry production system in South Africa?
2. What is the pattern of investment and relative viability of the private and public-sector funded enterprises?
3. What is the level of technical efficiency of the broiler production system?

4. Which factors influence the technical efficiency of the broiler production system of the project area and explain the high failure rates of the government-funded enterprises?
5. What are the factors that prevent small-scale farmers from improving the productivity of their enterprises?

1.5 Delimitations of the study

This study was conducted in areas North of KwaZulu-Natal, in uMkhanyakude, uThungulu and Zululand district municipalities. The study focused on the production and marketing activities practised by government-funded broiler producers within rural areas and their level of technical efficiency.

1.6 Limitations of the study

The prevalent number of broiler producers who were still in operation in the project area was low and led to a relatively low sample size. The researcher would have been more comfortable with a larger sample size that would allow for more reliable inference. By applying multiple statistical and econometric techniques, the researcher hoped to overcome this limitation and produce results that have a stronger predictive value.

1.7 Organisation of the thesis

The thesis is organised into six chapters. Chapter one introduces the topic and presents the problem context, research objectives, research questions and the research hypotheses. Chapter two presents the literature review on enterprise viability and suddenness failure and public versus private funding. The literature on broiler production, marketing channels, profitability and technical efficiency globally, as well as in South Africa are also reviewed. Chapter three presents and discusses the area of study, research design, model and theoretical framework, the data and data sources, sampling, data collection and the analytical framework. Chapter four presents and discusses the descriptive results. Chapter five presents and discusses the empirical results of the study while Chapter six provides the summary, conclusions and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW & CONCEPTUAL FRAMEWORK

2.1 Introduction

This chapter presents the review of literature on the economic viability of government-funded small-scale broiler projects in the KwaZulu Natal Province of South Africa. The economic viability of these enterprises remains questionable in light of the high failure rate of schemes in recent years. The review covers the theoretical questions around government intervention in the economy. The extent of food insecurity in the country and the continent was also reviewed to establish the basis for the conditions of market failure and development shortfalls that potentially justify government intervention in developing countries. The specific situation of the poultry production system in South Africa, poultry consumption in South Africa, poultry imports and exports, and trends in the consumption of poultry products were also reviewed, particularly focusing on the issues of competitiveness of South African broiler production, where factors that influence competitiveness in the broiler value chain were identified. Actual instances of government intervention in the production process and the occurrence of public sector investing were also examined. Production relationships in the broiler poultry industry depicted by a detailed conceptual framework were also examined in relation to the technical efficiency and inefficiency models that allow for the understanding of factors that influence the performance of the broiler industry.

2.2 Government intervention and enterprise failure

Government intervention in the running of the economy is best captured by the Keynesian Economic Theory (Jahan, Mahmud and Papageorgiou, 2014). Keynes and his disciples contended that the free market is an inefficient mechanism for ensuring that the economy reaches full employment, and some priming is necessary to nudge the economy into greater productivity (Jahan, Mahmud and Papageorgiou, 2014). Keynes asserted that free markets do not possess the necessary self-balancing mechanisms that lead to full employment (Jahan, Mahmud and Papageorgiou, 2014). The argument often put forward by the Keynesians is that economic growth is driven by aggregate demand growth, which

may not occur sufficiently in the short run and need to be influenced by government spending (Karnik, 1995; Jahan, Mahmud and Papageorgiou, 2014). Although ultimately, the market often eventually moves the economy to full employment, and this happens only in the long run due to the slow pace of market clearing (Jahan, Mahmud and Papageorgiou, 2014).

The foregoing thinking has influenced governments around the world, especially those that have the enormous burden of extreme poverty among its population. Evidently, the government of South Africa is grappling with the task of transforming the most unequal society in the world (The World Bank, 2022). The National Development Plan (NDP) recognises that faster, and broad-based growth is needed to transform the economy, create jobs and reduce poverty and inequality by 2030 (SALGA, 2011). South Africa's unemployment rate surged to the highest on a global list of 82 countries monitored by Bloomberg (Bloomberg, 2021).

The jobless rate rose to 34.4% in the second quarter from 32.6% in the three months through March 2021 (StatsSA, 2021). In rural-based pof South Africa, including the Eastern Cape and KwaZulu Natal, the youth unemployment rate increased to about 77% (StatsSA, 2021). There was also an eruption of deadly riots in July 2021 in the Gauteng and KwaZulu-Natal provinces linked to deteriorating living conditions in those two key economic hubs, which claimed 354 lives and saw thousands of businesses looted and shuttered (Vhumbunu, 2021). The COVID-19 pandemic and containment measures imposed by governments have triggered economic hardships across the world, especially for smaller businesses (The World Bank, 2020). The pandemic is causing untold human suffering across Africa and is likely to leave an indelible impact on the continent's small and medium-sized enterprises (IMF, 2021).

The broiler-related business plays an important role in economies and employ an estimated 80 percent of the continent's workforce in both the formal and informal sectors (IMF, 2021) but during times of crisis, they are often the least resilient (The World Bank, 2020). This is because they have limited cash reserves, smaller client bases and less capacity to manage commercial pressures than larger companies (Kalidas *at al*., 2020).

The foregoing situation increases inequality and the poverty rate. For South Africa to reduce its high levels of poverty, more jobs must be created in the economy to absorb the vast supply of surplus labour. This necessitates a high employment growth rate that will be facilitated by the economic growth of a labour-intensive nature. According to Simpson (2005), a rapidly growing economy will also provide the government with growing revenue, boosting its redistributive potential, especially in the field of education and training, healthcare and housing.

To explain the situation in South Africa concerning government intervention and failure, an illustration can be drawn from the Malaysian experience. According to Simpson (2005), Malaysian experience has shown that a high-quality civil service is essential for successful policy implementation. Therefore, it is of critical importance that the transformation of the South African public service be expedited. In the South African context, transformation challenges in the South African public services originated primarily from the country's history, while some are based on the lessons the country is learning from the experience of other countries internationally. According to Rakate (2006), South African society has been a divided society and it is presently in a state of transition. These divisions of the past and their present legacy have had and still have profound influences on the civil service in terms of culture, structures and functioning. Maphumulo (2019) argued that prior to 1994, public service was characterised by poor quality of services, a low skills base, inefficiencies, a lack of commitment and no respect for citizens. Rakate (2006) concluded that a low level of trust and confidence in public institutions overshadowed the public service environment. In this regard, education and training and innovative programmes should be aimed at changing the mindset within the civil service to one that values efficiency and service orientation (World Bank, 2013). A competent, professional and service-oriented organisation will enhance the implementation of public policy and programmes aimed at improving a lot of the millions of South Africans living in poverty (FAO, 2019).

In the field agriculture, the implication for South Africa is that land reform, significant investment in irrigation and inputs, financial assistance and the provision of basic infrastructure, especially for small-scale black farmers are critical for improved performance (World Bank, 2013) More importantly, it will contribute to the alleviation of rural poverty by

improving job creation and income distribution in addition to providing security against famine (FAO, 2019) As in Malaysia, improved agricultural productivity should also be seen as laying the basis for the further development of other sectors of the economy, such as manufacturing and services (Simpson, 2005).

Infrastructure can be further improved by careful and well-considered government investment. However, if South Africa is to be successful in export promotion, it needs to attract much-needed FDI and hence needs to boost investor confidence (Simpson, 2005). Foreign direct investors will be more cautious about investing in a developing economy like South Africa (Simpson, 2005). To boost investor confidence, South Africa must build a reputation for good macro-economic management (Simpson, 2005). In addition, foreign investors' perception of South Africa as a good investment option will be considerably enhanced if domestic private investors show confidence in the economy by investing their money in South Africa.

Furthermore, Malaysia was successful in paying low wages because of a weak and repressed labour movement. Since repression and authoritarianism are not a solution in South Africa, the state will have to intervene to broker an accommodation with labour and capital, which recognises the needs for growth, as well as the distributional expectation of the impoverished majority (Simpson, 2005). The success of a policy of export orientation will also be contingent on political stability and economic development in the Southern African region, since it constitutes a natural market for South African exports (Simpson, 2005).

For an example, Malaysia pursued its growth and redistribution strategies on the back of immense government intervention in the economy. The government ensured that economic fundamentals, for example, macroeconomic and political stability, a productive agricultural sector and an efficient civil service were in place.

Nevertheless, their experiences are valuable because they refute neo-liberal contentions and indicate how the role of the state in developing economies can be concretely defined. They also indicate how policies in various forms and combinations can be effectively used in pursuit of economic development. Malaysia has certainly illustrated that elements of an open market, together with a more interventionist approach that offsets distortions, can be

successfully employed (Simpson, 2005). Southern African countries, especially South Africa, can learn from government intervention in Malaysia and fashion economic policies to suit South African conditions. Not only should the South African government ensure that the country establishes and maintains a growing economy, but it needs to be proactive in ensuring that poverty and social inequalities are dramatically reduced. For this to materialise, it has to pursue policy interventions that will ensure that growth translates into redistribution and poverty reduction and a concomitant increase in the quality of life of poor South Africans. Failure to achieve such an outcome will propel South Africa down the path of civil strife and economic degeneration.

2.2.1 Theory of Government Intervention

The explanatory variable is government intervention (G), and government subsidies and tax incentives are the main means of government intervention.

(1) Government subsidy: Government subsidy (S) includes financial discounts, research, and development and policy subsidies. According to the practices of relevant scholars, the government subsidy selected is indexed under other income accounting subjects in the enterprise financial statements as the measurement index.

(2) Tax preference: Tax preference includes Research and Development (R&D) expenses plus deduction, value-added tax preference and income tax preference. Additional deduction of R&D expenses (EXP): additional deduction of enterprise R&D expenses is a kind of tax method and means for government intervention in enterprise R&D innovation activities.

According to the actual amount of R&D expenditure, a certain proportion is added as the deduction of tax payable. Referring to the research of some scholars, this study directly multiplies the actual amount of R&D expenses of enterprises by 50% during 2012–2016, and the actual amount of enterprise R&D expenses times 75% during 2017–2018, which are used as indicators to measure the additional deduction of R&D expenses. Value-added tax incentives (VAT): Value-added tax is one of the most important tax burdens of enterprises. The preferential policies of value-added tax mainly include VAT return and reduction and VAT deduction. Most of them are aimed at small- and medium-sized

enterprises with insufficient profits. However, strategic emerging industries have certain enterprise scales and profitability. Most listed companies have no obvious preferential policies for tax return and exemption, especially the sales of independent innovation products of strategic emerging industries that need to go through a long period to enjoy VAT refund and exemption. Some scholars use VAT deduction as the VAT preference in the process of R&D and innovation, which mainly refers to the VAT deduction of new fixed assets. This study uses the VAT deduction of newly added fixed assets of enterprises as the measurement index of value-added tax incentives. Enterprise income tax (EIT): Enterprise income tax is an important tax burden for enterprises, and it is an important means of government intervention. Referring to the existing literature this study directly uses income tax as the reverse indicator of tax preference to explain the impact of government intervention on independent innovation investment.

The input of enterprise independent innovation includes capital input of independent innovation and personnel input of independent innovation. (1) Capital input of independent innovation (R&D): Capital input of independent innovation is the investment of strategic emerging industry enterprises for research and development, which is mainly used in basic research, applied research and experimental development. In this study, the expenditure on R&D is taken as a measure of the scale of capital input of independent innovation. (2) Personnel input of independent innovation (L): The personnel input of independent innovation is one of the important resources for enterprises' independent innovation and the key source of the enterprises' independent innovation vitality. Therefore, this study takes the proportion of technical personnel in the whole company as an index to measure the personnel input of independent innovation.

2.2.2 Theory of government failure

This sub-chapter adopts the views of the study on theories of government failure in Europe and the United States of America. The study was conducted in 2015 by Di Vita and others at the University of Catania, where they analyzed the theory of government failure. Their analysis began from the origin of the concept of market failure and continued with an explanation of the reasons a measure of political economy could worsen market allocation and the level of social welfare. Also, they mentioned the differences between Europe and

the United States, regarding the weight of the State in the economy and of the efforts to give a quantitative measure to government failure. The reason for adopting this study is to merge the similarities in the failure of the South African government in supporting local businesses. In the South African context, as a study defining the role of the state, the following must establish, maintain, refine, and reform an enabling framework for private enterprises and individual initiatives. The hallmark of an intelligent and democratic state is as follows: strong institutions of governance and the rule of law, credible and independent judicial institutions, effective legal frameworks for economic activity, an open and competitive economic environment, an equitable tax system, access to information, price stability and fiscal responsibility and promotion of technological and infrastructural development (Rodinelli &Cheeman, 2003)

A study conducted by Di Vita (2015) revealed that the Great Depression started in the late 1930s and the subsequent Keynesian theory (Keynes, 1936) was further instrumental in destroying the myth of the free market. After the Second World War, the economic theory started to consider the existence and causes of market failure more seriously and saw the need for some government intervention, the so-called visible hand to improve market allocation and raise the level of social welfare. During the second half of the last century, the broad consensus regarding the positive consequences of adopting an economic policy to correct the effects of market failures on economic welfare introduced into the economic literature the expression “government failure”, as opposed to “market failure”, to express some concern about the continual assumption of the Pareto-improving consequences of economic policy measures (Posner, 1974).

In the economic study theory, at the government is seen as a benevolent planner who wants to correct the defects of the invisible hand, improve market allocation, and raise the level of welfare. The government solution to a problem is usually as bad as the problem and very often makes the problem worse. Winston (2006) affirmed that government failure arises when the government has created inefficiencies because it should not have intervened in the first place or when it could have solved a given problem or set of problems more efficiently, that is, by generating greater net benefits. Such a definition empathizes the inability of the government to improve market allocation. It is possible to affirm that a

government policy is worth adopting in the presence of a market failure that is a source of negligible social costs.

The first possible source of government failure is the dynamic nature of an economic process, such that the government in charge cannot commit itself to future measures, which will be adopted by the subsequent government. The dynamic nature of the economic process makes it necessary to consider the discount rate in the analysis. Stiglitz(1998) offered the example of hydroelectricity plants to produce electricity, which need to be subsidized for a period longer than the duration of the legislature, while the hydroelectricity industries have no guarantee that successive governments will leave unaltered the subsidies and the legislation. Inability to make commitments causes another set of inefficiencies, thus the cost of creating the next-best credibility-enhancing mechanisms. While those in the government at one date cannot commit to future governments, they can affect the transaction costs of reversing policies (Stiglitz, 1998).

Lynn (1994) argued that the economic policy measures worsen market allocation whenever there is imperfect information between the policymaker and the private parties involved. Imperfect information may represent an obstacle to improving Pareto efficiency, if the policymaker does not have access to all the relevant information to adopt the correct policy measure or establish the magnitude of the measure, for example, the amount of the rate of taxation. The third source of government failure is the so-called destruction competition, a process that occurs in the presence of imperfect competition. Firms can get ahead not just by producing a better product at lower costs but also by raising the costs of their rivals (Salop and Scheff, 1983). A lesson learnt is that to be effective, economic policy measures should have well-defined objectives to achieve. Otherwise, the measures taken by the government without a clear and precise statement of the objectives to be pursued and of their sources to meet them are just a way to leave unchanged the allocation of resources and the distribution of income (Cramton, 1964). This means that some cases that may be attributable to the concept of government failure are just from the point of view of social welfare because the government policies worsen market allocation but satisfy the real will of the policymaker to protect some established interests, without displeasing the public opinion. Finally, government policies may be constrained in their action and worsen welfare

due to the complexity of the economic measures that are hard for public opinion to understand (Stiglitz, 1998).

The theories of government failure have played a different role in the United States and the Old Continent because, in the former, they have been used to justify the limited adoption of economic policy measures and a reduced role of the state within the economy. In Europe, the limits of government action have been used to justify a reduction of the weight of the public sector in the economy (Vickers and Yarrow, 1991). Despite the differences between Europe and the United States in the role of the state in the economy that can be measured by the tax burden (Romer and Romer, 2010), the government follows the business cycle in its policies because, during crises, it is forced by public opinion to adopt stronger measures to curb the crisis (Rajan, 2009), while during periods of prosperity, it is more prone to pander to the desire of firms for freedom. Basing his theories on empirical research limited to antitrust, Winston's (2006) monopsony policy and economic regulation to curb market power, so-called social regulatory policies to correct imperfect information and externalities, and public production to provide socially desirable services, concluded that government intervention in markets has either been unnecessary or has missed significant opportunities to improve performance.

2.2.3 The capabilities of South African Multinational Enterprises

Africa has experienced relatively consistent growth over recent decades (Fosu, 2015) and is increasingly seen as an attractive host location for multinational enterprises (MNEs), due in part to slowdowns in other emerging markets. However, MNEs and other firms operating on the African continent face many challenges, including a lack of critical infrastructure, the high volatility of local currencies, and unusually high levels of policy uncertainty (Barnard, Cuervo-Cazurra & Manning, 2017. Even under these difficult conditions, some emerging market MNEs outperform their counterparts from high-income countries in the world's least developed countries (Cuervo-Cazurra and Genc, 2008). Research is needed to understand how emerging market MNEs deal with these challenges, including how they go about upgrading their capabilities to compete successfully in their host economies. Upgrading capabilities is generally understood to mean developing the capabilities needed to thrive in more advanced economies. However, firms operating in less developed contexts also need

specific capabilities to be effective (Becker-Ritterspach and Bruche, 2012). According to Cuervo-Cazurra and Genc (2008), for MNEs to succeed, they need to develop capabilities that are appropriate to specific contexts.

This chapter examines how capabilities are developed when going “downstream”, specifically in sub-Saharan Africa. This study of four MNEs from South Africa –relying on insights into C-suite executives of South African headquarters and drawn from some of their subsidiaries in sub-Saharan Africa –distils three key categories of capabilities needed to operate successfully in Africa. Generally, business acumen refers to abilities to understand and deal with business issues and problems in a manner that is likely to lead to a satisfactory outcome. Often taken for granted, this capability plays a big role in the success of emerging market multinationals operating in underdeveloped contexts. Embeddedness –the extent to which noneconomic institutions and environmental forces shape economic activity determines flows of information and behaviors among the actors. Intra-MNE embeddedness refers to value-adding relationships among the parent firm and its subsidiaries. Local embedding emerged as the most critical capability revealed in this study, and the one that most often determines whether MNEs succeed or fail when they try to operate in wider Africa. Local embedding takes place via relationships between actors within the firm and other actors, such as government agencies and industry partners in the value chain.

Overall, the MNEs were able to upgrade their capabilities through exchanges of shared and pooled knowledge from their subsidiaries abroad, as well as by learning to develop close interactions with important stakeholders in the markets they served, particularly regulators, politicians and customers. Understanding customers was key, as were efforts invested in building the local ecosystem, for example, through local partnerships and/or strategic alliances with credible organizations and other stakeholders who had long-established footprints in the host markets. Most of the capability upgrading happened as MNEs sought to improve upon their existing capabilities in key areas, such as cost efficiency, distribution and networking and allowed them to overcome several of the institutional impediments that are familiar to those working on the subcontinent. However, some level of arrogance was also apparent, probably because the host environments were less developed than the

MNEs' home environments. This meant that where MNEs needed to comprehensively engage with a host environment to develop new capabilities, they often faltered.

South Africa's economy still bears the imprint of apartheid, nearly a quarter-century after its fall. The country is troubled by socioeconomic issues, such as the highest income inequality in the world and high levels of unemployment, particularly among its black population (IMF, 2005). World Bank Development Indicators show that the official unemployment rate in South Africa grew from 22.4 percent in 2008 to about 29 percent in 2019 (World Bank, 2019c). GDP per capita in South Africa continues to lag behind that of its middle-income peers. With a population of nearly 56 million people, South Africa has a per capita GDP of USD 13,200, while Brazils and Russia's GDPs, for example, are USD 15,200 and USD 26,500 respectively (CIA, 2017).

Nonetheless, post-apartheid South Africa has progressed modestly in key areas, such as diversification of its economic base and trade liberalization (IMF, 2005, 2017. South Africa and Kenya ranked joint second in IFDI attractiveness among African countries, after Morocco (Ernst and Young, 2017). South Africa leads the continent in terms of IFDI stock holdings in continental Africa, at about USD 128.8 billion as of 2018 (UNCTAD, n.d.). In 1997, the stock of South Africa's IFDI (as a share of GDP) was barely 10.8 percent. A decade later, this number was about 44 percent. Nearly two decades later, IFDI reached about 47 percent. Table 5.2 compares the stock of South Africa's IFDI to that held by Angola, Egypt and Nigeria, other important FDI destinations in Africa. Outward FDI (OFDI) flows from South Africa have fluctuated, falling from USD 1.2 billion in 1994 to USD 271 million in 2000 and then rising from USD 565 million in 2003 to USD 6.7 billion by 2013 (see Table 5.3, which again compares South Africa with Angola, Egypt and Nigeria (UNCTAD, n.d.).

Reaching an all-time high in 2014, OFDI declined by about 25 percent in 2015 and a further 41 percent in 2016, relative to 2015 figures (UNCTAD, n.d.).The decline since 2015 can be attributed to the country's economic slowdown, which can be traced to falling commodity prices and depreciating local currency (African Development Bank *et al*., 2017). Nonetheless, South Africa ranks as the fifth-largest investor on the continent after the UK, US, France and China (Ernst and Young, 2017; RMB Global Markets, 2017). South African

MNEs initiated eighty-four greenfield FDI projects in 2015 and eighty-seven in 2016. The annual value of cross-border mergers and acquisitions rose from USD 559 million in 2015 to USD5.1 billion in 2016 (UNCTAD, 2017).

South Africa emerges as the African continent's undisputed leader in foreign assets owned by developing and transition economy MNEs (UNCTAD, 2017). African host countries generally have lower income levels and perhaps lower formal quality standards than South Africa. Most South African MNEs are required to comply with at least institutionally-based standards to achieve legitimacy in their host environments. After considering various options, we decided to focus on financial service and agro-processing firms. International financial service firms are knowledge-intensive service firms that enable client participation in the global economy. To provide services that cross borders not only at the level of the individual like remittances, but also at the firm level like investment banking, they need to meet both technical standards. For example, this can be done so by having a functioning global clearing-house system, as well as institutional standards, for instance, by conforming to Basel III. As South African MNEs expand in Africa, they must operate in a context with a very large informal and "unbanked" customer base (Osei-Assibey, 2009), and thus, they need to align their services to local norms and preferences.

Agro-processing firms manufacture food products that are typically highly regulated. However, African food safety performance is often weak (Kussaga, Jacxsens, Tiisekwa and Luning, 2014). Given that technical standards in South African agro-processing firms are likely to exceed those of their host countries, institutional standards are more important. The criticality of food safety often drives private firms to supplement the regulatory efforts of local institutions (Kirezieva, 2014). Indeed, because their products are perishable, it matters relatively little to South African agro-processing MNEs whether government regulations in some of the host African countries are less demanding than in their home country. Firms can lose inventory, unless they have a certain level of efficiency in their operations, for example, cold chains and relatively rapid distribution systems. In addition, in agro-processing, perhaps even more than financial services, local preferences matter. The study identified two MNEs in each of the two sectors. All of the MNEs in this study are listed on the Johannesburg Stock Exchange (JSE) and have a substantial African footprint.

Unless otherwise specified, the background company information provided is from company websites and documents filed with the JSE. Standard Bank Group Standard Bank is a financial services provider that has operated in Africa for over 150 years. Its core businesses are personal and business banking, and corporate and investment banking. In terms of assets, it is the largest financial services group on the continent, with an asset base of USD149 billion and a market capitalization of USD 18 billion.

Why do governments need microeconomic policies?

According to Tisdell (2008), economics, particularly microeconomics, is primarily concerned with studying the reasons for the existence of scarcity, and the impacts of different social mechanisms for resource use or the extent, distribution and nature of scarcity. The study of these social mechanisms includes the use of market mechanisms and these are given the greatest attention by microeconomists. The focus of microeconomics implies that some of its major objectives are to find policies that will minimize scarcity and predict in a social context the implications of government policies for scarcity. For example, a government policy that subsidizes the production of one commodity and reduces its scarcity may add to overall scarcity because it reduces the supply of other valued commodities that are foregone. An opportunity cost is incurred in a fully employed economy, the opportunity cost being the supply of other commodities foregone. However, it should be borne in mind that scarcity reduction is not the only goal of government policy and that human values often include additional considerations.

2.2.4 The Structure of Government Intervention in African Agriculture

Government intervention in agriculture is pervasive across all countries at different stages of economic development (Beghin and Kherallah, 1994). According to Bates (1981), African policymakers have often lowered the price farmers receive for their products, subsidised inputs to pursue cheap food policy goals and imposed indirect taxation through overvalued exchange rates. African governments intervene in their agricultural sectors for political as well as economic reasons. In fact, rent-seeking activities by special interest groups have played a major role in hindering economic growth and in determining the nature of government intervention in Africa (Gallagher, 1991). African countries, like many developing countries, implemented significant changes in agricultural policy under pressure

from external donors, such as the World Bank and the International Monetary Fund (Fasano-Filho, 1996). Under the so-called Structural Adjustment Programmes (SAPs), donors demanded the liberalisation of agricultural markets as well as macroeconomic policy reform. This meant a move from government control to markets by ending marketing board price regulation for commodities, the demise of agricultural input subsidy and credit programmes that underlay cheap food policies in Africa, and, hopefully, improved incentives through macroeconomic reform.

Although an understanding of the structure of government intervention in African agriculture is essential for the design of policy reform, empirical studies dealing with its determinants are generally lacking (Fasano-Filho, 1996). The evidence shown in the study conducted by Lopez and Hathie in 1990, using data from eight countries in Africa (Egypt, Kenya, Morocco, Nigeria, Senegal, South Africa, Tanzania and Zambia) for the 1982–89 period, identifies the political and economic determinants that explain subsidy rates resulting from government intervention in agricultural markets. It goes beyond previous studies by explicitly considering input policies and using more comprehensive measures of government intervention-producer subsidy equivalents (PSEs). These include a myriad of interventions resulting in input, output and exchange rate subsidies (or taxes,) instead of measures based on nominal or modified product border prices.

From that study, they concluded by identifying the thrust and obtaining some stylised facts about the determinants of agricultural subsidy rates in Africa. Cross-section time series data at the commodity-level were assembled from eight African countries for the 1982–89 period. Producer subsidy equivalents were decomposed into output, input and exchange rate distortions and were used as dependent variables in an empirical political-economy model. Explanatory variables included structural adjustment dummies, as well as a set of national and commodity market-level variables hypothesised to explain the political power of producers relative to consumers. Overall, the empirical results indicate that output policies were determined within the national context, while the input subsidies were more responsive to commodity-specific factors. Another main result is that structural adjustment policies had an inimical impact on sector-policy reform but a major impact on macroeconomic policy reform.

The impact of structural adjustment policies was strong and evident in the form of reducing indirect taxation through exchange rate realignment rather than through market liberalisation. In particular, the SAPs did not seem to have a discernible impact on output subsidy/taxation rates and only a marginal impact in lowering input subsidy rates. Generally, structural adjustment programmes have the potential to benefit agricultural producers in Africa. The pursuance of cheap food policies was strongly manifested in the empirical results. The lower the per capita income of a country, the more likely policymakers were to choose lower prices for agricultural output and higher subsidies for agricultural inputs. Likewise, as the percentage of the urban population increased, agricultural output prices were lowered while input subsidies were increased. A combination of these two types of policy strategies was to foster cheap food policies. The structure of government intervention outlined above will likely continue to influence current and prospects for policy reform. Although the results have shown that SAP conditions resulted in higher net incentives to producers in the African countries in the sample, it is left unresolved whether or not input (credit and fertiliser) or output subsidies that were targeted for elimination were addressing important market failures. If so, the social cost from their elimination in particular crop situations could significantly exceed the savings in public expenditures, an issue worthy of further enquiry but beyond the scope of this study.

2.2.5 Overview of the structure of government intervention in African agriculture

In the context of public policy, taking a conventional economics perspective, the fundamental issue is whether the total investment in agricultural R&D is right and the resources are allocated according to the right priorities sufficient to achieve maximum social benefits, with marginal social benefits equal to marginal social costs across projects and programmes (Alston, Norton and Pardey, 1995). The choice of the optimal mechanisms for least-cost funding and efficiently allocating the research resources, which determine the incidence of costs and benefits, are also relevant for achieving the optimum (Alston and Pardey, 1996). The evidence from the rate of return studies would suggest that the world as a whole has consistently fallen well short of the optimum in terms of total investment, let alone in terms of the balance of research priorities. This can be taken as evidence of government failure.

Government failure can also arise in the context of technological regulation, through failure to use the optimal instruments or failure to set instruments at the optimal levels or rates. It is easy to find instances of government failure, both in terms of the under-regulation of some farming activities (use of certain pesticides such as DDT, emission of greenhouse gases or the pollution of waterways with fertilizer runoff) and the over-regulation of others (the use of genetically engineered crops or the banning of some seemingly safe pesticides such as glyphosate) in many countries. More pernicious effects may come from the systematic mismatching of policies to purposes, as exemplified by the rising propensity to use agricultural science and technology policies as instruments for pursuing societal objectives related to human health, income distribution or environmental outcomes rather than as instruments for correcting market failures in innovation. One of the most important, but widely ignored or simply unknown, ideas from the economics of public policy is a rule of thumb, which states that policymakers trying to achieve multiple economic targets should employ at least one policy instrument for each policy target (Corden,1974).

According to Corden, (1974) these rules should not contemplate setting priorities for agricultural science investments based primarily on their implications for the carbon footprint of agriculture, the prevalence of obesity or any other social objective when the pertinent criterion is simply the benefit-cost ratio, giving due (that is, not too much) consideration to the implications for the carbon footprint and obesity.

2.2.6 SMME perceptions of government assistance within South Africa

According to the National Small Business Act of South Africa of 1996, as amended in 2003, an SME is classified as a "… separate and distinct business entity, including co-operative enterprises and non-governmental organizations, managed by one owner or more which, including its branches or subsidiaries, if any, is predominantly carried on in any sector or sub-sector of the economy" (National Credit Regulator, 2011). The European Commission (2005) defines SMEs as "… the category of micro, small and medium-sized enterprises (that) is made up of enterprises, which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million Rand, and/or an annual balance sheet total not exceeding 43 million Rand". The importance of SMEs in the

creation of jobs and economic upliftment is clear from the employment created by these businesses. SMEs in the United States of America, for example, provide over 50% of employment and enterprises are made up of less than 500 employees (Biondi and Iraldo, 2002). In the European Union, SMEs represent about 90% of all businesses (European Commission, 2015). This figure is quite similar to South Africa, whereby SMEs account for approximately 91% of formal businesses contributing between 51-57% of the country's gross domestic product (GDP) and providing approximately 60% of employment (Abor and Quartey, 2010).

The White Paper on National Strategy for the Development and Promotion of Small Business in South Africa highlights the fact that SMEs signify an important means to address the challenges of job creation, economic growth and equity in the country (Department of Trade and Industry, 1995). SMEs are the lifeline of many local and international economies, as they are vital in decreasing unemployment levels, stimulating technological innovation and advancement, as well as ensuring long term economic stability (Ardic, Mylenko and Saltines, 2011). SMEs play an even more critical role in developing countries and therefore the South African economy relies heavily on the contributions made by SMEs, and especially those SMEs who are birthed by true entrepreneurs (Business Environment Specialists, 2013). Failure rates of SMEs are, however, a point of concern. It is estimated that more than 72% of all SMEs fail in the first 3 to 4 years and in South Africa, this is no different. According to Van Scheers (2011), 40% of new SMEs within South Africa fail within their first year, 60% within their second year, and 90% within their first 10 years of operation. Such high failure rates may due to a number of factors, including management skills, finance, access to markets and appropriate technology (Kongolo, 2010). It is due to these high levels of failure of SMEs that government assistance is so important, as long as it is used correctly and properly. South Africa's government can be divided into three domains, namely: the national government, provincial government and local government. Furthermore, the government gear is made up of three parts, including legislatures, executive and administration (ETU, 2015). The domains of government have been considered as distinctive, inter-related and interdependent. However, they all operate according to the Constitution and laws and policies made by the national Parliament (ETU, 2015). The

development of SMEs and providing assistance forms an imperative element of all domains to create jobs and ensure a better life for all.

2.2.6.1 Government assistance

SMEs operate in a time where there is growing uncertainty in terms of global economic and political stability, accelerating technology change, and new laws and regulations are all obstacles a new SME owner needs to overcome (Abor and Quartey, 2010 (AFMA, cited in Ncube et al., 2016).)). The assistance provided by national and local governments to SMEs can therefore not be denied and is crucial in not only decreasing the SME failure rate as proposed by Robert (2010), but also ensuring the success of new and growing SMEs. For example, organizations such as the Small and Medium Industries Development Corporation (SMIDEC) in Malaysia, the Soros Economic Development Fund which operates internationally, the World Bank Group and SEDA (Small Enterprise Development Agency) (SEDA, 2013) in South Africa are all focused on assisting in developing nations (Hung and Effendi, 2011).

According to SEDA (2013), in South Africa, the government has focused on reducing the gap between rural, micro-enterprises and rich, high-end SMEs by fostering an environment where both can flourish (Nehen, 2012). In 2004, SEDA was founded with the mission to "…develop, support and promote small enterprises to ensure their growth and sustainability in coordination and partnership with other role-players" and to focus on nurturing innovation, customer service and ethical behavior with all the SMEs it comes into contact with (SEDA, 2013). The ultimate goal of SEDA and its New Growth Path is to create 5 million jobs by 2020, and this new strategy sees this organization focus on SMEs, which employ between 21 and 200 individuals, whereas the National Development Plan aims to create 11 million jobs by 2030 (SEDA, 2013).

While employment in South Africa can be seen as a key driving force for the development of SMEs, this reasoning can be universally experienced. For example, the UK SMEs have planned to create a record of 737,000 jobs and spend around £37.9 billion (which is around R3.790 trillion) by May 2016 (GE, 2015). Rogerson (2008) explains that three of the most significant areas addressed by governments in terms of SME development, include access to financing, training and development, as well as creating more flexible laws and

regulations. These areas are seen as the ones that contribute largely to SMEs battling to survive and grow. According to Olawale and Garwe (2010), a lack of education and training in business in South Africa seems to be the main reason for "low new firm creation and failure", while insufficient level of financial support and assistance is a close second. Smit and Watkins (2012) believe that entrepreneurs who have had managerial and business skills training are more likely to cope and overcome the challenges in a changing business environment. SMEs are finding it very difficult to not only raise capital but also to get access to debt financing (Fatoki, 2012).

Herrington, Kew and Kew (2009:90) explain that although organizations, such as the Khula Enterprise Finance, Small Enterprise Development Agency (SEDA), the Industrial Development Corporation (IDC) and the National Youth Development Agency (NYDA), are committed to assisting with financing entrepreneurial activities; they are not reaching their "target markets" as many entrepreneurs are unaware of their existence (Olawale and Garwe, 2010). Therefore, it is crucial that awareness is created and SME owners are made aware of the support available to them (Fatoki, 2012). If they do not know about it, they cannot use it, and if they know about it, then it must be made possible to make use of the assistance effectively. Finally, according to Herrington *et al*. (2009), South Africa suffers from an "inefficient government bureaucracy, restrictive labour regulations and a lack of suitable tax breaks for smaller businesses" and this creates colossal barriers for growth.

The high cost of taxes and SME licensing fees are other areas of concern (Olawale and Garwe, 2010). It is crucial for regulators to create an environment that uplifts new and growing SMEs and this can only be done with equally supportive business and trading laws. Jeppesen (2005) points out that the national government cannot carry all the responsibility and obligations for SME development; the obligation must be spread amongst local municipalities as well. Many organizations have stepped in and are offering SMEs the assistance they require in order to succeed, especially in terms of non-financial support, such as workshops on entrepreneurial skills development, networking opportunities, mentoring and coaching, advisory services and assistance with regulatory and legal compliance (ABSA, 2015; Malherbe, 2015; Dludla, 2014). The perception of SMEs regarding the available assistance and the regulatory requirements must be

established to clarify and determine where further assistance can be provided to SMEs, which may further influence or change these perceptions to have a more positive approach towards these efforts.

2.3 Government intervention in poultry production

There are several interventions and support services offered by the government of South Africa to the poultry industry. According to DAFF (2019), support from the government includes measures in boosting market competitiveness (trade measures, export support by assisting domestic producers to access foreign markets, finance and incentives with conditions to improve competitiveness, promote growth and transform the poultry industry), value adding and technology upgrading.

