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# Determinants of supplementary feeding use among commercially oriented smallholder farmers in the Eastern Cape province of South Africa

by

Anelisa Koshe

Submitted in partial fulfilment of the requirements for the degree
Master of Science Degree in Agricultural Economics

in the

Department of Agricultural Economics, Extension & Rural Development

Faculty of Natural and Agricultural Science

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# DECLARATION OF ORIGINALITY

I, Anelisa Koshe, hereby declare that this dissertation which I submit for the degree of Master of Science in Agricultural Economics at the University of Pretoria is my own work and it has not been previously submitted by me for a degree at this and any tertiary institution.

Signature……

Anelisa Koshe

Date……

Approved by: Dr. M.N. Makhura

Signature……

Date…….



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# DEDICATION

All students affected by mental health are encouraged to take things one day at a time. Giving up on harder days is not an option. I hope you do feel not alone during this time. My heartfelt thoughts and prayers are with you all.



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# ACKNOWLEDGEMENTS

I recognise and extend my gratitude to the following people and organisations for making this dissertation possible.

To start with, I thank the Almighty God for making all this possible and putting it together.

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# Determinants of Supplementary Feeding Use among Commercially Oriented Smallholder Farmers in the Eastern Cape Province of South Africa

**by**

**Anelisa Koshe**

**Degree:** M.Sc. Agric Econ (Agricultural Economics)

**Department:** Agricultural Economics, Extension, and Rural Development

**Supervisor:** Dr. M.N. Makhura

## ABSTRACT

The importance of the adoption of agricultural technology in productivity and productivity gains can be realised when yield-enhancing technologies are used and disseminated. The main objective of this study is to identify the socio-economic determinants of supplementary feeding use (adoption of agricultural technology) among commercially orientated smallholders in the Eastern Cape, South Africa.

The livestock sector is the largest contributor to the South African total agricultural output and consequently contributes greatly to the Gross Domestic Product. Communal farmers collectively keep the largest herd of livestock. Commercially oriented farmers in communal farming areas face the challenge of a shortage of grazing land. Many of these farmers share 13% of the South African agricultural land allocated to the former homelands, which are overstocked with the livestock population. As such, it has become necessary for communal farmers to use supplementary feeding for their livestock, especially in winter. However, it is not known how prevalent the use of supplementary feeding has become and what factors determine whether a farmer is likely to use it. Therefore, the first objective of this study is to describe the current state of supplementary feeding in the Eastern Cape. The second objective is to determine the proportion of smallholder farmers that have adopted supplementary feeding



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in the Eastern Cape. The third objective is to determine the factors that influence supplementary feeding use among commercially oriented smallholder farmers.

The study used secondary data collected through questionnaire from three districts in the Eastern Cape: Amathole, Chris Hani, and OR Tambo. The Eastern Cape was chosen because it is one of South Africa's major livestock-producing provinces. The study used secondary data collected from purposefully and randomly selected 379 commercial-oriented farmers collected from three districts "in the Eastern Cape: Amathole, Chris Hani, and OR Tambo". The probit model was used to assess factors influencing supplementary use among commercially oriented smallholder farmers. Where the dependent variable was dichotomous, i.e. whether farmers use supplementary feeding or not (0;1), and when regressed with a set of independent variables such as farmer's assets and socio-economic variables, four variables were found to significantly influence the decision to use supplementary feeding. The variable, the total number of household members, was significant at 10%. The total number of livestock was significant at 5%. The total farm income variable was significant at 1%. The variable market access was significant at 10%.

The study concluded that less than half (46.70 percent) of surveyed farmers used supplementary feeding. The determinants of the use of supplementary feeding include commercially oriented farmers in the Eastern Cape who own livestock as well as sell livestock. The results suggest that owning livestock as well as selling livestock are the major determinants of supplementary feeding among commercially oriented farmers in the Eastern Cape. These results could aid the decision-making of policymakers regarding drought relief support for communal farmers and identifying farmers for relocation to commercial farms in the Animal and Veld Management Programme. While the study provides certain useful results that could facilitate policy for decision-making, it would be more useful if it would have been possible to give detailed results on how big a flock or herd should be in determining if a household would supplement the feeding of its animals. Future work should expand in this direction.

**Keywords**: smallholder farmers, supplementary feeding, livestock, probit model, Eastern Cape, commercially orientated.



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# LIST OF ACRONYMS

| | | |
|---|---|---|
| AMFA | – | Animal Feed Manufactures Association |
| ARC | – | Agricultural Research Council |
| ARC - API | – | Agricultural Research Council - Animal Production Irene |
| AVMP | – | Animal and Veld Management Programme |
| CEF | – | Conserve Energy Future |
| DAFF | – | Department: Agriculture, Forestry, and Fisheries |
| DAR | – | Department of Agriculture and Rural Development |
| DNA | – | Deoxyribonucleic Acid |
| DSE | – | Dry sheep equivalents |
| DPIRD | – | Department of Primary Industries and Regional Development |
| DRDLR | – | Department of Rural Development and Land Reform |
| FAO | – | Food and Agriculture Organization of the United Nations |
| GDP | – | Gross Domestic Product |
| ILUPSA | – | Impact of Land Use Project in South Africa |
| OR Tambo | – | Oliver Reginald Kaizana Tambo |
| TDN | – | Total Digestible Nutrients |
| VIF | – | Variance Inflation Factor |
| WWF | – | Worldwide Fund for Nature |



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# CHAPTER 1:
# INTRODUCTION

## 1.1 Background

The livestock sector is a major role player in the global food system and contributes significantly to poverty reduction, food security and agricultural development. According to the FAO (2017), livestock contributes 40% of the global value of agricultural output and supports the livelihoods and food and nutrition security of almost 1.3 billion people. In South Africa, the livestock sector similarly plays a vital role in the agricultural output of the country, and, as a result, in its Gross Domestic Product (DAFF, 2017). Approximately 69 % of 78 million hectares of arable land in South Africa are marginal and only suitable for livestock grazing (Kirsten, 2017).

The livestock sector, like the rest of South African agriculture, can be described as dual, with large-scale farmers, mostly white-dominated, farming on private land on one hand, and smallholder farmers, mostly black-dominated, farming on communal land in the former homelands, on the other hand (Greenberg, 2013). However, within smallholder farming, one finds certain sub-groups of similar farmers (Halimani, Marandure, Chikwanha, Molotsi, Abiodun, Dzama & Mapiye, 2021). In this regard, numerous studies have formalised this diversity (Pienaar & Traub, 2015). According to Kuivanen et al. (2016), “smallholder farming systems have certain characteristics that distinguish them from large-scale, profit-driven enterprises (Taruvinga, Singatha & Mukarumbwa, P. 2021). These include limited access to land, financial capital, and inputs, high levels of vulnerability, and low market participation. Yet, the macro-and micro-level structures, drivers, and constraints of these systems are constantly shaped by the local social and biophysical context. The result is farming system diversity in space, variability through time, and multidimensionality in terms of production and consumption decisions. Smallholders are not all land-scarce, resource-poor, or market-oriented, and any attempt to understand or develop the sector must acknowledge this heterogeneity”.



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According to (Fanadzo *et.al.,* 2021), "smallholder farmers as those farmers who produce for household consumption and markets, subsequently earning ongoing revenue from their farming businesses, which form a source of income for the family". Across the world, small-scale farmers face a number of challenges in agricultural and rural policies. These challenges include disease outbreaks, land degradation, and climatic variability (Stringer et al., 2008). The agricultural industry in South Africa is vulnerable to drought. Smallholder farmers face difficulties in dealing with recurrent droughts because of a lack of resources (Maltou & Bahta, 2019). As a result of extreme rainfall deficits, there is a low flow of water, which is considered a drought. Drought is described as a lengthened period of rainfall deficiency, which causes widespread damage to crops, resulting in low yields (Olaleye, 2010). As Olaleye (2010) points out, establishing a drought policy might also benefit from having a conceptual definition of drought in place

According to FAO (2017), small-scale farming is "an agricultural holding run by a family using mostly (or only) their labour and deriving from that work a large but variable share of its income, in kind or cash. The family relies on its agricultural activities for at least part of the food consumed – by it through self-provision, non-monetary exchanges, or market exchanges. The family members also engage in activities other than farming, locally or through migration. The holding relies on family labour with limited reliance on temporary hired labour, but maybe engaged in labour exchanges within the neighbourhood or a wider kinship framework". In the context of this study, participants who are termed commercially oriented small-scale farmers were selected on the basis that they had sold at least 20% of their livestock in the previous production season.

Droughts have led to decreases in crop production in the farming sector and reductions in livestock productivity. In the midst of South Africa's 2015 drought, it was estimated that agricultural production fell by 8.4% and that the national livestock herd was reduced by 15%, including 40 000 cattle losses in the KwaZulu-Natal province alone (Vetter et al., 2020). Crop failures and pasture losses are the main impacts that droughts have on the agricultural sector and the livelihoods of communities (Lottering et al., 2020).

The 2015 drought severely impacted on cattle and sheep stocks, resulting in a 15% reduction in the national herd. Because of the intensity of drought, the cash flow, mental health, and resilience of smallholder livestock farmers were threatened (Maltou & Bahta, 2019). The availability of forage for livestock is greatly reduced in drought conditions. Rangeland and



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forage production in the country are also negatively affected. Short-term and long-term consequences will continue to impact on livestock management (LeValley & McPhail, 2014).

According to Austin (2008), "as a natural hazard, drought has adverse effects on many aspects of society, such as land quality, the area planted for both local and export consumption, food imports, labour supply, and rural poverty". According to Serdeczny et al. (2017), droughts result in serious consequences on the economy of a country and the population at large. Some of the most severe impacts of droughts will be experienced by populations predominately residing in developing countries that experience high levels of poverty and have inadequate access to basic human needs such as food and clean water.

The main objective of this study is to determine the use of supplementary feeding among commercially oriented smallholder farmers in the Eastern Cape Province of South Africa. Feed used with another feed to improve the nutritional balance or performance of the total feed and is intended to be fed undiluted as a supplement to other feeds". According to the Department of Agriculture (2006), supplementary feed is "feed that is used in conjunction with another feed to improve the nutritional balance or performance of the overall feed and is intended to be fed undiluted as a supplement to other feeds."

## 1.2 Problem Statement

Crop residues alone do not always provide sufficient supplements to accommodate livestock kept during a dry season. Supplementary feeds of high quality must be provided, if supplementing is to be beneficial to the livestock. Numerous supplementary feeding routines can dimmish working oxen's weight, improve their performance, and reduce the amount of time they spend on feeding (Israel & Pearson, 2000). Previous studies by Makhura (2002) and by Khapayi and Celliers (2016) have documented the obstacles that small-scale farmers face. These obstacles include institutional constraints – unsecure land rights and shortage of grazing, among many others. The shortage of grazing land can be traced back to colonial policies, particularly the 1913 Land Act, which allocated only 13 percent of the land to the majority of black people.

This negative consequence was referred to in the Tomlinson Commission Report (Union of South Africa, 1955). Recently, Zantsi (2021) demonstrated how communal rangelands in one



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of the Eastern Cape villages have shrunk over time, which results in winter feed shortages. The long-term effects of overgrazing include food scarcity, which can cause livestock to starve. Without sufficient pasture for livestock grazing, herds of livestock are deprived of the nutrients they require to survive. Nutrient deficiencies prevent the animals from gaining weight appropriate to their productive stage and life, thus lowering their chances of survival (CEF, 2020).

Obtaining more feed is the obvious solution for a farmer during a drought. Unfortunately, this comes with increased expenses, which may cause a farmer to face even more financial difficulties (Vetter, 2003). As a result, before attempting this strategy, the availability of funds, as well as the likelihood of returning to profitable farming within a reasonable time after the drought, should be ensured (DAR, 2019).

Supplemental feeding is frequently required for livestock farmers conducting extensive farming practices because it can increase the nutrient intake of grazing ruminants and thus correct pasture deficiencies (Foster et al., 2016). However, in other regions in the Eastern Cape, it remains unknown what percentage of smallholder farmers supplement their animals' feed and what magnitude of feed they use, as well as the season during which they supplement their animals' feed. Such information could assist rural development policies, for example the Animal and Veld Management Programme, implemented by the Department of Rural Development and Land Reform (DRDLR, 2016). The use of supplementary feeding among smallholder farmers is still low and this affects the expected income for the farmers. However, there are no published studies that have examined the social and economic factors affecting the adoption of supplementary feeding among smallholder farmers in the Eastern Cape. Hence, this study endeavours to fill this gap.

A closer study was conducted by Sultana et al. (2016), focusing on the socio-economic determinants of milk production in Bangladesh. Another recent study was conducted by Gebretsadik et al. (2020), who focused on the determinants of milk production in the North-Western and Western Zones of Tigray, Ethiopia. The present study addresses the issue of supplementary feeding, particularly the factors that influence the use or adoption of supplementary feeding by commercially orientated smallholder farmers in the Eastern Cape province.



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## 1.3 Research Questions

This study's overarching question is to ascertain what determines the use of supplementary feeding among commercially oriented smallholder farmers in the Eastern Cape Province of South Africa.

The specific research questions include:

- What is the current state of supplementary feeding in the Eastern Cape?
- What is the proportion of commercially oriented smallholder farmers who have adopted supplementary feeding?
- What are factors that influence supplementary feeding use among commercially oriented smallholder farmers?

## 1.4 Research Objectives

The main objective of this study is to determine the use of supplementary feeding among commercially oriented smallholder farmers in the Eastern Cape Province of South Africa.

The specific objectives are:

- To describe the current state of supplementary feeding in the Eastern Cape.
- To determine the proportion of smallholder farmers who have adopted supplementary feeding in the Eastern Cape.
- To determine the factors that influence the use of supplementary feeding among commercially oriented smallholder farmers.

## 1.5 Research Hypothesis

The hypothesis of this study is that socio-economic factors determine the use of supplementary feeding among commercially oriented smallholder farmers in the Eastern Cape Province of South Africa.



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The Specific Hypothesis covers the following aspects:

$H_0$: The use of supplementary feed in the Eastern Cape has increased.

$H_0$: The majority of commercially oriented smallholder farmers make use of supplementary feeding.

$H_0$: Income is the major factor that influences the use of supplementary feeding among commercially oriented smallholder farmers.

## 1.6 Methodology

This study used secondary data, collected in three District Municipalities in the Eastern Cape Province. They are the Amathole District, the Chris Hani District, and the OR Tambo District Municipalities. This study made use of semi-structured questionnaires to collect data on socio-economic demographics, farm characteristics, and the like. This study used descriptive statistics and probit regression to address the research question of the study.