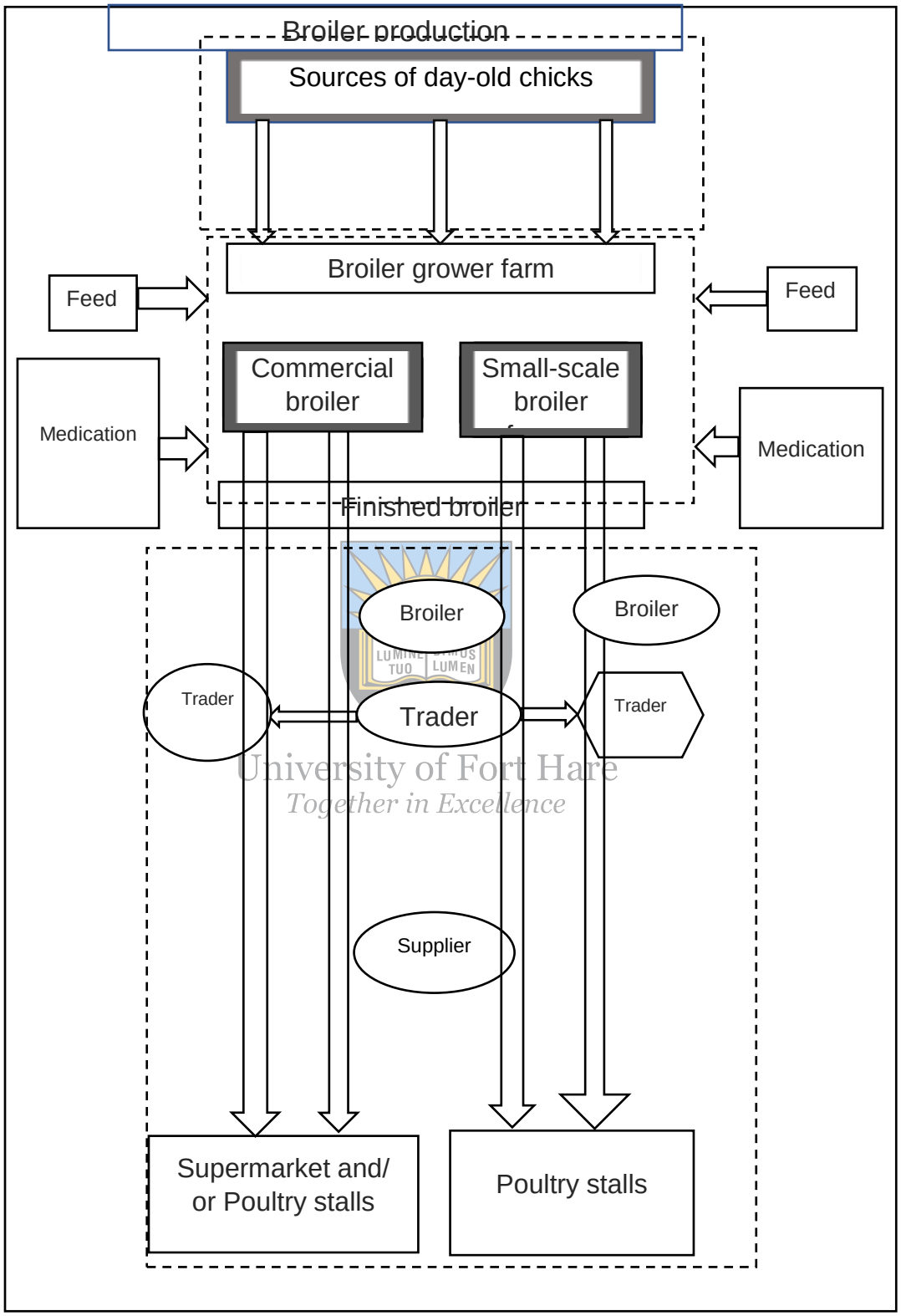


Figure 2.1: value chain of broiler
Study 2022

Picture 2.1 above shows the complete broiler value chain as it shows production starting from the sources of day-old chicks entering the farms (commercial or/and small scale). In both farms, farmers fed their chicks with different feeds and medication. When broilers are ready (matured enough), commercial farmers sell or trade them to Supermarket and/ or Poultry stalls while small scale broiler farmers sell or trade their broilers to Poultry stalls.

Since that time, government has re-arranged and put in place trade measures to avert the demise of the poultry industry. These measures include but are not limited to the implementation of anti-dumping, as there is evidence through the International Trade Administration Commission of South Africa's (ITAC) investigations that poultry products are dumped in our market. Some measures of safeguard have been implemented to surge imports that are threatening and disturbing the South African poultry market (DAFF, 2019). Given a rise in consumption, these measures have been major pushback from the industry's trading partners in the South African market.

Consumption of poultry meat is on the increase. The higher-income consumers prefer breast, which is mostly in developed countries and other meat portions are preferred in developing countries (FAO, 2018). In this regard, World price has been affecting the pattern of trade for poultry. Countries like South Africa have been experiencing import challenges as several trading partners put pressure on the domestic poultry industry.

Furthermore, South Africa prioritises food safety and assesses the food safety risks associated with meat products (both locally produced and imported) regularly through the Departments of Agriculture Forestry and Fisheries and Health. For locally produced meat products, there are processes followed to ensure food safety. Meat products at the ports of entry are imported in line with the South African food safety requirements. Non-compliant products are rejected and either sent back to the country of origin or destroyed (DAFF, 2020).

2.3.1 Government interventions to save the poultry industry

The South African government continues to deploy many interventions to support the poultry industry. These include measures to boost competitiveness, value-addition and

technology upgrading. They are trade measures, export support to assist the domestic industry to access foreign markets, industrial finance and incentives with conditions for improving competitiveness and measures to promote growth and transformation of the poultry industry among others. In this regard, a task team was established to work towards a comprehensive plan for the industry that will respond to the immediate threats facing the industry and long-term measures to improve the competitiveness and transformation of the industry. The task team comprises representatives of the government (Department of Trade & Industry {DTI}; Department of Agriculture Forestry & Fisheries; Economic Development Department); the Industrial Development Corporation; the private sector (SA Poultry Association {SAPA} and one representative from major poultry companies) and labour (Food & Allied Workers Union). To date, the DTI, the industry and SAPA have commenced research work on the development of the Poultry Master Plan, which feeds into the work of the Task Team (DTI, 2019).

Agricultural Outlook database [FAO] (2019) indicated that global poultry meat consumption is rising, with white breast meat preferred by higher-income consumers, mostly in developed economies and brown meat preferred in developing countries. This affects the global price patterns for poultry. In this regard, South Africa has experienced a rise in imports of the bone-in chicken portions from several trading partners and that puts pressure on the domestic industry. There is a broad agreement that manufacturing-led growth is critical for high economic and employment growth, and the poultry sector is critical to this effort. South Africa has adopted a developmental trade policy, which at its core is to support industrial policy. Therefore, the role of the International Trade and Administration Commission (ITAC) is critical to inform the level of tariff afforded to industry. An industry that is experiencing challenges and seeks tariff protection is encouraged to apply to ITAC, which will undertake an independent investigation and make recommendations, as appropriate to the Minister of Trade and Industry in accordance with South Africa's international commitments on trade. This relates to both tariff investigations and trade remedies.

According to DTI (2021), to this effect, the government has put in place a range of trade measures to avert the demise of the poultry industry. These include the implementation of

anti-dumping measures in cases where through the ITAC investigations, there is evidence that poultry products are dumped in our market. Safeguard measures have been implemented in cases of a surge in imports that are causing a threat of serious disturbance in the South African market. Duties on imports of whole birds have been increased to 82%, the maximum duty allowed following our World Trade Organization commitments. The current duty on the bone-in chicken portions is 37%. In addition, the government has opened market access opportunities in the spirit of promoting export-led growth to some countries and regions, including the Gulf and the EU. All of these measures have assisted to give the industry the necessary protection. These have been done with major pushbacks from our trading partners given the rise in consumption of especially bone-in chicken portions in the South African market.

Furthermore, South Africa prioritizes food safety and assesses the food safety risks associated with meat products (both locally produced and imported) regularly through the Departments of Agriculture Forestry and Fisheries and Health. For locally produced meats, there are processes followed to ensure food safety. Meat products at the ports of entry are imported in line with the South African food safety requirements. Non-compliant products are rejected and either sent back to the country of origin or destroyed.

The poultry industry is an important sub-sector within South African agriculture. It provides the most affordable source of animal protein to the South African consumer, which makes it critical to food security.

2.3.2 Poverty in South Africa

The occurrence of poverty in rural South Africa is high. Training, education and job creation are required as a means of elevating the living standards of rural individuals. Unemployment is high in South Africa and the government, trade unionists, businesses, and industry all agree that job creation is of paramount importance for the country (Craven, 2010).

Aside from its importance as a source of food and a substantial contributor to the national Gross Domestic Product (GDP), the poultry industry contributes to job creation, both in the

formal and informal sectors. More than 80% of its establishment consists of Small-, Medium- and Micro-scale Enterprises (SMMEs).

2.3.2.1. The socio-economic importance of family poultry farming

It is possible to eradicate malnutrition in rural areas by encouraging rural people to keep a few egg-laying hens for their households. A dozen hens kept under cover in a battery of cages are capable of producing 11 eggs a day. A family can easily manage such a unit. This would supplement the necessary dietary requirements of the family and at the same time, the extra eggs can be sold to provide desperately needed additional income (Gueye, 2009). Rural poultry is defined as a flock of not more than 100 birds, maybe of improved or unimproved breed and reared in either extensive or intensive farming systems (Sonaiya and Swan, 2004).

2.3.2.2 Sustainability of poultry farming

The FAO (1995) defines sustainable development as "the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations". Intensive poultry farming has done extensively well in South Africa. The poultry industry is currently the largest segment of agriculture. The level of consumption of poultry meat in South Africa suggests that this industry is viable. According to Erasmus (2011), 60% of all protein consumed in South Africa in 2011 was from poultry.

The sustainability of poultry farming in South Africa is affected by volatility in profitability, which is inherent in the broiler industry. Biological factors, such as poultry diseases, and lengthened turnaround times in the production chain, coupled with rises in the costs of feed, fuel, electricity and labour, directly impact production costs. If such increases in production costs happen, together with a downswing in the economy and reduced demand for products, profit margins become severely depressed. The broiler industry has had to deal with such a situation over the past four years (SAPA, 2011).

2.3.2.3. Why poultry farming?

Erasmus (2011) and SAPA (2012) indicate several reasons poultry farming would be considered a swift way of attempting to alleviate rural poverty:

1. It is a type of farming of which most rural people will have some knowledge.
2. A considerably short time is required from the time of inception of the project to the time when a farmer can sell some produce. Broilers can be sold for meat after six weeks, if they are reared under optimal conditions.
3. A relatively small amount of capital is required for starting, compared with the rearing of cattle, for instance. As few as 50 poultry can significantly change the livelihood of a poor rural dweller.
4. No hired labour is required for such an endeavour. Family labour is usually sufficient.
5. According to Erasmus (2011), 1.7 kg of grain-based feed is required to produce 1 kg of poultry since poultry does not eat a lot of food. In contrast, 5.5 kg of feed is required to produce 1 kg of beef.

Poultry production continues to show a growing trend locally and internationally, outperforming other protein sources, such as beef and pork.

2.4 Government Intervention in Poultry Industries: A Cross-Country Comparison

The purpose of this paper is to improve our understanding of the impact of government intervention affecting the poultry industry. The net effects of intervention in both poultry product and intermediate input markets, principally feed grains, on the poultry industries are evaluated in three important producing and consuming countries: Canada, the Federal Republic of Germany (FRG) and the United Kingdom (UK). These countries illustrate the typical systems of poultry policy intervention found in industrialised countries. Canada represents countries that have protected their traditional poultry producers from having to adjust to technological changes by setting high internal prices, restricting imports and limiting the volume of sales per producer. The FRG and UK represent countries that have used product market interventions to compensate producers for their high feed costs because domestic feed grain prices are set administratively well above the world market

price for feed grains. The difference between the FRG and the UK is that the former overcompensates poultry producers while the latter under-compensates them. The next section of the paper deals with the distortion of price signals as a result of the intervention. The concepts of nominal and effective rates of protection are used for this purpose. The third section presents a comparison of intervention in the three countries considered, based on the effects of these distortions on quantities, welfare and income distribution. After the limitations of the analysis are presented, important lessons learnt about the impact of intervention in the three countries are drawn from the analysis.

2.4.1 Poultry as a tool in poverty eradication

Rural people are disproportionately burdened by the effects of unemployment and poverty. Poverty limits the ability of the rural community to invest in the development of their communities. World leaders, through the United Nations, have made poverty alleviation a top priority, as evidenced by its designation as the first of the Millennium Development Goals (United Nations, 2010). Agriculture-related activities are known to provide approximately 70% of employment in the rural areas of developing countries (The World Bank, 2013). Nonetheless, poverty is still mostly concentrated in rural areas, and this will in all probability remain the case for a few more decades to come (United Nations Water Assessment Programme, 2014). Sustainable poultry farming requires knowledge, but these are relatively uncomplicated skills that can be taught to rural individuals who possess little or no formal education. The majority of rural individuals have some knowledge of rearing poultry on an extensive scale because it is common practice for most rural people to keep a few poultry running around in their backyard. The intention is to get rural farmers rearing poultry on a semi-intensive scale so that they can earn some money and also supplement their dietary requirements, ultimately elevating their living standards.

2.4.2 Mapping sustainable development as a contested concept

The notion of ‘sustainability’ and ‘sustainable development’ is, in many ways, contested. It is challenging to deal with all aspects of it in connection with a single sector within agriculture because it is interlinked with so many other sectors and developments, including the global food system. One major starting point for the concept of sustainability came in

1987. According to the World Commission on Environment and Development, (1987), sustainable development was attained when current generations could meet their needs without undermining or destroying the future generations' chances of having their needs met. This core principle of sustainable development aims at balancing economic, social and environmental interests. Valentin and Spangenberg (2000) argued for a fourth imperative for the concept of sustainability, namely 'institutional sustainability'. At the same time, Thompson (2007) raised the philosophical point that should take care not to equate 'what is sustainable' with 'what is good per 'non-substantive uses of sustainability'. Thompson (2007) argued that 'once you have deemed a practice worthwhile on other grounds, it becomes meaningful to ask whether it is sustainable, and to seek relatively more sustainable ways of securing the values or achieving the goals that make a practice worthwhile in the first place'. In this way, 'sustainability' becomes an 'add-on value' to a practice, which is judged ethically 'good' and an agreed goal in the community.

This study aims to unfold the concept of sustainability and discuss a range of aspects of this in the context of the current poultry sector in its many forms throughout the globe. An initial definition of the concept of sustainability will give the theoretical framework for this discussion.

2.4.3 The concept of sustainability

The theoretical framework for this study on sustainability in poultry production is the multi-dimensional understanding of the concept as discussed Valentin and Spangenberg (2000) Their work in four dimensions supported Agenda 21 or the Rio Declaration, which included social, environmental, economic and institutional objectives. So, when their study stated that 'democracy' is a key for the interlinkage between the institutional and social dimensions, this was seen as increasing tolerance and social cohesion developed in a society, which can only be fostered through the creation of institutional structures that can ensure participatory democratic processes. In Valentin and Spangenberg's model, the social imperative included 'human capital', that is, the skills and capabilities of people, whereas the institutional imperative comprises governance, and, to some extent, certain social capital perspectives.

There is a wealth of literature dealing with ‘sustainability,’ meaning many different things. In some cases, only one aspect of sustainability is considered (Castellan *et al.*, 2012), which is described as a multi-criteria approach for measuring the sustainability of different poultry production systems. Their assessment addressed human food needs (the social dimension), environmental preservation, economic feasibility and the quality of life. FAO (2012) developed a system of sustainability assessment, SAFA, in which four dimensions are considered and measured, using multiple indicators, namely ‘environmental integrity’, ‘economic resilience’, ‘social wellbeing’ and ‘good governance’.

2.4.4 Aspects of sustainability of poultry production

2.4.4.1 Environmental aspects

Globally, livestock takes up about 70% of all agricultural land, and 26% of the ice-free terrestrial surface is used for livestock grazing (Steinfeld *et al.,* 2006. The current global growth of the livestock sector is, however, achieved at a substantial environmental cost (Gerber *et al.,* 2008). Biodiversity loss - one of the most critical environmental losses of our time, among others because 65-70% of global food production relies on pollinators which are heavily reduced - is to a large extent a result of changes in land use, such as increased cropland (Röckström *et al.,* 2009). Livestock activities have been estimated to contribute about 18% of the total anthropogenic greenhouse gas emissions (Steinfeld *et al.,* 2006). Considering the agricultural and forestry sector as a whole, the livestock share alone is over half. These activities are linked to multiple factors related to the production of feed and include deforestation, N fertiliser use, processing and transport. However, poultry is the livestock species with generally the least impact in terms of land size, water use, environmental stress and footprints both for poultry meat and eggs (De Vries and De Boer, 2010). Transport must be considered as an environmentally burdening activity, although it is at the moment ‘cheap’ in terms of price. The trade with poultry meat is huge (Anonymous, 2013).

A Life Cycle Assessment (LCA) is a method to examine the complete production or value chain while tracing the inputs back to natural resources and emissions produced along the way. Williams *et al*. (2009) conducted an LCA specifically for broiler production and

concluded that it is the most resource-efficient meat production in agriculture, mostly due to genetic development and nutritional efficiency. They pointed to the potential for such improvements as increasing overall lifetime feed conversion efficiency and energy use to explore opportunities for reducing reliance on fossil fuels.

Gerbens-Leenes *et al*. (2013) conducted a study on modelling the water footprint in poultry and other meat production in Brazil, China, the Netherlands and the United States, and concluded that this was mainly determined by FCR, feed composition and ingredient origin. The concentrated feed has a larger water footprint than roughage, but a higher FCR. Industrial systems generally had a considerably smaller water footprint than other systems, mainly because the animals are bred to grow faster, move less and have better FCR. This term distinguished between rainwater and ground or surface water, where rainwater was regarded as having a less environmental impact than other freshwater sources. Gerbens-Leenes *et al*. (2013) emphasised that the impact of poultry production had to be viewed in context with local water scarcity, among other factors. Obviously, the production which requires much water is unsustainable in an area with water scarcity.

A relevant aspect of resource management related to feed and food is the potential risk of poultry competing with humans for protein sources, for example, if more of a protein-rich feedstuff is fed to animals. Magdelaine *et al*. (2005) provides a very interesting case, in which different aspects of 'environmental sustainability' are challenged, especially concerning the EU requirement for 100% organic feed in a few years. The final date for transition to 100% organic feeding in the EU has been postponed until January 2018, allowing 5% non-organic ingredients until then (EU, 2012; 2014), indicating a concern about the availability of sufficient protein sources of suitable quality. The 100% organic feeding can be based on increased amounts of locally-sourced feedstuffs, which do not compete with human food or needs transport and therefore can be regarded as more sustainable. This can lead to increased difficulty meeting the birds' need for methionine, leading to protein overfeeding and increasing N-excretion to the environment, with the risk of disease and impaired production. This calls for a broader understanding of 'adequate feeding' seen from a systems approach, where animals are more robust and there is more emphasis on resilience related to feeding and keeping poultry (Horsted and Hermansen, 2007).

In a well-integrated farming system, animals are part of a nutrient cycle. Ideally, the animals are sustained from products on the farm, which in the current situation are made ‘best use of’, with minimum use of labour and resources, in particularly non-renewable resources. The manure of the animals contributes to soil fertility. This cycle does not exist in industrial animal production, which relies on the transport of all resources. Manure becomes ‘waste’ that needs to be handled, like medicine residuals or by-products, odours or dead animals.

The use of fossil fuels is a part of food and trade-related pollution, needed for growing and transporting feed, live animals and poultry products and to heat or cool poultry barns. Given the fact that poultry can be raised under many different local circumstances, it may be unnecessary to involve so much transport when meeting the need for human protein supplies (Horsted and Hermansen, 2007).

2.4.4.2 Antibiotics

Two specific types of growth promotors in feed for poultry were prohibited (Engberg and Petersen, 2001). However, in 25 EU countries, a total of 8.420 tonnes of antibiotics (not including coccidiostats) were sold for farm animal use in 2011 (Third ESVAC report). Poultry account for 13% of antibiotics in the EU, given in the forms of premix or oral solutions (about 84% of all antibiotics, primarily for mass medication of pigs and poultry). Any type of production, which relies on the use of medicine, where there is a risk for developing resistant bacteria over time, or whose residuals pollute the surrounding environment, cannot be classified as ‘sustainable’, especially if medication is used for preventive purposes and/or as mass medication.

2.4.4.3 Breed diversity

Humankind has domesticated 30 species of animals, which accounts for about 8,000 registered breeds, including hundreds of poultry breeds. Most of these breeds are kept by smallholder farmers throughout the world, who produce a large part of the world's poultry meat and eggs, and at the same time, conserve some of the world's livestock breeds. Many of these breeds are locally adapted, multi-purpose and indigenous and suited to various farming enterprises. The current breeds in industrial systems are almost exclusively single-

purpose breeds, either broilers or layers. Very few genotypes exist in today's broiler production, which is selected for growth and FCR but is more vulnerable in terms of immune competencies (Rauw *et al.,*1998). Eradicating breeds means not only losing natural capital or genetic ‘wealth’ but also exterminating the possibilities for adapting to different environments and situations, for example, climate changes (FAO, 2015). Furthermore, killing millions of male chickens immediately after hatching raises ethical concerns, and the sustainability of this can be questioned.

2.4.4.4 Social aspects

Several studies have been carried out regarding the working conditions of farm workers in industrial farms in general, specifically on poultry farms. These studies deal with two different categories of social aspects for humans: 1) working conditions and health of the humans (owners or workers), and 2) the fairness of employment contracts like health insurance, decent salaries and collective bargaining rights. Poultry farmers and their family members are at higher risk of being infected with antibiotic-resistant bacteria, as well as of developing allergies to antibiotics. Since 2012, poultry farmers in the Netherlands have been categorised as people who need quarantine and special attention if hospitalised because of this risk. Other risks include health problems due to dust exposure from litter and feathers ((Le Bouquin, 2014). Quandt *et al*. (2013) conducted qualitative interviews of Latino chicken catchers in the US. about their working conditions and concluded in short: ‘Chicken catching is characterised by a work environment and organisation of work that promotes injuries and illnesses’. Studies like this show the close connections between disease risks, human rights issues and general working conditions. Many workers in the food-producing industry are exploited unfairly and employed under poor conditions to keep the direct costs of production low. Furthermore, many poultry farmers today are contract farmers, meaning that they are ‘out-growers’ delivering to a bigger producer or a processor. The arrangements and conditions under which these arrangements are taking place vary widely and are in some cases highly unfair (FAO, 2011).

2.4.4.5 Gender balance

The third Millennium Development Goal is to promote gender equality and empower women. Poultry production has been and still is a type of production in which women are heavily involved throughout the world, especially on an individual, family and/or small-scale farms (Dolberg, 2007), for the benefit of the whole family.

2.4.4.6 Animal welfare

Animal husbandry systems, which cause suffering to the animals, are unacceptable, as seen from an ethical point of view. Thompson (2007) argued that human society wants to secure practices for the future that we find worthwhile for ethical reasons, and giving animals life without suffering can be seen from a sustainability perspective, either in relation to social aspects or as in SAFA (Kennedy, Nantel, and Shetty, 2012), as an environmental aspect of sustainability. The EU-sponsored Welfare Quality research project established a list of 12 criteria for animal welfare, that is, that poultry should not suffer from prolonged hunger and thirst, have space to move around freely, and be able to express normal non-harmful behaviour. The 12th criterion stated that 'Positive emotions should be promoted and negative emotions, such as fear, distress, frustration and apathy should be avoided'.

Many systems today do not give animals sufficient opportunities to fulfil these criteria, and some systems and methods of rearing poultry cause suffering, for example, foot pad dermatitis, which may be associated with fast growth. This may compromise animal welfare, and cause abnormal behaviour, such as spending more time resting than slower growing genotypes (Nielsen *et al.,* 2003) Some studies discuss the strategy of providing growing female broiler breeders with low-density diets, as an alternative to feed restriction (De Jong *et al.,* 2005) and reported reduced hunger and frustration, observed as reduced stereotypic and tail pecking and increased dust bathing and other comfort behaviours compared with those fed standard restriction diets (Nielsen *et al.,* 2011). However, further research is needed to study if high fibre diets can increase the birds' feelings of satiety. Irrespective of the applied animal welfare definition used, it is a fact that farm animals, including poultry, are living, sentient individuals, which need to be protected and offered opportunities for living a life worth living.

2.4.4.7 Institutional aspects itemized

Institutional aspects of sustainability include the control and governance of global systems and ensuring that the institutions are accountable, transparent and open to their members and representatives (UN, 1992). This is challenged in our current food regime, where a few breeding companies control a large part of the market, making it difficult for smaller companies to establish. Secondly, the different interests embedded in the sustainability concept should be balanced in the governance of the systems. Although the united nations have a wide range of policies to address the economic, environmental and social dimensions of sustainability, these have developed without enough coordination. Too often, action to achieve objectives in one policy area hinders progress in another while solutions to problems often lie in the hands of policymakers in other sectors or at other levels of government. This is a major cause of many long-term unsustainable trends. In other words, policies that are implemented to support, for example, economic development can undermine initiatives to support social development. Such governance can include the responsibility to protect the environment in other parts of the world, such as in South America or support a more sustainable local production and market, for example, in Africa or Asia or production which contributes to gender balance.

The ‘concentration ratio’ (CR) is a term that describes an industry's control over a certain enterprise. For example, the CR4 gives an estimate of the market share of the four biggest firms in control of this particular product. When it is over 40%, such as the poultry production, where CR4 for broilers was 58.5% in the USA in 2010, there are reasons for concern for the competitiveness of the market (Kennedy, Nantel and Shetty, 2013).

2.4.4.8 Economic aspects

Chicken has been domesticated, raised and eaten throughout the world for many centuries, but its role as food has changed during the last century. In the U.S., chicken meat was reported as a luxury food in the 1920s. Since the US broiler industry developed into the first real ‘agribusiness’ in the 1960s, over the decades, chicken meat has turned into an increasingly cheaper ‘staple food’ (Godlay, 2007). Now, broilers are considered to be ‘the cheapest source of protein’ (Anonymous, 2013). In the UK, the chickens which were eaten

in the 1940s were by-products in the form of cockerel chicks from a growing egg industry. The growing demand and the relatively high price for chicken became a huge driver for mass production, leading to specialisation within production, and an emergent industry of significant efficiency (Godley, 2007). Currently, Africa is experiencing a growth in intensive poultry production near cities (Kennedy, Nantel and Shetty, 2011), while frozen poultry is exported in large quantities from subsidised EU-industrial farms to African and Asian countries (Anonymous, 2013). For instance, the Netherlands exported approximately 119,000 tonnes of poultry meat to African countries in 2012 (Anonymous, 2013). Titze *et al*. (2007) discussed the consequences of such trade in undermining the local viable poultry production, which has the potential to improve the livelihoods of many local farmers. The livelihood concept gained widespread prominence following the report entitled 'Our common future' (WCED, 1987). In its simplest form, it can be understood as 'getting a living', and comprising 'the capabilities, assets and activities required for a means of living' (Chambers and Convey, 1991). Village poultry makes a significant contribution to poverty alleviation and household food security in many developing countries (Alders and Pym, 2009).

2.5 Poultry production as part of the current agricultural and food system

2.5.1 Consumption patterns and demand for poultry products

Despite the huge rise in the consumption of poultry products over the past decades, projections suggest that demand will double by 2050, compared to 2010 (Kennedy, Nantel and Shetty, 2011). We have never before in the world's history produced more calories per capita. Today's challenges in food insecurity are not due to a lack of food but rather to the lack of ability among poor people to buy it. Today there are estimated to be about 1 billion hungry people and close to 1.5 billion people who suffer from obesity and/or lifestyle diseases. Different consumption patterns can develop in various directions, whereby demand for animal products increases in some countries, while others foresee an increasingly 'green' healthier diet, as people grow wealthier. Kennedy, Nantel and Shetty (2011) stated that 'Livestock source food is not essential to human nutrition, but it is highly

beneficial. McMichael *et al*. (2007) suggested an average global meat consumption of about 100 g per consumer per day.

If poultry is integrated into self-sustaining agricultural systems, for example, on marginal land, forest areas or fruit production areas, there can be a synergy between the different components of the farm. If not, then the need to import feed and dispose of manure adds to the environmental costs of livestock production, even though poultry has a good efficiency in transforming feed into animal products. This raises the issue of the 'true costs of low prices', in combination with the consequences of industrial poultry production. The long-term external costs of poultry systems (loss of biodiversity, pollution, use of fossil fuels and water shortage) can be discussed in relation to sustainability. The poultry sector has developed into one of the high animal concentrations, with risks for animal and human health, as reported and discussed in connection with Avian Influenza (Leiblein *et al*., 2009), which can increase costs of the production.

Current food waste, due to cheapness and availability, is estimated to be between 30% and 40% of all produced food, taking place on every level from production to the consumers' homes. The systematic killing of male chicks from egg production in both organic and conventional production is also a waste. It seems relevant to address this dimension of the food system as part of the effort for more sustainable production on the farm and processing levels.

2.5.2 Consumers' choice

With a CR4 over 40%, the true decision power of consumers is questionable. If there is a real choice for consumers to choose poultry products by their preferences, they need to be aware and well informed about the background for and potential consequences of production methods. This means that certain transparency throughout the chain is necessary. Sæbjørnsen (2013) investigated Oslo's egg market and described it as complex and non-transparent. A Dutch report on chicken meat (Hin *et al.,* 2013) concluded that chicken products were based on very non-transparent procedures, trade and chain relations and called for new business models. However, it is a fact that animal welfare is on the agenda in many countries in the EU, in the USA, and Australia, among others.

Influenced by consumer groups and NGOs, some supermarket chains have chosen to sell ‘alternative poultry products.

Many sustainability aspects need to be addressed in the current poultry sector. One major challenge for the sustainability of a complex system is that it cannot be classified as ‘sustainable’. This is so if one or more of its subsystems presents unsustainable challenges, for example, feed production in environmentally and socially critical conditions nor can a system be considered sustainable in itself if it forms part of a larger system that involves unsustainable practices or structures, such as resulting in a lot of food waste. In search of solutions, there will be many cases, where potential conflicts between different priorities arise, for instance, between long-term consequences versus short-term costs or benefits of the production. This is illustrated by Williams*et al*. (2009), who compared different poultry production systems and concluded that organic and non-organic systems had different aims, thus difficult to compare. However, the nutrient output per hectare was generally lower in organic systems, due to slower growth rates and lower livestock density. This can be seen as unsustainable because it produces less human food using more resources.

Leinonen*et al*. (2012) reported that feed seems to be the factor in poultry production that caused the largest environmental impact, being highest in organic egg and meat production compared to other systems (cage, barn or free range), due to higher feed intake, less output efficient production and poorer FCR. However, some ingredients in conventional feed have a high environmental impact, such as the use of non-organic soya, palm oil and pure amino acids (Leinonen*et al.,* 2013). If a production system did not rely on imported feed, poultry fitted well into a diverse farming system, with locally sourced feed, and then the slower growth of chickens and access to outdoor areas could lead to higher animal welfare and better use of marginal areas. There may even be synergistic effects between chicken production and fruit production, for example, in terms of pest and weed management and manure to the trees on one side and better animal welfare on the other side (Pedersen*et al.,* 2004).

Poultry has the potential to be part of many systems, creating a more resilient poultry sector. Kennedy, Nantel and Shetty (2011) pointed to the necessity to ensure resilience in

food production. Darnhofer*et al*. (2010) explored possibilities to assess farm sustainability, using a resilience theoretical approach and concluded that this can only be achieved through adaptability and change, where farmers retain diversity and redundancy to ensure the adaptability of their production. As discussed in this study, there is potential for producing poultry in diverse rural and urban settings, where smallholders, as well as large-scale animal systems can be integrated into the household and local food chains, and poultry can utilise food and plant by-products and produce manure and protein-rich food to the family and the local community in return. In France, for example, the Label Rouge concept has been known for many years and formed the original basis for the EU regulation for organic broiler production systems (Hermansen*et al.,* 2014). This free-range production system has a high market share in France, especially for whole chickens. In addition to the Label Rouge system, other regional broilers are extensively produced in several places in France, such as the Bresse and Geline de Touraine chickens (Verrier*et al.,* 2010). This means that changes from the current poultry production systems must be introduced, such as locally adapted breeds, for example, dual-purpose breeds and local markets.

2.5.3 Supply chain

Production procedures, along with suppliers, stakeholders and customers, are linked by information, material and capital flows. In line with the value of the product comes the environmental and social burden incurred during different stages of production (Seuring and Muller, 2008). To uphold an unharmed environment for the next generation, it is always crucial for the industry to maintain its optimum production based on changing customers' demands. Besides, the literature review suggests that organisational sustainability consists of three components: the natural environment, society and economic performance (Elkington, 2004). These triple bottom lines of social, environmental and economic aspects are dealt with in sustainability, which is vital and acute to maintain by a company. It is always intricate for corporates to combine sustainability and supply chain management involved with their production process in order to gain sustainability.

In Bangladesh, thousands of poultry farms have grown up through private ownership without getting adequate scientific knowledge on it. Lots of poultry owners practice triple

bottom line of sustainability but not in an organised way. There is a plethora of research on it so that farmers or its stakeholders can understand what they should do for effective sustainability within this industry. Elkington (2004) describes the supply chain as the processes from the initial raw materials to the ultimate consumption of the finished product linking across supplier, user companies; and the functions within and outside a company that enable the value chain to make products and provide services to the customer (Cox, Blackstone and Spencer, 1995). The Supply Chain Council (1997) uses a different dimensional definition of "A term increasingly used by logistics professionals – encompasses every effort involved in producing and delivering a final product, from the supplier's supplier to the customer's customer". Four basic processes – plan,

Quinn (1997) broadly defined these efforts, which include managing supply and demand, sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels and delivery to the customer. Once more, supply chain management is "an integrating philosophy to manage the total flow of a distribution channel from supplier to the ultimate customer" (Ellram and Cooper, 1993). Supply chain management has been defined by Mentzer (2002) as the systemic, strategic coordination of the traditional business functions, and the tactics across these business functions within a particular company and across businesses within the supply chain, for improving the long-term performance of the individual companies and the supply chain as a whole.

According to Lummus and Vokurka (1999) supply chain can be stated as all the activities involved in delivering a product from raw materials through to the customer, including sourcing raw materials and parts, manufacturing and assembly, warehousing and inventory tracking, order entry and order management, distribution across all channels, delivery to the customer, and the information systems necessary to monitor all of these activities. Supply chain management coordinates and integrates all of these activities into a seamless process. It links all of the partners in the chain, including departments within an organisation and the external partners, including suppliers, carriers, third-party companies and information systems providers (Lummus and Vokurka, 1999). A focus on supply chains is a step towards the broader adoption and development of sustainability since the supply

chain considers the product from the initial processing of raw materials to delivery to the customer. However, sustainability also must integrate issues and flows that extend beyond the core of supply chain management: product design, manufacturing by-products, by-products produced during product use, product life extension, product end-of-life and recovery processes at end-of-life (Linton, Klassen and Jayaraman, 2007).

Apart from the supply chain, sustainability is described as “the potential for reducing long-term risks associated with resource depletion, fluctuations in energy costs, product liabilities and pollution and waste management” (Shrivastava, 1995a). Again, more microeconomic applications of sustainability have been investigated in the management, operations and engineering. Within the management literature, most of the existing conceptualisations of organisational sustainability have focused on ecological (the natural environment) sustainability, with only implicit recognition of social and economic responsibilities (Jennings and Zandbergen, 1995). This literature shows that a number of research works have been done on sustainability, supply chain and sustainable supply chain management. But, there are some gaps in implementing this theory in the practical fields or particular industries or specific operations which might practice different ways to implement as the environment differs from circumstances and location.

2.6 Poultry-based strategy on poverty alleviation in South Africa

The contribution of food of animal origin to the nutritional status of the world population is well documented (Jensen and Dolberg, 2003; Radolph*et al.,* 2007; Ndlovu, 2010; Wang, Nguyen, Aengwanich, Ilha and Li, 2015). Demand for animal products due to the ever-increasing human population, especially in marginal rural areas of sub-Saharan Africa, poses serious challenges with respect to how to reduce food and nutrition insecurity. Apart from this, the food of animal origin is required to help combat poverty in environments that are extremely vulnerable to climate variability and change. Thus, it is unsurprising that livestock projects, in particular, those that are poultry-based, remain popular in anti-poverty strategies in many developing countries, including South Africa (Jensen and Dolberg, 2003; Tshitangoni, Okorie and Francis, 2010; Dube, Francis and Maliwichi, 2016; Mikihyaev, Afra and Hashemi, 2017).

In South Africa, the need for an effective and efficient agricultural extension system that assists poultry-based Poverty Alleviation Projects (PAPs) to improve productivity and competitiveness has been highlighted in past studies. For example, Oladele and Mabe (2010) contend that improvement in the country's agriculture, especially in rural areas, demands considerable efforts that might enhance the quality of the government extension service. Ngomane (2006) believes that the main focus of the extension service should be to increase food production and spread the benefits of improved farming techniques more widely. This is crucial because of the need for increased production and liberating the residents of rural areas from poverty. Agricultural extension and advisory services encompass systems and mechanisms designed to build and strengthen the capacity of farmers to produce more efficiently. This is accomplished through the improved provision and access to relevant information and suitable scientific technologies (Ssemakula and Mutimba, 2011).

In addition, farming skills and practices, the capacity to innovate and address varied rural development challenges are enhanced through training programmes and better management (Birner*et al.*, 2009; Christoplos, 2010). Magoro and Hlungwani (2014) believe that one of the factors that often hampers the extension system to have a significant impact is the tendency to apply top-down approaches, which disempowers farmers. Yet, practitioners who value sustainability seem to be the most relevant in providing extension services in the 21st century. Achieving the latter goal demands that extension officers transform their way of doing business and become catalysts, as well as agents of empowerment, with special emphasis on developing human capital. As Opio-Odongo (1999) contends, strict adherence to the top-down approach undermines the value of the wealth of knowledge, expertise, wisdom and experience that farmers accumulated over time.

2.7 Poultry/Broiler Value Chain in South Africa

The broiler is the biggest sector within the agricultural sector of South Africa in terms of production value. In 2018/19, the sector generated R46.2 billion of gross value, which was about 16.2% of the total gross value of agricultural products. In comparison to other

livestock products, broiler accounts for 34% of all animal products in South Africa in Rand terms. South Africa remains the major broiler producer in Southern Africa, accounting for 80% of the total broiler production in the region. Broiler production dominates the agricultural sector and it remains the cheapest supplier of protein relative to other animal proteins followed by beef. The growth had spill over effects in the grain and chick industries. Broiler meat accounts for about 90% of the total poultry-meat production, with the rest made up of mature chicken slaughter (culls), small-scale and backyard broiler meat production and other specialised broiler meat products (geese, turkey, ducks and guinea fowl). The gross value of broiler meat is dependent on the quantity produced and prices received by producers. The trend shows that gross value has been increasing during the period under review. It was only in 2018/19 where there was a slight decrease in value from the previous year. The average gross value of production is approximately R35 billion per annum over the ten years. The gross value increase was due to increasing production and price of broiler meat.

2.7.1 Production trends

Of late, the increase in local production of chicken remains a consent in South Africa. Broiler meat production has been increasing from 2010 to 2015, followed by a decline in 2017. This might be due to the increasing input prices that put the profits under pressure, coupled with the 2015/16 drought. In 2018, the production slightly increased by 2%. The broiler slaughtering has been fluctuating over the past decade. Despite the fluctuation, the number of birds dressed has increased by about 14% in 2019, compared to the year 2010, whilst production increased by 23%. This is mainly driven by the increasing demand for chicken meat.

2.7.2 Local consumption.

Over the past decades, there has been a rapid consumption growth. South Africa consumes more broiler meat than what is produced locally, which means the country is not self-sufficient and depends on imports to meet local demand. During 2018/19, South Africa produced 1.76 million tonnes of broiler, while its consumption was at 2.3 million tonnes in the same year. The gap between consumption and production continues to widen, which

causes South Africa to become the growing net importer of broiler meat during the period under review. The per capita consumption of broiler meat in South Africa has increased from 39.19 kg per person in 2017/18 to 39.85 kg per person in 2018/19, which marks an approximately 1.7% increase. This may be because beef prices increased, which encouraged the consumers to buy chicken as an alternative to cheaper meat and for health reasons. Broiler meat has the highest per capita consumption of all other meat. This is the case, as chicken remains the most affordable source of animal protein in South Africa.

According to SAPA, it is estimated that broiler, hatchery and rearing industries employ 15 533 people. The processing sector employs 29 565 people, and the broiler distribution industries employ 6 514 people in 2019. The total of employment within the broiler industry is 51 612 employees. The number of employments in field crops that are produced specifically for poultry feeds is 18 817. The domestic market consists of approximately 265 formal abattoirs. These abattoirs sell mainly to five main retailers (Pick n Pay, Shoprite-Checkers, Spar, Woolworths and Massmart) and SMMEs in the retail sector. These retailers buy the largest share of domestic production. Figure 5 below shows the price movements from 2010 to 2019. The average broiler producer price for this period was R17.63/kg per annum. The producer prices show an increasing trend for the past decade. The annual producer price in 2019 was R22.89/kg, which was R0.45 higher than in 2018. Generally, the price of broiler meat increased significantly mainly due to the increased input costs. For the past decade, the producer prices increased by about R10.61, which is 86%.

2.8 Evaluating the competitiveness of the South African broiler value chain

The South African poultry industry is an important subsector within the South African agricultural sector. It is the single largest contributor to total gross agricultural production value and has significant up and downstream multiplier effects through its long, integrated value chain. In addition, it provides the most affordable source of animal protein to the South African consumer, which makes it critical to food security. Given its strategic national importance, increased imports in recent years have triggered questions on sustainability and international competitiveness. The sector is characterised by a complex value chain, exhibiting high levels of integration and coordination. High capital requirements and clear

benefits from economies of scale favour large-scale production, and contract growing is a popular form of broiler production. The industry operates in a global market and over the past few years, producers have struggled to compete amid rising feed costs. Since 2010, imports have accounted for a rising share of consumption growth. Within this highly competitive commercial environment, a significant number of small-scale poultry producers is also making a living, producing a small share of the national product.

To inform the debate around competitiveness and inclusivity, the general objective of this research was threefold. Firstly, it was meant to quantify the current levels of competitiveness of the industry in the global context by identifying the factors that underpin this position. Secondly, it intended to expand and refine the BFAPs quantitative modelling framework, enabling a wider scope of policy analysis leading to informed recommendations related to sustainability and competitiveness. South Africa's economic development policy, expressed through the New Growth Path, emphasises a broader-based industrialisation path, characterised by greater participation of historically disadvantaged people, businesses and marginalised regions in the mainstream economy. Within this context, the third objective relates to the examination of the impediments faced by developing poultry growers. An in-depth analysis of small-scale poultry production and marketing systems was performed, amongst others, to contextualise smallholder production within the commercial economy and outline limitations and opportunities for developing farmers to enter the commercial market, thus promoting inclusive growth. The issue of competitiveness was approached in terms of value chain structure, as well as technical and economic efficiency at the farm level and relative to other global producers. The integrated structure of the value chain, pricing structures, as well as the high levels of concentration derived from the large and specific investment required to enter the value chain was found to be very similar to leading producers globally.

At the farm level, the technical efficiency of South African producers has improved significantly over the past 20 years and indicators, such as the production efficiency factor and feed conversion ratios, compare well in the global context, yet consideration of the costs results in a less favourable position in terms of economic efficiency. The cost of feed and day-old chicks in particular was found to be significantly higher than leading global

producers. Whilst this is a challenge to competitiveness, it was also noted that the rapid growth in imports did not originate from these lower-cost producers, such as Brazil and the USA. Instead, the largest increase comprised bone-in portions from the EU, which are imported duty-free and where the cost of production was found to be higher than in South Africa. The inability to compete with these imported products is related to the value attached to different products by consumers in different parts of the world. Premiums obtained for chicken breasts in the EU allow producers to remain profitable even when a much lower price is obtained in the export market for bone-in portions.

However, in South Africa, the market is largely based on IQF pieces, which compete directly with imported bone-in portions, but the market for premium cuts is limited and producers, therefore, require a higher price for IQF pieces to remain profitable. Export possibilities for higher-value products or whole birds could be considered, similar to the export of high-value beef products into key Middle Eastern markets. The modelling framework was expanded through the addition of representative farm-level models, both for contracted and independent producers, allowing the impact of policy simulations to be quantified in terms of farm-level profitability. Furthermore, the inclusion of transmission elasticities to retail prices, combined with the refinement of the meat demand system provided valuable improvements and refinements to the consumer side of the modelling system. It provided updated own and cross-price elasticities, whilst also treating IQF pieces as a differentiated product from other chicken. This improved modelling structure has already been applied to policy-related questions and provided critical inputs to the negotiations surrounding the renewal of the African Growth and Opportunities Act (AGOA). Multiple simulations were provided to the negotiating team relating to the impact of different quota levels for bone-in portions imported free of the normal anti-dumping duty from the US.

In light of the diversity evident in the size and structure of small-scale broiler producers, investigations of the challenges faced by small-scale broiler producers were approached as a benchmark analysis, illustrating the cost of production and prices obtained by a range of small, medium and large-scale producers in both the formal and informal value chains. It was found that whilst the inability to procure in bulk, combined with difficulties in chick placement planning, result in higher production costs and challenges related to consistent

availability, producers in the informal value chain were also found to obtain a significant premium when marketing live birds directly to the consumer. Thus, margins per bird were significantly higher in the informal value chain, yet lower margins per bird at a larger production scale can still provide a significantly higher income and the marketing model makes organic growth from small to large scale production very difficult.

Many producers continue to operate well below the capacity of their housing facilities. Further challenges were identified related to ongoing support and mentorship of producers that are supported through the construction of broiler or layer housing facilities. Given the risks and investment requirements, entry into the formal value chain would typically need to be supported through off-take agreements (such as production contracts), where integrated holding companies take a significant share of the production risks away from the primary producer. However, this 'commercialisation' approach will also expose emerging producers to significantly lower prices and growing competition from imported products. Challenges related to input costs and availability would be overcome and investment could ensue in order to increase volumes. As an alternative, a larger number of emerging producers could be better supported within the informal value chain, where opportunities were highlighted to grow demand, particularly in rural areas, where these small producers typically operate.

The opportunity costs of commercial production were also evaluated within the context of size and scale requirements to earn the equivalent of minimum wages in alternative industries. The study suggests that to revitalise former investments and support developing poultry farmers to the benefit of both producers and rural consumers, not all small producers need to deliver into the formal poultry value chain. Development does not necessarily mean 'large scale commercial'. In line with the Agri-parks ideology, the informal sector has a considerable role to play in the development of the rural economy through the production of local food. Optimisation of this chain to improve availability and reduce the cost of inputs (feed & day-old chicks) will narrow the current gap in production costs, allowing a less expensive end-product for rural consumers.

The poultry industry is an important subsector within the South African agricultural sector. It is the single largest contributor to total gross agricultural production value and has significant up and downstream multiplier effects through its long , integrated value chain. In addition, it provides the most affordable source of animal protein to the South African consumer, which makes it critical to food security. In the recent past, the industry has struggled to recover costs amid rising feed costs and, since 2010, a growing share of growth in chicken consumption has been met by increased imports rather than domestic production. Figure 1 illustrates that while 72% of the growth in domestic chicken demand in South Africa from 2000 to 2010 was produced domestically, the balance was imported. From 2010 to 2015, domestic production growth slowed to the extent that only 47% of the growth in chicken consumption was produced domestically, with 53% being imported.

At the heart of the recent debates surrounding imports and the dilemma faced by the industry is the issue of competitiveness. While the importance of the broiler industry within the South African agricultural sector cannot be denied, its inability to enter the global export market and compete against surplus products sold within the global context raises concern regarding its long-term sustainability. Through the South African poultry association, the industry successfully applied for increased tariff protection in 2013. However, Davids, Meyer and Louw (2013) indicated that the composition of imports, as well as the share of imports entering South Africa duty free from the European Union (EU) under the Trade, Development and Cooperation Agreement (TDCA), limits the impact of higher tariffs on domestic chicken prices. Recognising the importance of the industry for food security, as well as the fact that the cost of increased support to producers will be borne by lower-income consumers, tariffs alone should not be the ultimate solution and hence the underlying factors that influence competitiveness need to be identified.

The industry remains highly dualistic: on the one side are large-scale commercial producers for whom scale is critical and competitiveness in the global context has become paramount, but on the other, a significant number of small-scale poultry producers are also making a living, even though they produce a very small share of the national product. South Africa's economic development policy, expressed through the New Growth Path, emphasises a broader-based industrialisation path, characterised by greater participation of historically

disadvantaged people, businesses and marginalised regions in the mainstream economy. Thus, while the sector has been exposed to an increasingly globalised market. It also faces the challenge of improving the efficiency and cost competitiveness of the small-scale producers to enable inclusive growth going forward.

In light of the continued debates around the industry's sustainability, challenges related to transformation in an environment where economies of scale provide substantial advantages and its classification by the Department of Trade and Industry (Dti) as an industry in distress, the poultry industry was prioritised in a call for proposals dealing with competitiveness under the Agro-Processing Competitiveness Fund. This report presents an integrated overview of the findings of three different studies conducted by the Bureau for Food and Agricultural Policy (BFAP) and the National Agricultural Marketing Council (NAMC).

Thus, the general objective of this research was threefold: 1) To quantify the current levels of competitiveness of the industry in the global context by identifying the factors that underpin this position. 2) To expand and refine the current quantitative modelling framework, enabling a wider scope of policy analysis, and leading to informed recommendations related to sustainability and competitiveness. 3) To examine the impediments faced by developing poultry producers, thus providing an in-depth analysis of small-scale poultry production and marketing systems, amongst others, to contextualise smallholder production within the commercial economy and outline limitations and opportunities for developing farmers to enter the commercial market, thereby promoting inclusive growth.

In line with the objectives of the research conducted by different institutes, the remainder of the report is structured into four broad sections. Section 2 provides an overview of the South African broiler value chain, providing context to the sections that follow. Section 3 is focused on competitiveness, identifying critical factors that enhance or constrain competitiveness throughout the value chain whilst also providing an in-depth analysis of the technical and economic efficiency of South African producers at the farm level relative to important global markets. Section 4 provides several quantitative tools used to provide

a baseline outlook for the industry at different levels of the value chain, as well as some different scenarios related specifically to trade policy. These scenarios are depicted in terms of partial equilibrium analysis, focusing on the effects within the broiler subsector, as well as a general equilibrium framework that quantifies the impact of changes in the poultry subsector across the broader South African economy. Finally, Section 5 focuses on transformation and inclusive growth, highlighting the challenges and opportunities for small scale, emerging producers, before conclusions are drawn in Section 6. 2.

For an overview of the South African broiler value chain, it is part of a global food system and can be described as a complex integrated structure of different chains interacting with each other. Whilst the integrated nature of the global system provides South African producers with access to the best genetic material and production technology in the world, it also exposes domestic producers to international competitors. Feed remains the biggest single cost to producers, hence the efficiency and competitiveness of the value chain rely and depend on the efficient operation of other value chains, such as maize and soybeans. The commercial sector accounts for the bulk of domestic production, with subsistence production representing only 3% of the market respectively in 2015. Imports account for approximately 20% of domestic consumption, but have increased rapidly in recent years.

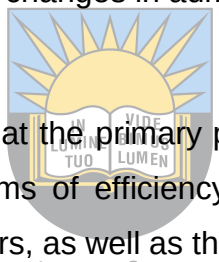
Similar to leading broiler producers globally, the commercial value chain in South Africa displays high levels of integration and coordination. Significant investment is required into highly specific assets to produce efficiently, and consequently, the market is highly concentrated with a few big companies dominating production. The five largest producers account for almost 70% of the total production and the two largest, RCL Foods and Astral alone, represent almost half of the market. Figure 3 provides a generic overview of this complex and sophisticated value chain, which can also be represented as individual company chains. South Africa is a small player in the world market, contributing only 1.4% to global production while accounting for only 1.7% of worldwide consumption between 2013 and 2015 (OECD-FAO, 2016). Given its relative size in the global context, as well as its level of integration in international markets, it is essential to understand the functioning of the South African broiler market within the global setting.

As a net importer of poultry, changes in the international broiler market will influence the South African broiler industry (De Beer, 2009) and as such, an understanding of the dynamics within the domestic broiler market must be guided by a brief review of global trends. As an affordable and accessible source of protein, the consumption of poultry products has expanded rapidly worldwide over the past decade. Production has responded continually, expanding by an annual average of over 3% for the past 10 years, but remains concentrated in a few areas. In 2015, Brazil, the European Union (EU), the United States of America (USA) and China accounted for almost 60% of global production (Figure 4). Exports are even more concentrated, with the EU, USA and Brazil accounting for more than 70% of global export volumes. South Africa is a small player in the global market and its level of imported products has increased in recent years. In line with global trends, consumption has expanded rapidly over the past decade, supported by rising incomes, dynamic class mobility and continued urbanisation. However, production growth has been significantly slower and Figure 2.4 indicates that chicken imports into South Africa have increased by an annual average of more than 10% since 2001, which has been one of the critical factors underpinning questions related to competitiveness. Rising imports would suggest that there is scope for expansion of domestic production if producers were able to compete more successfully with imported products.

2.9 Competitiveness of South African broiler production

The issue of competitiveness is far-reaching and relates to a number of factors, including efficiency in the value chain and the marketing strategies employed by producers in different regions of the world. It can be measured at different levels, and the analysis undertaken by this study relies on two different approaches. The first was conducted by the NAMC and involved the circulation of questionnaires to several role players across different levels of the value chain to identify the factors that enhance or constrain competitiveness across the value chain. This approach is mostly qualitative and was followed by an in-depth quantitative review of the technical and economic efficiency of primary producers, conducted by BFAP in partnership with the LEI, a research institute within Wageningen University in the Netherlands.

Factors that affect competitiveness within the broiler value chain can be separated into macro-, meso and micro-environments. The macro-environment refers to regulatory and administrative issues, global and domestic economic trends, as well as chance factors, such as the exchange rate and the political environment. The microenvironment relates to issues that can be managed by producers within the business environment, whereas the meso-environment refers to the supporting functions and services within the value chain. The survey was conducted to determine the factors that enhance or constrain the competitiveness of poultry producers across different levels of the value chain, whereas large numbers are associated with factors that enhance competitiveness. Within the macro-environment, the most important factors identified as enhancing competitiveness relate to consumer tastes and preferences and the size of the export market, both regionally within SADC and the rest of the world. Factors identified as most constraining to competitiveness include changes in input cost levels, changes in administered prices and the import/export environment.



For the production cost benchmark at the primary producer level, competitiveness in the global context is considered in terms of efficiency, both technically and economically. Considering the main global exporters, as well as the origin of South African imports, a list of important countries was identified as a benchmark against which the cost of producing chicken in South Africa could be compared. Thus, the relative competitiveness of South African poultry production can be quantified. To measure the relative cost of production within a range of countries, information regarding technical productivity and the cost of production in 2013 for 15 countries was obtained from the LEI, a research institute within Wageningen University in the Netherlands. A survey was conducted on technical productivity and production costs in South Africa in 2013 to benchmark South African production costs against these international competitors. South African costs were converted to Euro values for comparability, using the average exchange rate recorded in 2013.

About technical efficiency, several indicators exist for the measurement of technical efficiency in broiler production. The most commonly used indicators are feed conversion ratios (FCR), which provide a measure of the amount of feed required per kilogramme meat

produced, as well as production efficiency factors (PEF), which combine multiple indicators, such as slaughter weight, mortality, age and feed conversion into a single indicator. Literature indicates that South African producers achieve high levels of technical efficiency (Davids, 2013; Lovell, 2012; Louw, Schoeman and Geyser, 2011), achieving PEFs that are comparable to top broiler-producing countries, such as Brazil and the USA. Technological improvement in both genetics and housing facilities, combined with improved management practices, has resulted in continuous improvements in the technical efficiency of the South African producers over the past 20 years, as illustrated by declining FCRs and rising PEFs

2.10 Governance of poultry value chains

South Africa has a substantial poultry industry and continues to grow on the back of strong demand locally and regionally. However, the increasing demand for poultry in South Africa and the region has been met with an increase in imports. Improving the competitiveness of the value chain to meet this demand requires concerted effort from multiple fronts, including learning from experiences of established value chains in countries, such as Brazil and the USA. As an example, Brazil has implemented effective national strategies to develop an integrated value chain from the main feed inputs of maize and soya to penetrating export markets. In contrast, there has been a lack of coordinated approach to capabilities development in the poultry value chain in South Africa, with interventions being piecemeal. The paper contrasts the experiences of South Africa and Brazil, looking at how governance has impacted competitiveness and capabilities development in the two value chains. We conclude that the ability of the South African industry to compete internationally is dependent on producing poultry cheaply. Regrettably, production costs have been higher than for leading producers like Brazil and the US (who are surplus producers of soybean), with the differences being attributed mainly to feed costs. Given the centrality of feed to poultry production, bringing the costs of feed down is critical. With the challenges in expanding soybean production in South Africa, the value chain needs to take soybean production capabilities in the greater region into account. That is, developing a competitive poultry industry in Southern Africa requires a regional strategy for the production of low-cost animal feed inputs (maize and soya bean).

Poultry production is part of a long-integrated value chain that includes backward linkages to agriculture (production of maize and soya), the processing of these into feed (required for energy and protein needs), the growing of chickens and the slaughtering, packaging, distribution and retailing of the final product. This means that the industry has significant employment and income multipliers in the rest of the economy. This study contrasts governance and power in the poultry value chains in Brazil and South Africa, and how these have impacted capabilities development. Brazil and South Africa are both upper-middle-income countries, and the GDP per capita in Brazil is higher than in South Africa (US$ 9,897 for Brazil compared to US$ 6,182 for South Africa in 2017). Brazil also has a much larger population at around 208 million compared to 57 million for South Africa. Brazil is the most successful example of a developing country, building a competitive value chain in poultry. It has achieved enormous success in the last 20 years in both agriculture and agro-processing products like poultry. In contrast, the South African poultry sector has experienced increasing consolidation and an inability to ramp up production, despite significant demand in the region.

Using the immensely successful Brazilian poultry value chain as a comparator, we contrast the experiences of South Africa and Brazil, looking at how governance has impacted capabilities development in the two value chains. In doing so, we consider the role of technology and investment incentives in developing capabilities to promote competitiveness. Contrasting the Brazilian experience with South Africa provides insight into the kinds of measures that can be taken to help develop capabilities. Information from interviews in South Africa and Brazil is supplemented with existing research and information.3 South Africa's poultry value chain is substantial, producing around 1.7 million tonnes of poultry in 2018. It employed around 112,000 of the 800,000 people in agriculture in 2017 and accounted for 19.6% of the total agricultural value (SAPA, 2017).

With strong demand for poultry in both South Africa and the region, the poultry value chain presents opportunities for domestic and regional industrialisation. However, increasing demand for poultry in South Africa and the region has been met with an increase in imports. In 2017, imports accounted for 24% of domestic demand. The process of structural transformation or industrialisation is the movement of factors of production to higher

productivity and more complex activities (McMillan*et al.,* 2017). In the agricultural sector, there are industrial capabilities in moving to higher value agricultural production – in improving yields, moving to higher quality agricultural products, as well as the coordination required with logistics and packaging (Cramer and Sender, 2015).

Growing the poultry value chain requires the development of several different capabilities. This includes capabilities in the agricultural production, growing sufficient maize and soya competitively, as well as capabilities related to the production of poultry, that is, productive breeds for broiler production. Moreover, it includes technically efficient broiler production at scale, large-scale investment in production facilities and technical and organisational capabilities required in commercial poultry production. Furthermore, there are competencies required in services too (logistics). The poultry value chain in South Africa is characterised by large, vertically integrated producers who have control over key inputs, namely animal feed and licenses for breeding stock. At the upstream level, given that South Africa does not produce sufficient soybean (a key ingredient for animal feed), soybean or oilcake is imported to produce animal feed. Literature on value chains emphasises the importance of linkages in vertical stages of processing, governance and power within value chains, and upgrading at the firm-level.

Using the value chains framework, this study reflects on the inability of the poultry sector in South Africa to respond to the increased demand by looking at the role that government has played in upgrading the value chain and developing capabilities through a comparison of the South African and Brazilian experiences. The global value chain (GVC) framework is useful to identify opportunities for, and bottlenecks to, upgrading and developing of capabilities in global industries. It provides a methodology for tracing patterns of value creation, as well as understanding power and governance across the full range of economic activities within an industry. It does so by exploring the linkages amongst geographically dispersed economic activities and actors (Gereffi and Fernandez-Stark, 2011).

The traditional GVC literature employs two core concepts to assess global industries namely governance and industrial upgrading. Governance refers to authority and power relationships that determine the allocation and flow of resources within a value chain

(Gereffi, 1994; Dallas, Ponte and Sturgeon, 2017; Gereffi and Lee, 2012; Gereffi and Fernandez-Stark, 2011). While governance is about understanding the value chain in a 'top-down' manner, upgrading takes a 'bottom-up' approach, exploring how firms or countries can maintain or improve their positions within global value chains. The role played by powerful 'lead' firms in coordinating production activities and shaping the distribution of profits and risk within an industry is central to understanding governance structures (Gereffi and Lee, 2012). Lead firms in GVCs control production by setting and enforcing product and process parameters, including standards and protocols that must be met by other players operating in the value chain. This includes controlling decisions about what to produce, how to produce and how much to produce (Humphrey and Schimtz, 2002; Gereffi and Fernandez-Stark, 2011). Thus, governance is one of the critical elements for the competitiveness of global value chains.

Specific patterns of governance can become a hindrance to the building up of innovation capabilities (Lema,*et al.,* 2018). The ability of local producers within the GVC to engage in different forms of upgrading can be constrained by how local firms are inserted into the GVC and the power asymmetries between them, lead firms and other actors. The GVC structures and chain leaders' strategies set the pace and direction of knowledge flows and upgrade either in favour or against the interest of local producers (Morrison*et al.,* 2008). The exertion of power is not always limited to a 'lead' or powerful firm exercising its authority on other actors in the value chain. There are often other multiple dimensions of power exercised in GVCs, beyond the simple bargaining power between buyers and suppliers captured in most of the GVCs' literature (Dallas,*et al.,* 2018). Clarifying the concept of power has become increasingly important, following the growth of new forms of the GVC frameworks with multiple stakeholders and mechanisms. Governance can be shaped by various factors and actors, including standards and certifications on quality and sustainability, multi-stakeholder initiatives, corporate social responsibility and social movements. Building on existing frameworks, Dallas*et al*. (2018) try to capture the emerging collective approaches to power and governance in GVCs by considering the role of government, business associations and social and consumer movements. They categorise the different types and usages of power exercised in GVCs into four groups - bargaining, demonstrative, institutional and constitutive power. These forms of power are

an interaction of two principal dimensions – 1) transmission mechanisms, which can be direct or diffuse, and 2) arena of actors, which can be dyadic or collective. Power can be transmitted through direct and diffuse mechanisms. Within the direct forms of transmission, the actor or collective wielding power and those who are objects of it are relatively easy to identify by all parties. The exertion of direct power is most often intentional and the goals of powerful actors are well known. These actors 'possess' power either by wielding material or ideational resources or by leveraging their structural or network position within a GVC.

Transmission mechanisms can also be diffuse, based on less direct and more demonstrative processes. Such mechanisms follow broader societal trends or are based on taken-for-granted or emergent 'best practices', for example, corporate conduct and organisation or dominant quality conventions. The arena of actors specifies how power is exercised in both dyadic and collective relationships. Most GVC literature focuses on direct power in dyadic relations between individual buyers (lead firms) and suppliers. Collective power, on the other hand, is a function of the collective behaviours of multiple players acting simultaneously (intentionally or not). For example, institutional power is a form of direct power that is exercised by collectives that are more formally organised, such as through business associations, multi-stakeholder initiatives, shared technological platforms or within the state. The state, in regulating the conduct of all actors, or categories of actors, applies institutional power.

Various levels of state action and authority have structuring effects on GVCs (Jespersen*et al.,* 2014), by setting more or less transparent rules for all or specific groups of actors. The state may also impact coordination in the value chain through specific measures. However, it may also "outsource governance", in that it may engage in a process of delegating a variety of governance functions and authority to private actors (Mayer and Phillips, 2017), impacting who holds power and how much power they hold.

2.11 Poultry production system in SA and Brazil

The poultry value chain has multiple levels - from the production and processing of agricultural commodities through to a quasi-industrial process of batch production in the rearing and processing, to the distribution of poultry in fresh and frozen form. The poultry

production systems in Brazil and South Africa are similar, with production carried out under production contracts between poultry producers and independent poultry farmers (called an integrated system). In Brazil, the poultry producers negotiate contracts with growers and provide growers with all the raw materials namely, day-old chicks, feed, vaccine and veterinary services. Large companies in Brazil provide support to contract growers, through dedicated support staff. For instance, Aurora (the 3rd largest producer in Brazil) employs six technical people that assist farmers concerning several issues, like ventilation and litter to mention a few Growers provide labour and housing for chickens. Growers must grow the chickens to meet the market weights required by producers. They receive payment for the service they provide with premiums and discounts tied to efficiency, that is, the rate at which feed is converted to liveweight broiler production.

There are an estimated 180,000 poultry farmers in Brazil, and around 85% of total poultry produced in 2014 was done through the integrated system of broiler production (Valdes*et al.,* 2015). The implementation of the integrated system in the poultry industry has been key to the development of an industrial poultry production system in Brazil, bringing in technical and scientific developments and unifying the entire production chain (UBABEF, 2011). There is a significant concentration in the poultry industry in Brazil. Eight producers account for 55% of broiler production, while the top four accounts for 38% of production (EMBRAPA, 2014). Furthermore, two Brazilian multinationals, JBS and BRF, account for almost 70% of poultry exports. However, there is participation in the industry, with a significant number of cooperatives involved in poultry production. Cooperatives came about in the 1930s/1940s, when the Ministry of Agriculture organised the National Poultry Cooperative to set up poultry cooperatives throughout Brazil.

The 3rd largest producer in Brazil is a cooperative, Aurora Alimentos, which consists of 11 affiliated cooperatives, representing more than 75,000 associated families and 28,000 employees. The vast majority of South African poultry is produced by large-scale commercial players, who are generally vertically integrated with key inputs, such as animal feed, all the way to slaughtering operations. Most of the broiler meat from commercials is sold through abattoirs, which slaughter broiler meat and sell it as a carcass to processors and packers, who sell chicken fresh, frozen or further processed to retailers or further

processors (or export some of the chicken). Processors and packers rely on imports for their supplies. Furthermore, the processors sell to retailers for final distribution to the consumer. The industry in South Africa is dominated by two large producers, namely Astral Foods and RCL Foods (RCL). Together these two companies produced 46% of the total broiler meat production in both 2014 and 2018 (Figure 1), with the remaining 54% produced by smaller producers. Market shares of key producers have changed slightly in the past five years. Astral increased its market share from 22% in 2014 to 27% in 2018, replacing RCL as the leading producer. RCL's market shares declined by 5 percentage points in the same period, due to a restructuring process that saw the company sell off some of its poultry facilities.

Broiler production by contract growers in South Africa has increased over the years and is currently at approximately 60-80% of total broiler production (Bosiu*et al.,* 2017). The entry of contract growers has been partly facilitated by the sale of the poultry farms by the major poultry producers to new contract farmers. For example, Daybreak Farms sold off seven of its farms to black poultry producers. The shift towards a greater reliance on contract growing has largely been a result of an increasing desire by the major poultry producers to shift costs associated with owning large pieces of farmland from themselves to the contract growers. Contract growing creates opportunities for entry, given the low cost of capital required to start up in comparison with other stages of the value chain, which require a significantly higher level of expertise. The increasing prevalence of contract growers is also important in the context of inclusive growth.

However, despite the opportunities created by contract farming to become effective competitors', entrants still need to enter multiple levels of the value chain for vertical coordination and to leverage inputs. The entry of Grain Fields Chicken (GFC) illustrates this. This may not be the case if access to breeding stock and competitive feed was available at fair terms as discussed below. The poultry value chain starts with the two main inputs: animal feed and breeding stock. Feed constitutes around 70% of the cost of poultry production (Ravindran, 2010). The cost of feed is an important driver of both poultry production and day-old chick costs, effectively influencing the cost of production at two levels. Brazilian producers have access to cheap maize and soya, since both are grown

locally, and these make up about 90% of the cost of feed (Ncube and Zengeni, 2016). Access to animal feed has been a key determinant of the success of Brazilian poultry producers. The movement of crop production into the central (corrido) region of Brazil has been crucial for the success of the industry in Brazil. We discuss this further in section 5 below.

In South Africa, animal feed, which is generally made from milled maize and soybean or sunflower, accounts for between 50 and 70% of the total input costs (Bagopi*et al.,* 2014). Animal feed production is carried out in the feed mills where the main ingredients (maize and soya), including vitamins and antibiotics, are combined to produce stockfeed. Feed products typically comprise 60% maize, 25-30% of soya and vitamins/supplements (Ncube *et al.,* 2016). South Africa is a net exporter of maize, but a net importer of soya. This means the prices of feed are driven by the international prices of soya and local prices of maize. Despite soybean production increasing significantly from 282,000 tonnes in 2008 to 1,070,000 tonnes in 2017, still, South Africa does not produce enough soybean to meet local consumption. Furthermore, less than ideal agro-ecological conditions mean that production is unlikely to meet the demand of around 2 million tonnes per annum (AFMA, cited in Ncube *et al.,* 2016:22).

Brazil is the world's largest exporter of soybeans, followed by the US, Argentina, Paraguay and Canada (USDA, 2018). South African soybean farms are less competitive than international counterparts, such as Brazil, Argentina and the US – their yields are lower, and they have higher costs for selected input items, such as seeds, fertilizer and crop insurance (BFAP, 2018). While the yields of soybean producers in the USA, Brazil and Argentina have increased by up to 1.5% over the last decade, South African soybean yield over the same period improved by around 0,4% per year. Part of the reason has been a shortage of new cultivars and biotechnology.

Globally, there have been several different primary breeders which have consolidated into three major companies over time (Tyson, Aviagen and Grimaud, 2020). While Brazil's research institution focused on poultry and swine (EMBRAPA Swine and Poultry) was initially involved in the production of poultry breeds, this was not widely used commercially

in Brazil. Given the advancement in the global breed business, Brazil, like other major poultry-producing nations, uses international breeds. For industrial chicken meat production, there are two major international breeds in the Brazilian market (Dos Grupos Tyson, Cobb14) and Aviagen (Ross,15). About 60% of poultry production in Brazil is produced using Cobb, while Ross has about 35%, with the remaining 5% covered by other breeds. Like in Brazil, the two main global firms provide poultry breeding stock to South Africa. Cobb and Ross broiler breeders are imported into SA at the grandparent or great-grandparent level. Rainbow Chicken, Astral and CBH are the only holders of exclusive commercial genetic breeding licenses in South Africa. Astral holds a license for the Ross 308 breed, Rainbow Chicken for the Cobb 500, while CBH holds a license for Arbor Acres breed. As a result, any producer seeking to participate within the poultry value chain in South Africa would need to purchase breeding stock from Rainbow Chicken, Astral or CBH, whether for their production or commercial sales (Bagopi*et al.,* 2014).

Breeding stock (grandparent stock or great grandparent stock) is imported into South Africa by the owners of franchise rights; setting up a great grandparent stock requires huge capital outlays (Grimbeek and Lekezwa, 2013). This is unlike Brazil, where breeding companies have multiplier farms that produce parent stock and day-old commercial chicks. Big parent stock farms have contracts with large contract-system producers, while smaller farms sell chicks in the open market where smaller producers can purchase them. According to APINCO (Meat Chicks Association), 85% of chicks produced go to contract-system producers, while 15% are sold in the open market. In 2015, there were 235 registered hatcheries, of which about 200 were producing commercial day-old chicks for meat and egg production. Day-old chick costs account for about 20% of variable costs (Davids and Meyer, 2017). In 2017, day-old chick costs in South Africa were among the highest compared to a range of other significant producers (in Eurocents per live kg) (BFAP, 2019). The cost of feed is an important driver of day-old chick costs, while the exchange rate represents another important component of costs. There is significant variation in the cost of day-old chicks in South Africa, as some integrated companies deliver at a cost while others deliver at market value (BFAP, 2017). The successful entry of Arbor Acres breeds in 2007 (as a result of a case taken to the Competition Commission on the grounds of exclusionary conduct) resulted in growth in local production and declining margins by the

three major poultry-producing companies in South Africa (Grimbeek and Lekezwa, 2013). This highlights the importance of access to breeds at competitive prices for the poultry industry.

Production of poultry in Brazil has increased dramatically since the 1970s, increasing from the production of 217 thousand tonnes in 1971 to 12.9 million tonnes in 2016/2017. While the majority of poultry is consumed domestically (estimated at around 66%), Brazil is the largest exporter of poultry in the world, exporting to over 150 countries. Production of poultry concentrated in the southern states of Brazil farming accounts for a significant proportion of production in Brazil, producing 50% of all poultry. The poultry industry accounts for 4.5million direct and indirect jobs (UBABEF, 2011).

2.12 Overview of issues in food insecurity

The term ‘food security’ refers to the availability of and access to food. The definition of food security has expanded to increasingly acknowledge the concept of the importance of availability, access, utilization and stability and the contribution of the vulnerability of individuals. According to De Muro (2011), the working definition from the FAO (2010) is that food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Food insecurity is mostly considered for its effect on human nutritional constraints. However, its effect on other health and behavioral outcomes is increasingly being recognized. Food security became an issue when farming was simply a hunter-gatherer phenomenon, which meant human beings depended on the environment for their everyday food security. A 70% increase in food production is projected by 2050 to meet the nutritional needs of the world's postulated population increase of 9.1 billion (Silva, 2018). The largest of this population growth is expected to be in Africa.

Several options have been explored to address the food security challenges through the adoption of new technologies and investment in research, including increasing production potential that is coordinated in a multifaceted and linked global strategy to ensure sustainable and equitable food security (Godfray *et al.,* 2010). Abdu-Raheem (2013)

argued that food insecurity is still a serious concern for many households in South Africa. Poultry production provides affordable quality protein for consumers, while it provides investment opportunities for producers, thus contributing to food security and economic and social sustainability (Rodic *et al.,* 2011).

2.13 Overview of international and South African broiler industry

The poultry industry remains the largest single contributor to the agricultural sector in South Africa. In 2019, 20% of the total agricultural gross value and 41% of animal product gross value stemmed from poultry production. The industry provides direct and indirect employment to over 110 000 people, at the same time, it is the second largest consumer of maize and supports many peripheral businesses, including the feed industry and those downstream in the value chain (Schepina and Charykova, 2019).

The year 2019 commenced in a sombre mood, as poultry producers faced steep increases in animal feed prices and ongoing constrained consumer spending. Broiler farms campaigned for government intervention to control cheap poultry imports and egg producers found themselves in a situation of oversupply and decreasing returns. Although broiler imports decreased by 4.7% in 2019, levels remained 5.6% above the five-year average (SAPA, 2019). Although per capita consumption of chicken continues to climb, spare domestic capacity has been frustrated over the past decade as cheap, frozen imports and predatory pricing have put severe pressure on bottom lines.

2.13.1 International broiler markets (consumption and production)

Globally, chickens are the most commercialized variety of avian species and are valuable animals. However, chickens convert many feed types, such as residuals from agricultural activities, households and food processing industries, into protein food more efficiently than other animal species (Kennedy., Nantel and Shetty, 2017). For small-scale producers who aspire to produce commercially, poultry is important because it is produced in large quantities and intensive operations, making it one of the fastest-growing agricultural sub-sectors that require small piece of land (Mottet and Tempio, 2017). Since the early 1990s, economic and political conditions in South Africa have supported the formation of co-

operatives and farmer associations among small-scale producers, allowing them to exploit economies of scale. For many years, broiler production, in particular, has provided a pathway to enterprise development for small-scale farmers and women, and in ensuring food security for underprivileged households, thus contributing to Millennium Development Goals (MGD) regarding gender issues (Vaarst *et al.,* 2015). However, broiler production is an expensive business that requires costly investments in specialized infrastructure.

Despite the important role of poultry production in alleviating food insecurity, uplifting rural livelihoods and supporting gender equity, most governments in developing countries attribute low importance to this production system (Pym, 2013). The advantages of poultry production lie in its diverse nature, responding to the main purpose of the flock, feed and nutrient requirements, orientation and the type of housing (Mottet and Tempio, 2017). Throughout the world, poultry can easily be integrated into many farming systems, particularly in rural communities at subsistence and small-scale level for sustainable livelihoods. Extensive poultry production is practiced by virtually every household in rural communities, even some urban ones, using hardy indigenous breeds or nondescript breeds that can be kept in low-cost housing and are provided with complete feeds and water, and are also vaccinated against diseases. Several poultry equipment manufacturers operate in the country, providing services to commercial and small-scale producers. In South Africa, poultry housing equipment suppliers, such as Dicla, Chicken Shack and Big Dutchman, manufacture and supply environmental to semi-environmentally controlled houses, as well as drinking, feeding, lighting and ventilation equipment to small-scale farmers.