## 1.7 Outline of the Study

The first chapter has given an overview of the South African smallholder farming sector and a definition of smallholder farmers. Chapter 2 presents a literature review on supplementary feeding in commercial-oriented smallholder farmers**.** Chapter 3 gives an overview of the methodology used in the study. It, therefore, explains all the steps used in the analysis of supplementary feeding in commercial-oriented smallholder farmers. Chapter 4 presents the findings and explains the findings on the specific group classifications. The sixth chapter contains the summary of the study findings, a synthesis of those findings, a conclusion, and policy recommendations.



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# CHAPTER 2:
# SUPPLEMENTARY FEEDING IN COMMERCIALLY ORIENTED SMALLHOLDER FARMERS

## 2.1 Introduction

The previous chapter provided a summary of the research content. The purpose of this chapter is to provide an overview of supplementary feed available for use by commercial farmers. This chapter begins with a discussion of the concept of animal feed and follows with a discussion of additional feeds. It explains more about the role of extra feeds, the history of extra feeds, and the different types of extra feeds. This chapter expands upon the feed economy by assessing the cost of emotions, features, or drivers of additional feeds, as well as an ARC research list on food and the economic framework for additional feed.

## 2.2 Concept of Animal Feeding

Animal feed is food given to pets and other animals. It also refers to the food used to care for and treat farm animals by humans for profit. Animal health is guaranteed by the availability of quality food. “Poultry feed, sheep husbandry, cat food, pet food, pig farming, cattle feeding, dog food, equine nutrition, and bird food are all examples of feeds” (Yimam, 2020).

Feed comprises the most important and largest part of ensuring that animal protein for consumption by animals is safe, plentiful, and affordable. Key factors that influence the structure of animal feeding are the quantity of raw material, the amount of healthy food in portions, the nutritional requirements of a particular animal, and the laws and regulations of the state. (DAFF, 2019).

Livestock often need the same nutrients as humans do. Some foods are grown exclusively for animals, “such as pasture grasses, hay and silage plants, and certain cereal grains. Some foods, such as sugar beet pulp, cereals, and pineapple bran, are products of processed food plants for human consumption. Remaining food crops such as wheat, other grains, fruits, vegetables, and roots can also be fed to animals” (Loosli et al., 2018).



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According to Makkar (2016), malnutrition in animals reduces the output of animal production. Numerous studies on the interaction with the production of nutritious foods show that good animal nutrition increases the milk output of mammals. It also accelerates the growth of meat-producing animals, leading to an increase in meat produced. Nutrition improves fertility efficiency by increasing rotation, reducing the age at first breeding, reducing reproductive time, increasing productivity, and increasing farmer profits.

Improper feeding, an unbalanced diet, excessive sucking, or overeating can all have a detrimental effect on health and render animals more susceptible to disease. Proper nutrition can help to reduce infectious diseases by improving the integrity of cell membranes and improving immune systems (Makkar, 2016).

One of the major issues that smallholder farmers face, according to Chinembiri (1999), is the feeding of their livestock. Livestock in rural areas is mostly fed by grazing on communally owned natural pastures. These pastures are generally of poor quality and they are overgrazed because of a lack of control. Pastures do not produce enough fodder to feed the animals put on them during the dry season. Therefore, the animals must use their reserves for care and other functions, which leads to weight loss.

Farmers who keep draught livestock are occasionally unsure of how to best use the stored residues to benefit the working cattle, in terms of when and how the livestock should be fed (Israel & Pearson, 2000).

### 2.2.1 Animal nutrition

Food is essentially the source of nutrients for animals. Nutrients are necessary for the body's growth and maintenance, and some nutrients even provide energy. According to Yimam (2020), "animal food supplementation is the process of adding specific nutrients to animal food to increase the levels of certain nutrients in the overall diet or to compensate for a deficiency. Supplements are also used to improve digestive functions, boost vitality, regenerate the liver, and keep the body in balance."

Arai (2014) defines "nutrition as the process of providing and obtaining the food required for an animal's health and growth. Food nutrients are used as the primary energy source by an



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animal through a variety of processes, including digestion and absorption in the digestive tract, blood transport, and cell metabolism".

Moore (2018) defines "animal nutrition as the study of the composition and characteristics of the material consumed by the animal, as well as how this material is metabolized, converted, utilized, and excreted in the digestive tract and body cells of monogastric animals such as pigs, broilers, layers, ruminants-sheep, cattle, goats, and lower digestive tract fermenters horses, ostriches, and others".

Moore (2018) further states that livestock require "proper nutrition for growth and maintenance, as well as to provide energy for work and vital functions. The nutrition required for an animal to maintain its current weight is referred to as maintenance. The ability of the body to perform functions is defined as energy. Proper nutrition is also required to keep the body temperature stable, produce milk, reproduce, and develop healthy bone structures. Animals can develop health problems if they are not properly fed, which can result in expensive treatment or even death. Good nutrition is required for all of an animal's systems to function and work properly". Nutrition, according to Tona (2018), can be a serious constraint to livestock production, particularly when feed resources are insufficient in both quality and quantity. Nutrition can be obtained through either natural or supplemental feeding.

According to Makkar (2016), "poor feeding reduces livestock productivity. A large body of research on nutrition-reproduction interactions shows that good feeding increases lactating animals' milk production. It also accelerates the growth of meat-producing animals, resulting in more meat. Good nutrition boosts reproductive efficiency (higher cyclicity, younger age at first calving, shorter inter-calving interval, longer productive life, and higher farmer profitability). Furthermore, there is now a substantial body of evidence indicating that in utero nutrition affects the productivity and health of offspring later in life".

### 2.2.2 Natural feeding

South Africa is a subtropical country with temperatures that vary, depending on altitude. The interior, which contains the majority of grasslands, is semi-arid to arid, with rainfall decreasing westward (Manel et al., 2003).



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Grasslands are also the most important resource available to graziers in South Africa's developing regions. On the eastern seaboard, the former homelands of Transkei, Ciskei, and Kwa-Zulu Natal are mostly grassland. The people who live in these areas rely on this resource to produce meat, milk, hides, and fleece (Palmer & Ainslie, 2005).

Grazing animals feed largely on natural meadows or cultivated grazing areas in a grazing system. When the grass supply is limited or non-existent because of environmental circumstances (such as snow or drought), farmers substitute it with hay or silage. This feeding technique is exceedingly difficult to manage because grass supply fluctuates by season, both in terms of quality and quantity (Sollenberger et al., 2020).

Sollenberger et al. (2020) state that there are two types of grazing systems, "continuous cabbage and flexible pasture". Continuous grazing, also known as year-round grazing or a continuous growing season, is a way of grazing cattle in an area where animals can enter the area continuously, without restrictions throughout the year.

In southern Africa, natural grazing is the most important and least expensive source of nutrition for beef cattle. It can successfully be used to grow weaner calves and prepare them for slaughter, allowing the farmer to add value to the final product (Gouws, 2018).

According to Oduniyi et al. (2020), "the livestock sector is a major consumer of natural resources, accounting for approximately 80% of agricultural land used for grazing and 8% of water consumption. Primary production entails grazing animals on pastures, while secondary production necessitates finishing animals in feedlots. Because the majority of communal farmers allow their animals to graze freely, primary and secondary production activities are combined. Extensive farming is a term used to describe such systems".

Cattle and sheep grazing in southern Africa's extensive grassland and savanna regions are unable to maintain their condition and rate of production during the dry winter seasons. Un-supplemented animals lose 25–30070 percent of their maximum summer body mass, resulting in a significant decrease in reproductive rate and animal performance (Van Niekerk, 1985). Van Niekerk (1985) adds that early studies, which included extensive surveys, revealed a significant decrease in protein content and in the level of most mineral elements during the dry season, while fibre levels increased.



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## 2.3 Supplementary Feeding

### 2.3.1 Role of supplementary feeding

The Department of Agriculture (2006) defines supplementary feeding as "feed that is used in conjunction with another feed to improve the nutritional balance or performance of the overall feed and is intended to be fed undiluted as a supplement to other feeds. It is the feed used with another feed to improve the nutritional balance or performance of the total feed and is intended to be fed undiluted as a supplement to other feeds".

According to Cronje (1990), supplemental feeding is the addition of catalytic amounts of strategic nutrients to the basal diet to increase the efficiency of feeding utilisation. Supplemental feeding is defined by the National Research Council of the United States (2016) as providing grazing sheep with additional feed containing energy, protein, vitamins, and minerals that may be lacking in the pasture.

When the pasture, veld, or stubble is insufficient, supplemental feeding in the form of grain and/or protein concentrates provides energy or protein. Roughages such as hay and silage are only used as a veld supplement when there is a lack of available plant material (Louw, 2019).

Many studies have been published on the "beneficial effects of additional feeding on animal reproduction and growth in certain areas with substantial grazing, and as a result, supplementary feeding has become standard practice in the South African livestock farming business" (Foster et al., 2016).

The goal of supplementary feeding programmes is to correct nutrient and mineral deficiencies and/or imbalances in the forage available to livestock. Because of the seasonality of our rainfall, natural veld or planted pasture experience periods of abundant growth, followed by dry spells in which not only is forage scarce, but the nutrient content and digestibility of the forage also decreases (Meadow Feed, 2018).

As noted above, supplementary feeding can also be defined as the addition of catalytic amounts of strategic nutrients to the basal diet to improve feed utilisation efficiency. However, supplementary feeding strategies can only be addressed with any degree of scientific certainty if feed deficiencies can be linked to animal needs (Cronje, 1990).



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### 2.3.2 History of supplementary feeding of livestock

According to Yimam (2020), “animal food supplementation is the process of adding specific nutrients to animal food to increase the levels of certain nutrients in the overall diet or to compensate for a deficiency. Supplements are also used to improve digestive functions, boost vitality, regenerate the liver, and keep the body in balance”.

A supplemental feed or feed mixture is used to supplement the nutrients in the base feed and improve the nutritional value of the ration. A supplement contains “one or more proteins, energy, vitamins, or minerals that, when combined with the base feeds, produce a more complete feed” (Saha et al., 2010).

According to Coffey et al. (2016), no one knows when the carnivorous animal feeding programmes came about because they occurred before the development of writing. “Nearly 12,000 years ago, animal husbandry originated spontaneously in many parts of the so-called 'Fertile Crescent,' an ancient civilization that included Mesopotamia, Assyria, and Egypt. The ability of animals to create sustainable food supplies allows the world’s population to grow, habitat to grow, and cities to be built”.

The South African animal feed business originated in the early 1930s when the nation was suffering from severe droughts and the Great Depression, according to the Animal Feed Manufacturers Association (AFMA) (2020). “The animal feeds industry is divided into two parts: the formal feed industry (AFMA members) and the rest, which includes feedlots, smaller feed mills, and home mixers. To make balanced feed for poultry, cattle, sheep, and other animals, sixty different products, most of agricultural origin, are used. For the past two decades, the animal feed market in South Africa and elsewhere has grown steadily. It is an essential part of the life of a South African farmer. The growth of the animal feed industry over the next few years is entirely dependent on the growth of the animal product market, which is determined by consumer spending, particularly in the poultry, beef, sheep, and dairy industries, which are major users of animal feed in the animal production value chain. Importing poultry products into the country, for example, puts pressure not only on the local poultry industry but also on the animal feed industry. The expansion of the animal feed industry is good news for grain producers” (AFMA, 2020).



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The consumption of animal products has increased in developing countries, particularly in African countries, while consumption in developed countries has decreased. This would also contribute to the savings of resource-hungry inputs, such as feed resources, and would significantly improve the sustainability of the livestock section (Makkar, 2016).

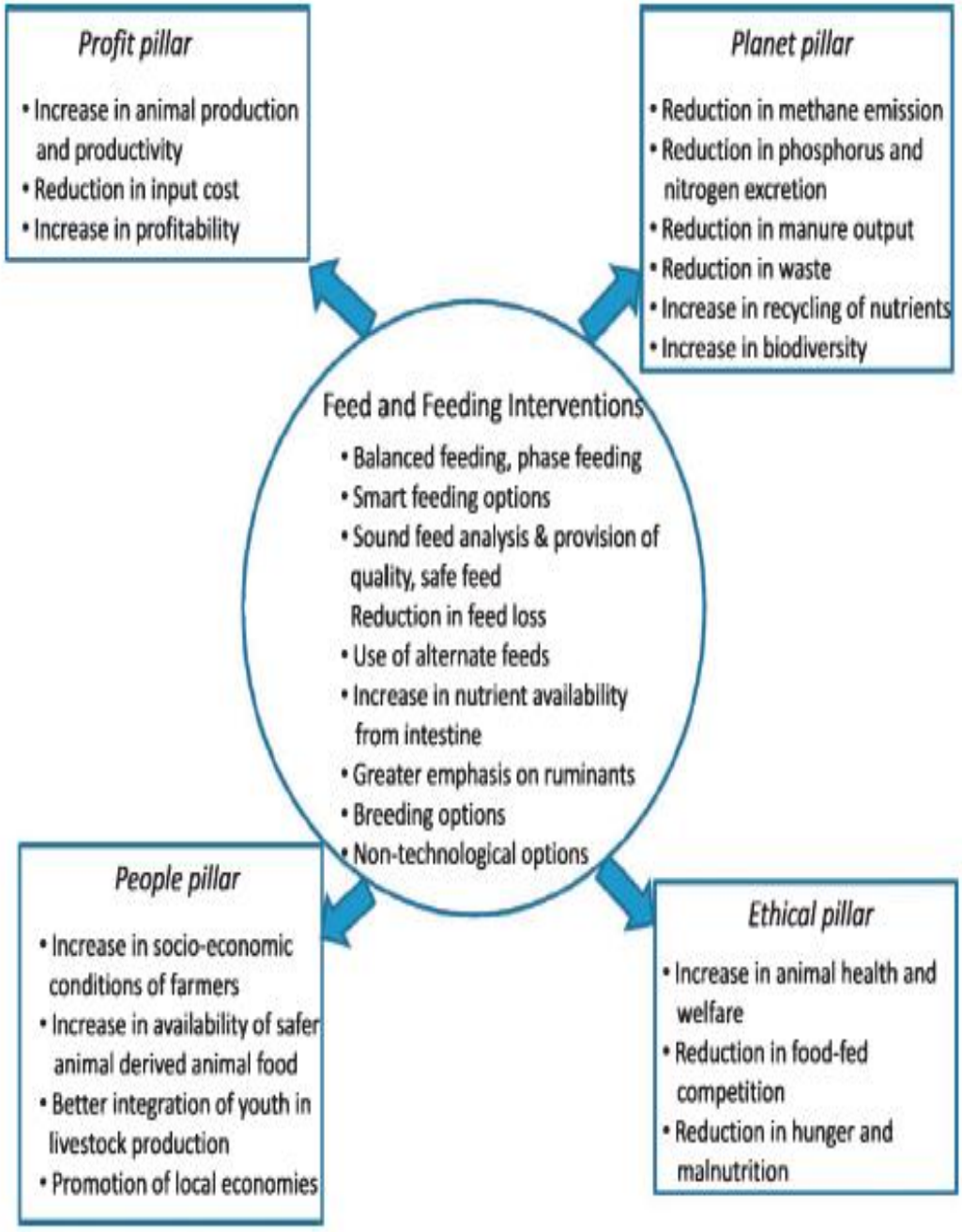


**Figure 2.1: Feed and feeding interventions and their impacts on sustainability pillars**

Source: Makkar (2016)



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### 2.3.3 Types of supplementary feeds

Animal feeds are classified into two types, namely concentrates and roughages (Mahgoub et al., 2011).