Although the poultry sector has strong potential to adapt and thrive, it is often impossible for small-scale producers to make the necessary adjustments (McLeod*et al.,* 2009). Owing to factors of competition and a lack of biosecurity controls, a majority of small-scale producers fail to enter the retail market for operating sustainable enterprises (Nkukwana, 2018). Nkukwana (2018) argued that factors at play include the cost of feeding, electricity, water quality and supply, as well as the proximity of small-scale producers to chicks and feed suppliers, processors and markets. The major successes in poultry production are seen in integrated business structures, which necessitate the adoption of cooperative

farming in a value-chain system, in which farmers buy together and sell together, whether they are in feed manufacturing or breeding and rearing (Nkukwana, 2018).

Engaging in the commercial poultry production system requires that all standards of operation are adhered to, starting with breeding to handling and transportation of chicks, processing (feed ingredients and chicken products) and feed manufacturing (Kennedy, Nantel and Shetty, 2013). For instance, the key activities for Astral and RCL, both leading South African integrated poultry producers, consist of manufacturing animal feed premixes (vitamins and minerals) and complete feeds, broiler genetic production and sale of day-old chicks and processing plants, which produce whole birds, portioned birds and processed meats. Nkukwana (2017) argues that among the advantages of full integration, the industry has access to optimal genetic material that is internationally owned and enters the country only as fertile eggs for parent stock. This genetic material is wholly accessible to the commercial sector, with small-scale producers struggling to access day-old chicks and point-of-lay pullets. While access to markets remains critical for small-scale farmers, growing markets continue to benefit from large-scale operations.

Transformations to increase the productive capacity and stability of small-scale production can be achieved, provided that the most appropriate technologies and practices are identified through building an accessible knowledge-based support system (Branca *et al.,* 2013). Many small-scale producers in South Africa practice contract growing, rear day-old chicks for large commercial producers, provide them with all the inputs, and then purchase the live birds back on an agreed kilogramme per Rand basis. This has become a popular alternative way to enter the broiler production market - it provides small-scale producers with an incentive to invest and offers protection against input cost increases. Any producer can enter this arrangement, provided he or she has a facility that is conducive to sizeable production.

2.13.1.1 The nutritional benefits of chicken meat compared with other meats

Chicken meat is white meat distinguished from other meats, such as beef and lamb by its lower iron content (0.7 mg compared with 2 mg/100 g). Chicken meat has several

advantages over other meats (Bingham, 2006). The fat content of cooked chicken varies, depending on whether it is cooked with the skin on or off, the portion of the bird and the bird's diet and breed. Breast meat contains less than 3 g fat/100 g. An average value for dark meat (skin off) is 5 to 7 g/100 g. About half of the fat from chicken meat is made up of the desirable monounsaturated fats, and only one-third of the less healthy saturated fats (Bingham, 2006). There are much higher proportions of saturated fats in most cuts of red meat, which also vary considerably in total fat. Chicken meat is, therefore, seen as healthy meat. Chicken meat does not contain the trans fats that contribute to coronary heart disease, and can be found in high amounts in beef and lamb. In Canada, values of 2 to 5 percent have been reported for beef and as high as 8 percent for lamb. The World Cancer Research Fund and others (Bingham, 2006) have suggested that the consumption of large amounts (more than 500 g/week) of red meat, particularly processed meat, but not chicken meat, may be unhealthy. Poultry meat is rich in omega-3 fats Poultry meat is an important provider of essential polyunsaturated fatty acids (PUFAs), especially omega (n)-3 fatty acids.

Scavenging chickens are a particularly good source because of their varied diet. The amounts of these important fatty acids can be increased more easily in chicken meat than in other livestock meats, so too can some trace minerals and vitamins. The recommended dietary intakes (RDIs) of niacin can be met with 100 g of chicken meat per day for adults and 50 g for infants. By feeding broiler chickens only small amounts of a supplement rich in alpha linoleic acid (an n-3 PUFA), such as flax seed, the n-3 PUFA in thigh meat can be increased from 86 mg to 283 mg/100 g, and that in the minced carcass from 93 to 400 mg/100 g. To a large extent, the fat contents of the different portions determine the content and enrichment of PUFAs, so dark chicken meat always contains more PUFAs than white breast meat. Poultry meat can be enriched with several important dietary nutrients Unlike most other meats, chicken meat can also be easily enriched with several other important nutrients.

A recent study Yu *et al*. (2008) showed that by adding 0.24 mg of selenium (as organic selenium) per kilogramme of feed, the selenium content of breast meat was increased from

8.6 µg to 41 µg/100g, which is more than 65 percent of the RDI (Bingham, 2006). The same amount of selenium in the form of inorganic sodium selenite also increased selenium in the breast meat but only to 16 µg/100g. Selenium deficiency is becoming more widespread in humans because soils are becoming depleted and the foods grown on them are, therefore, lower in selenium. The RDI of selenium is 55 µg per day. Selenium is a powerful antioxidant and plays a role in the prevention of some forms of cancer. A deficiency in selenium can cause Keshan's disease, a heart ailment in the young, which is common in parts of China and cognitive decline in adults. Enriched poultry meat could help alleviate this condition.

2.13.2 Poultry production system in South Africa

According to Tempio (2019), poultry production makes a substantial contribution to food security and nutrition, providing energy, protein, and essential micro-nutrients to humans, with short production cycles and the ability to convert a wide range of agri-food by-products and wastes into meat edible by humans. Poultry is the fastest-growing agricultural sub-sector, especially in developing countries. The global poultry sector is expected to continue growing as demand for meat is driven by growing populations, rising incomes and urbanization (Mottet and Tempio, 2017). In this context, the sector is facing unprecedented challenges, particularly for smallholders and the poor households, where poultry is a major asset and the key to poverty alleviation, providing income and market participation. Birds can be sold in times of crisis and act as household insurance. A typical example is during the hard COVID-19 lockdown, when agricultural production was reduced to comply with COVID-19 regulations. The production of poultry remains generally stable. However, there is great concern about the welfare of animals, hygiene and disease control that may result from great genetic pressure to boost egg and meat production (Hafez and Attia 2020).

The broiler industry in South Africa is the largest individual agricultural industry boasting a gross value of about US$3 billion and contributing about 17% in the 2017/18 financial year to the total gross value of agricultural products (Berkhout, 2019). Commercial broiler meat production accounts for approximately 90% of the chicken meat industry, with the remaining 10% comprising subsistence farming production and depleted flock. According to SAPA (2019), the 983 million broilers dressed in 2018 equaled 1. 27 million tonnes of chicken

meat (excluding offal). If depleted flock and subsistence farming production is added, South Africa's total chicken meat production for 2018 is calculated at 1. 41 million tonnes, a 5% increase from 2017. A 1% decrease in chicken meat production is estimated for 2019 to 1. 40 million tonnes.

According to DAFF (2013), high feed costs – a 70% contribution to the total cost of a broiler producer – constrained consumer demand and an expected decrease in exports are putting downward pressure on producer prices. As a result, broiler producers are expected to reduce production to 970 million broilers dressed in 2019. In 2020, chicken meat production is projected to increase by 2% to 1. 42 million tonnes, under the assumption of normal weather conditions (SAPA, 2019).

2.13.3 Poultry consumption in South Africa

The growth of world consumption of meat and meat products is noteworthy, not only for its scale but also for its constancy. Despite several health crises, it has remained stable in recent years. All the branches of this sector have benefited, including beef, but in the 1990s, poultry proved to be the most attractive. In 1995, it became the meat with the second highest consumption worldwide, after pork but ahead of beef (Kennedy, Nantel and Shetty, 2006).

According to Berkhout (2019), South Africans consume about 3, 9 million tonnes of poultry, beef, lamb and pork meat per annum. In 2018, the South African consumer spent approximately US$15 billion on meat products (35% of total food expenditure). Poultry meat represents more than 60% of the total meat consumed. In 2018, chicken meat consumption (excluding offals) is expected to be 1, 88 million tonnes (DAFF 2018). The demand for chicken meat (excluding offals) is anticipated to increase by only 1% in 2019 to 1, 90 million tonnes. This is due to an estimated economic growth of less than 1% in 2019. A 2% increase in the demand for chicken meat is expected for 2020 to 1, 93 million tonnes (Berkhout, 2019).

2.13.4 Trends in the consumption of poultry products

Global food production, driven by scientific and technical advances in crop production and many innovations in animal sciences, fisheries and more recently aquaculture, for many years has been able to meet the demand to feed an ever-increasing human population (Lang and Ingram, 2013). Human diets constitute a variety of plant and animal foods, depending on availability and accessibility within a context that promotes and supports healthy behaviors (Johns and Sthapit, 2004). Often, the analyses of food security assume that insecurity stems from insufficiency of production or supply, thus, pursuing the public policy notion of a situation where everyone is fed or could be fed adequately, appropriately, affordably and regularly (Lang and Ingram, 2013). Realistically, people eat what is available, affordable and familiar to them. For low-income households, food prices are important decision-making tools, implying that buying red meat or selecting a steak menu evokes guilt emotions associated with having to spend too much of their limited income (Sosa *et al.,* 2015). Foods, such as rice, wheat, maize (corn), millet, sorghum, roots and tubers (potatoes, cassava, yams and taro), and animal products, such as meat, milk, eggs, cheese and fish, are important staples for over 1 000 million people in the developing world, accounting for 40% of the food eaten by half the population of sub-Saharan Africa (Kennedy, Nantel and Shetty, 2016). However, meat consumption is related to living standards, dietary choices, livestock production and consumer prices, as well as macroeconomic aspects related to the gross domestic product (GDP) of that particular country. Poultry meat is perceived as good value, dependable, versatile and healthy but mostly affordable. Globally, consumer demand trends reveal an increase in white meat consumption and a decline in red meat.

In 2016, the world meat production forecast was at 320.7 million tonnes carcass weight equivalent. While the anticipated growth for all meats was a meagre 0.3 percent, poultry meat output was expected to rise by more than 1 percent to a record high of 116.2 million tonnes in the same period. This means total poultry meat production would have risen by some 5.2 million tonnes (4.7 percent) since 2014, with hardly any changes in other meats (The Poultry Site, 2016). In 2013, SAPA reported that the only protein source more affordable than broiler meat was eggs, with poultry meat consumption by South Africans

quantified at close to 35.7 kg for that year (The Poultry Site, 2014). Approximately 2.9 million tonnes of poultry, beef and pork meat were consumed in 2016, with poultry meat representing more than 60 percent of the total meat consumption (The Poultry Site, 2016). Unfortunately, in recent years, even poultry meat consumption seems to have declined due to a rise in unemployment and a drop-in consumer spending power.

Global statistics show that backyard systems contribute 8% to egg production and 2% to meat, with 92% of poultry meat production being specialized broiler systems, while layers contribute only 6% of the total, with a small contribution to meat from spent layers from egg production and broiler breeding systems (Mottet and Tempio, 2017). Then, again, global figures do not reflect important regional differences and the significant contribution that backyard systems make to eggs and poultry meat production in Eastern Europe, South Asia and sub-Saharan Africa and, to a lesser extent, East Asia and Latin America and the Caribbean (Mottet and Tempio, 2017). In contrast, egg consumption is low, because it is associated with raised blood cholesterol levels. This is coupled with cultural perceptions in black communities that eggs speed up the attainment of puberty, therefore early maturity in girls (SAPA, personal communication).

2.14 Technical efficiency

Technical efficiency is the process of using the available resources in the best combination to maximise output (Battese and Coelli, 1995). Esparon and Sturgess (1989) described technical efficiency as efficiency in relation to factor-product transformation. For a farm to be technically efficient, it has to produce at the production frontier level. However, this is not always the case due to random factors, such as bad weather, animal destruction and/or farm-specific factors, which lead to producing below the expected output frontier (Battese and Coelli, 1995). Although it is related to productivity, where inputs are transformed into outputs, technical efficiency estimation provides better results in identifying the best performing firm among a given set of firms compared to the average productivity estimates (Battese and Coelli, 1995). Furthermore, efficiency measurement provides an opportunity to separate production effects from managerial weakness (Ogundari and Ojoo, 2005).

2.14.1 Technical efficiency of the broiler production system

The concept of efficiency in the use of farm resources is concerned with the relative performance of the processes used in transforming given inputs into output (Gaviglio, 2021). Efficient use of inputs is very essential for broiler farmers to get the maximum possible output for enhancing productivity and ultimately profit of the farm (Ullah, 2017). The stochastic frontier model has normally been applied in estimating the technical efficiency of production systems, including the small-scale broiler production system, such as is practised in three of the Northern KwaZulu Natal district municipalities covered in this study (Battese and Coeli,1992; Kumbhakar and Lovell, 2000; Battese and Tessema, 1993).

In general, the major problem with broiler production in South Africa is the low productivity and inefficiency in resource allocation and utilisation (Nkukwana, 2018). The broiler industry is characterised by high production costs, low-profit margins and high feed bills. According to Olayide (1976), an increase in livestock production derives mainly from acreage expansion rather than higher intensification and productivity of resources. With the increasing population, the scope for expansion of cultivated areas is limited in the long-term. This means that the present production and supply chain is inadequate, hence the need to provide present and intending broiler farmers with useful information that will assist and sustain the poultry industry in South Africa (Olaofe, 2004).

The determinants of technical inefficiency among the poultry farmers include age, education, farmers' experience and the number of extension visits. Issues related to predator prevalence and competition from imports were ranked high among the challenges of the broiler production sector. For improved efficiency and maximum production of broilers, there is a need for increased feed and water intake, while encouraging farmers to increase their capacities of stocking. There is also the need to increase extension contact and introduction of non–formal education to farmers.

2.14.2 Technical Efficiency Measurement

Technical efficiency can be measured using both, parametric (stochastic frontier estimation) and non-parametric (Data Envelopment Analysis (DEA)) methods. The stochastic frontier is when the deviation from the frontier is attributed to the random

component reflecting measurement error and statistical noise and an inefficiency component (Ogundele and Okoruwa, 2006). The stochastic frontier method can be a good measurement of performance because of its advantage of incorporating the random error of the regression. The random error, therefore, captures the effect of unimportant left-out variables and errors of dependent variables, as well as the farm-specific inefficiencies. It provides the farm efficiency estimates with much lower variability than any other method, due to the error term decomposition (Neff *et al.,* 1994). Because of its ability to decompose errors, this method of estimation is reported to be superior to others. A widely used Cobb-Douglas production is linearized and used to estimate the technical efficiency (Stochastic frontier) and allocative efficiency (Ogundele and Okoruwa, 2006).

2.14.2.1 The Stochastic Frontier Analysis

The stochastic frontier is a linearized Cob-Douglas production function and can be expressed mathematically as:

$$\ln (Y_i)=\beta_0+\Sigma_i\beta_i \ln X_{ij} +\varepsilon_i \quad \ldots\ldots (7)$$

Where ln is natural logarithm, Y_i is output of the i farmers, β_0 is a Constant, β_i is a Coefficient, X_{ij} is the j input used by farmer i, ε_i = a “composed” error term.

The “composed” error term (εi) is the essential component that distinguishes the stochastic frontier model from other models (Sharma and Leung, 2000; Bravo-Ureta and Pinheiro 1997; Rahman, 2003; Chavas*et al.,* 2005). The Composite error term (εi) can be rewritten as:

$$\varepsilon_i=v_i - u_i \quad \ldots\ldots (8)$$

but I = 1...n, n=158

When εi is substituted by $v_i - u_i$, then equation (7) is rewritten as;

$$\ln(Y_i)=\beta_0+\Sigma_i\beta_i\ln X_{ij} + v_i - u_i \quad \ldots\ldots (9)$$

Where the efficient component v_i is a two-sided (–∞<v<∞) normally distributed random error (v ~N[0, σv2]) that captures the stochastic effects outside the farmer's control, for example, weather, natural disasters and luck, measurement errors and other statistical noise. The efficiency component u_i is a one-sided (u>0) and measures the shortfall in output Y from its maximum value given by the stochastic frontier f (Xi; βi) + v. We assume u has an exponential distribution [U ≈ N(0,σu2)]. The two components v and u are also assumed independent of each other. The parameters are estimated by the maximum likelihood method, following Bravo-Ureta and Pinheiro (1997) and Bi (2004). If the efficient component u_i takes on a half-normal distribution, then equation (7) above can be rewritten as:

$$\ln(Y_i)=\beta_0+\Sigma_i \beta_i \ln X_{ij} + v_i \text{……………………………………………………(10)}$$

Following Jondrow *et al*. (1982), in addition to the half-normal distribution, the assumption of conditional distributional error term, coupled with the assumed independence of efficient components v_i and $u_{i,}$ should be satisfied when using a stochastic frontier. If all assumptions are satisfied, then the conditional mean of u_i given ε_i is defined as:

$$E(u_i|\varepsilon_i) = \delta_* \left[\frac{f^*(\varepsilon_i\lambda/\delta)}{1-F^*[\varepsilon_i\lambda/\delta]} - \frac{\varepsilon_i\lambda}{\delta}\right] \text{………………………………… (11)}$$

Where $\sigma^{*2}=\sigma_u^2\sigma_v^2/\sigma^2$, f* = the standard normal density function, F* = the distribution function, and f* = F* = λε/σ

The technical efficiency of a single farm is specifically defined as:

$$TE_i = \exp(-\hat{u}_i / \Sigma_i\beta_i) = \exp(-E(u_i | \varepsilon_i) / \Sigma_i\beta_i) \text{………………………………(12)}$$

The estimates for v and u are derived by replacing ε, σ*, and λ in equations (7) and (10). Then, the stochastic frontier is estimated by subtracting v_i from both sides of equation (9).

$$\ln(Y^*_i) = \beta_0+\Sigma_i\beta_i \ln X_{ij} - u_i=\ln(Y_i) - vi \text{…………………………………(13)}$$

Thus, $\ln(Y^*_i) = \beta_0+\Sigma_i\beta_i \ln X_{ij} + vi - u_i = \ln(Y_i)$

Where $\ln(Y_i^*)$ is the observed output of the farm I, which regulates the statistical noise contained in v_i, and Y_i is the corresponding frontier output. Explicitly, for an individual firm, technical efficiency is defined in terms of the ratio of the observed output to the corresponding frontier output and it can be expressed as:

$$TE = \frac{Y_i}{Y_i^*} \quad \text{...} \; (14)$$

2.14.2.2 The Data Envelopment Analysis (DEA) Modelling

The non-parametric method of estimating efficiency includes the Data Envelopment Analysis and the Free Disposal Hull (FDH) (Kibaara, 2005). The DEA is based on the notion that a production unit employing less input than another to produce the same amount of output is more profitable. The DEA approach applies the linear programming method, where a series of equations are used to construct linear production frontiers (Lemba *et al.,* 2012). Thus, production frontier functional assumptions play less or no role when using this method. The first DEA models were deterministic but have been modernised by including stochastic characteristics (Khai *et al.,* 2008).

The DEA has some advantages over the parametric approaches (Speelman *et al.,* 2007). Firstly, since it uses linear programming and constructed series of the equation, there is no need for assumptions set for a DEA production function. The method also gives an allowance for comparing different production frontiers in terms of a performance index. Also, the efficiency estimate is not affected significantly when using a small sample size. Finally, the DEA gives the freedom of determining efficiencies of the sub-vectors, for example specifying a target resource use, unlike the stochastic production frontier (Speelman *et al.,* 2007).

2.14.3 Recent Studies Estimating Production Efficiency using DEA and SFA

A study by Kibirige (2013) analysed the impact of human dimensions on smallholder farming in the Eastern Cape province of South Africa. The research evaluated the current smallholders' production efficiency and the link between smallholder farmers' human

dimensions (entrepreneurial spirit and positive psychological capital, goals and social capital and other efficiency-related variables) with production efficiency and household commercialisation index/level. The study used participatory approaches for site selection, sample selection and data collection. The analysis was based on both information from informal interviews and formal primary data collection. The Data Envelopment Analysis and Stochastic Production Frontier techniques were used to determine the relative efficiencies of individual farmers and to identify the major factors that influence the efficiency of production.

Overall, 158 farmers were interviewed both at Qamata and Tyefu irrigation schemes. Results from their study indicate that farmers' human dimensions that could be more positively and significantly associated with production, efficiency and household commercialisation level included risk-taking (hope), innovativeness (confidence) and optimism for entrepreneurial/positive psychological capital. Farmers' goals included self-esteem and independence, and only external social capital was identified to be more positively and significantly associated with farmers' production efficiency and commercialisation level. The transition from homestead subsistence to commercially-oriented small-scale irrigation farming is inevitable, since smallholder irrigators earn more incomes from maize and cabbage and are relatively food secure. However, the key policy options that must be considered to address inefficiencies and improve the commercialisation level to aid the transition include: agricultural policies geared towards attracting youth to farming, improved quality of extension services, speeding up the land reform processes and formation of cooperatives and participatory policy formulation that take full cognisance of the farmers' human dimensions

According to Khai*et al*. (2008), most smallholder farmers in developing countries have failed to optimise fully the potential of technology. This may be due to inefficient decisions made when using these technologies, leading to low productivity. These technical inefficiencies may be attributed to several factors that include socioeconomic, institutional and management-related factors. Furthermore, these factors can be split into household education, farming experience, age of the farmer, farm size, non-farm employment, and

access to extension service, credit constraint, institutional constraint, farm assets and membership to farmer associations, among others. Several studies have been carried out to estimate technical efficiency and its determinants.

On estimating a trans-log production function to determine the technical efficiency differential between small and medium scale tobacco farmers in Uganda, Obwona (2000) found out that credit accessibility, extension service access and farm assets contributed positively to technical efficiency. The differences in efficiency between farmer groups were explained with only socio-economic and demographic factors. Mubarik*et al*. (1989) used profit efficiency and Ordinary Least Squares (OLS) model estimations to establish the inefficiency and factors causing inefficiency among Basmati rice growers in Pakistan. Results indicated that generally these farmers were inefficient between 5 and 87%. Socio-economic factors, like household education, non-farm employment and credit constraint and institutional constraints, were found to have an impact on the farmer's efficiency. Institutional constraints identified were late delivery of fertilizers and thus late planting, which impacted the technical efficiency of farmers. Studies carried out by different researchers like Ogundari and Ojoo (2005), Padilla-Fernandez and Nuthall (2001), and Obwona (2000) indicated that age, farming experience, extension service access and farm assets contributed to farmers' inefficiency.

In 2005, Kibaara estimated the technical efficiency of Kenya's maize production using a stochastic frontier approach and reported that the mean technical efficiency of Kenya's maize production was 49%. The research further estimated the determinants of technical efficiency and these included the farmer's years spent in school (formal education), age of the household head, health of the household head, gender of the household, use or none use of tractors and off-farm income.

In their study to estimate the production efficiency of soybean production in the Mekong River Delta of Viet Nam, Khai*et al.* (2008) found out that governmental policies like fertilizer, pesticides and seed subsidies had a positive and significant influence on TE and EE function at 20% level. Also, farmers' experience was found to have a positive and significant

influence on AE and EE at 20% level. Land size had a positive and significant influence on TE and a negative and significant influence on AE and EE at 1% level, respectively. The geographical location of farms also had a positive and significant influence on TE at 10% level. However, government policies and farmers' experience and their impact were not considered important because of the assumed large error estimation (20% level or confidence interval of 80%). These results were generated using a stochastic frontier function.

A study carried out by Kelemework (2007) compared farmers' technical efficiency of irrigators and non-irrigators in two selected areas in Ethiopia. Although many studies have attributed access to irrigation water as a major contributor to improved farmer production efficiency, the inverse was found to be true for Doni and Godino irrigation scheme community. Results indicated that the mean efficiency of farmers of Doni and Godino irrigation schemes was 0.556, whereas dry-land farmers in the same locality had a mean technical efficiency of 0.798. However, Batu Degaga irrigators were more technically efficient at 0.76, compared to the dry-land farmers whose mean efficiency was estimated at 0.656. The determinants of farmers' technical efficiency included gender, agricultural advice/extension services, off-farm income and the location of farms on the watercourse.

Haji (2008) research established the economic efficiency and marketing performance of vegetable production in the eastern and central parts of Ethiopia. The study employed the data envelopment analysis (DEA) and Tobit regression models to estimate the technical, allocative and economic efficiency and factors affecting thereof. Results of the study indicated that farmers were technically efficient (0.91), but allocatively and economically inefficient at 60% and 56% levels, respectively. Determinants of farmers' technical efficiency included household size, the value of assets owned, farm size, extension services and off-farm incomes. Extension services exhibited a negative relationship with technical efficiency. Allocative and economic efficiency were found to be significantly influenced by an asset ownership, farm size, consumption expenditures and crop diversification. Consumption expenditure and crop diversification were found to have a

negative and significant relationship with both the allocative and economic efficiency of vegetable farmers in the selected study areas.

According to the study carried out by Bifarin *et al*. (2010), results indicated that plantain farmers in the Ondo State of Nigeria averagely were 61% technically efficient, 57% allocatively efficient and 35% economically efficient. The factors responsible for technical, allocative and economic efficiency included age, which had a positive and significant impact on technical and economic efficiency. Access to extension service was found to have a positive and significant impact on technical efficiencies. Farmers' experience and extension services had a positive and significant influence on the efficiency of plantain farmers in the Ondo State of Nigeria. Bifarin *et al*. (2010) used the stochastic frontier to execute their results.

Kibirige (2008) carried out a study aimed at analysing the impact of the Agricultural Productivity Enhancement Programme (APEP-USAID) on the technical and allocative efficiency of maize farmers in Uganda. The study used a stochastic frontier to estimate technical efficiency and a robust standard error OLS model to estimate the determinants of technical efficiency. Results generated from this study indicated that, on average, 57% of these farmers were operating above 60% technical efficiency. Positively and significantly related factors to technical efficiency included group membership, household size, respondent spouse's education level, a respondent spouse's major occupation and variety of seeds planted. Selling at the farm gate had a negative and significant relationship with technical efficiency. Also, farmers who belonged to APEP groups were reported to be allocatively more efficient than non-APEP members, especially in utilising improved seeds (allocative efficiency scores for seeds were 0.92).

Using a Cobb-Douglas production stochastic frontier and logistic regression model, Tshilambilu (2011) found out that small-scale maize farmers in Ga-Mothiba in Limpopo of South Africa were technically inefficient due to several socio-economic factors. The socio-economic factors that significantly affected the technical efficiency of maize farmers in Ga-Mothiba included household size, level of education, farming experience, household

monthly incomes, farm size, cost of hiring a tractor, fertiliser use, use of hybrid maize seeds, membership to farmer groups and farmers' perceptions on maize profitability. Household size, tractor hiring costs, use of hybrid maize seed and farmers' perceptions on maize profitability had a negative influence on the technical efficiency of smallholder maize farmers in the study area.

In their study to establish the technical efficiency of water use and its determinants among small-scale irrigation schemes in the North West Province of South Africa, Speelman *et al*. (2008) reported that farmers were generally technically efficient at 49% under Constant Returns to Scale (CRS) and 16% efficient water use under Variable Returns to Scale (VRS), respectively. Thus, farmers were operating at low technical efficiency and had the potential of improving their water use efficiency by 84% for increased productivity when using the same available technology. Determinates of water use efficiency included farm size, land ownership, fragmentation, the type of irrigation scheme, crop choice and the irrigation methods applied.

Most studies mentioned (Kelemework, 2007; Haji, 2008; Kibirige, 2008) have some elements of human capital (education, experience, training/extension services accessibility) and social capital, which are mainly presented in form of a group membership. Thus, human capital and social capital are crucial intangible factors needed for improved production efficiency, which, in turn, result in increased productivity. Iranian (2015) acknowledged that there are few studies carried out in South Africa to estimate production efficiency, especially among smallholder farmers. This was mainly attributed to the scarce information in the national statistics related to smallholder farmers' operations. This has created a knowledge gap that needs to be closed for a meaningful policy formulation and implementation to save the stagnant and declining smallholder agricultural production and productivity in South Africa (Aliber and Hart, 2009; Iranian, 2015).

2.14.4 Graphical Explanation of Allocative and Technical Efficiency

Following Kumbhaker and Lovell (2000), technical efficiency and allocative efficiency can be presented graphically as shown in Figure 2.2. The graphical explanation, in this case, used a simplified example of two input (x_1, x_2)-two output (y_1, y_2) production processes as shown in Figures 2.2 and 2.3. Figure 2.2 illustrates efficiency estimation in terms of the optimal combination of inputs employed to achieve a given level of output, and this type of approach is called input-orientation. Figure 2.1 explains the second approach of explaining efficiency based on the optimal output that could be produced from a given set of inputs and it is known as the output orientation.

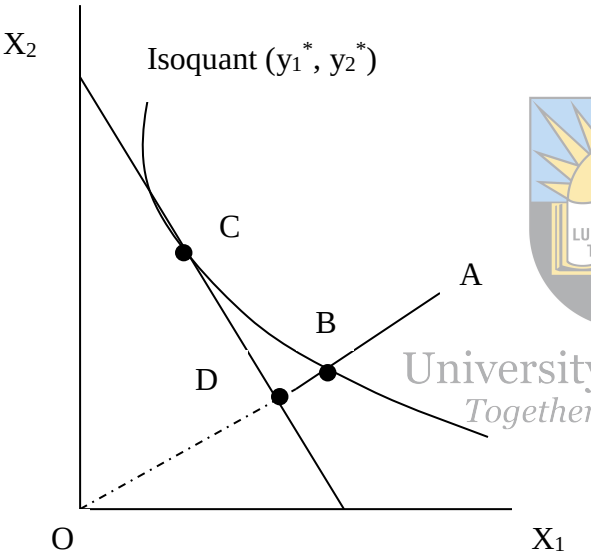


Figure 2.2: Input Oriented Efficiency Measures

Source: Kumbhaker and Lovell (2000)

According to Figure 2.2, using an input combination defined at point A, the firm produces a given level of output (y_1*, y_2*). The input-oriented level of technical efficiency (TEI(y, x)) is defined by 0B/0A and can be achieved by radially reducing (contraction) both inputs (X_1, X_2) used from point A back to point B, when producing the same level of output. Point B lies on the isoquant associated with the minimum level of inputs required to produce (y1*, y2*) (Isoquant (y1*, y2*)). The least-cost combination of inputs that produces (y1*, y2*) is given by point C. At Point C, the marginal rate of technical substitution (MRTS) is equal to the input-input price ratio P_{x2}/P_{x1}. For the farmer to be cost efficient (CE), both inputs use

can further be reduced (contracted) to point D when maintaining the same level of input cost. Cost efficiency (CE(y, x, P_X)) can, therefore, be defined by the ratio 0D/0A. According to Coelli (1996), resource/input allocative efficiency (AEI(y, P_{X1}, P_{X2})) is subsequently given by CE(y, x, P_X)/TEI(y, x) or 0D/0B

Summary of Figure 2.2 illustrations:

OB/OA = Input Oriented Technical Efficiency (TEI (y, x)) (At point B)

P_{X2}/P_{X1} = Marginal Rate of Technical Substitution (MRTS) (least cost combination of inputs to produce a given output (y1*, y2*) (At Point C)

OD/OA = Cost Efficiency (CE(y, x, P_X) (At Point D)

OD/OB = Resource/Input oriented Allocative Efficiency (OD/OA ÷ OB/OA) = (CE(y, x, PX)/ TEI (y, x)) (At Point D)

Figure 2.2 illustrates the production possibility frontier for a given set of inputs. The output-oriented measure of technical efficiency (TEO(Y, X)) given by 0A/0B can be achieved if the inputs employed by the firm were used efficiently, and when the output (Y_1^*, Y_2^*) produced by the firm at point A, increases (expands) radially to point B. At point B, the farm/firm is said to be technically efficient because it is on the production possibility frontier. Also, higher revenue could be achieved by producing at point C the point where the marginal rate of transformation (MRT) is equal to the output price ratio (P_{Y2}/P_{Y1}). To maximize revenue, therefore, there is a need to produce more of Y_1 and less of Y_2. Revenue efficiency (RE(Y, X, P)) is represented by point D and can be attained when output at point C is expanded to point D when maintaining the same input and output combination and RE(Y, X, P) = 0A/0D. According to Coelli (1996), output allocative efficiency (AEO(Y, P_{Y1}, P_{Y2})) can be estimated as RE(Y, X, P_Y)/TEI(y, x) or 0B/0D in Figure 4.3.

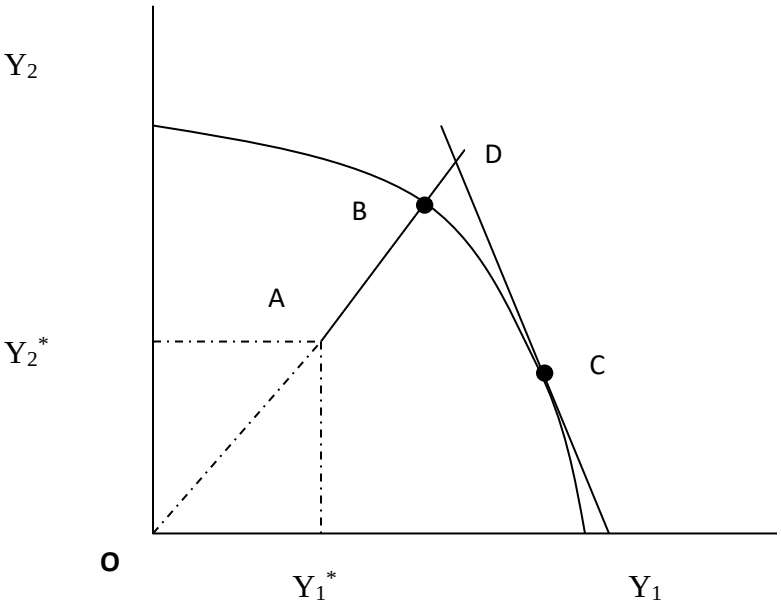


Figure 2.3 Output Oriented Efficiency Measure

Source: Kumbhaker and Lovell (2000)

Summary of figure 2.3 illustration

0A/0B = Output oriented measure of technical efficiency (TEO (Y, X)) (At point B)

P_{Y2}/P_{Y1} = Marginal Rate of Transformation (MRT) (Higher revenues achieved at point C)

0A/0D = Revenue efficiency (RE (Y, X, P)) (At Point D)

0B/0D = Output allocative efficiency (AEO (Y, PY1, PY2)) = RE (Y, X, PY)/TEI (y, x)

= 0A/0D ÷ 0A/0B.

2.14.5 Graphical Presentation of the CRS and VRS Frontiers

Coelli (1996) explains methods for determining returns to scale. In essence, the researcher examines the technical efficiency, given different returns to scale and determines whether or not the observed levels are along the frontier corresponding to a particular return to scale (Coelli, 1996). The Data envelopment Analysis produces different results, depending on the scale assumptions that are considered when modelling (Coelli, 1996). There are two scale assumptions generally employed and these are constant returns to scale (CRS) and variable returns to scale (VRS). A variable return to scale includes both increasing and decreasing returns to scale (Coelli, 1996). The CRS reflects the fact that output will change by the same proportion as inputs are changed, while the VRS appreciates the fact that production technology varies and exhibit increasing, constant and decreasing returns to scale.

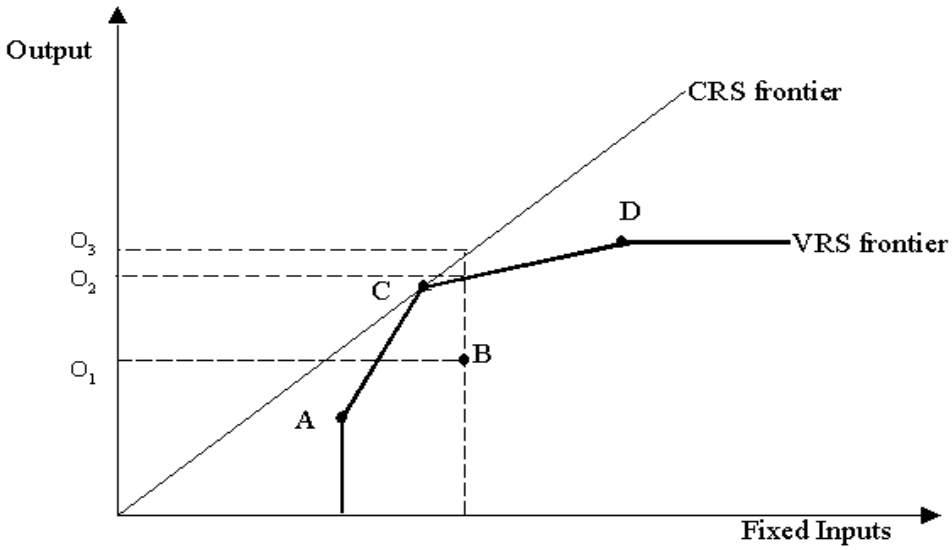


Figure 2.4: CRS and VRS Frontier
Source: Coelli (1996)

Figure 2.4 presents the effect of the scale assumption on the measure of capacity utilisation. Four data points namely A, B, C and D are used to estimate the efficient frontier under both scale assumptions, thus, constant returns to scale (CRS) and variable returns to scale (VRS). Figure 2.3 above considers inputs fixed inputs. The frontier defines the full capacity output given the level of fixed inputs. Considering constant returns to scale (CRS), the frontier is defined by point C for all points along the frontier, with all other points falling below the frontier (hence indicating underutilisation). Considering variable returns to scale (VRS), the frontier is defined by points A, C and D, and only point B lies below the frontier, that is to say, it exhibits underutilisation. According to Figure 4.4, the variable returns to the scale frontier curve is lower than the constant returns to scale frontier curve.

2.15 Chapter summary

This chapter discussed literature on government intervention and enterprise failure, where it deeply discusses the increases in inequality and poverty rate. This chapter escalates to the current body of local and international marketing and production challenges. Moreover, this chapter identifies the uniqueness of this study, as it was conducted in South Africa in KwaZulu-Natal province, focusing on the northern region of the province, where the

province is earmarked as poor in terms of economic growth and high population rate, with high incident of incurable diseases, unrest and floods. Studies of this nature remain relatively sparse in developing markets as compared with developed markets, despite the observation that developing and emerging economies now present the next great opportunity for global business. Likewise, consumer behavioural patterns observed in developed countries when purchasing food products do not always correspond with those observed in developing nations. This chapter also discusses the uniqueness of this study as the poultry industry grapples with nationwide lockdowns because of the Covid-19 pandemic. The industry has been further beset by mobs of thousands of people invading farms, stealing poultry and equipment and destroying infrastructure and lastly floods in the Province. In addition to the challenges, supply chains and the transport of poultry products have been severely disrupted with logistics services and distribution centres being forced to close. This chapter also discussed the concept of technical efficiency, where it analysed that poultry production has great potential to increase protein supply in South Africa. The chapter also highlighted the major problems with broiler production in South Africa as in low productivity and inefficiency in resource allocation and utilisation.