#### *2.3.3.1 Concentrates*

Cereal grains such as maize, grain, sorghum, oats, and barley are examples of concentrates. “These are feedstuffs that contain less than 18% crude fiber and more than 60% TDN. They are less bulky and digest more easily. Because they are a concentrated source of nutrients, they have a higher nutritive value than roughages. Concentrates are further classified as follows”:

- Concentrates High in Energy (Cereal grains and cereal grain by-products).
- Concentrates High in Protein.

#### *2.3.3.2 Forages*

Forages are defined as fresh, dried, or ensiled vegetable material, such as pastures, hay, or silage, which is fed to livestock (Bacon, 1982).

Grass, herbaceous legumes and tree legumes are examples of forage feeds consumed by grazing livestock. Forages can be fed as freshly cut fodder, hay, or silage. Forages include crop residues from cereal crops and hulls from some oilseeds. Forages have a high fibre content. Dried vegetable matter containing more than 18% fibre is fed to animals. This vegetable matter includes tropical grasses, such as elephant grass and Bermuda grass, as well as “legumes such as alfalfa, clover, leucaena, and stylo” (Mahgoub et al., 2011).

#### 2.3.3.3 **Pastures**

According to Loosli et al. (2018), “pasture grasses and legumes, both native and cultivated, are the single most important source of feed for ruminants like cattle, horses, sheep, and goats. During the growing season, they provide the majority of the feed for these animals at a lower



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cost than feed that must be harvested, processed, and transported. Grazing animals can be fed hundreds of different grasses, legumes, bushes, and trees. The nutritive value of cultivated varieties has been studied, but data for many of those that occur naturally is lacking".

### 2.3.3.4 **Feeds**

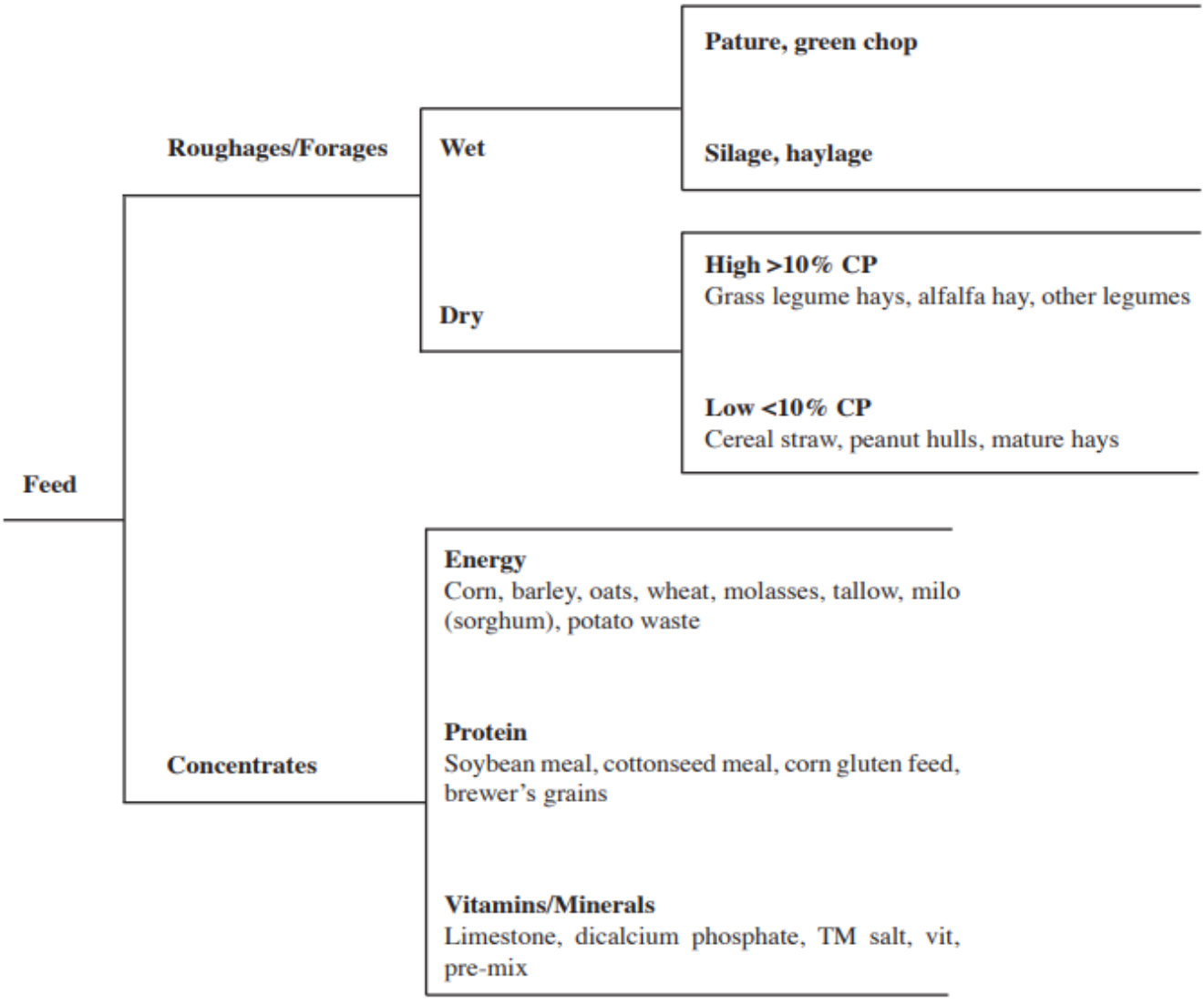


**Figure 2.2: Classification of feeds for beef cattle**

Source: Hall et al. (2005)



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## 2.4 Economics of Animal Feeding

### 2.4.1 Benefits of feeding supplements

When pastures or stubble materials are low in energy and protein, livestock must be supplemented with grain, hay or silage. A good supplementary feeding programme ensures that livestock use as much dry paddock feeds as possible, while also providing sufficient supplementary feed for maintenance or growth (Department of Primary Industries and Regional Development, 2019).

Supplemental feeding can be used to meet the nutritional needs of sheep at various stages of their lives, such as increasing their consumption of dry pasture and specific nutrients, or improving growth rate, fertility, meat production, or the wool quality. Sheep nutritional requirements vary according to age, size, pregnancy and lactation (Queensland Government, 2016).

What livestock eat has a significant impact on the performance, profitability and quality of the end products derived from the livestock. Cereals, legumes and protein meals make up the majority of the diet for intensive livestock (pigs, poultry, sheep, and cattle in feedlots), which is formulated to meet diet specifications. For large animals, pasture quality and year-round supply become critical issues (DPIRD, 2019).

In grazing systems, supplemental feeding is frequently used to help meet production requirements. This might be as a regular part of the production cycle to help match feed demand to feed supply, or it might be reserved for drought situations. The amount of supplementary feeding used is determined by the business objective and seasonal conditions (Meat and Livestock Australia, 2020).

Supplemental feeding may increase the nutrient intake of grazing ruminants and also correct pasture deficiencies for animal production (De Waal, 1990). Despite the significant costs incurred, the responses of animals to supplementation can only be described as unpredictable and sometimes far below what might be expected based on feeding standards.



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### 2.4.2 Cost of animal feeding

Regardless of species or production system, feed is the single most important financial component of animal production. Feed costs can account for up to 70% of the total cost of production of an animal product. A livestock-rearing operation can be bankrupted by high feed costs. The high cost of feeds in 2008 reduced the supply of animal products and increased prices. Optimising feed use efficiency, or producing more with less feed, reduces feeding costs and increases the livestock operation's economic viability (Makkar, 2016).

The feed bill is the most expensive part of running a livestock production business. To keep this cost low, the animals must be fed the appropriate amount of feed, as it is wasteful to overfeed. On the other hand, animal performance and profitability will suffer as a result of underfeeding. As a result, proper animal nutrition and feeding are critical to the profitability of the livestock enterprise (Saha et al., 2010).

According to Becker (2008), livestock producers faced sharply higher feed costs in 2008, owing to competing use demands for corn and soybeans, as well as higher energy prices. Some analysts argue that current government policies, such as financial incentives to divert corn from feed to ethanol production, have exacerbated, if not caused, these higher costs. Declines in crop production attributable to weather and the increased global demand for commodities are two other factors that some authorities believe are at least as important. Changes in ethanol incentives, the use of conservation land for forage, and direct aid to producers are among the proposed options for mitigating the effects of higher feed costs.

Feeding programmes should be designed to be cost-effective, while also meeting the nutritional needs of animals for a variety of nutrients such as protein, minerals, vitamins, carbohydrates, and fats. When calculating the costs of a diet to be fed, income must be considered in addition to feeding costs. Spending a little more on feeding costs may result in higher profits if the animal products are better, and the animals rebreed faster, or become healthier (Buza et al., 2014).



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### 2.4.3 Conceptual and economic framework of supplementary feed

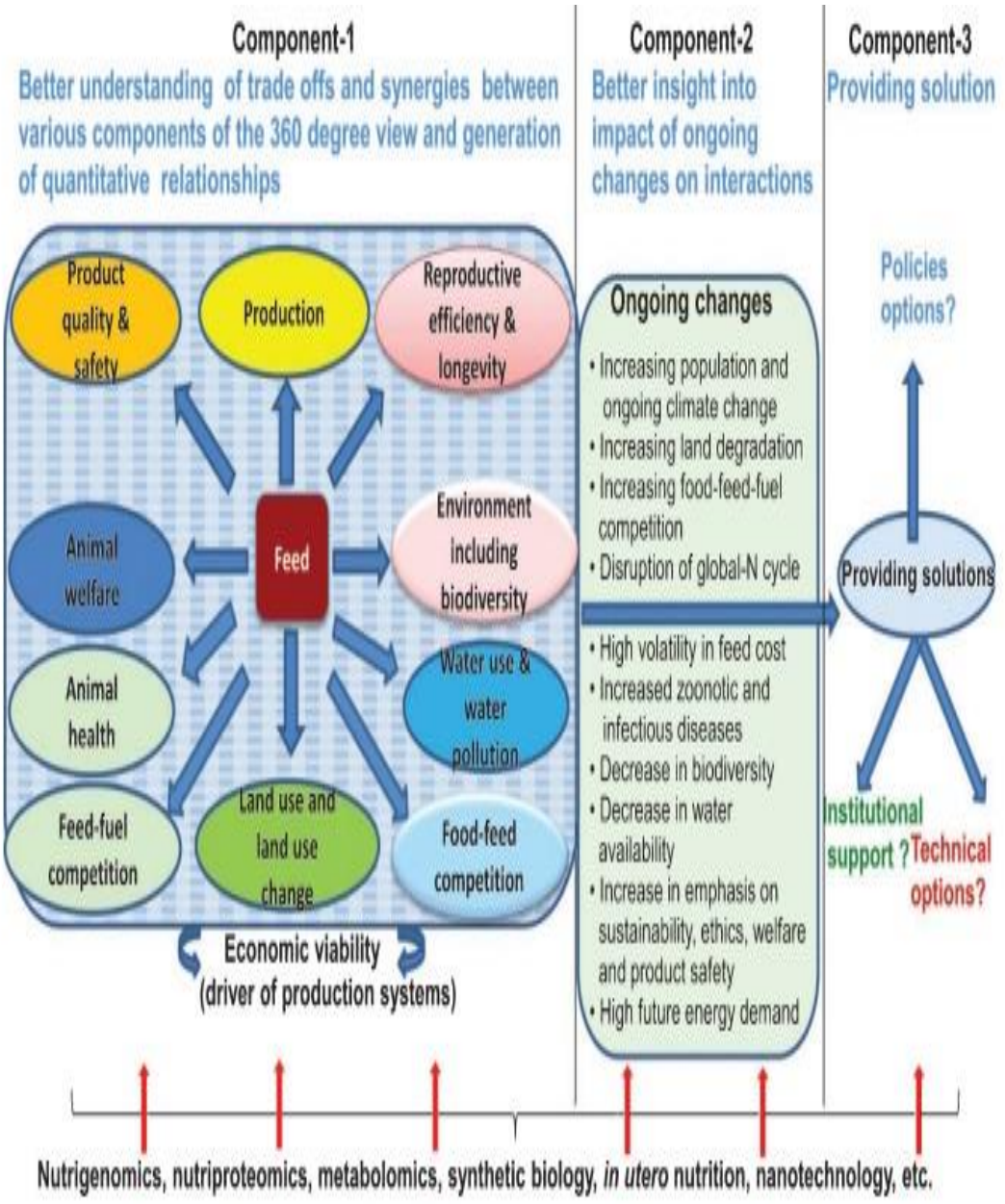


**Figure 2.3: 360-degree view and a framework for future R&D work**

Source: Makkar (2016)

## 2.5 Factors or Drivers of Supplementary Feeding

Drought conditions persist in many parts of the summer rainfall region, forcing farmers to revise their winter-feeding strategies to compensate for nutritional losses. Hinton (2007) further



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states that there are three main reasons to supplement sheep and cattle diets, which are as follows:

1. To increase the rate of growth or production as much as possible (lot feeding);
2. To make up for a dietary deficiency, such as a lack of protein or magnesium; and
3. To make up for a lack of or poor quality pasture.

According to Hinton (2007), five factors can influence the need to provide supplementary feed to grazing stock:

1. Seasonal variation in pasture rate over a year;
2. Stock rate per hectare – sheep, cattle or dry sheep equivalents (DSE);
3. Breeding or growth stage;
4. Lack of normal pasture growth as a result of drought, fire, disease, and unusual seasons; and
5. The effects of weather and environment on sheep and cattle.