CHAPTER THREE

DESCRIPTION OF THE STUDY AREA

3.1 Introduction

This chapter provides a partial, socio-economic and geophysical description of the study areas, within the broader context of the province. It starts by describing the location of the study areas within the KwaZulu-Natal province. The geophysical description of the study area is provided with a focus on the selected district municipalities: uMkhanyakude, uThungulu and Zululand district municipalities in terms of their geophysical aspects, topography, climate, vegetation, land use, socio-economic status, population, unemployment, education, economic activities and agricultural potential.

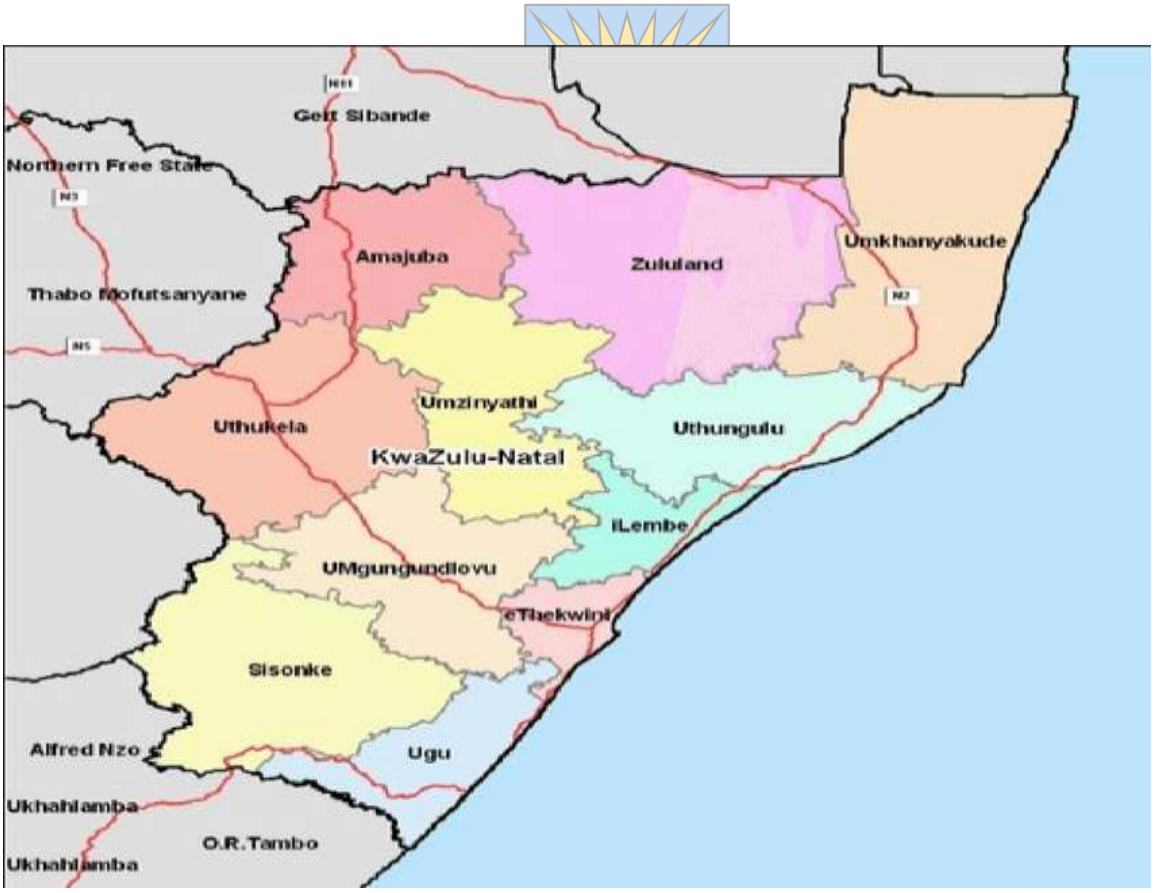


Figure 3.1: Map showing the location of KwaZulu-Natal province in South Africa

Source**:** KZN municipalities.co.za (2022)

3.2 Selection of the study areas

Figure 3.1 is a map showing the location of KwaZulu-Natal province in South Africa. This study was conducted in areas of North of KwaZulu-Natal, in uMkhanyakude, uThungulu and Zululand district municipalities. The geophysical description of the study areas is provided with a focus on the selected districts (uMkhanyakude, uThungulu and Zululand). The choice of the northern region districts was because of its similarities in terms of its geographical aspects and poverty levels. These districts were also identified as the ones with high poverty levels, which are as high as 40% (Stats SA, 2011).

3.3 Description of the study areas

Figure 3.1 above provides a geophysical description of the study area, within the broader context of the province and South Africa. It shows the location of the study areas within the KwaZulu-Natal province. The geophysical description of the study area is provided with a focus on the selected districts: uMkhanyakude, uThungulu and Zululand in terms of their geophysical aspects.

3.3.1 uMkhanyakude District Municipality

uMkhanyakude district municipality comprises five local municipalities namely: Hlabisa Local Municipality, Jozini Local Municipality, uMhlabuyalingana Local Municipality, Big 5 False Bay Local Municipality and Mtubatuba Local Municipality. uMkhanyakude is named after the yellow-barked fever tree, literally meaning “seen from afar”. It contains many areas of outstanding natural beauty, such as the St Lucia Greater Wetland Park, Sodwana Bay and Kosi Bay. Game parks include Hluhluwe-Umfolozi, Ndumo and Tembe Elephant Park. Figure 3.2 is a map showing uMkhanyakude district and its local municipalities.

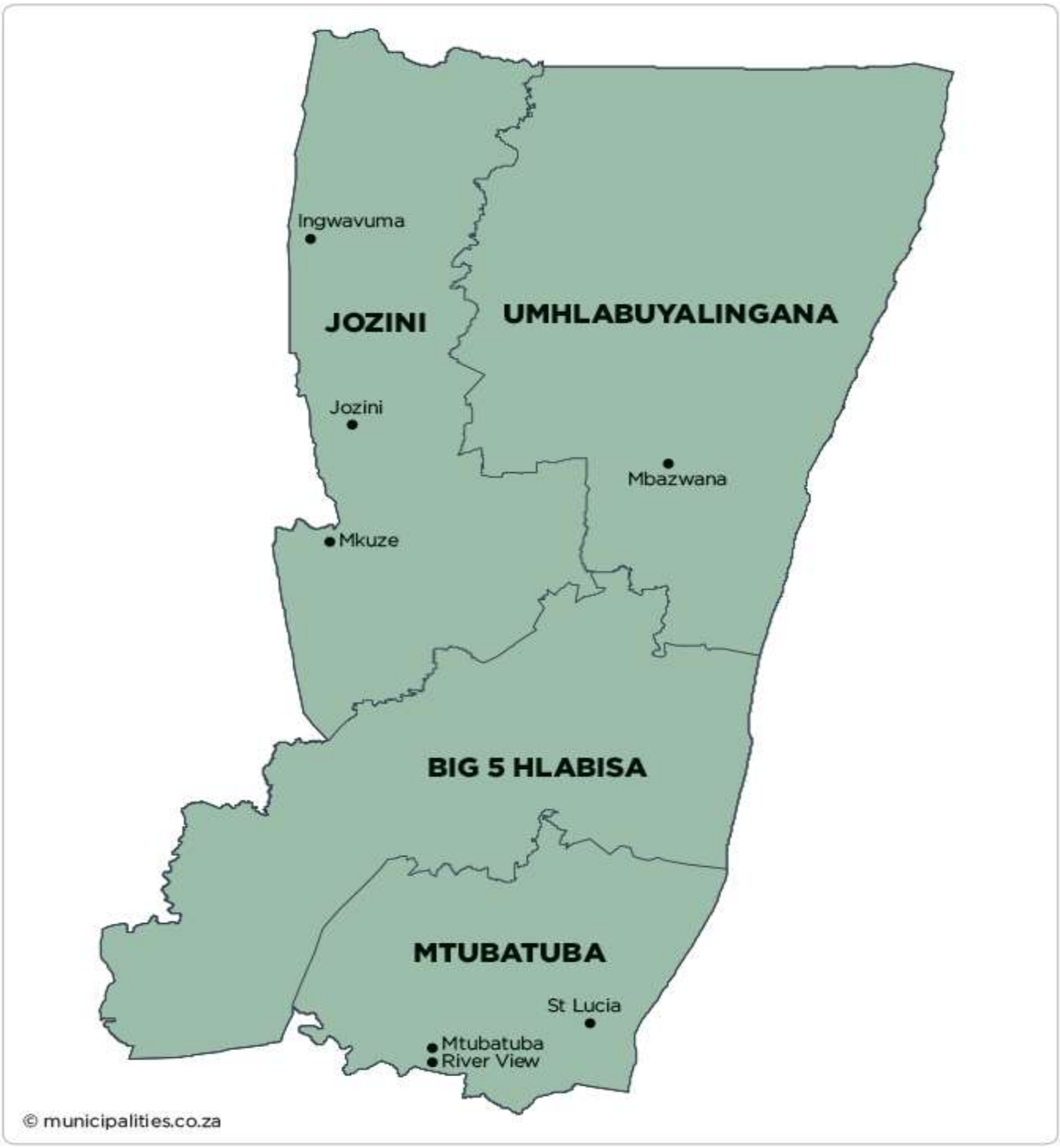


Figure 3.2: Map showing uMkhanyakude district

Source: KZN municipalities.co.za (2022)

uMkhanyakude District Municipality is mainly rural, with the only formalised town being Mtubatuba in the south. However, several towns are growing rapidly, such as Hluhluwe, Manguzi, Jozini, Mkuze and Mbazwana (uMkhanyakude Municipality, 2013).

3.3.1.1 Geophysical aspects

These include topography, climate, vegetation, soils and land use.

3.3.1.2 Topography

uMkhanyakude is composed of both steep slopes and flat lands (being uMhlabuyalingana). UMhlabuyalingana Municipality is flat but other local municipalities have slopes. These local municipalities include Big 5 and Mtubatuba local municipalities. Jozini local municipality is dominated by the steep slopes (uMkhanyakude Municipality, 2016).

3.3.1.3 Climate and vegetation

Table 3.1 below shows the rainfall ratings on a monthly basis in uMkhanyakude District Municipality, and the mean annual rainfall is 650mm. It also shows that the winter months have low rainfall when compared to the summer months. Table 3.2 shows that the winter months are colder than the summer months, with an average of 21.4^{0}C.

Table 3.1 Average monthly rainfall (mm) for uMkhanyakude District
Source: uMkhanyakude BRU (2015)

	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Median	709	108	96	80	41	28	13	10	17	34	77	98	107
Mean	650	97	82	74	37	29	14	21	20	37	77	84	78

	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	21.4	24.6	25.0	23.9	22.1	19.9	17.7	17.6	18.9	20.6	21.0	22.2	23.6
Min	16.1	19.7	20.1	18.9	16.9	14.3	11.7	11.8	13.1	15.2	15.9	17.4	18.6
Max	26.7	29.5	29.9	28.9	27.3	25.5	23.6	23.4	24.7	26.1	26.0	27.1	28.6

Table 3.2: Average, minimum and maximum monthly temperature (0C) for uMkhanyakude District

Table 3.2 above shows that summer months are very hot and winter months have no frost, thus, summer crops can also be grown in winter. The above climatic parameters exhibit sub-tropical conditions, with no frost hazard and temperatures above 15^0C throughout the year. Most sites in this district make are ideal for vegetables and field crops to be successfully produced throughout the year.

3.3.1.4 Soils

Soils in most areas of uMkhanyakude District Municipality are poorly drained, except for Jozini Local Municipality. This area has different soil patterns and types, ranging from well-drained high potential soils to duplex, moderately drained soils. In-depth soil classification is necessary in this area to optimise the high potential soils. These soil ecotopes represent the best soil classes and have a high crop potential. These soil ecotopes are H.2.4. and H.3.4. A soil ecotope is a class of land defined in terms of soil form, texture, depth, wetness, slope and soil surface characteristics (uMkhanyakude BRU, undated). An ecotope is defined by soil texture, clay percentage, depth, slope and rockiness. Therefore, ecotope B: 1:1 found in the site defines soils that are well drained, with a clay percentage of less than15% and a soil depth of greater than 800m.

3.3.1.5 Land use

Table 4.3 indicates the agricultural enterprises and land use practised in uMkhanyakude, taking from natural veld, dry-land pasture, irrigated pastures, arable lands under irrigation, dry land and others. Natural veld is mostly kept as game reserves, as well as grazing and browsing, while pastures and arable lands are kept for agriculture.

Table 3.2: Agricultural enterprises and land use practices in the stud y area
Source: uMkhanyakude IDZ (2015)

Enterprise	Comments
Natural veld	These lands are kept for natural grazing and browsing; this area comprises 30% of the total district.
Dry-and pasture	These lands are reserves for planted pasture without irrigation; they are about 0.5% of the total district.
Irrigated pasture	These lands are reserved for planted pasture with irrigation, and are about 10% of the total district.
Arable land under irrigation	These lands are reserved for planted crops, especially vegetables and green mealies with irrigation. They are about 15% of the total district.
Arable dry-land	These lands are reserved for planted crops grains and forests, and they are about 25% of the total district.
Farmyard, Homesteads and roads	These lands are not used for production; and they are about 19.5% of the total district.

3.3.1.6 Socio-economic status

This section describes the socio-economic status of the study area (uMkhanyakude district). This includes population distribution, unemployment, education, infrastructure and economic activities.

3.3.1.6.1 Population

Stats SA (2011) states that uMkhanyakude district has a population of approximately 504 000 people who are distributed unevenly among five local municipalities. The population of

this district municipality increased by 0.3% annually though the unemployment rate is higher (Stats SA, 2011).

3.3.1.6.2 Unemployment

Out of nine districts in Kwa-Zulu Natal, uMkhanyakude is one of the two most deprived districts in South Africa, in terms of health status (District Health Barometer, 2014). According to Stats SA (2011), uMkhanyakude is sitting at 61.23% of the unemployment rate. “Deprivation” is defined as a combination of indicators, including unemployment rates, access to piped water and electricity, female-headed households with high numbers of children and low education levels.

3.3.1.6.3 Education

In uMkhanyakude district, those with no schooling account for 27,4% of the total population; those with a higher education qualification account for 20% and those with matric account for 25,2% and the rest of the population is unspecified (Stats SA, 2011). Education is the key to the economic development of the area; the higher the number of people without schooling, the fewer people that can read, write and calculate.

3.3.1.6.4 Economic activities

uMkhanyakude is one of four district municipalities in KwaZulu-Natal that were selected as Presidential Nodes for the implementation of the Integrated Sustainable Rural Development Programme (ISRDP).

3.3.1.6.5 Agricultural potential

uMkhanyakude has outstanding potential for agriculture and tourism developments, with the district having a wealth of natural beauty and outstanding landscape, as well as favourable climate and fertile soils for major agricultural production, especially in Jozini local municipality. The district is closely associated with the Simangaliso, "Maputaland", the Makhathini Flats and the Pongola- Port/Jozini Dam, constructed in the 1970s to unleash the agricultural potential of the area. Several initiatives have been taken to boost economic

activity in the sub-region. The alluvial soils surrounding the river have considerable agricultural possibilities. Jozini dam is designed to irrigate more than 80 000 hectares of agricultural lands. Crops include sugar cane, rice, coffee, cotton, fibre crops and various sub-tropical fruits. Other agricultural products in the region include timber, tomatoes, chillies and pineapples. A high proportion of the district is under the thicket, grassland and wetland and is in the traditional authority areas under the jurisdiction of the Ingonyama Trust. The remaining areas are under state conservation and private ownership, with limited formal urban areas.

3.3.2 uThungulu/King Cetshwayo District Municipality

uThungulu/King Cetshwayo district municipality is one of the 11 district municipalities of KwaZulu-Natal province and comprises six local municipalities that include Nkandla, Mthonjaneni, Mbonambi, uMlalazi, uMhlathuze and Ntambanana (Richards Bay IDZ, 2015). Figure 3.3 is a map showing uThungulu district and its local municipalities.

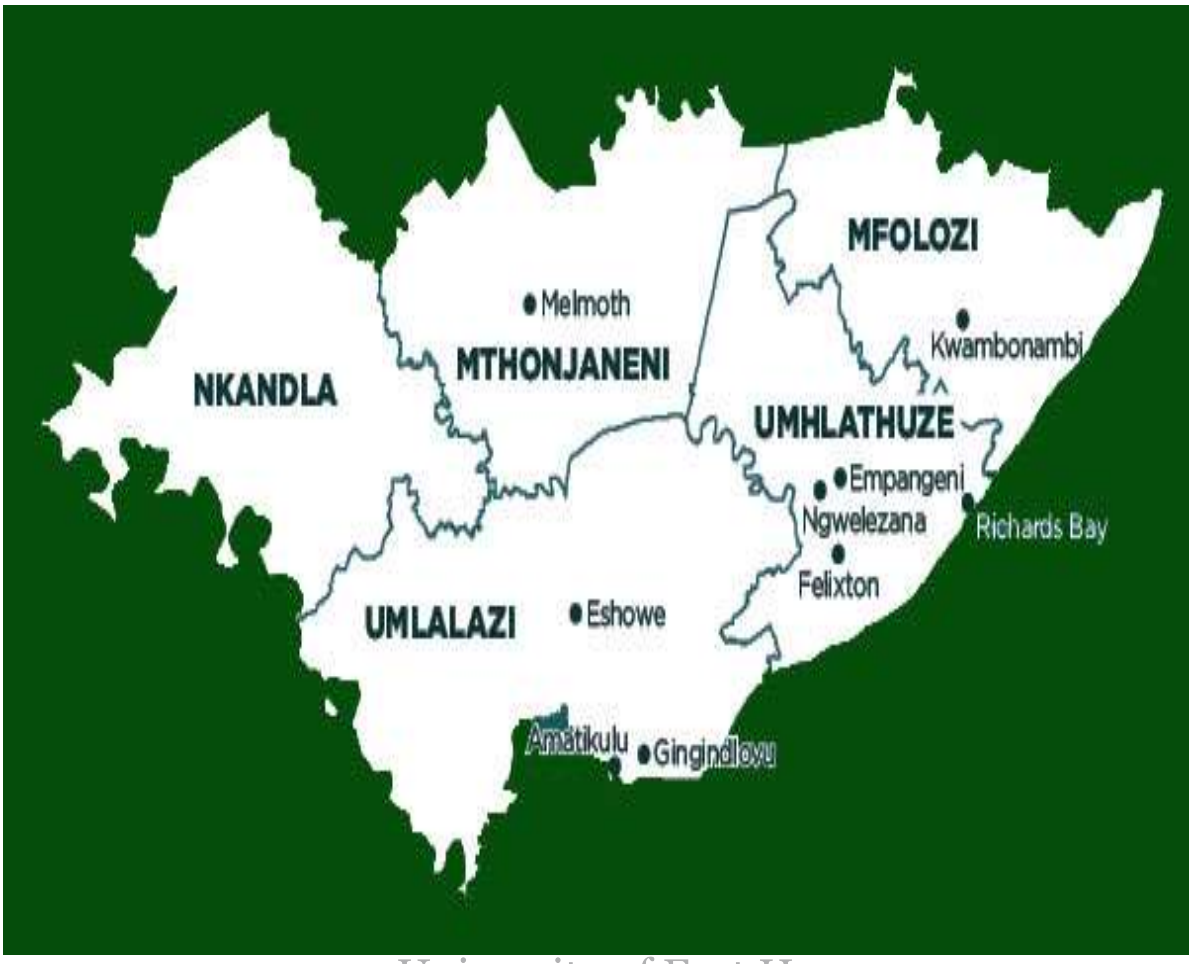


Figure 3.3 is a map showing uThungulu district and its local municipalities.
Source: KZNONLINE (2017)

uThungulu district municipality is in the North-Eastern region of the KwaZulu-Natal province of South Africa, with an area of about 9000km², and with close to 1 million inhabitants (KZN Top Business, 2015). The district is mainly dominated by agricultural activities, such as sugarcane and forestry with some citrus, nuts and animal husbandry (Trade and Investment KwaZulu Natal, 2009).

3.3.2.1 Geophysical aspects

This section describes the geophysical aspects of the study area (uThungulu/King Cetshwayo District). These include topography, climate, vegetation, soils and land use.

3.3.2.2 Topography

uThungulu district municipality has steep slopes, uMlalazi and Mhlathuze local municipalities have gradual slopes whereas else Nkandla and Mthonjaneni local municipalities have steeper slopes.

3.3.2.3 Soils

uThungulu district has moderate to poor soils; the drainage is good on the coast and gets poorer as you go further inland. The district has diverse soil types, ranging from Hutton to Mispar soil forms. Crops such as sugarcane adapt well, and even bananas are thriving because of soils and favourable temperatures.

3.3.2.4 Land use

UMlalazi and uMhlathuze local municipalities are dominated by sugarcane and bananas and in the inland local municipalities such as Mthonjaneni and Nkandla local municipalities, forests dominate.

3.3.2.5 Socio-economic status

This section describes the socio-economic status of the study area (uThungulu district). This includes population distribution, unemployment, education, infrastructure and economic activities.

3.3.2.6 Population

DC28 (district code) has its majority of its 885 944 people speak isiZulu (Stats SA, 2011). uThungulu/King Cetshwayo district has the third highest population in the province after eThekwini Metro and uMgungundlovu district municipalities (Stats SA, 2011).

3.3.2.7 Unemployment

The district has an unemployment rate of 47.5%, including youth unemployment of 59.9%, with a growth rate of 3% (Stats SA, 2011). The unemployment rate is a bit lower when compared with uMkhanyakude and Zululand districts.

3.3.2.8 Education

The total non-formal education sits at 30% of the total population, and those that have primary education account for 23%, secondary education is 7% and tertiary education 6% (Stats SA, 2011).

3.3.2.9 Infrastructure

uThungulu's gateway to the world markets is the Port of Richards Bay, which is the largest deep-water port on the African continent. The harbour facilities at Richards Bay are world-class and there is tremendous potential for further expansion of this Industrial Development Zone. This has resulted in Richards Bay becoming the fastest growing urban centre in South Africa, boosting economic activity and attracting international investors. The port imports the highest volume of bulk cargo of all African ports and has double the capacity of the Port of Durban and handling over 75 million tonnes of cargo annually.

The city of uMhlathuze comprises the economic powerhouse of Richards Bay and Empangeni and its supporting areas of eSikhawini, Ngwelezane, Nseleni, Felixton, Vulindlela and the rural areas. The City of uMhlathuze is not only financially stable but offers investors and visitors first-class facilities, services and infrastructure. The city is the home to world-class industry and the world's largest export coal terminal, Richards Bay Coal Terminal.

Farmers who were trained in this financial year are already supplying local retailers with their produce, and the municipality anticipates that the pre-market will be a sound vehicle for economic development and agricultural growth in rural areas. Richards Bay and Empangeni serve as industrial and service centres to many other parts of the district.

Nkandla, Melmoth, Ntambanana, Bucanana, KwaMbonambi and Eshowe are other administrative nodes of economic significance in the district (uThungulu IDP, 2015).

3.3.2.10 Economic opportunities

Important sectors in the district include mining and forestry. The district is well endowed with natural resources. Its comparative advantages include a good climate that opens up avenues for productive agricultural and tourism development.

uThungulu is popular for its mineral-rich land homes and two mining giants. Richards Bay Mineral, a leading producer of titanium mineral, high purity iron and zircon supplying the country, is on the coastal sands of the district. Exxaro KZN sands are involved in the mining, beneficiation and smelting of mineral sands, mainly to produce titanium slag from smelting ilmenite. Other products include zircon, rutile, leucoxene and low manganese pig iron.

3.3.2.11 Climate and vegetation

uThungulu district has a warm climate all year round, with very mild winters and hot, humid summers, with an annual mean temperature of 20^0C. There is also a good seasonal rainfall, with a mean rainfall of 750mm (uThungulu BRU, 2015). The temperate climate and warm seas of the coastline make it an ideal location for the development of agricultural projects and tourism facilities.

3.3.2.12 Economic activities

3.3.2.12.1 Manufacturing

Manufacturing contributes over 50% of the district's GDP. It is the largest economic contributor to the gross geographic product in the district, (uThungulu IDP, 2015). The manufacturing activity in uThungulu is minerals, metal products and equipment, chemical products, wood and paper. The sector is highly specialised and focuses on exports.

3.3.2.12.2 Mining

The district is home to two mining giants, which have capitalised on the mineral-rich land in uThungulu. Richards Bay Mineral is a leading producer of titanium minerals, high purity iron and zircon. Exxaro KZN sands is SA's flagship empowerment mining company, involved in the mining, beneficiation and smelting of mineral sand

3.3.2.12.3 Forestry

The commercial forestry sector is well developed, with large plantations by private companies, such as Mondi and Sappi.

3.3.2.12.4 Tourism

The district also has several wetlands, the most notable being Cubhu and Greater uMhlathuze Wetlands to the south of Richards Bay in Eskhaleni. uThungulu district is well developed, with an abundance of natural resources. It forms a gateway to some of the country's finest game reserves and is rich in cultural heritage, offering a unique Zulu Kingdom experience.

3.3.2.12.5 Agricultural potential

The major land uses in the district are commercial agriculture and sugarcane grown largely in the lower-lying coastal belt. The district practises both commercial and subsistence agriculture. Subsistence agriculture is mainly practised in the rural areas of uThungulu district. In these areas, there are limited economic opportunities and poor infrastructure - throughout the district, there is a great concern about transport infrastructure to rural communities. Agricultural production by small-scale farmers is practised in tribal areas, which are characterised by high levels of poverty and under-development (KZN Top Business, 2015). The production of horticultural crops includes citrus, sub-tropical fruits and vegetables.

3.3.3 Zululand District Municipality

Zululand district municipality is one of the 11 district municipalities of KwaZulu-Natal province and comprises five local municipalities: Nongoma, Ulundi, Vryheid, Pongola and Paul Pietersburg. Manufacturing includes food and beverages, clothing and textiles, leather, paper and paper products, printing and publishing, metal products, machinery and equipment. The beneficiation of primary products offers many possibilities. Figure 3.4 is a map showing Zululand district and its local municipalities.

Figure 3.4 is a map showing Zululand district and its local municipalities

Source: KZNONLINE (2017)

3.3.3.1 Geophysical aspects

This section describes the geophysical aspects of the study area, Zululand district. These include topography, climate, vegetation, soils and land use.

3.3.3.1.1 Topography

Zululand district municipality has a variety of landscape. Abaqulusi, Dumbe and Pongola local municipalities have slopes, while Nongoma and Ulundi local municipalities are steeper.

3.3.3.1.2 Climate and vegetation

The major limitation in this area is low rainfall during certain months. The area has an annual mean rainfall of 800 mm and has occasional frost. Despite these climatic limitations, a wide range of crops (as proposed in the cropping plan) can be successfully produced.

Table 4.3 indicates the average, minimum and maximum monthly temperatures in Zululand district. The annual mean temperature is 20.9 degrees Celsius. Table 3.4 shows that the temperatures are high in the summer months and low in the winter months.

Table 3.3: Average, minimum and maximum monthly temperature (0C) for Zululand district

Source: Zululand BRU (2015)

	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	20.9	24.8	24.5	23.7	21.4	18.7	16.0	16.0	17.8	19.9	21.2	22.4	24.1
Min	14.6	19.1	19.1	18.2	15.4	11.7	8.5	8.5	10.6	13.4	15.2	16.7	18.3
Max	27.3	30.5	30.0	29.4	27.5	25.7	23.6	23.7	25.1	26.5	27.3	28.1	29.9

Summers are very hot while winters have frost, thus, summer crops can be stunted in winter. According to Zululand BRU (2015), the above climatic parameters exhibit sub-tropical conditions, with no frost hazard and temperatures above 15^0C throughout the year, the site makes it ideal for most vegetables and crops to be successfully produced throughout the year.

3.3.3.1.3 Soils

The area has different soil patterns and types, ranging from well-drained high potential soils to duplex, moderately drained soils. In-depth soil classification is necessary in this area to optimise the high potential soils.

Zululand district has moderate to poor soils although some areas have very good soil, places, such as Abaqulusi, Dumbe Pongola, Babango, Nkonjeni, Bululwane, Dabhasi and Emahhashini (Zululand BRU, 2015).

However, a general description based on crop ecotope factors was used to estimate crop capability. These soil ecotopes are H.2.4. and H.3.4. A soil ecotope is a class of land defined in terms of soil form, texture, depth, wetness, slope and soil surface characteristics. An ecotope is defined by soil texture, clay percentage, depth, slope and rockiness. According to Zululand BRU (2015), ecotope B: 1:1 found in the site defines soils that are well drained, with a clay percentage of <15% and a soil depth of > 800m.

The analysis of the natural resources found in this site, as described in the above section, reveals a highly suitable area for most agricultural enterprises. Therefore, this site lends itself highly suitable for the proposed enterprises. With the right crop choices, good management and technical support, there is a great opportunity for this area to be commercially viable. The high agricultural potential of the land is considered to be the key to the future development of the region and should be protected for long-term sustainability.

3.3.3.1.4 Land use

A large percentage of the district is communal land. Within these areas, there is considerable pressure to extend grazing rights into adjoining areas. The high potential of the land is considered to be the key to the future development of the region and should be protected for long-term sustainability. However, this does not mean that it should be excluded from consideration in a project that relates to land reform and commercial ventures. The high population number and stock concentrations in the freehold settlements highlight the need for additional land and create possible land conservation measures.

Any strategy to deal with the need to accommodate the increasing demands for grazing land need particular attention, and this will require extensive consultation between all key role players in the region.

3.3.3.1.5 Socio-economic status

This section describes the socio-economic status of the study area (Zululand district). This includes population distribution, unemployment, education, infrastructure and economic activities.

3.3.3.1.6 Population

The majority of its 804 456 people speak isiZulu (Stats SA, 2011). The district code is DC26. It is a large historical area also known as Zululand.

3.3.3.1.7 Unemployment

Zululand district has 49.3% of unemployment rate, including youth unemployment of 59.9%, with a growth rate of 3% (Stats SA, 2011). This is a very high rate when compared with uThungulu district, especially when considering the coal mines that are closed in Abaqulusi and only leaving only one coal mine only in Ulundi.

3.3.3.1.8 Education

Zululand district has 25% of non-formal education, 32% with primary education, 30% with secondary education and 20% with tertiary education (Stats SA, 2011). Educational status shows the number of people that can read, write and calculate.

3.3.3.1.9 Infrastructure

Zululand's main internal road is dominated by three routes that form a triangle linking Vryheid, Ulundi and Pongola. Up to the early 1990s, Zululand's economic base depended heavily on coal mining, supported by agriculture, transport, trade and government services. The potential for economic growth in Zululand lies in tourism and agriculture.

3.3.3.1.10 Economic activities

Vryheid and Ulundi are the major towns. Vryheid is a commercial and business centre, while Ulundi is an administrative Centre with the seat of the district municipality and a well-equipped airport. The potential for economic growth in Zululand lies in tourism and agriculture. The district experiences a high level of poverty and has a high incidence of HIV/AIDS infection (StatsSA, 2013). Another major setback is poor access to basic services and facilities.

3.3.3.1.11 Agricultural potential

Agriculture provides the economic base of the area and opportunities range from commercial sugarcane and wattle farming to livestock farming and small-scale agricultural production. Products farmed are maize, groundnuts, soya beans, sunflowers and sorghum, as well as sub-tropical fruit. Many private game farms, hunting lodges and photographic safaris operate in the Zululand district.

3.3.3.1.12 Tourism

Zululand district is home to the origin of the Zulu and the Valley of the Kings, where King Shaka was born and is part of a heritage park, where the spirit of emakhosini memorial has been erected in honour of the Zulu kings whose graves lie here. The site of the Battle of Blood River and various other battlefields on the battlefield's route are popular tourist attractions. Here young Zulu maidens take part in colourful cultural festivals, the Zulu Royal reed dance. Zululand district has a rich diversity of wildlife, attracting many tourists, both internationally and locally.

3.4 Chapter summary

This chapter has provided a partial, socio-economic and geophysical description of the study areas, within the broader context of the province. It started by describing the location of the study areas within the KwaZulu-Natal province. The geophysical description of the study areas provided focus on the selected districts: uMkhanyakude, uThungulu and Zululand district municipalities in terms of their geophysical aspects, topography, climate,

vegetation, land use, socio-economic status, population, unemployment, education, economic activities and agricultural potential.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

This chapter is a presentation of the research methodology applied in the assessment of the viability of the government funded small-scale broilers projects in Northern KwaZulu-Natal namely King Cetshwayo/uThungulu, uMkhanyakude and Zululand district municipalities. All the steps entailed in the research process are outlined, including the research design and the theoretical and empirical models. Further, the chapter describes the sampling techniques employed, the procedure for determination of the sample size and the data collection procedures. The specific research tools employed in carrying out the analyses were also described.

4.2 Research design

Research design is a plan and structure of the investigation, which is put together to attain answers to study questions. This study employed a cross-sectional research design, where data were collected at one point in time on several variables, such as demographics, market participation, government interventions, market integration, socio-economic factors, profitability and profit determinants. Only a subset was selected to represent the population. Both qualitative and quantitative data were gathered on demographics, household socio-economic factors, market potential, marketing costs, socio-economic features, marketing constraints and prices.

4.2.1 Units of analysis

To achieve a meaningful assessment of the profitability of the government-funded small-scale broiler projects, the researcher designed a questionnaire to interview the broiler project participants, who constitute the unit of analysis. These comprise broiler projects that are within Zululand, uThungulu and uMkhanyakude districts municipalities. To have a basis for comparison and simulate a base situation, projects that are not funded by the

government were also enumerated. Trained enumerators were used to collect data. A sample of 75 projects was interviewed. Projects financed during the 2012/2013 financial year and residing in the Northern KwaZulu-Natal districts of uThungulu, Zululand and uMkhanyakude districts were purposively selected. The questionnaire was designed to extract information, such as demographics, production challenges, marketing channels and the information on the viability of the broiler projects. The relevant authorities (local Indunas or councillors) were contacted with the assistance of the extension officer(s) responsible for their respective ward(s), for permission to collect information from government-funded small-scale broiler producers and non-government-funded small-scale broiler producers.

After collection, the data were captured and coded in Microsoft Excel and exported to Statistical Package for the Social Science (SPSS) software version 26.0 for analysis and STATA for analyses. Descriptive statistics were applied; frequencies and means were used. In addition to these, a gross margin (GM) and gross profit margin (GPM) analyses were employed to assess the profitability of government-funded small-scale broiler projects in the Northern KZN region. Both profitability and gross margin analyses were used as proxies for farmers' motivation and incentives to participate in broiler production. To determine the factors influencing the profitability of government-funded small-scale broiler projects, a multiple regression model analysis was employed.

Gross margin was employed. Gross margin has a central place, since it provides opportunities and relevant information that substantiate decisions in the specific farm conditions, relating to planning the structure of production, reducing variable costs based on the analysis of different combinations of resources allocated, establishing deviation causes between partially planned results and the achieved ones. Equation 1 shows a simple mathematical expression of GM for an enterprise 4.1: GM = GI – TVC (1).

The computation of gross margins alone has the disadvantage of not showing the profit obtained by each enterprise. Therefore, a gross profit margin (GPM) had to be computed. A gross profit margin is a gross margin expressed as a percentage or in total financial terms or the ratio of gross profit to costs. A higher margin percentage is a desirable profit indicator. Equation 2 is an expression of a GPM for an enterprise: 4.2

Gross Profit Margin (GPM)= (Gross Profit)/(Net Sales (Revenue)) X 100%

For this research, a multiple regression model was also used to identify the factors influencing the profitability of government-funded small-scale broiler projects in the study areas. The dependent variable for this study was the profitability measure, where the gross margin (GM) was used as a proxy for profitability following Zulu (2011). The predictive association for profitability or the independent variable was the socio-economic characteristic(s) of the small-scale broiler producers. Multiple regression analysis was also used in this study because it allows one to discriminate between the effects of the explanatory variables, making allowances for the fact that they may be correlated (Zulu, 2011). Researchers take GM as the dependent variable (a proxy for profitability) following Zulu (2011). The predictive associations for profitability or the independent variables are the socio-economic characteristics of small-scale broiler producers. The multiple regression models are specified as follows (equation 4.3):

$Y (GM) = \beta 0 + \beta 1X1 + \beta 2X2 + ... + \beta nXn + Ui$

The choice for a multiple regression model analysis in this research was because it allows one to discriminate between the effects of the explanatory variables, making allowances for the fact that they may be correlated. The regression coefficient of an independent (X) variable provides an estimate of its influence on the dependent variable (Y), which is a proxy for profitability for small-scale broiler enterprises, in this case, controlling for the effects of all the other explanatory (X) variables. Guided by literature, the factors that affect farm profitability are regressed against the independent variables that include demographics of the small-scale broiler producer (age, gender, education), farm production costs, farm gate price, availability of markets, distance to markets, access to market information and infrastructure.

This study also assesses the extent to which government-funded poultry projects achieve the commercial objectives of viability, and profitability while delivering on broader developmental goals, such as food security and poverty reduction. Although the study deals with the concept of business investment, the traditional theory of the firm, with its

assumptions of perfect rationality, perfect information and profit maximisation, was inadequate to capture the multiple goals of government policy. For this reason, the study is based on the Theory of Government Intervention.

4.2.2 Sampling procedure

The study employed a design and quantitative approach to understand the viability of government-funded broiler projects. Data for this study were collected from individual government-funded small-scale broiler producers that were financed during the 2012/2013 financial year and residing in the Northern KwaZulu-Natal districts of uThungulu, Zululand and uMkhanyakude. A total of 75 small-scale broiler projects (25 broiler projects in each district) took part in the study. A probability sampling procedure was employed to sample 75 small-scale broiler producers.

Table 4.1: Number of governments funded small-scale broiler producers in KZN northern region in 2012/13.