"Seasonal variation in pasture growth rate within a year"

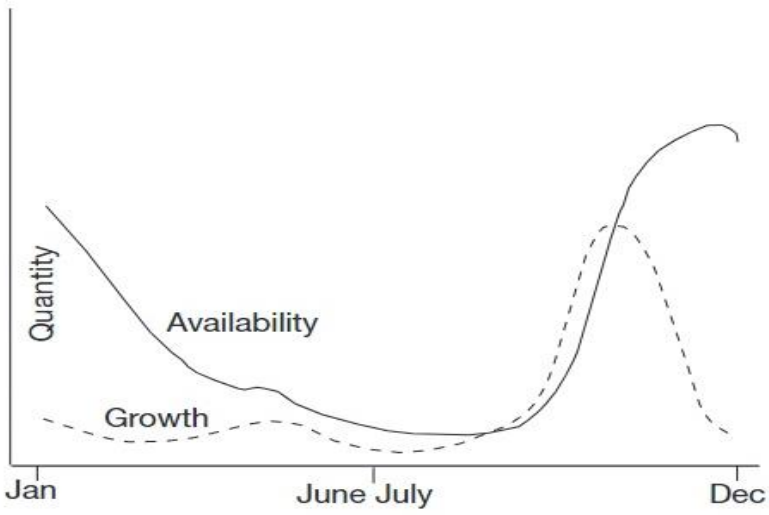


**Figure 2.4: Pasture growth and availability in winter rainfall area**

Source: Hinton (2007)



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### 2.5.1 Drivers and threats facing farmers regarding supplementary feeding

Table 2.1 below sets out the drivers and threats faced by farmers, based on literature in the supplementary feeding industry.

**Table 2.1: Drivers and threats of supplementary feeding**

| Drivers | Threats |
|---|---|
| Growth in livestock production | Increases in ingredient prices |
| Increasing consumption of animal-based food products | High pricing |
| Untapped market potential | Lower impacts on native breeds |
| Growth of user industries | The unpredictability of climatic conditions |
| Growing population | |
| Increase in disposable income | |

Source: DAFF (2019)

## 2.6 Agricultural Research Council (ARC) Research on Feeding

The Animal Production Institute of ARC is based in Irene, Pretoria, and has a number of well-placed satellite stations, nationwide. Following structural changes in 2008, the ARC's research API focused on basic and secondary research, development and transmission of information on animal reproduction and development; diverse areas and nutrition; and food science and technology, all in order to improve productivity and sustainable use of resources (ARC 2014).

In addition, the research focus area of the ARC-API includes serving as the custodian of national assets, such as the conservation of genetic material in animal collections, fodder and viruses, as well as the database of related DNA banks. Research conducted in ARC-API units can be divided into three research programmes, namely: Rangeland and Food, Animal Records and Development, and Food Science and Technology (ARC, 2014).



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The nutrition programme is part of the efforts to enhance animal production. The programme focuses on feeding small herds, such as sheep and goats, large herds, such as dairy cows and beef, fodder conservation (silage), and, finally, deer (ARC, 2014).

### 2.6.1 Focus of ARC nutrition research

The ARC nutrition research is focused on the following aspects:

1. Development of conventional and unconventional feeding systems.
2. Researching the efficacy of conventional and alternative feed sources.
3. Assessment of feed additives that promote efficiency and health.
4. Feed and feedstuff compositional analysis and interpretation.
5. Research into nutritional requirements.
6. Improvements in feed intake and digestive efficiency.
7. Assistance with the development of regulations and policies.
8. Rural farmer development through research assistance and infrastructure development.
9. Animal nutrition models.
10. Silage inoculant evaluation to improve the nutritional quality of preserved forages.
11. Forage preservation.

The ARC database is also used for technology transfer, such as course presentations, farmers' days, and training of students from tertiary institutions and farmers. Manuals, books and pamphlets were created for the Department of Agriculture, Forestry and Fisheries (DAFF), the Provincial Department of Agriculture, and farmers. Creating stock for farmers' livestock. Educating new farmers. The ARC also participates in industrial and higher education conferences (e.g. AFMA and TUT), and in refereeing articles for scientific journals (ARC, 2014).



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## 2.7 The Current State of Supplementary Feeding in South Africa

The South African feed industry arose in the aftermath of severe droughts and the Great Depression experienced in the 1930s. The industry produces a wide variety of animal feed, including feed for poultry, milk, beef, sheep and pig farmers. The South African animal feed industry is divided into five main categories: pork, beef and lamb, poultry, poultry, and all other animal feeds. For the 2018/19 financial year, the different stocks of animal feed production are as follows (DAFF 2019).

According to DAFF (2019), AFMA members stated that consumption of raw materials and maize imports accounted for 46.77 percent of total feed sales from 2013/14 to 2018/19. The average intakes of soybean meal, sunflower seeds, oil cake, and fishmeal were approximately 12.98 percent, 4.49 percent, and 0.24 percent, respectively.

Animal feed is an important part of the entire food production process, especially in the livestock-based food industry. Usually, production takes place in industrial mills or on-farm mixing. Poultry production, which is the largest consumer of animal feed, is expected to grow by 24 percent over the next ten years, reaching 131.5 tons by 2025. From 2017 to 2021, the market value of the agricultural business in South Africa was expected to grow by 7% per annum. These figures inspire the future of the animal feed industry (Agriseta, 2020).

Broiler feed accounted for approximately 28 percent of the animal feed volume produced during the 2018/19 season, “followed by beef and sheep feed at 27 percent. Dairy and layer feed consumption accounted for approximately 20% and 11% of total feed consumption, respectively. Although pig production is the world’s second-largest animal feed producer, it accounts for only 9% of total feed production in South Africa. Other species’ feed (dogs, horses, ostriches, and aquaculture) contributed 5% of total consumption. The effect of the South African poultry industry’s ongoing challenges has manifested itself in the feed volumes sold in this segment. Although poultry remains the most cost-effective source of protein when compared to other protein sources, feed sales in this segment increased in 2018/19, with broiler feed increasing by 4.1 percent and breeder feed declining by 1%”. Beef and sheep feed sales increased by 4% in volume terms, when compared with the previous season.



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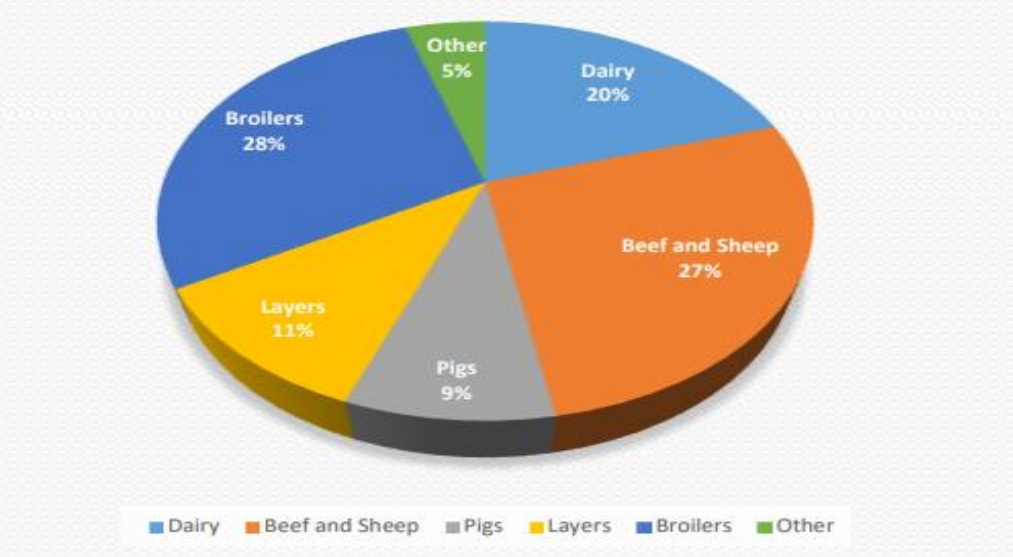


**Figure 2.5: Animal Feed Production Segmental Share (2018/19)**

Source: DAFF (2019)

## 2.8 Supplementary Feeding Programmes Provided by the Government in South Africa

### 2.8.1 Animal and Veld Management Programme

In 2015, the Department of Rural Development and Land Reform implemented the Animal and Veld Management Programme (AVMP) project (SA Yearbook, 2015/2016).