Study area		**Number of government funded small-scale broiler producers**	**Number of government funded broiler projects still surviving**
Zululand	Ulundi	9	5
	Abaqulusi	14	5
	Nongoma	15	5
	Pongola	8	5
	Dumbe	5	5
uMkhanyakude	Mtubatuba	10	5
	Hlabisa	11	5
	Big 5 False Bay	7	5
	Jozini	9	5
	Mhlabuyalingana	8	5
uThungulu	Mlalazi	9	6
	Nkandla	12	7
	Mhlathuze	9	6
	Mthonjaneni	8	6
Total		134 (N)	75 (n)
Percentage of the total population		56%	

Table 4.1 above shows the number of broiler projects funded by the Government. Table show the total number of small-scale broiler project funded by Government. Table 4.1 also shows the number if small scale broiler projects which are still surviving. From the table, it's clear that about only a half of small-scale broiler projects are surviving.

4.2.3 Data collection

Data were collected using a personally administered questionnaire. The questionnaire was designed to extract information, such as demographics, production challenges, marketing channels and information on the viability of broiler projects. The relevant authorities (local Indunas or councillors) were contacted with the assistance of the extension officer(s) responsible for their respective ward(s), for permission to collect information from government-funded small-scale broiler producers. Face-to-face structured interviews were conducted. Given the apparent poor outcome of their contact with government, it was necessary coincidence to treat the respondents with more sensitivity than would have been the case with the respondents and therefore gain their co-operation. There was a need for the researcher to clarify ambiguous answers and when appropriate, seeking follow-up information was a mixture of close and open-ended questions.

Questionnaires were also a key factor in the absence of this approach used by the researcher because this type of questionnaire enabled the researcher to obtain multiple responses to a set of questions asked and allowed for detailed responses as well.

Primary data collected include production and marketing challenges faced by government-funded small-scale broiler projects and information on the factors that influence the profitability of the small-scale broiler projects. The interviews were in the privacy of each respondent so that other respondents would not influence the responses of others. The researcher understood the respondents' vernacular (isiZulu) and was, therefore, able to translate the questions into isiZulu from English.

4.3 Data analysis

The field data were captured and encoded in Microsoft Excel and subsequently exported to the Statistical Package for the Social Sciences (SPSS) software version 26.0 for

analysis. Descriptive statistics were applied, particularly frequencies and means. In addition to these, the Gross Margin (GM) and Gross Profit Margin (GPM) analyses were computed to assess the profitability of the invigorated projects. Both profitability and gross margin analyses were used as proxies for farmers' motivation and incentives to participate in broiler production. To determine the factors influencing the profitability of government-funded small-scale broiler projects, a multiple regression model was employed.

Table 4.2 Objectives, research questions and analytical tools

Objectives	Research questions	Analytical tool
1. To describe the poultry production systems in the farming systems of South Africa	a) What is the poultry production system in South Africa?	Descriptive
2. To analyse the pattern of investment in the poultry industry in the area of study	b) What is the pattern of investment in poultry production in the area?	Descriptive
3. To determine the relative viability of the private and public-sector funded enterprises.	c) What is the pattern of investment and relative viability of the private farmers and public-sector funded enterprises?	Gross Margin Analysis (GMA) & Gross Profit Margin Analysis (GPMA)
4. To estimate the technical efficiency of the broiler producers and the entire industry in the project area.	d) What is the level of technical efficiency of the broiler production system?	Stochastic Frontier Analysis (SFA)
5. To analyse the factors that affect the technical efficiency of the small-scale broiler producers and determine the factors that prevent small-scale farmers from improving the productivity of their enterprises	e) Which factors influence the technical efficiency of the broiler production system of the project area and explain the high failure rates of the government-funded enterprises?	OLS & Stochastic Frontier Analysis (SFA)

4.3.1 Gross Margin and Gross Profit Margin Analyses

The gross margin is the difference between gross product value and specific variable costs. The government-funded small-scale broiler producers keep broilers for seven weeks and

the "rest period" for the house is two weeks. This gives 5.8 batches per annum. According to DAFF (2013), a 4% mortality rate is expected in small-scale broiler producers. This study assumed the mortality rate in the computation of the GM and GPM. Equation 1 shows a simple mathematical expression of GM for an enterprise:

4.3.1 Gross Margin = Gross Income – Total variable cost

(GM = GI – TVC) (1)

Where:

GM = Gross margin measured in terms of the Rand (ZAR)

GI = Gross income measured in terms of the Rand (ZAR)

TVC = Total variable costs measured in terms of the Rand (ZAR)

The computation of gross margin alone has the disadvantage of not showing the profit obtained by an enterprise. Therefore, the study also computed a GPM. to express the GM as a percentage or in total financial terms or as the ratio of gross profit to costs. A higher margin percentage is a desirable profit indicator. Equation 2 is an expression of a GPM for an enterprise:

4.3.2 $\text{Gross Profit Margin (GPM)} = \frac{\text{Gross Profit}}{\text{Net Sales (Revenue)}} \; X\; 100\%$

Where:

Gross Profit = Sales - Cost of Goods Sold

Net sales (Revenue) = Gross Sales - Total Sales Discounts + Returns

Benchmarking is a common practice and is used extensively in a range of industries to compare key performance parameters and financial results among competitors or best-performing firms. In broiler production, benchmarking is critical in assessing performance and evaluating expenditure in significant cost areas, including feed, cost of chicks, vaccines

and transport. To achieve a meaningful assessment of the profitability of the government-funded small-scale broiler enterprises, a comparison of the GM analysis per hectare (ha), with that of small-scale farmers that produced for a large-scale enterprise – Rainbow Chickens near Pietermaritzburg, was conducted. The Rainbow Chicken programme was an initiative to uplift small-scale farmers. The GM reports for the small-scale farmers that produced Rainbow Chickens supplied by the market economists for Rainbow Chickens (using data of the 2014/15 financial year) were obtained and utilised for that purpose. Rainbow Chickens is the largest broiler chicken producer in South Africa, and is also in uMgungundlovu district and supplies broiler meat to the whole country and abroad.

4.3.2 The Multiple Regression Modeling

This study employed the multiple regression model based on the Ordinary Least Squares (OLS) to determine the factors influencing the profitability of government-funded small-scale broiler enterprises in the study areas. A previous study carried out by, for example, Zulu (2011) utilised the multiple regression model to assess the determinants of the profitability of smallholder cowpea production in Zambia. In this study, Zulu (2011) takes the GM as the dependent variable (a proxy for profitability) . The predictive association(s) for profitability or the independent variables are the socio-economic characteristics of small-scale broiler producers. The multiple regression models are specified as follows (equation 3):

Y is equal to a plus bX1 plus cX2 plus dX3 plus E where Y is dependent variable, X1, X2, X3 are independent variables, a is intercept, b, c, d are slopes.

[Y (GM) = β0 + β1X1+ β2X2+... + βnXn + Ui]

Where,

Y is the dependent variable measured by the GM

β1, β2.... βn are coefficients of independent (explanatory) variables;

X1, X2,... , Xn are the independent (explanatory) variables, and

Ui is the error term.

The choice of a multiple regression model analysis in this study is because it allows one to discriminate between the effects of the explanatory variables, making allowances for the fact that they may be correlated. The regression coefficient of an independent (X) variable provides an estimate of its influence on the dependent variable (Y), which is a proxy for profitability for small-scale broiler enterprises, in this case, controlling for the effects of all the other explanatory (X) variables. Guided by literature, the factors that affect farm profitability are regressed against the independent variables that include demographics of the small-scale broiler producer (age, gender, education), farm production costs, farm gate price, availability of markets, distance to markets, access to market information and infrastructure (such as storage facilities, transport, electricity and extension services).

4.3.2.1 Explanatory variables used in the multiple regression model and their expected outcomes

Table 5.2 below provides a brief description of the explanatory variables used in the multiple regression model (factors influencing the profitability of small-scale broiler projects) and their expected outcomes and how each variable was measured.

4.3.2.1.2 Age of small-scale broiler producer

Age is an important variable that determines the commitment of a producer to agricultural practices, as this illustrates the fitness of the producers. The older the farmers, the more chances there are to have more resources at their disposal (Mushunje *et al.*, 2003). This variable was measured by the actual number of years of the small-scale broiler producers. It was hypothesized to have a negative relationship with the profitability of small-scale broiler projects.

4.3.2.1.3 Gender of small-scale broiler producer

This variable is intended to show whether the household is male or female, as this gives a clear indication of the dedication of the gender, mostly more females means people are taking care of the household, and it means otherwise if there are more males (Cerrato, 2018). Agriculture in rural areas is usually practiced more by women than men because men tend to move from rural areas to urban areas to look for paid employment. This means women are more involved in farming in rural areas to a greater extent, especially in

subsistence agriculture, as well as in food processing (Food and Agricultural Organization of the United Nations (FAO)), 1995). The gender of small-scale broiler producers was hypothesized to have either a negative or positive relationship with the profitability of small-scale broiler projects.

4.3.2.1.4 Years of schooling of small-scale broiler producer

Literacy rate was measured by the number of formal years in schooling by a small-scale broiler producer. Education is an important attribute of agricultural production, as it contributes to the knowledge of many aspects of agriculture. Education is also important in decision-making (Mulaudzi, 2015). The number of years in schooling by a small-scale broiler producer was hypothesized to have a positive relationship with the profitability of small-scale broiler projects.

4.3.2.1.5 Farm production costs

Farm production costs were measured by calculating production costs such as feed, sawdust, medication, water and marketing costs (Wong, 2017). Farm production costs were hypothesized to have a negative relationship with the profitability of small-scale broiler producers, as they reduce profit if they are not minimized.

Table 4.3: Explanatory variables used in the multiple regression model and their expected outcomes

Variable	Description	Type of measurement	Priori expectations (+/-)
Age	Actual years of the small-scale broiler producer.	discrete	-
Gender	The gender of the small-scale broiler producer (male/female).	Dummy	+/-
Years of schooling	Number of years in schooling by the small-scale broiler producer.	discrete	+
Farm production costs	Operational costs.	Continuous	-
Farm gate price	Price of broiler on the farm.	Continuous	+
Access to markets	Availability of ready output markets for broilers (yes/no). Dummy	Dummy	+
Distance to market	The physical units in km of distance to the market.	Continuous	-
Market information	Whether the small-scale broiler producer has access to information on broiler marketing (yes/no). Dummy	Dummy	+
Access to storage facilities	Whether the small-scale broiler producer has access to storage facilities and refrigeration (yes/no). Dummy	Dummy	+
Access to own transport	Whether the small-scale broiler producer has access to own transport (yes/no). Dummy	Dummy	+
Access to electricity	Whether the small-scale broiler producer has access to electricity (yes/no). Dummy	Dummy	+
Extension contact	Whether the small-scale broiler producer has access to extension services (yes/no). Dummy	Dummy	+/-

4.3.2.1.6 Farm gate price

Farm gate price was measured by computing income received on the farm where individual customers buy directly from the farm; this type of marketing excludes other marketing costs such as abattoir and delivery costs. Farm gate price was hypothesized to have a positive relationship with the profitability of small-scale broiler producers because it excludes other marketing costs**.**

4.3.2.1.7 Availability of formal markets

Availability of formal markets was measured by calculating the number of sustainable markets, where small-scale broiler producers have a written agreement to sell and it was hypothesized to have a positive relationship with the profitability of small-scale broiler production.

4.3.2.1.8 Distance to markets

The actual distance in kilometers travelled by the broiler producers to reach the marketing place to sell the broiler product measured this variable. The distance to markets was hypothesized to have a negative relationship with the profitability of small-scale broiler producers because the longer the distance to the market, the higher the costs associated with the travelling.

4.3.2.1.9 Availability of market information

Market information was measured by asking whether the small-scale broiler producer had ready access to market information in terms of broiler prices during sales, national and international broiler prices and inputs costs. Market information was hypothesized to have a positive relationship with the profitability of small-scale broiler producers.

4.3.2.1.10 Availability of storage facilities

The availability of storage facilities was measured by asking whether the small-scale broiler producer had access to storage facilities and refrigeration. The availability of storage

facilities was hypothesized to have a positive relationship with the profitability of small-scale broiler producers.

4.3.2.1.11 Own transport

Own transport refers to whether the small-scale broiler producers had their own transport for the transportation of both inputs and produce to the market. Access to own transport was hypothesised to have a positive relationship because own transport is more reliable in terms of reducing costs with the profitability of small-scale broiler producers.

4.3.2.1.12 Access to electricity

Access to electricity was measured by asking whether the small-scale broiler producer had access to electricity. Access to electricity was hypothesised to have a positive relationship with gross profit margin because electricity makes it easy to feed, control temperature, control vaccines and other production and marketing operations that used to be manual and labour intensive.

4.3.2.1.13 Access to extension services

Access to extension services was measured by asking whether the small-scale broiler producer had access to extension services. It was expected to have a positive relationship, since extension services give a guide to the farmers based on a new technological way of producing broilers, best broiler breeds, medication and many more with strategies aimed at enhancing the profitability of small-scale broiler production.

4.4 Estimation of Technical Efficiency of Broiler Production

This study applies the Stochastic Frontier Model to estimate individual broiler farms' technical efficiency. The model is based on the Cobb-Douglas model in which capital represents various forms of non-labour inputs, including the variable costs entailed in the flock size, medication/vaccination, housing, lighting and heating costs. While there are many other factors affecting economic performance and technical efficiency, the flexibility of the Cobb-Douglas model makes it a very convenient tool for modelling technical efficiency. It is generally the case that policymakers rely on the results of resource use

efficiency of farmers as a platform to suggest the best enterprises to capitalize on for a more efficient, profitable and sustainable farming business.

4.4.1 Empirical Model Specification

The formal model implicit form as:

$$Y = f(Xi, \beta) + \varepsilon \quad \text{.....(i)}$$

Where:
Y is the output which can be expressed as the revenue or gross income from the production activity,
X is a vector of the variables employed in the production process, representing the capital and labour inputs and all the variable factors involved in the production process,
β is the coefficient of the variables being modelled,
ε is the error term
Linearizing the Cob-Douglas production function yields the stochastic frontier model as follows:

$$\ln(Y_i)=\beta_0+\Sigma_i\beta_i \ln X_{ij} +\varepsilon_i \quad \text{.....(2)}$$

Where ln is natural logarithm,
Y_i is output of the i^{th} farmer,
β_0 is the Constant,
β_i is the regression coefficient or parameter to be estimated,
X_{ij} is the j^{th} input used by the i^{th} farmer
ε_i = a composite error term. One is a random (stochastic) component *V* which are errors beyond the control of the broiler farmers and are assumed to be symmetric, identically and independently distributed (*iid*) with zero mean and constant variance (0, σ) and depicts the random variation of the production function from one farm to the other. It is also assumed to arise from measurement errors (which of course is outside the control of the farmer). The

second error component, U, is the non-negative technical inefficiency term that is assumed to have a truncated normal distribution which looks like:

$\left(U \cong iidN(\mu_i\ \sigma_{ii}^2)\right)$.....(3)

Based on the foregoing, the technical inefficiency can be expressed as:

$U_i = Z_i^i\delta + W_i^1$.....(4)

In this instance, Z_i is a (Px1) vector of explanatory variables that capture the technical inefficiency effect that will normally comprise the socioeconomic characteristics of the farmers and some farm management factors that are at the instance of the farmer, such as access to extension services, access to electricity, and so on. Going on, δ is a (Px1) vector of unknown parameters to be estimated and W_i represents the unobserved random variables, which are assumed to be independently and normally distributed with zero mean and constant variance.

In line with the Battese and Coelli (1992) modified estimations that combine the stochastic frontier model with inefficiency effects in a one-step process, the log-transformed linearized model is stated as:

$\ln Y = \beta_0 + \beta_1 \ln X_{i1} + \beta_2 \ln X_{i2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \beta_n \ln X_{in} + \varepsilon_i$ .....(5)

Where ln = natural logarithm; Y is the output of the i^{th} farm; β_0 represents a constant term; $\beta_1 \ldots \beta_n$ represent the vectors of the production function, which are the unknown parameters to be estimated; $X_{i1} \ldots . X_{in}$ are the independent variables or the input bundles that go into the production of the broiler chickens comprising the capital items, the cost of day-old chickens, medication, feed, sanitation and housing, to mention a few. The model is defined as follows:

X_1 = Quantity/Price of Feed for each production period
X_2 = Flock size (total number of birds at sale)
X_3 = Labour input in workdays
X_4 = Medication given to birds for immunization and therapy
X_5 = variable housing costs, including lighting and heating

4.4.2 Inefficiency Model

Variations in production efficiencies of each farming unit can explain the differences in performance from one farm to the other. These differences are captured by the inefficiency model, which is incorporated in the one-step estimation approach whereas, in the two-step approach, the inefficiencies are captured by a separate estimation using OLS techniques to determine the factors influencing technical efficiency. Specifying the inefficiency model gives the following expression:

$U_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i}$……………………………………..(6)

Where:

U_i = the technical inefficiency of the i^{th} broiler farmer

δ_0 = a constant term

$\delta_1 \dots \delta_5$ = the coefficients

Z_{1i} = age of farmer in years

Z_{2i}= educational level of broiler farmer in years

Z_{3i} = experience of farmer (years spent in broiler farming)

Z_{4i}= veterinary service (dummy: 1=Yes; 0=No)

Z_{5i} = extension contact (dummy: 1=Yes; 0=No)

4. Chapter summary

This chapter described the research design, and the sampling method employed was also highlighted and fully explained. Data were collected from 75 government funded broiler projects and 15 non-government-funded broiler projects. This study also explained data and how it was obtained and the analytical methods used to obtain the results. It also highlighted and explained the explanatory variables considered in the multiple regression model on factors influencing small-scale broiler profitability and their expected outcomes. This study further informed about the multiple regression model and its expected outcomes, which include farm production costs, farm gate price, access to markets, distance to market, market information, access to storage facilities, access to own transport and access

to electricity and extension contact. The following chapter presents and discusses the descriptive results of the study.

CHAPTER 5

DESCRIPTIVE RESULTS AND DISCUSSIONS

5.1 Introduction

The first section of the chapter begins with offering explanations of the demographic characteristics of the sampled government-funded small-scale broiler producers; to describe their relationship with the dependent variable, which is broiler viability (profitability). Demographic characteristics presented in this chapter include age distribution of the small-scale broiler producer, gender of small-scale producer and educational level of the small-scale broiler producer. This is followed by the farm characteristics (production and marketing information) describing their relationship with the viability of the small-scale broiler projects. The farm characteristics presented in this chapter include costs of producing broilers, the level of knowledge of the small-scale broiler producers and the marketing aspects of broiler produce and lastly the gross margin and gross profit margin analysis. Within the chapter, descriptive statistics, such as mean values, frequencies and percentages, are presented in the form of tables and figures and narrative descriptions.

5.2 Demographic characteristics

Households' demographic characteristics are very important when analyzing economic data because their influence on economic behavior. These demographics are also relevant in analyzing factors that influence the profitability of small-scale broiler projects that are funded by the government.

The focus of this study is on three district municipalities: Zululand, uThungulu and uMkhanyakude. It is concentrated in northern region, where there are small-scale broiler producers, both government-funded and non-government funded projects.

In uMkhanyakude, uThungulu and Zululand district municipality, the average age of small-scale broiler producers was 49, 51 and 61 years respectively (see Table 5.1 below). The age of the farmer is a very important aspect of agricultural activities, as this ensures farming

experience, knowledge and ability to carry out farming activities. These results suggest that broiler farmers are economically active, energetic and experienced to make a positive contribution to broiler production and exploit the opportunities presented by the sector (Sibanda, 2012).

In uThungulu, females represented the majority of the farmers accounting for 67%, while uMkhanyakude and Zululand districts had more males (80%) than females (20%) in both cases (Table 5.1). The gender disparities between the district present an important opportunity for comparison and generation of gender-sensitive poultry production and management practices. Stats SA (2011) noted that women perform well in broiler production in terms of record-keeping and tracking business profitability.

The study results revealed that most of the respondents achieved formal education in all three district Municipalities. These results are similar to the one observed by SAPA (2016). However, Ngemntu (2010) argued that little or no formal education may affect performance negatively, including farm decision making. DAFF (2011) concurs with Bester *et al*. (1999) who assert that educational levels influence the adoption of innovations by farmers and this directly affects the profitability of broiler production. In these three districts, most small-scale producers have some formal education (primary and/or secondary education), and this made it possible for them to interpret and process information systematically The existence of uneducated participants in the projects and the broiler production industry calls for knowledge-based support systems to help with innovation and adoption of new management practices (Daudu, Oladipo and Kayode, 2019). Broiler development support programmes should emphasize the capacity building of the producers, since broiler production is dynamic and also a knowledge-intensive sector.

Table 5.1: Demographic characteristics of respondents (N=90) = (75 government funded and 15 non-government funded)

		uMkhanyakude	uThungulu	Zululand
Age Distribution (years)		49(10.8)	51 (12.29)	61(13.97)
Age Categories	<30	0	0	8
	30-39	12	5	16
	40-49	24	20	24
	50-59	36	25	32
	>60	16	50	20
Gender	Male	80	33	80
	Female	20	67	20
Level of education	No Education	10	9	12
	Primary	60	52	62
	Secondary	28	30	20
	Tertiary	2	9	6

Source: Survey data (2021)

5.3 Broiler Production and Marketing Constraints

This study presents and discusses the findings on production and marketing challenges. this includes inadequate knowledge on broiler production, accessing the extension services, marketing and market information.

5.3.1 Lack of knowledge in broiler production

Relevant knowledge in broiler production, financial, marketing and human resource knowledge are the key elements of sustainable broiler projects (FAO, 1995). The majority (98%) of the government-funded small-scale broiler producers in the study agreed that they have received some training and have acquired skills in broiler production. According to Clover and Darroch (2005), known and avoidable diseases can affect broiler projects with up to a 50% mortality rate. It is very important to vaccinate and control all known diseases,

including Newcastle. In this study, the majority (65%) of the government-funded small-scale broiler producers indicated that they have knowledge of common broiler diseases, and this reduces mortalities and increases the profitability of the production unit.

5.3.2 Extension services

Extension officers may play a vital role in educating and uplifting farmers' skills in most spheres of production and marketing. Figure 5.1 below demonstrates the level of extension services on the ground, and it also illustrates how farmers view extension services in these three district municipalities.

Fig 5.1: Illustration of the availability and access to extension services by the small-scale broiler (source: data survey 2021)

In addition to training and poultry production skills, access to extension services remains key to improving production and efficiency. Figure 5.1 above shows the level of extension services available to funded farmers. Sasidhar (2019) argued that livestock extension service is key to farmers' ability to take advantage of the increased demand and improved competitiveness. The extension services should assist with both production and marketing of chickens. The developments and interventions in livestock programmes should form capacity building of broiler producers among other things.

5.4 Marketing and Market Information

The investigated broiler producers are producing solely for the market, therefore, in this case, the importance of access to markets and market information cannot be

overemphasized. Figure 5.2 presents information on the types of markets accessed by the producer and the sources of market information, respectively.

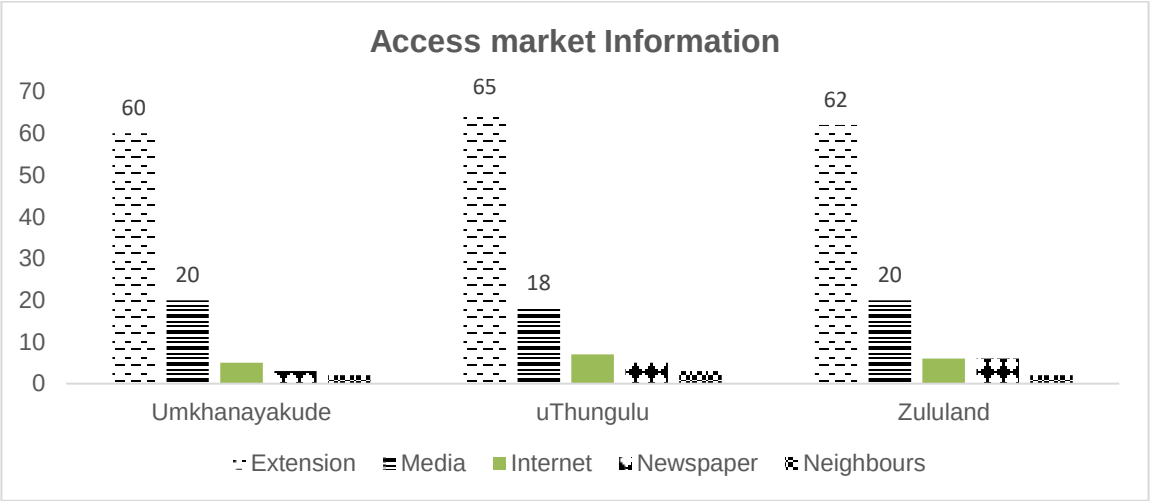


Fig 5.2: illustrates the availability and access of market information by the small-scale broiler

(source: data survey 2021)

The second most important source of market information, as indicated by the government-funded and non-government funded small-scale broiler producers, was the radio, television, internet and newspapers as a medium of communication.

Although South Africa is a net importer of poultry products, the respondents revealed that they do not have access to formal markets, thus low market off-take. The interrogated farmers have regular buyers.

5.4.1 Accessing different types of markets

The sustainability of all businesses depends on the availability of a range of different markets. Figure 5.3 below illustrates different types of marketing to be accessed by small-scale broiler producers.

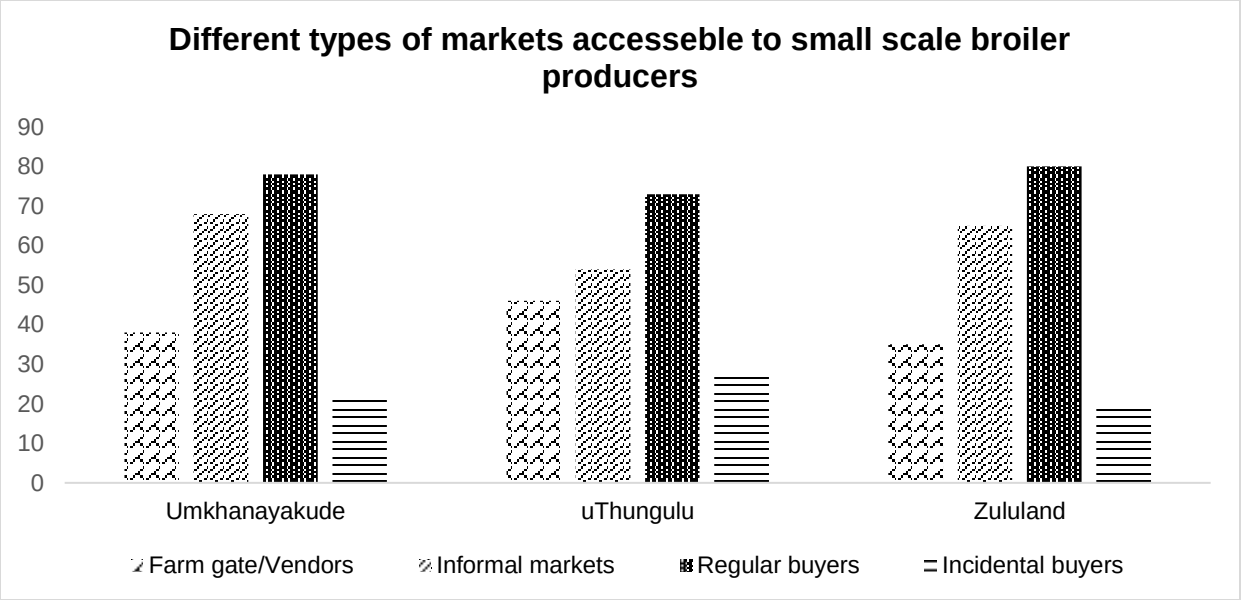


Fig 5.3: Illustration of the availability and accessibility of different types of markets by the small-scale broiler

(source: data survey 2021)

The results revealed that neither the small-scale broiler producers travelled to sell at the nearest town nor did they practice informal trading. The possible reasons for not taking part in street vending might be attributed to a lack of own transport to carry their broilers to the nearest markets, as well as reducing transport costs. The findings revealed that pensioners are frequent buyers during their paydays. However, this does not guarantee the continuation of sales through the production cycle as the pensioners only get paid monthly.

5.4.2 General challenges faced by small-scale broiler producers

This study presents the general challenges faced by small-scale broiler producers, both governments funded and non-government funded. Figure 5.4 below illustrates those challenges.

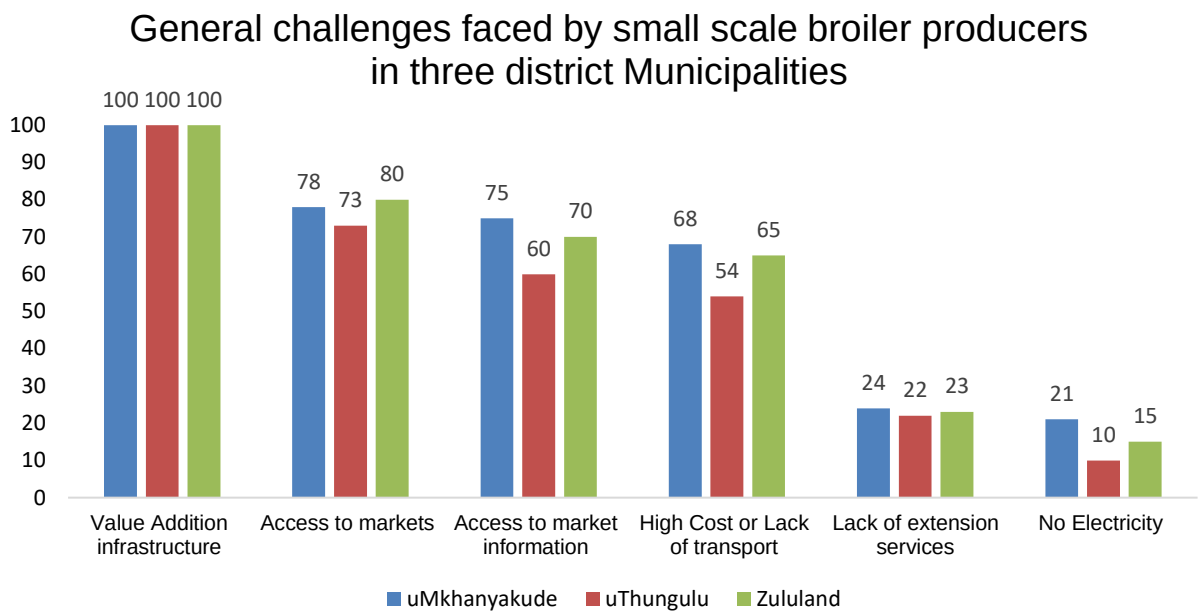


Fig 5.4: Illustration of the general challenges faced by small-scale broiler producers in different district municipalities

(Source: data survey 2021)

The poultry producers in the study area reportedly experience a myriad of challenges that range from infrastructural challenges, institutional challenges and marketing constraints. Lack of value addition infrastructures like refrigeration and abattoirs posed particularly serious constraints, as was reported by all the producers. All respondents (100%) indicated that they do not have access to proper processing and storage facilities, such as abattoirs and refrigerators. In all three municipalities, 77% of the producer's experience problems in accessing the market, while 68% report having challenges in accessing market information. Small-scale broiler producers have multi-challenges accessing formal markets and do not have regular or established markets for their chickens. In addition to travelling a maximum distance of 30km and a mean distance of 14.6km, 68% of the producers complain about either high transportation costs or a lack of transport, as most producers depend on hired transport and it is costly.

Figure 5.4 shows that fewer farmers (24% in uMkhanyakude, 22% in uThungulu and 23% in Zululand) complain about a lack of access to extension services and this implies that

most of the government-funded small-scale broiler producers have access to extension services.

According to Bhopal (2005), the main problem is the lack of transport to ferry the broilers as this is the main reason for the small-scale broiler producers for their business not being viable. This finding is in line with that of DAFF (2012), which suggests that over 60% of small-scale broiler producers receive a lower profit, as they keep feeding unsold and mature broilers. Madhin (2005) notes that it is not good for a business to have few regular customers, as there is no assurance that the product will gain a market. Besides, Madhin (2005) argues that higher transport costs reduce profit, as they increase the cost of production. In addition, the lack of market information reduces the viability of the project because there is no guarantee that all broilers will be sold in time. Of note is Naude (1998), who believes that the lack of market information harms the viability of small-scale broiler projects.

According to Bhopal (2005), most formal markets prefer transaction in dressed broiler produce to live broilers, which deprives small-scale broiler producers of the opportunity of selling all of their birds on time. This can have negative impacts on broiler profitability. For these reasons, it is evident that extension services have a major role to play in empowering small-scale broiler farmers in farming knowledge, techniques and required skills in broiler management (Kaliba, Verkuiji and Mwangi, 2000). Therefore, it is critical to assess the availability of extension services, as it can influence a small-scale broiler producer's decision making. DAFF (2011) believes that extension services play an important role in improving broiler production and the marketing ability of small-scale broiler production.

Access to market information is very important, as it provides an opportunity for a farmer to sell the produce at the best price while reducing production costs without information asymmetry (Bett *et al.,* 2012). Although poultry traders are the main sources of output price information for producers, they often collude in setting prices, leaving producers at a disadvantage (Bett *et al.,* 2012).

5.5 Broiler production and marketing information

Information about broiler production and marketing refer to technology of production and marketing of broiler by small-scale broiler producers in Northern KwaZulu-Natal. In this section, data collected in both broiler production and broiler marketing in uMkhanyakude, uThungulu and Zululand district Municipality are presented.

Space of selling means the area where marketing of broiler takes place, which might be within the production place, village, pension points, retail stores or any other places where broiler producers meet their customers to sell their birds.

5.5.1 Marketing places available for the farmers

This study presents marketing places where farmers may sell their birds. Figure 5.5 below illustrates the percentage or ratio of farm gate to pension point.

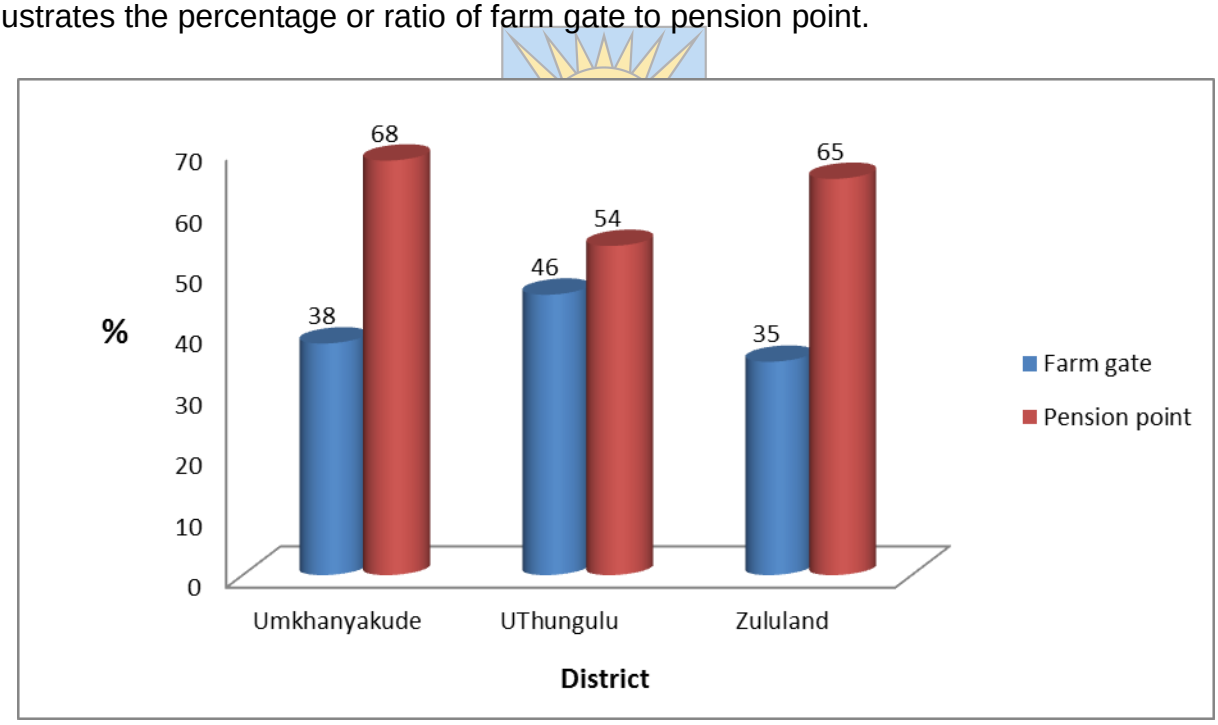


Fig 5.5: Illustration of the availability and access of marketing places by the small-scale broiler producers

(Source: data survey 2021)

Figure 5.5 indicates that most of the small-scale broiler producers sell their produce on pension points, as it indicates that 68%, 54% and 65% are at uMkhanyakude, uThungulu and Zululand, respectively. It also shows that selling on farm gates is 35%, 46% and 38% in uMkhanyakude, uThungulu and Zululand, correspondingly. The study shows that government-funded small-scale broiler producers neither travel to sell the produce in the nearest towns nor practise bakkie trading. Bakkie trading is when a farmer uses a bakkie to sell his or her birds. This may happen when farmer does not have a marketing site but hoots his bakkie to alert customers of selling broiler. Broiler producers are always confident that there are abundant customers at pension points to buy their live broilers. However, pensioners get paid at least once a month, and this does not guarantee continued sales throughout the production cycle. Bhopal (2005) suggests that the lack of transport by small-scale broiler producers is a major problem and the main reason for the small-scale producers and their business not being viable.

5.5.2 Small-scale broiler production challenges

Small-scale broiler producers have challenges in producing their broiler produces, and these challenges include high farm production costs, a lack of production knowledge as well as the risk of theft.

5.5.2.1 High farm production costs

Farm production costs refer to the production input cost, which includes among others day-old chicks, feed (starter, finisher and post finishes), vaccine, brooders and market costs. Table 5.2 below shows the average cost of production in small-scale broiler producers in northern KwaZulu-Natal.

Table 5.2: Average broiler input costs per producer per 100-day-old chicks

ITEM	UNIT	COST/UNIT (R)
Feed		
Starter	50 Kg	395.00
Pellets	50 Kg	372.00
Finisher	50 Kg	358.00

Total		1 125.00
Vaccine		
Gumboro	1000 doses	65.00
Medication: Lassotta		45.00
Total		110.00

Source: Survey data (2021)

According to Table 5.2, feed is the most expensive item in broiler production, followed by the vaccine. From the study, it can be seen that feed (starter, pellets and finishers) costs up to R1 125.00 when combining units, while dose costs R110.00.

Given that input costs are a critical element when computing the profitability of a business, Naude (1998) opines that the higher the cost of the broiler inputs, the lower the gross margin, which would translate to less profit. Hence, small-scale broiler producers must buy inputs in bulk to reduce the costs of individual interest and to share the transport costs.

5.5.2.2 Skills and basic training in broiler production

Skills in basic broiler production are vital, especially to small-scale broiler producers. When comparing broiler farmers who received training and those that did not, farmers with better training better understand production processes. The graph below differentiates (in percentage) farmers who received training and those without training.

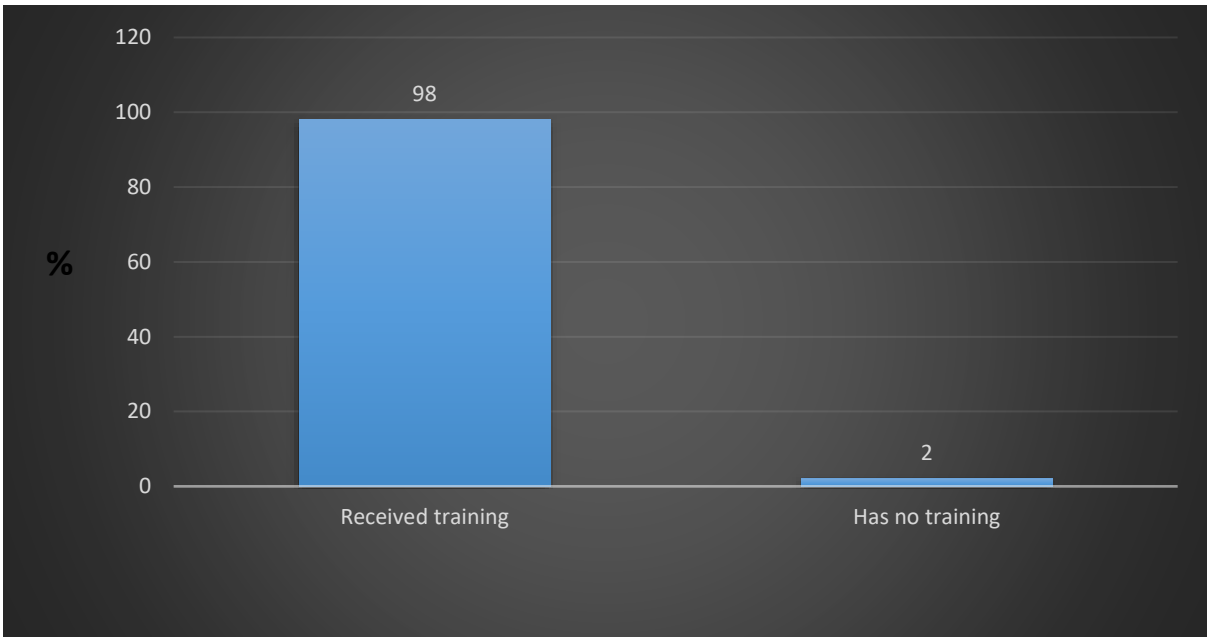


Fig 5.6: Illustration of the number of broiler producers exposed to broiler production pieces of training

Source: Survey data (2021)

Results in Figure 5.6 reveal that the majority (98%) of the government-funded small-scale broiler producers agreed that they have received some training and skills in broiler production and it helps them in sustaining their production.

5.5.2.3 Lack of knowledge of broiler production

Lack of relevant knowledge of broiler production, financial management, marketing and human resources are the key elements to the deprived sustainability of small-scale broiler projects (FAO, 1995). Lack of broiler business and production skills among small-scale broiler producers are always harmful to small-scale businesses. Clover and Darroch (2005) note that giving skills and training is very important to small-scale broiler producers to sustain broiler production.

5.5.2.4 Knowledge of broiler production

Knowledge is always a key to success in all entrepreneurship. Figure 5.7 below illustrates the importance of knowledge of broiler producers.

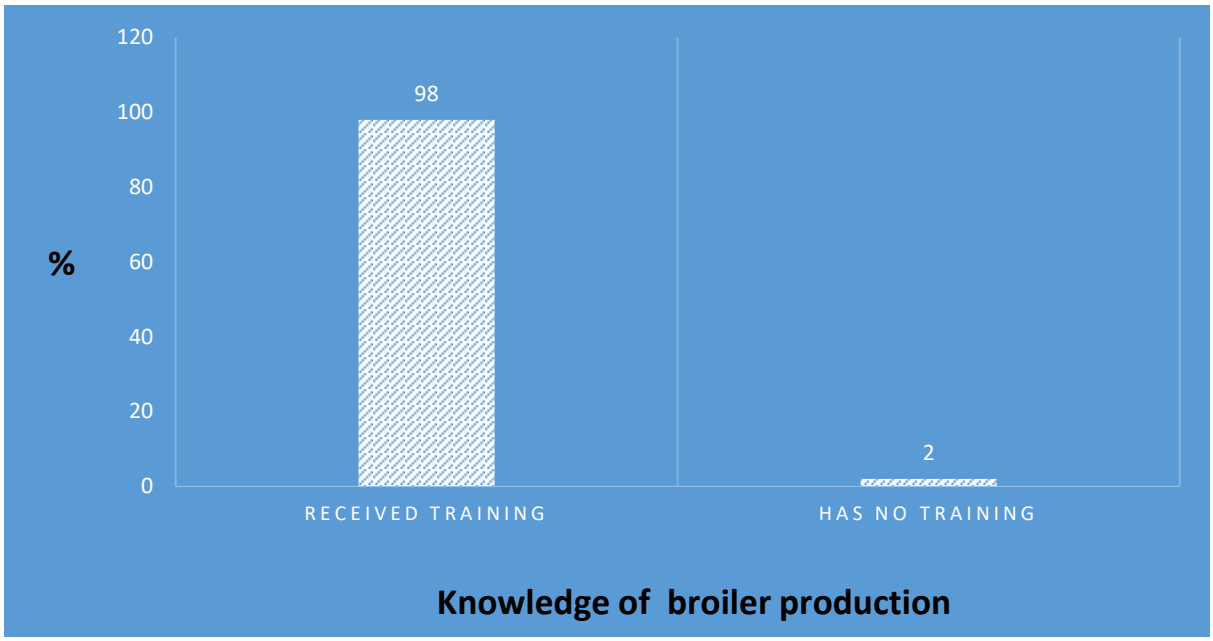


Fig 5.7: Analysis of knowledge of broiler production by calculating the number of pieces of training received by the small-scale broiler producers

Source: Survey data (2021)

Figure 5.7 indicates that most (98%) small-scale broiler producers across all districts had the basic knowledge of broiler production, and this has a positive impact on the profitability of their small-scale broiler projects. In addition, this helps small-scale broiler projects quantify the profit or loss made by the project.

5.5.2.5 Access to electricity

Access to electricity is very important to small-scale broiler producers, as it modernizes and improves technology in producing and stocking broiler produce. This is by keeping refrigerators for dressed broilers, lighting and other elements of broiler production that need electricity.

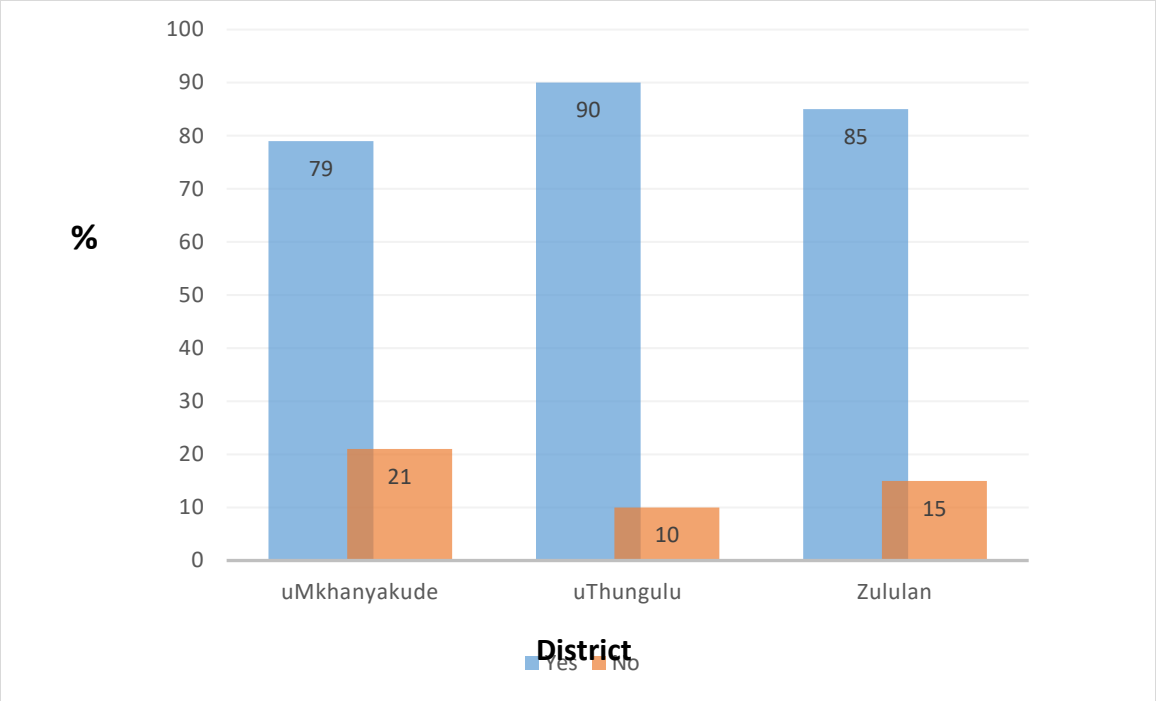
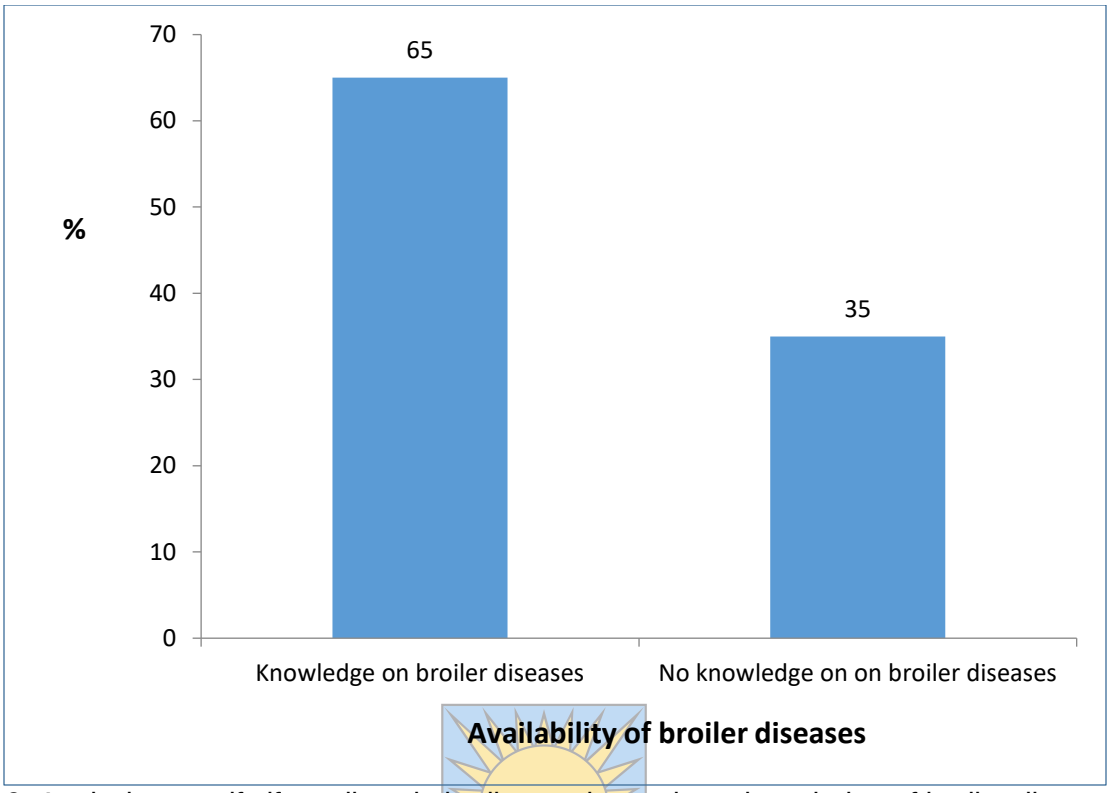


Fig 5.8: Illustration of the number of small-scale broiler producers with electricity
Source: (Survey data, 2021)

Results in Figure 5.8 show that the majority (79% - uMkhanyakude, 90% - uThungulu and 85% - Zululand) of small-scale broiler projects indicated that they have access to electricity. to improve broiler growth rate, and lighting is very crucial, as it assists broilers to feed even at night. (DAFF, 2011).

5.5.2.6 Availability of broiler diseases

According to Clover and Darroch (2005), poor control of known diseases can affect broiler projects up to 50% mortality rate. It is very important to vaccinate and control all known diseases, including Newcastle.



5.9: Analysis to verify if small-scale broiler producers have knowledge of broiler diseases

Source: Survey data (2021)

Results in Figure 5.10 show that the majority (65%) of the government-funded small-scale broiler producers indicated that they know about known broiler diseases and how to control them, which is good for them to make a profit through their broiler production.

5.6 Small-scale broiler marketing challenges

There are many market challenges that small-scale broiler producers face, especially concerning formal markets. Among the difficulties they face are a large number of unsold broilers and failure to get regular customers.

5.6.1 Lack of access to markets

The challenge of accessing formal markets has been identified in all three district municipalities. This affects the on time selling of broilers produced by small-scale broiler producers, as most customers prefer dressed broilers. This is likely to have a negative impact on the profitability of the broiler enterprises in the event that there are unsold broilers

due to a lack of market. All the interviewed government-funded small-scale broiler producers across all three districts (uMkhanyakude, uThungulu and Zululand) indicated that they have a problem with unsold broilers when they access informal markets. The challenge of unsold broilers will increase the cost of production due to an increase in wasted feed.

A study to investigate the fate of the unsold chickens revealed that most small-scale broiler producers keep their broiler production until late, as they do not have slaughter facilities as remit. These unsold broilers are stored for sale at a later stage. Thus, producers sell their broiler produce alive. However, this further raises the feed costs, since the birds are fed beyond the maturity phase. According to DAFF (2012), this lowers the gross margin and reduces profit by 60%.

Fig 5.10: Identifying regular customers to buy broilers from small-scale broiler producers
Source: (Survey data, 2021)

Results in Figure 5.11 show 78%, 73% and 80% in uMkhanyakude, uThungulu and Zululand district municipalities, respectively, and this is not a positive business picture.

According to Madhin (2005), a business must have its regular customers to run smoothly, and just a few regular customers indicate the non-sustainability of the business.

5.6.2 Lack of transport and high transport costs

These are the challenges of moving products to the markets encountered by the small-scale broiler producers as they do not have the means to move their produce to the markets.

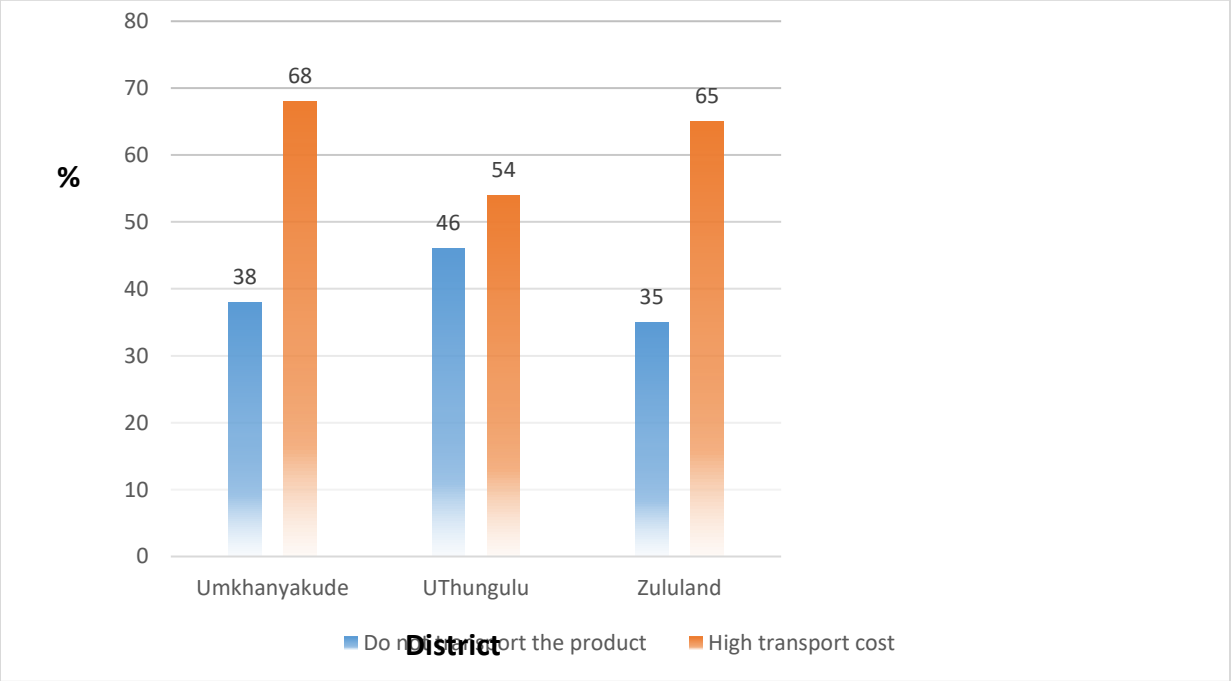


Fig 5.11: Analysing transport challenges faced by small-scale broiler producers during production and marketing

Source: (Survey data, 2021)

Figure 5.12 indicate that for the small-scale government-funded broiler producers, the only means of transporting their produce is through very expensive public transport. Hiring transport is dominant in all three district municipalities, as it is at 38%, 46% and 35% in uMkhanyakude uThungulu and Zululand, respectively. However, Figure 5.10 indicates that there is no small-scale broiler producer who owns a vehicle. Mahdin (2005) postulates that most increases in transaction costs are caused by the high transport costs than the production and marketing costs.

5.6.3 Distance to markets

Distance to market refers to the distance from the broiler project location to the marketplace, which has an impact on the transport costs. Respondents were asked to state the distance in kilometers to the market where they sell their produce.

Table 5.3: Minimum, maximum and average distance to markets (km)

	Minimum (km)	Maximum (km)	Mean (km)
uMkhanyakude	2	30	16
uThungulu	3	24	13.5
Zululand	3	27	15
All districts	2	30	14.6

Source: Survey data, (2021)

Table 5.3 shows that on average, small-scale broiler producers travelled longer distances (about 15km) to selling points. The maximum distance travelled was 30km in uMkhanyakude, 24km in uThungulu and 27km in Zululand. The minimum distance travelled was 2km in uMkhanyakude, 3km in uThungulu and 3km in Zululand. These results generally show that the small-scale broiler producers, in some cases, had to travel longer distances to selling points. According to Clover and Darroch (2005), the longer the distance travelled, the higher the transport costs.

5.6.4 Lack of access to market information

Information about the market is very important, as it gives insight into the performance of the market at that particular time. It also informs the present and the future (projections) of the market.

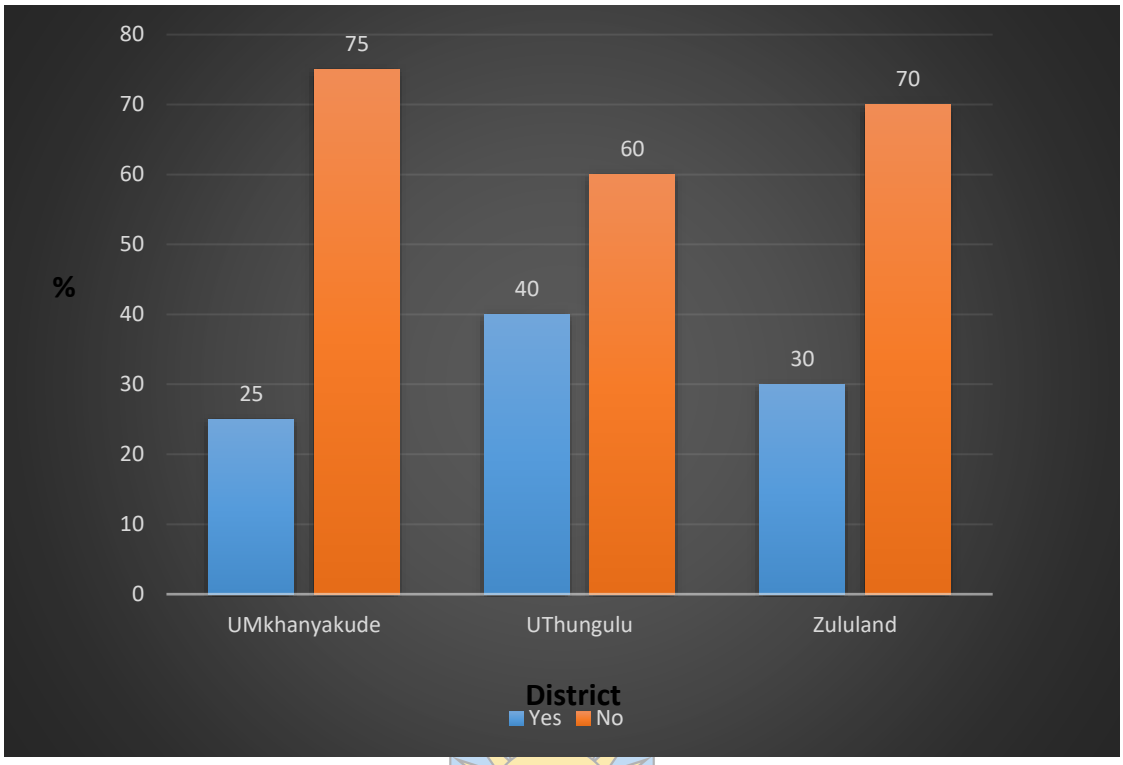


Fig 5.12: Illustration of the availability and accessibility of market information by small-scale broiler producers

(Survey data, 2021)

Figure 5.12 shows that most small-scale broiler producers have no access to broiler market information. The results show 75% in uMkhanyakude, 60% in uThungulu and 70% in Zululand, thus indicating that they had no access to market information. According to Gabre-Madhin (2005), a lack of market information reduces the viability of the project because there is no guarantee that all broilers will be sold on time, as now has the correct information about the price of the bird and available market among the others.

5.6.4.1 Sources of market information

Sources of market information refer to those with broiler marketing information. Respondents were asked to indicate the sources of market information.

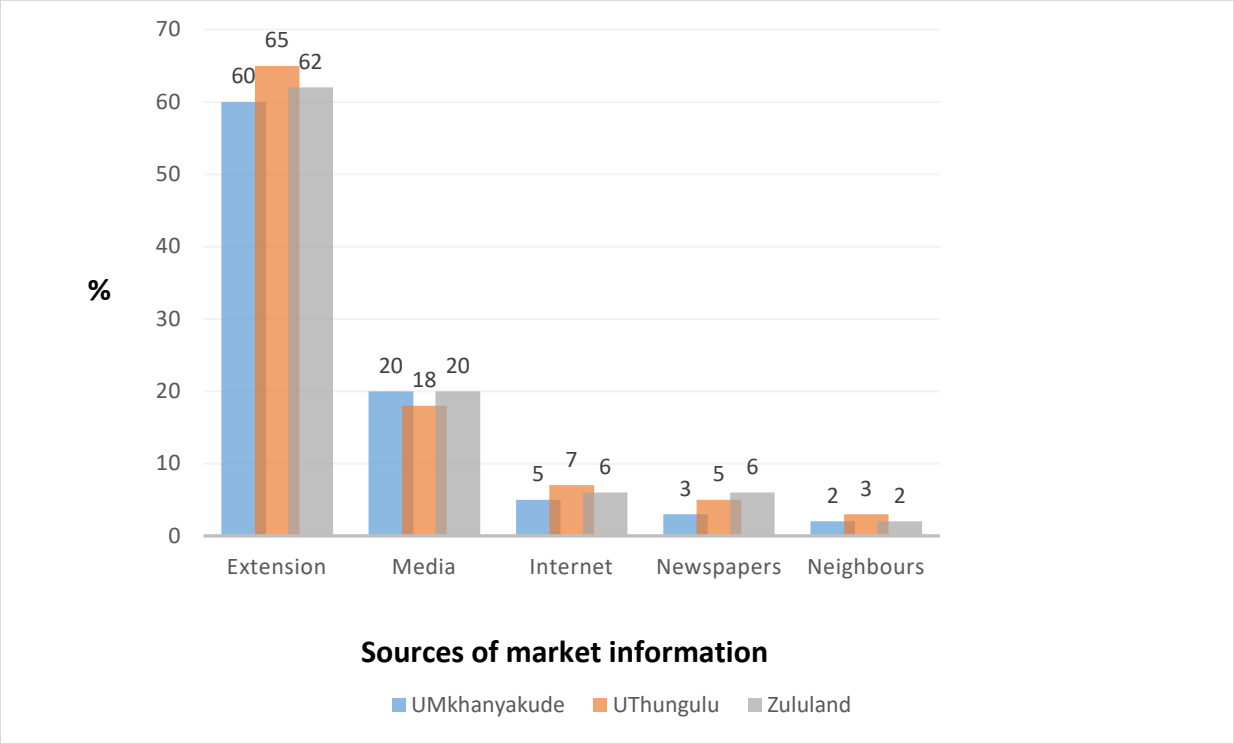


Fig 5.13: Illustration and analysis of the sources of market information by small-scale broiler producers

Source: (Survey data, 2021)

Figure 5.14 shows that small-scale broiler producers depend on extension services, as a source of market information, with 60% in uMkhanyakude, 65% in uThungulu and 62% in Zululand. The second most important source of market information, as indicated by the government-funded small-scale broiler producers, was the media through radio and television. In addition, other sources of market information, though to a lesser extent, included the internet and newspapers. Given the findings, they are in line with the limitations outlined by Naude (1998) that a lack of reliable sources of market information harms the viability of small-scale broiler projects.

5.6.5 Availability of storage facilities (abattoirs/refrigeration)

Access to storage facilities refers to the facilities that are kept to store the produce that is ready for market. Respondents were asked to indicate whether they had access to

processing and storage facilities, such as abattoirs and refrigerators. All respondents (100%) indicated that they did not have access to proper processing and storage facilities, such as abattoirs and refrigerators. According to Bhopal (2005), most formal markets prefer buying dressed broiler produce. This signifies the backdrop and deprivation of small-scale broiler producers of selling all of their broiler production on time, thus, this can have negative impact on broiler profitability.

5.6.5.1 Lack of extension services

Extension plays a crucial role in empowering farmers with farming knowledge, techniques and skills (Kaliba, Verkuijl and Mwangi, 2000). Therefore, it is critical to assess the availability of extension services, as it can influence a farmer's decision on broiler production by small-scale broiler producers.

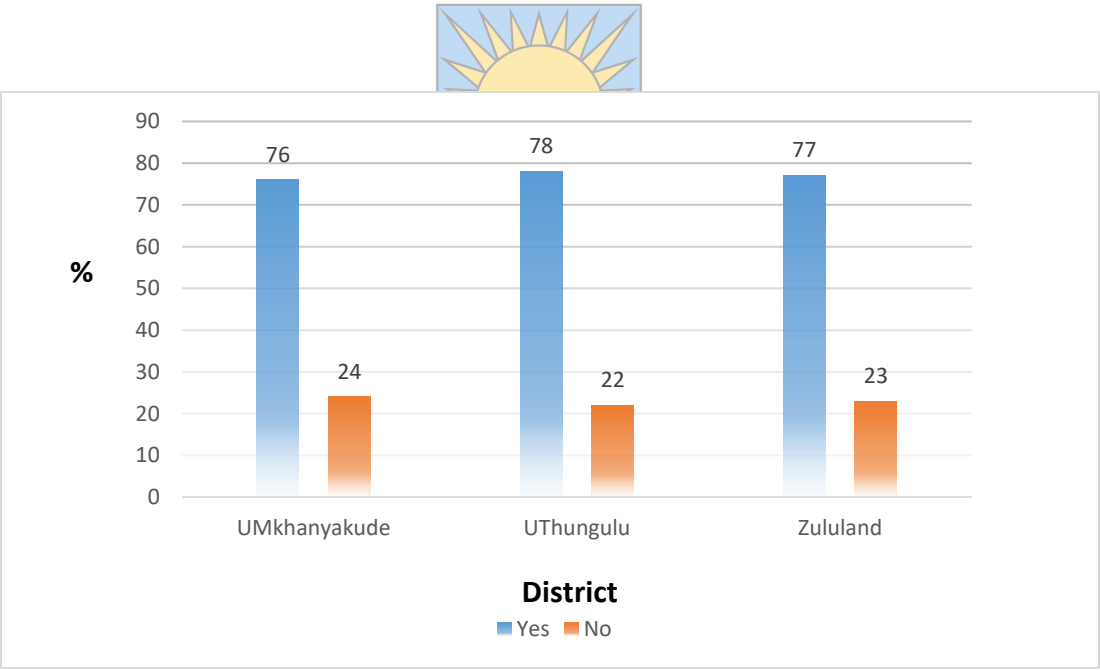


Fig 5.14: Illustration of the availability and accessibility of extension services by small-scale broiler producers

Source: (Survey data, 2021)

Figure 5.15 shows that most government-funded small-scale broiler producers had access to extension services. The majority (76% in uMkhanyakude, 77% in uThungulu and 78% in

Zululand) indicated that their broiler production depends on extension services, while the minority (24% in uMkhanyakude, 23% in uThungulu and 22% in Zululand) specified that they did not have access to extension services. According to DAFF (2011), extension services play an important role in improving broiler production and enhancing the marketing ability of small-scale broiler producers.

5.7 Gross profit margins analysis

This section presents the gross margin and gross profit margin analysis. In the current study, the gross profit margin from government-funded small-scale broiler producers is compared with non-government-funded small-scale broiler producers in terms of their gross margin per production term for the 2014/15 financial year. The small-scale broiler producers keep broilers for seven weeks and the "rest period" for the house is two weeks. This gives 5.8 batches per annum. According to DAFF (2011), a 4% mortality rate is expected in small-scale broiler producers, and it was used in the computation of the gross margins and gross profit margins.

5.8 Gross profit margins analysis

Gross margins were calculated for all the government-funded small-scale broiler producers under study *(*see Appendix 1 for the average gross margins*)*. The mean gross margin was obtained from the interviewed government small-scale broiler producers and compared with that of Rainbow chickens' gross margin to assess their viability. Table 5.5 indicates the minimum, maximum and mean gross margin for the government-funded small-scale broiler producers in comparison with that of Rainbow chickens.

The results show that the government-funded small-scale broiler producers obtained a mean gross margin of R1 935.01 per 100 broiler batch across all districts, while Rainbow chickens' producers realized a mean gross margin of R3 050.06 per 100 broiler batch. The results show that Rainbow chicken producers reviewed a higher average gross margin than the government-funded small-scale broiler producers. Government-funded small-scale broiler producers have a lower mean gross margin. However, they are meant for consumption and not for business Besides, they are still using the low input technology,

which may affect their gross margin. Nonetheless, the gross margins obtained by the government-funded small-scale broiler producers are positive, suggesting that these enterprises are viable (profitable).

Table 5.4 Comparison of mean gross margin for government-funded small-scale broiler producers versus non-government-funded small-scale broiler producers (R/100 broiler batch)

	Government-funded small-scale broiler producers				Non-government-funded small-scale broiler producers
	uMkhanyakude	uThungulu	Zululand	All 3 Districts	
Mean Total Gross Income	4,320.00	4,320.00	4,320.00	4,320	5248.00
Mean Total Allocable Costs	2,797.28	2,389.28	2,521.88	2 569.48	2,197.94
Mean Gross margin	1,522.72	1,930.72	1,798.12	1 750.52	3,050.06

Source: Survey data (2021)

5.9 Chapter summary

This chapter presented and discussed the descriptive analysis of the study. The chapter began by presenting the respondents' demographics and their socio-economic characteristics. The gross margin and gross profit margin analysis were presented and discussed in this chapter. From the study findings, it was revealed that, generally, production challenges and a lack of infrastructure plus marketing challenges are some of

the challenges are likely to affect the profitability of small-scale broiler projects. Mostly, the results of the study suggest that the small-scale broiler producer demographics and socio-economic characteristics may influence the viability of the small-scale broiler projects. Besides, gross margins and gross profit margins for the government-funded small-scale broiler producers were computed. The gross profit margin analysis shows that the government-funded small-scale broiler projects in the Northern KZN region have a positive gross margin and gross profit margin, indicating that they are profitable, albeit less profitable as compared to a large-scale broiler producer - Rainbow chickens. The next chapter presents the empirical results of the study on the factors influencing the profitability of government-funded small-scale broiler projects.

CHAPTER 6

EMPIRICAL RESULTS AND DISCUSSION

6.1 Introduction

This chapter presents the empirical results of the study. A multiple regression model was employed to determine the factors influencing the profitability of government-funded small-scale broiler projects, which were formulated and explained in Chapter 4. Within the chapter, the independent (explanatory) variables are tested for their significance and conclusions are drawn based on the results. An in-depth explanation is provided for the statistically significant variables.

6.2 Factors affecting the profitability of government-funded small-scale broiler projects (multiple regression analysis)

A multi-regression analysis was used to test for the factors that influence the profitability of broiler production in the study areas. The dependent variable used in this study is the gross margin (GM). The method was adopted from Zulu (2011), which regressed against independent variables that included the age of the small-scale broiler producer, gender of the small-scale broiler producer, years of schooling of the small-scale broiler producer, farm gate price, access to markets (yes/no), distance to market (km), access to market information (yes/no), access to own transport (yes/no), access to storage facilities (yes/no) and access to electricity.

6.3 Variables excluded from the model

Several variables were targeted for inclusion in the model. However, due to some variables being constant (access to own transport, access to markets and access to storage facilities), the variables were eventually excluded from the final model.

6.4 Model Fit

The unadjusted multiple R-Square for this data is 0.850, and the adjusted multiple R-Square is 0.832. This suggests the model accounts for about 83% of the total variability. The assumption in running the multiple regression models was that errors in regression are independent. This assumption was met by computing the Durbin-Watson statistic. The Durbin-Watson statistic is computed to test for serial correlation (whether adjacent error terms are mutually correlated). The Durbin-Watson for this data is 1.504. A Durbin-Watson statistic that is around 2 (between 1 and 3) is normally acceptable. Additionally, the variance inflation factors (VIF) were used to inspect the level of multicollinearity between the independent variables. The variance inflation factor (VIF) quantifies how much the variance is inflated. A VIF of 1 suggests that there is no correlation between the k^{th} predictor and the remaining predictor variables, and hence the variance of bk is not inflated at all. The general rule of thumb is that VIFs above 4 warrant further analysis, while VIFs above 10 are indicators of serious multicollinearity. The classification accuracy in this data indicated that multicollinearity was not a problem, thus the correctness of the model.

6.5 Gross profit margins analysis

This section presents the results of the benchmarking process, the comparative analyses of the key profitability parameters of the government-funded small-scale broiler producers and Rainbow Chicken (a large-scale broiler producer) using data from the 2014/15 financial year.

6.5.1 Gross margin analysis

6.5.1.1 Broiler production and marketing information

Increasing livestock productivity in developing countries generally requires simultaneous interventions in the areas of production practices, animal feed, health and genetics. Broiler production intervention programmes in developing countries and less competitive producers should promote the availability and accessibility of inputs, as well as the provision of new technologies or customization of existing technologies. Farm production

costs refer to the costs of production inputs, including day-old chicks, feed (starters, finishers and post finishers), vaccine/medication, brooders and marketing costs. Table 7.1 shows the average costs of production by the small-scale broiler producers in the North Region of KZN. The costs used in this table are average costs taken from all three district municipalities (uMkhanyakude, uThungulu and Zululand).

Table 6.1 cost of production and the average share of variable production cost

	Government Funded Small Scale Producers		Rainbow Chickens	
Allocable Costs	Average production cost per unit/100	Rainbow Chickens' average share of variable production cost	Average production cost per unit/100	Rainbow Chickens' average share of variable production cost
Day-old chickens	485.00	18.9%	439.59	20.0%
Feed Costs	1479.85	67.3%	1567.13	71.3%
Vitamins and vaccinations	25.11	0.98%	13.19	0.6%
House sanitation/ Maintenance	8.44	0.32%	15.39	0.7%
Shavings	13.15	0.51%	37.36	1.7%
Gas for brooder/ Heating and Electricity	130.00	5.06%	72.53	3.3%
Other Costs	427.93	16.65%	52.75	2.4%[b]
Mean Total Allocable Costs	2 569.48		2,197.94	
Mean Total Gross Income	4320.00		5248.00	
Mean Gross margin	1750.52		R3 050.06	
% Gross margin		31%		57.7%

The cost of critical inputs is important when computing the profitability and competitiveness of an enterprise. Table 6.1 above shows the cost of production and the average share of variable production cost spend. Table 6.1 attempts to present a comparative analysis of the gross margins of government-funded small-scale broiler producers with Rainbow Chickens' gross margin to assess their viability. According to Naude (1998), the higher the cost of the broiler inputs, the lower the gross margin, which would translate into lesser profit. The results show that the government-funded small-scale broiler producers are getting a mean gross margin of R1 935.01 per 100 broiler batch across all districts. The Rainbow chickens' producers are getting a mean gross margin of R3 050.06 per 100 broiler batch. These results show that the mean gross profit margin for all the districts was about 31% and the mean gross profit margin for Rainbow chickens was about 58%. Of the three districts selected, uThungulu was more profitable, with a GPM of about 54%, followed by Zululand, with a GPM of about 42% and lastly uMkhanyakude, with a GPM of about 35%. In addition, uThungulu District performed better than Zululand and uMkhanyakude districts because it has better formal markets, better roads and water services than Zululand and uMkhanyakude districts.

Small-scale broiler producers must buy inputs in bulk to reduce the costs of individual interest and to share the transport costs. The results show that Rainbow Chickens producers are getting a higher average gross margin compared with the government-funded small-scale broiler producers. This can be attributed to economies of scale, since Rainbow Chickens producers buy bulk feed and medication and have controlled environments that contribute to the increased gross margins. Government-funded small-scale broiler producers have a lower mean gross margin because they are still using the low input technology, which may affect their gross margin. Nonetheless, the gross margins obtained by the government-funded small-scale broiler producers are positive, suggesting that this enterprise is viable (profitable).

Table 5.6 shows the mean gross profit margins for uMkhanyakude, uThungulu and Zululand districts in comparison with those of Rainbow Chickens. Both Tables 5.4 and 5.5 show that both gross margin and gross profit margin for the government-funded small-scale broiler projects are positive, though their profit margin is less when compared with that of

Rainbow chickens. This means that small-scale broiler producers need to put extra effort into production management, financial management and marketing strategies so that their broiler production can be more viable.

6.6.2 Regression results

Table 6.1 presents the results of the multiple regression model employed to determine the factors influencing the profitability of government-funded small-scale broiler projects and an in-depth explanation for the statistically significant variables. Table 6.1 presents the empirical results of multiple regression analysis.

Table 6.2: Factors influencing the profitability of government-funded small-scale broiler projects in Northern KZN

Variable	**Unstandardised Coefficients**		**Standardised Coefficients**	**t**	**Sig.**	**VIF**
	ß	**Std. Error**	***ß***			
Constant	-320.484	143.637		-2.231	0.029	-
Age	21.551	19.257	0.058	1.119	0.267	1.213
Gender	1.176*	0.642	0.101	1.832	0.071	1.360
Educational level	15.469	11.044	0.075	1.401	0.166	1.263
Price	27.218***	1.699	0.951	16.016	0.001	1.572
Distance to market	-5.142	6.291	-0.046	-0.817	0.417	1.420
Access to market information	-40.745*	23.426	-0.095	-1.739	0.087	1.321
Access to electricity	-1.603	27.490	-0.003	-0.058	0.954	1.297
Access to extension	68.865**	25.296	0.140	2.722	0.008	1.179
Number of observations	75					
R-square (Adjusted R-Square)	0.850 (0.832)					
Durbin Watson	1.504					

*Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively*
Source: Results from STATA (Version 14.2) generated from Field Survey, 2020.

Results show that the factors that significantly influence the profitability of government-funded small-scale broiler projects include gender, farm gate price, access to market information and access to extension services. The unadjusted multiple R-Square for this data is 0.850, and the adjusted multiple R-Square is 0.832. This suggests that the model accounts for about 83% of the total variability. In running the multiple regression models, the assumption was that errors in regression are independent. The Durbin-Watson for this data is 1.504. A Durbin-Watson statistic that is around 2 (between 1 and 3) is normally acceptable. Besides, the variance inflation factors (VIF) were used to inspect the level of multicollinearity between the independent variables. The classification accuracy in this data indicated that multicollinearity was not a problem, hence the correctness of the model.

The variable gender is statistically significant at a 10% significance level (p=0.071) and positively related to the gross margin. The results suggest that male small-scale broiler producers are more profitable than female small-scale broiler producers. This is in contrast with other studies, for example, Bagamba *et al*. (1998) and Manona (2005), who postulate that women in small businesses are more likely to be profitable than men. On the other hand, these findings are supported by Hilmi *et al*. (2011) that men produce more profitably than women. Some reasons for men to be more profitable than women could be that men are more resourceful in terms of access to resources, infrastructure and land as well as credit facilities. Gueye (2000) argues that capacity building and support systems in poultry production should consider socio-cultural issues, including gender-based aspects to promote gender equality. In line with conventional understanding and prior expectation, selling price was positively related to gross margin (p=0.001), B = 27.218. These findings agree with those of Zulu (2011), who also found that the farm gate price is positively associated with the gross margin.

Access to market information and a proxy for the cost of gathering market information were statistically significant at a 10% significance level (p=0.087) and negatively related to the gross margin. Farmers struggle to access market information, and this has a detrimental effect on their profitability. This disagrees with the prior expectation and is in contrast with other studies. For example, Chetroiu and Lurchevici (2012) indicated that access to market information is positively related to gross margins. Strategies seeking to address information

asymmetries, either through promoting the use of cheaper sources such as the use of ICT, or government extension services, could reduce the cost of marketing, thus making the sector competitive. Access to cheaper market information promotes farmers' participation in high-end markets, increasing profitability (Omondi, 2018). These findings could be explained by descriptive results, which revealed that the total allocable costs by the small-scale broiler producers were higher than those of a large-scale broiler producer (Rainbow Chicken). In turn, this translates to lower GMs realized by small-scale broiler producers given the fact that they do not perform value-adding to their products.

Collective action to take advantage of economies of scale in input procurement, as well as output marketing, could potentially be developed and tested for replication on a wider scale. The variable access to extension services is statistically significant at a 5% significance level (p=0.008) and positively related to the gross margin. The model predicts that access to extension (coded with 1) would result in an increase in gross margin by about 69%. The results show that an improvement in the access to extension services greatly increases the gross margin. This agrees with the prior expectation. These findings are supported by Chetroiu and Lurchevici (2012), who indicate that access to extension is positively related to gross margins. An extension is likely to play a positive role in small-scale broiler production through improved broiler management and broiler marketing aspects.

6.7 Technical Efficiency of Broiler Production

An important objective of this study was to determine the technical efficiency of the broiler industry in the project area. To achieve this objective, the stochastic frontier model was fitted to the production and socioeconomic data collected as part of the study. As explained in the methodology chapter, the one-step approach was adopted to allow for the determination of factors affecting inefficiency at the same time as the frontier analysis was performed. The Maximum Likelihood Estimation option was employed on STATA, which yielded the results through multiple iterations. The variable costs of production, such as the cost of procuring the day-old chicks, cost of purchasing feeds, heating and lighting costs, vaccinations and therapies, were all included in the initial runs of the model, and the

iterations continued until the most influential variables were shown in the output table. The results of the frontier estimation are presented in Table 6.3.

Table 6.3: Maximum Likelihood Estimation (MLE) of Broiler Farmers

Gross Income	Coef.	Std. Err.	z	p>z	[95% Conf. Interval]	
Frontier						
Flock Size	0.0253697**	0.0129673	1.96	0.050	-0.0000458	0.050785
Feeds	0.0877613***	0.0305764	2.87	0.004	0.0278328	0.14769
Labour	13.851***	0.0978389	141.57	0.000	13.65924	14.04276
Medication	0.0032996	0.0171971	0.19	0.848	-0.0304061	0.037005
Constant	-22.2411	.	.	.	.	.

*Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively*
Source: Results from STATA (Version 14.2) generated from Field Survey, 2020.

The results in Table 6.3 show that the estimated coefficients of Flock Size (number of day-old chicks), feeds consumed by the birds, and the labour input to run the broilers were statistically significant at 1% level. These coefficients are all positive, which supports the notion that the more birds that are kept to maturity, the better the performance in a commercial sense. Similarly, the more feeds that are fed to the birds, the more their liveweight at the time of sale and the higher their economic value. At the market, buyers hold up chickens to size them up before quoting a price and the heavier the chicken the higher the price asked by seller and accepted by buyer. The appearance of heaviness is also related to the weight and state of health of the chicken which are all influenced by the feeding regime on which the chickens have been raised. It also stands to reason that the more labour that is devoted to taking care of the birds, the better their performance although this is also likely to add to costs. Labour is needed to place feed and water in the pens at least two times a day in the morning and evening although it may often be necessary to take a tour of the pen during the day to ensure that everything is going well and to refill the feeders and waterers. Labour is also required to clean the chick pen periodically. The wood shavings more commonly spread on the floor becomes wet and muddy within a short time due to the activities of the birds and needs to be replaced to avoid their becoming fertile media for disease-bearing micro-organisms. Many lethal diseases of chickens arise from

contaminated and unhygienic environments. There has to be a balance between cost-effective use of labour and its optimal use to ensure that profitability is not compromised.

Ironically, the coefficient of medication was insignificant, which could be due to the absence of a consistent and systematic use of the medications in the small-scale broiler production as a result of limited awareness, low capital base and weak extension contact. While the use of medications, particularly antibiotics, is rampant in poultry production worldwide, it is not unlikely that the small-scale sector will not be typical and must exhibit the usual constraints in technology adoption that characterize smallholder production systems. Contrary to previous studies, Bruce *et al*. (2014) establish that farmers who access extension services have a lower probability of adopting technologies. Also, in Ghana, extension services are shown not to be significantly associated with the likelihood of increasing household food security position (Nata *et al*., 2014).

6.8 Technical Inefficiency

The one-step approach for the estimation of technical efficiency incorporates an inefficiency model within the same operation. In line with theory, factors such as the age of the farmer, gender of the farmer, educational level of the farmer and extension contact are considered to have an important influence on the efficiency of any system. For this reason, those variables were included in the model, and the results are presented in Table 6.4.

Table 6.4: Determinants of Technical Inefficiency

Inefficiency model	**Coef.**	**Std. Err.**	**z**	**p>z**	**[95% Conf. Interval]**	
Age	4.135937***	0.3426792	12.07	0.000	3.464298	4.807576
Gender	-2.554404**	1.082274	-2.36	0.018	-4.675621	-0.43319
Educational Level	-2.955808***	1.079291	-2.74	0.006	-5.071179	-0.84044
Extension Access	1.341414	1.513759	0.89	0.376	-1.625499	4.308328
Constant	-19.28456	.	.	.	.	.

*Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively*
Source: Results from STATA (Version 14.2) generated from Field Survey, 2020.

The results show that the estimate of age had a positive coefficient that was statistically significant at 1% probability level. This means that the older the farmer, the more inefficient the operations of the farm, thus implying that younger farmers might be more technically efficient than older farmers. While this result makes intuitive sense, it contradicts the findings of Ali and Riaz (2014) and Pakage *et al*. (2015). On the other hand, the results support the findings of Mbanasor and Kalu (2008) and Ahiale, Abunyuwah and Yenibehit (2019).

The results in respect of gender, educational level and extension access were also examined. According to the results, the estimate for gender and educational level of the farmer had a negative coefficient but were statistically significant at 5% and 1%, respectively. These results are consistent with results obtained elsewhere by Ahiale, Abunyuwah and Yenibehit (2019), with respect to the educational level and Alabi and Aruna (2006), with respect to the gender of the farmer. These results could suggest that, with respect to gender, women are more technically efficient than men in the management of broiler projects. With respect to educational level, the negative coefficient suggests that a lower level of education corresponded with more technical inefficiency, meaning that the more educated the farmer, the more technically efficient the broiler business. Curiously, extension access was not statistically significant probably because it was not well-structured and delivered according to the farmers' needs.

It is often necessary to test the reliability of the estimates. One element that tends to be susceptible to error is the inefficiency model, since problems of heteroscedasticity may arise. When such a problem exists, then, the estimates are likely to be biased. In STATA, the cross command allows for the testing of the inefficiency term, *USigma*, and its correction where heteroscedasticity is detected. Table 6.4 presents the results of the heteroscedasticity test of the inefficiency term, which confirms that its variance is explained by differences in age and the educational level of the farmer, which invariably suggests that the experience of the farmer determines how efficient the operations would be.

Table 6.5: Test of heteroskadasticity on the error term (U)

	Coef.	Std. Err.	z	p>z	[95% Conf. Interval]	
U-sigma						
Age	0.9937991***	0.2713766	3.66	0.000	0.4619107	1.525688
Educational Level	1.409272***	0.4279824	3.29	0.001	0.5704423	2.248103
Extension Access	0.4924208	0.802442	0.61	0.539	-1.080337	2.065178
Constant	-7.311918	.	.	.	.	.

*Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively*
Source: Results from STATA (Version 14.2) generated from Field Survey, 2020.

It may be the case that the heteroscedasticity is coming from the disturbance term, *v*, rather than the inefficiency term, *U*. In that case, the Vsigma is tested to ascertain whether the variables fitted with respect to the inefficiency term provide any information that might help understand the behaviour of the overall model. Table 6.5 provides the results of the test with respect to the disturbance term and confirms that only the age of the farmer has the possibility of varying to the extent that it affects the estimation results.

Table 6.6: Test of heteroskadasticity on the error term (V)

V-sigma	Coef.	Std. Err.	z	p>z	[95% Conf. Interval]	
Age	-0.7776877***	0.1170086	-6.65	0.000	-1.00702	-0.54836
Educational Level	0.1430705	0.4574664	0.31	0.754	-0.7535471	1.039688
Extension Access	-0.9391633	0.6854974	-1.37	0.171	-2.282714	0.404387
Market Information	-0.0429347	0.5843637	-0.07	0.941	-1.188266	1.102397
Constant	-2.786895	.	.	.	.	.

*Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively*
Source: Results from STATA (Version 14.2) generated from Field Survey, 2020.

6.9 Technical Efficiencies Distribution of Individual Broiler Units

The technical efficiency of the broiler units was predicted at the end of the estimation process, and it was shown that no unit attained a technical efficiency of 1 or 100%. This suggests that all the broiler units performed below the frontier, leaving room for

improvements in their performance. However, the average performance was high, with only two being in the 80-89% range and the rest (113) being in the 91-100% range. The results are presented in Table 6.7.

Table 6.7: Frequency distribution of technical efficiency of broiler projects

Technical Efficiency Range %	Frequency	Percentage (%)
<= 50	0	0
51-60	0	0
61-70	0	0
71-80	0	0
81-90	2	2
91-100	113	98
Total	115	100

6.10 Chapter summary

This chapter presented results of the inferential analysis to determine the factors affecting the profitability of government-funded small-scale broiler projects. A multi-regression analysis was used to test for the factors that influence the profitability of broiler production in the study areas. The dependent variable used is the gross margin (GM), which was regressed against such independent variables as the age of the small-scale broiler producer, gender, years of schooling, farm gate price, access to markets (yes/no), distance to market (km), access to market information (yes/no), access to own transport (yes/no), access to storage facilities (yes/no) and access to electricity. The model fit was good and there was no evidence of multicollinearity. The most important finding in this regard was the crucial roles that gender, access to market information, access to extension services and collective action can potentially play in boosting broiler profitability in the small-scale enterprises. It was revealed that men could be more profitable than women although this is a rather controversial finding as it is supported and contradicted by other studies in equal measure.

This chapter also presents an important objective of the study, which is to determine the technical efficiency of the broiler industry in the project area. To achieve this objective, the

stochastic frontier model was fitted to the production and socioeconomic data collected as part of the study. The Maximum Likelihood Estimation option was employed on STATA, which yielded the results through multiple iterations. Variable costs of production were all included in the initial runs of the model and the iterations continued until most influential variables were identified.

CHAPTER 7

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

South Africa adopted a policy that entails supporting and promoting agricultural enterprises. The south African government finances small-scale broiler production as a means of addressing poverty and the national deficit in meat production. South Africa provides an excellent location for this study because of a high number of supported small-scale broiler farmers, high amounts of poultry products imported and high consumption of poultry products. The KwaZulu-Natal province embarked on a purposeful strategy to accelerate the development and modernisation of broiler production in the province by supporting small-scale broiler projects in the KZN Northern region. However, these projects have scored mixed results because of social problems, market availability, poor infrastructures, poor financial management and poor resource management. To date, the economic viability of broiler production enterprises has not been systematically accessed and is therefore unknown with any certainty. It is acknowledged that differences in factors of production are largely influenced by both the production and marketing environment, and the socio-economic landscape plays an important role in determining both productivity and profitability. This study was undertaken to determine the economic viability (profitability) of the government-funded small-scale broiler projects in a way that seeks to promote them as tools for addressing poverty and easing food supply deficits. Thus, the results are expected to help farmers and other developmental agencies to select the most appropriate innovations for broiler production improvement. Such an understanding or information could be crucial and helpful in the design of viable or sustainable small-scale broiler projects. Besides, this could go a long way, not only in addressing or improving the small-scale rural livelihoods in the long run but also in addressing permanently the issue of poverty in South Africa and other countries with similar predicament. This chapter presents a summary of the research findings and draws conclusions. This will be based on what it

puts forward as a set of recommendations for enhancing the viability of the government-funded small-scale broiler projects in the province in the hope that they can be applied wherever similar conditions exist.

7.2 Summary

The main aim of the study was to assess the economic viability (profitability) of the government-funded small-scale broiler projects in northern KwaZulu-Natal. A probability sampling procedure was employed to sample 75 small-scale broiler producers under the KZN North region. A simple random sampling procedure was used. The advantage of using a random sample is the absence of both systematic and sampling bias (Bless and Smith, 2000). Not all government-funded small-scale broiler producers in the study areas were selected for the study, but a sample was drawn. For the sample to best represent the total population, a complete sampling frame was employed. A complete sampling frame was obtained from the KZN Department of Agriculture. In total, there are about 134 small-scale broiler projects that have been funded by the KZN Department of Agriculture. A total of 75 small-scale broiler projects (25 broiler projects in each district – uMkhanyakude, uThungulu and Zululand) were investigated. Under this broad objective, the specific objectives were:

1) Firstly, to determine production challenges faced by government-funded broiler projects in northern KZN. The study found that the challenges constraining government-funded small-scale broiler projects in Northern KwaZulu-Natal included the high input costs, especially for feed, electricity and vaccines. In addition, the small-scale broiler producers also lacked production and management skills.

2) Secondly, to analyse the marketing channels used by the government-funded small-scale broiler projects in northern KZN. The study found that there were no formal markets used by the small-scale broiler producers to sell their broiler produce, as most formal markets prefer dressed broilers. In the case of these small-scale broiler producers, they do not have the slaughtering and storing facilities, thus, this negatively impacted them in terms of accessing formal markets. As a result, they marketed their produce to informal markets, which included pension points, farm gate, selling to the vendors and the nearby households.

3) Thirdly, to determine the marketing challenges faced by government-funded small-scale broiler projects in Northern KZN. Generally, customers prefer the dressed and packaged broiler carcass to live broilers. The result of the study indicated that the small-scale broiler producers in the study areas do not have the necessary facilities for slaughtering and packaging. Other marketing challenges included a lack of access to formal markets, unavailability of proper processing and storage facilities, long distances to the market and a lack of own transport that resulted in the use of expensive hired transport to collect inputs and to deliver the broiler products to the market.

4) Fourthly, to determine the viability of government-funded small-scale broiler projects in Northern KZN. The study found that the gross margins and gross profit margins of government-funded small-scale broiler projects are positive, thus viable. However, when compared with a large-scale producer like Rainbow Chicken, the government-funded small-scale broiler projects were less profitable. The findings suggest that there is still a need for small-scale broiler producers to improve their management and marketing skills and lower feed and accumulation costs through cooperatives or farmers union.

5) Fifthly, to determine the factors influencing the profitability of government-funded small-scale broiler projects in northern KZN. The study found that gender, farm gate price, access to market information and extension services were significant factors influencing the profitability of government-funded small-scale broiler projects in the study areas. Gender, farm gate price and access to extension services were found to be positively related to gross margin, whereas access to market information was surprisingly found to be negatively related to gross margin.

6) Lastly, to determine the technical efficiency of the broiler industry in the project area. The study found that the more birds that are kept to maturity, the better the performance in a commercial sense. Similarly, the more feeds that are fed to the birds, the more their liveweight at the time of sale and the higher their economic value. It also stands to reason that the more labour that is devoted to taking care of the birds.

7.3 Conclusion

In conclusion, the study found that the lack of access to formal markets and high input costs are the major constraints faced by government-funded small-scale broiler producers in Northern KZN. It was found that small-scale broiler projects relied on the local informal market, which buys live chicken. Even though the government-funded small-scale broiler projects were found to be profitable, they were not as much viable as large-scale broiler producers like Rainbow Chicken due to some of these constraining factors. The government-funded small-scale broiler producers are failing to penetrate the formal market because of a lack of value addition infrastructure and their distance away from markets. The main requirement for participating in a formal market is to supply dressed chicken. These projects are unable to meet this requirement because they do not have formal facilities to slaughter birds. It is very difficult to run a sustainable broiler project that produces only live birds if there is no market to take them all at a particular time. The study concludes that the more feeds that are fed to the birds, the more their liveweight at the time of sale. Their higher their economic value and results could suggest that women are more technically efficient than men in the management of broiler projects. The study also concludes that a lower level of education corresponds with more technical inefficiency, meaning that the more educated the farmer, the more technically efficient the broiler business.

7.4 Recommendations

Profitable broiler production requires a high degree of efficiency. After going through the assessment, the following recommendations are made:

7.4.1 Strategies for improving women's skills in broiler production

The study generally found that there were more females than males in the study areas. Interestingly, the empirical results predict that males exhibited potential for higher profits than females. However, results from many studies are not unanimous on this finding. Bagamba *et al*. (1998) note that women are more responsible than men when it comes to paperwork, such as keeping proper records, doing accountant work and other calculating

work. It may not be accurate to generalize that small-scale male broiler producers are more profitable than female small-scale broiler producers. In many cases, women are actively involved in small-scale broiler projects, particularly in rural areas (Martin, Frans and Robyn 2011). The study recommends empowering women producers with the necessary resources and improving their access to markets. Again, the study recommends encouraging men to be involved in small business enterprises, such as small-scale broiler production rather than migrating to mining areas or urban areas in search of employment.

7.4.2 Improving farm gate prices

At present, the farm gate price of a broiler in the northern region is around R70 per broiler. According to Martin *et al*. (2011), the production cost of broiler production is around R50 per broiler. The small-scale broiler producers pass those costs to the consumers. The broiler industry hopes that this new initiative will help in assisting the falling farm gate prices of broilers. It is important to ensure that the products, the market channels and the markets be properly organised. It is very difficult to run a sustainable broiler project that produces only live birds if there is no market to take them all at a particular time. It is, therefore, recommended that the products of the broiler projects should be diversified to allow broilers to be ready for the market at six weeks of age. The broiler project should have organised market channels and markets to take some of the live birds dressed at six weeks of age. Broiler projects are struggling to market their chickens. They are only depending on the local informal market, which buys live birds. These projects cannot penetrate the formal market, which buys dressed chickens. It is, therefore, recommended that a poultry abattoir is established to allow broiler projects to penetrate the formal market. However, it is unclear if the abattoir will be able to compete in terms of price and quality with large brands such as Rainbow Chickens. There is a belief that large brands brine their chickens. This makes their products look good in the eyes of the customers. This will pose a challenge to the abattoir. Thus, it is recommended that the abattoir should target government institutions, such as government hospitals, prisons and education departments for a reliable market. Municipalities can play a major role in establishing and controlling those broiler abattoirs and also attracting local government departments, retailers, international markets and others.

7.4.3 Strategies for improving access to information

Most successful projects have individuals who have certain skills that are relevant to the operations of the broiler projects. Essential skills such as record keeping, financial management, business management and broiler production technical skills are crucial to the success of the projects. Pieces of training will be more beneficial if people who get trained are either the committee members or members who can influence and train the whole group or labourers. The project members must receive skills training that covers all the relevant aspects of the project as indicated above. Market information is important for a project to be sustainable. Government extension services have to play an important role in disseminating market information. The study suggests that small-scale broiler producers should use other sources of information and not rely on one source of market information, which is the extension services but use other sources, such as media, the internet, newspapers and neighbours**.**

For optimum production, input suppliers must deliver on time and deliver quality products at a reasonable cost. The following essential inputs such as chicks, feed, and wood shavings are being sold at high prices. This situation affects the production process, and thus the final product of the project. The pricing system also gets affected, as the produced birds would not compete with other producers in areas next to urban areas. The farmers in these areas can produce at low prices and sell cheaper than most of the rural areas. The study found that the major production challenge that the projects are facing is the high input costs. To minimise inputs costs, farmers may be encouraged to buy inputs collectively and in bulk.

7.4.4 Strategies for improving access to extension services

Market information is important for a project to be sustainable. Government extension services have to play an important role in disseminating market information. Extension services are the main source of information for small-scale broiler producers. Extension services must be equipped with recent information because small-scale broiler producers are relying on them. Extension services are the source of information that most small-scale

broiler producers are dependent on. The upgrading in extension services can improve the profitability of small-scale broiler producers.

7.5 Suggestions for future research

The study assessed the viability of government-funded small-scale broiler producers in the Northern KZN. It was only focusing on small scale broiler projects as exclude large scale broiler projects and projects for any other enterprises. The study found that these projects are economically viable. However, the socio-economic impact it has on the small-scale broiler producers was not investigated. Future research can focus on the socio-economic impact of the government-funded small-scale broiler producers and the broader community at large.

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APPENDIX

Appendix 1: Questionnaire

UNIVERSITY OF FORT HARE, DEPARTMENT OF AGRICULTURAL ECONOMICS

THE VIABILITY OF GOVERNMENT-FUNDED BROILER PRODUCTION: LESSONS FROM NORTHERN KWAZULU-NATAL, SOUTH AFRICA

Questionnaire number…… Name of Interviewer ……
Contacts……

District Municipality ……Local Municipality…….

Are you funded by Government? 1) Yes [ ] 2) No [ ]

A) BACKGROUND INFORMATION

1) Respondent's Name……..……..

2) Household composition

	Gender 1.-Male 2.-Female	**Age**	**Marital status** 1-Single 2-Married 3-Divorced 4-Widow	**Education level** 1-No formal Education 2-Primary 3-Secondary 4-Tertiary 5-Others	**Years spent at school**	**Occupation category** 1Retired 2-Unemployed 3- Farmer 4- Employee 5- Self-employed 6- School/ pre-school	Specify Occupation type	Years of employment
Head								
Spouse								
Children								
Other								

How do you rate farming knowledge? ***(Please tick the correct option)***

Employees knowledge	Poor		Average		Good	
How was the knowledge acquired?	Experience		Education		Training	

Is there any project member with any of the following skills?

SKILL	Yes	No	If yes, where was it obtained?
Animal production			
Financial management			
Record Keeping			
Marketing			
OTHER (Please *Specify*) ……			

What specific training is needed?

SKILL	Yes	No	Why do you think it is important?
Animal production			
Financial management			
Record keeping			
Marketing			
OTHER (Please *Specify*) ……			

B) PRODUCTION COSTS

What is the maximum capacity of production per year? (e.g. 500 broiler birds)…….....

What is the current production capacity per year? (e.g. 300 broiler birds)……

Who are your input suppliers and how far are they from your location?

ITEM	SUPPLIER'S NAME	DISTANCE
Day-old Chicks		
Feed		
Vaccine		
Medication		
Other ……		

What is the total production cost per year? **Batch of …….. broiler birds**

ITEM	UNIT	COST/UNIT (R)
Feed		
Starter		
Pellets		
Finisher		
Vaccine		
Newcastle Disease1		
Newcastle Disease2		
Gumboro		
Medication		
Other (*Please Specify*)		
Storage/Refrigeration (if they do slaughtering)		
Labour		
Packaging		

Marketing costs		
TOTAL COSTS		

What is the total fixed cost per 1000 broilers?

Item	Unit cost	Total cost
Site		
Environmental impact assessment		
Business plan		
Broiler structures		
Equipments		
Office and furniture		
Refrigerated truck		
Bakkie		
Electricity		
Water		
Electric fence		
Poultry abattoir buildings		
Backup engine		
Backup borehole		
Labourers		
Totals		

C) MARKETS

What quantity of broiler is marketed per month? (e.g. 500)) ……

Do they sometimes have unsold produce? Yes ☐ No

Approximately, how much is unsold produce? ……

What happens to the unsold produce? ***(Please tick the correct option)***

Eat (family and friends)	Sell at low prices	Keep and sell later	Process it	Other

When do you start looking for buyers? ***(Please tick the correct option)***

Before production		Two weeks before broilers reach maturity		Once broilers are ready for marketing	

Where do you sell most of your produce? ***(Please tick as appropriate)***

PLACE	**Tick**	**Reason**
Farm gate		
Around the village		
Pension Pay points		
Nearest town		
Other (*Please Specify*) ……		

Who are your current customers? ***(Please tick correct appropriate)***

Friends/ neighbours	hawkers	teachers	pensioners	Government institutions	Spaza shops	Abattoirs	Other

Do you have any contractual agreements (formal or informal)? (Give Details)

……

……

……

Do you have customers who always buy from you? YES ☐ ☐

If yes, who are these customers?

.....

Are there other possible markets?

.....

Before selling your produce, what value-adding activities do you perform?

ACTIVITY	**TICK**	**PLEASE GIVE DETAILS**
Slaughtering		
Other (*Please Specify*) ……..		

What is the possible value-adding activity?

Slaughtering of broiler	
Processing polonies, burgers, etc.	
Processing feathers	
Other (specify)	

How is your produce moved to the marketing points? ***(Please tick as appropriate)***

	TYPE OF TRANSPORT					
	Truck	Bakkie	Bus	Other (Specify)	Distance to Market	Cost of a single trip to the market (R)
Own transport						
Hired vehicle						
Public transport						
Buyers transport						
Other (*Please Specify*) ……						

Is the farmer promoting the produce for marketing? Yes ☐ N ☐

If yes, how does the farmer promote the produce?

Item	Cost per month	Cost per year
Launch the project		
Word of mouth		
Distribution of Pamphlet/Flyers		
Mobile Advertising Boards		
Social media		
Total		

What problem do you experience in moving your produce? ***(Please tick as appropriate)***

Small size of transport	Lack of transport	High transport costs	Other (Specify)

D) MARKET INFORMATION

What or who are your sources of information?

Extension Officer	
Media	
Internet	
Social media	
Other (specify)	

How do you want the information to be delivered? ***(Please tick as appropriate)***

INFORMATION MEDIUM	**Tick**
Post	
Telephone	
Cell phone SMS	
Internet	
Extension officers	
Tribal meeting	
Farmer groups	
Other (*Please Specify*) ……	

The main challenges faced in running the project? ***(Please tick as appropriate)***

CHALLENGES	**Minor Challenge**	**Major Challenge**
The search for information		
Lack of support by the government		
Access to extension services		
Frequency of extension visits if minor above		
Financial		
Access to credit		
Access to electricity		
Problems associated with crime		
Road infrastructure		
Other (please specify)		

For how much do you sell your broilers?.....

List what you consider to be the major problems you face in marketing your goods.……

Transport	
Slaughtering facilities and packaging	
High marketing costs	
High competition	
Other (specify)	

Suggest ways how such problems can be addressed.……..……

Government intervention	
Support from other stakeholders	
Support from marketing agencies	
Support from other farmers	
Other (specify)	

Thank you for participating in this survey; your co-operation is much appreciated.

Appendix

Appendix 2: Gross margin and gross profit margins (income and cost budget)

Appendix 2.1: Average income and cost budget for uMkhanyakude

ESTIMATED INCOME	UNIT	PRICE/UNIT (R)	QUANTITY PER BATCH	VALUE PER BATCH (R)
Gross Income				
Sale of Live Birds	Each	45.00	96.00	4,320.00
Total Gross Income (A)				**4,320.00**

ESTIMATED COSTS	UNIT	PRICE/UNIT (R)	QUANTITY PER BATCH	COST PER BATCH (R)
Less: Allocable Costs				
Day-old chickens	Each	4.40	100.00	440.00
Feed:				
Starter Crumbles	50kg	177.30	2.00	354.60
Grower Pellets	50kg	166.35	3.00	499.05
Finisher Pellets	50Kg	156.55	4.00	626.20
Vaccinations:				
Newcastle Disease 1	1000 doses	34.40	0.20	6.88
Newcastle Disease 2	1000 doses	28.75	0.20	5.75
Gumboro	1000 doses	62.40	0.20	12.48
House sanitation	Batch	84.35	0.20	16.87
Transport:				400.00
Day-old chickens	Batch	173.00	0.20	34.60
Shavings	km	3.46	100.00	346.00
Contingencies	2.00%			54.85
Total Allocable Costs (B)				**2,797.28**

GROSS MARGIN (A-B)	**1,522.72**
Gross profit margin	**0.35**

Appendix 2.2: Average income and cost budget for uThungulu

ESTIMATED INCOME	UNIT	PRICE/UNIT (R)	QUANTITY PER BATCH	VALUE PER BATCH (R)
Gross Income				
Sale of Live Birds	Each	45.00	96.00	4,320.00
Total Gross Income (A)				**4,320.00**

ESTIMATED COSTS	UNIT	PRICE/UNIT (R)	QUANTITY PER BATCH	COST PER BATCH (R)
Less: Allocable Costs				
Day-old chickens	Each	4.40	100.00	440.00
Feed:				
Starter Crumbles	50kg	177.30	2.00	354.60
Grower Pellets	50kg	166.35	3.00	499.05
Finisher Pellets	50Kg	156.55	4.00	626.20
Vaccinations:				
Newcastle Disease 1	1000 doses	34.40	0.20	6.88
Newcastle Disease 2	1000 doses	28.75	0.20	5.75
Gumboro	1000 doses	62.40	0.20	12.48
House sanitation	Batch	84.35	0.20	16.87
Transport:				
Day-old chickens	Batch	173.00	0.20	34.60
Shavings	km	3.46	100.00	346.00
Contingencies	2.00%			46.85
Total Allocable Costs (B)				**2,389.28**

GROSS MARGIN (A-B)	**1,930.72**
Gross profit margin	**0.45**

Appendix 2.3: Average income and cost budget for Zululand

ESTIMATED INCOME	UNIT	PRICE/UNIT (R)	QUANTITY PER BATCH	VALUE PER BATCH (R)
Gross Income				
Sale of Live Birds	Each	45.00	96.00	4,320.00
Total Gross Income (A)				**4,320.00**

ESTIMATED COSTS	UNIT	PRICE/UNIT (R)	QUANTITY PER BATCH	COST PER BATCH (R)
Less: Allocable Costs				
Day-old chickens	Each	4.40	100.00	440.00
Feed:				
Starter Crumbles	50kg	177.30	2.00	354.60
Grower Pellets	50kg	166.35	3.00	499.05
Finisher Pellets	50Kg	156.55	4.00	626.20
Vaccinations:				
Newcastle Disease 1	1000 doses	34.40	0.20	6.88
Newcastle Disease 2	1000 doses	28.75	0.20	5.75
Gumboro	1000 doses	62.40	0.20	12.48
House sanitation	Batch	84.35	0.20	16.87
Transport:				
Day-old chickens	Batch	173.00	0.20	34.60
Shavings	km	3.46	100.00	346.00
Gas for brooder	48kg	650.00	0.20	130.00
Contingencies	2.00%			49.45
Total Allocable Costs (B)				**2,521.88**

GROSS MARGIN (A-B)	**1,798.12**
Gross profit margin	**0.42**

Appendix 2.4: Average income and cost budget for all three districts (uMkhanyakude, uThungulu and Zululand)

ENTERPRISE: 100 Broiler Birds

ITEM	UNIT	PRICE/UNIT	QUANTITY PER BATCH	VALUE PER BATCH	VALUE PER ANNUM
Gross Income					
Sale of Live Bird	Each	65.00	96.00	6 240.00	36 192.00
Total Gross Income				**6 240.00**	**36 192.00**
Day-old chickens	Each	6.50	100.00	650.00	3 770.00
Feed:					
Starter Crumbles	50Kg	330.00	2.00	660.00	3 828.00
Grower Pellets	50Kg	315.00	2.00	630.00	3 654.00
Finisher Pellets	50Kg	288.00	6.00	1 728.00	10 022.40
Vaccination:					
Newcastle Disease 1	1000 doses	34.40	0.20	6.88	39.90
Newcastle Disease 2	1000 doses	28.75	0.20	5.75	33.35
Gumboro	1000 doses	62.40	0.20	12.48	72.38
House Sanitation	Batch	84.35	0.20	16.87	97.85
Transportation:					
Day-old chickens	Batch	173.00	0.20	34.60	200.68
Shaving	Km	3.46	100.00	346.00	2 006.80
Gas for brooder	48 Kg	650.00	0.20	130.00	754.00
Contingencies	2.00%			84.41	489.59
Total Allocable Cost				**4 304.99**	**24 968.95**
Gross Margin				**1 935.01**	**11 223.05**
Gross Profit Margin (GPM)				**0.31**	**0.31**

Appendix 2.5: Average income and cost budget for Rainbow Chicken

ESTIMATED INCOME	UNIT	PRICE/UNIT (R)	QUANTITY PER BATCH	VALUE PER BATCH (R)	VALUE PER ANNUM (R)
Gross Income					
Sale of Frozen Chicken	Each	55.00	100	5 500.00	14,699,.00
Total Gross Income (A)				**5 500.00**	**17,706.00**
ESTIMATED COSTS	**UNIT**	**PRICE/UNIT (R)**	**QUANTITY PER BATCH**	**COST PER BATCH (R)**	**COST PER ANNUM (R)**
Less: Allocable Costs					
Day-old chickens	Each	4.85	100.00	485.00	2,813.00
Feed:					
Starter Crumbles	50kg	177.30	2.00	354.60	2,056.68
Grower Pellets	50kg	166.35	3.00	499.05	2,894.49
Finisher Pellets	50Kg	156.55	4.00	626.20	3,631.96
Vaccinations:					
Newcastle Disease 1	1000 doses	34.40	0.20	6.88	39.90
Newcastle Disease 2	1000 doses	28.75	0.20	5.75	33.35
Gumboro	1000 doses	62.40	0.20	12.48	72.38
House sanitation	Batch	84.35	0.10	8.44	48.92
Transport:					
Day-old chickens	km	3.50	3.80	13.30	77.14
Shavings	km	3.46	3.80	13.15	76.26
Gas for brooder	48kg	650.00	0.20	130.00	754.00
Contingencies	2.00%			43.10	249.96
Total Allocable Costs (B)				**2 197.95**	**12,748.05**
Gross Margin (A-B)				**3 302.05**	**4,957.90**
Gross Profit Margin (GPM)				**0.58**	**0.28**