The AVMP aims to assist farmers in rural areas who are facing severe conditions attributable to overcrowding and environmental degradation caused by overgrazing. The AVMP project focuses on rehabilitating degraded areas to improve crop production, as well as "deforestation and livestock industry support infrastructure" (SA Yearbook 2015/2016).

The programme will also help to deal with soil erosion, compaction, and the regeneration of the environment. It is part of a government intervention to reverse the legacy of the 1913 Indigenous Land Act, which confined the majority of black people to 13% of the land, and created problems of overcrowding and overcrowding in communal areas. Farmers in communal areas who have shown that they can farm successfully will be recognised by the Department. Based on their history, such farmers will be relocated to state farms to enable them



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to expand their farming activities. The AVMP is expected to reach the poorest 24 district municipalities in the country. More than 451 AVMP projects were launched in 2015, benefiting 2 206 smallholder farmers. The DRDLR spent approximately R2.25 million on AVMP-related activities in the Leliefontein community. These include the Spoegrivier and Tweerivier forest rehabilitation and deforestation projects, which will employ 50 community members, as well as developing a plan to develop agricultural and rural infrastructure, in conjunction with a multi-million rand water supply infrastructure (2015/2016 Yearbook).

## 2.9 Chapter Summary

The chapter discussed literature on animal feeding in order to gain an understanding of the process, importance, and extent of the feed industry in South Africa. In the review, we ascertained that what livestock eat has a significant impact on the performance, profitability, and quality of the end products – this is important information for farmers to know. Animal feed supplementation is the process of adding specific nutrients to animal food to increase the levels of certain nutrients in the overall diet or to compensate for a deficiency. The South African feed industry arose in the aftermath of severe droughts and the Great Depression experienced in the 1930s.

The feed industry produces a wide variety of animal feed, including feed for poultry, milk, beef, sheep, and pig farmers. The South African animal feed industry is divided into five main categories: pork, beef and lamb, poultry, poultry, and all other animal feeds. While it is mostly commercial farmers who make use of supplementary feeding, the frequent occurrences of droughts and the shortages of grazing land have prompted smallholder farmers to start making use of supplementary feeding. There are benefits of feeding supplements, which reflect in the cost of animal feeding. The study further showed that there are looking at the factors or drivers of feeding or supplementary feeding. There is also some evidence of supplementary feeding programmes provided by the government in South Africa to support smallholder farmers.



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# CHAPTER 3:
# RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter describes the methods used to achieve the research objectives. This chapter outlines the methodological methods used in following the course of the study. It begins with a description of the research area, and then moves on to research design, sampling process, model specification, and descriptive statistics.

## 3.2 Description of the Study Area

Smaller holder farmers are concentrated in three provinces, according to the Statistics South Africa General Household Survey (2016): KwaZulu-Natal, Limpopo, and the Eastern Cape. The current study focuses only on the Eastern Cape, which is one of the three largest provinces for smallholder farmers, particularly livestock farmers. Smallholder farmers in the Eastern Cape have large herds of local animals. This is so because large tracts of land are suitable for livestock grazing, but most of these managed by communal farmers are overgrazed. This study was conducted in three district municipalities in the Eastern Cape province. These districts were chosen because they house the majority of smallholder farmers in the Eastern Cape. The municipalities are Amathole District, Chris Hani District, and OR Tambo District.

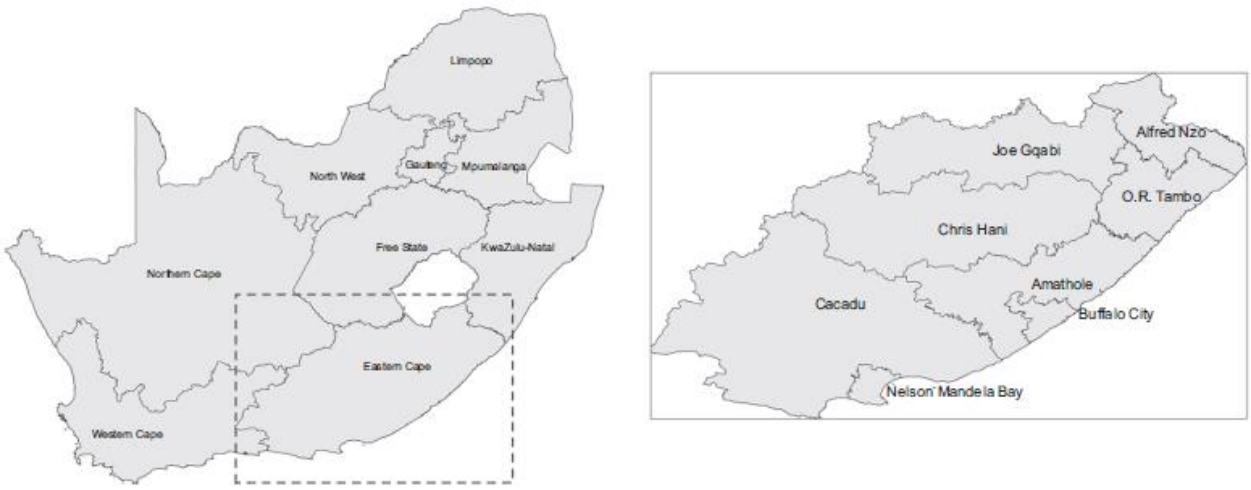


**Figure 3.1: Map showing the Eastern Cape province and its district municipalities**
Source: Zantsi et al. (2020)



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### 3.2.1 Climate conditions

The Eastern Cape is a province located between Kwa-Zulu Natal and the Western Cape, and its climate is a hybrid of the two. Its coastal cities have both a subtropical and Mediterranean climate, while the interior is a little hotter. The area is vast, stretching from the coast to more mountainous escarpment regions inland, resulting in a climate that varies greatly.

Conditions inland are typically drier and hotter, with lower rainfall levels than along the coast. The Eastern Cape has a high level of annual sunshine, with temperatures ranging from 16 ° to 26 °C in summer and 7 ° to 20 °C in winter.

### 3.2.2 Agro-ecological features

The Eastern Cape Province in South Africa covers an area of approximately 17.1 million ha and has a diverse range of soils and climatic conditions that allow for a variety of agricultural practices. Approximately 30% of the area is made up of smallholdings, where farmers mostly practise mixed farming for home consumption. This includes grazing cattle, goats and sheep on communally owned natural rangeland; growing maize, beans and pumpkins on individual arable holdings of 1 to 5 ha; and growing a diverse range of grains and vegetables, including maize (Mandiringana et al., 2005).

## 3.3 Research Design and Data

The focus of this study is to determine the factors that influence the use of supplementary feeding among commercially oriented smallholder farmers in the Eastern Cape province of South Africa. This study made use of secondary cross-sectional data collected by Zantsi (2021). The data used in this study is also being used for an ongoing Impact of Land Use Project in South Africa (ILUPSA), which is a collaboration between Stellenbosch University and Agroscope – a Swiss federal research institute. Before the collection of the data was conducted, an ethics clearance application was submitted to Stellenbosch University's Ethics Committee, and an ethics clearance, number REC-2017-1856, was granted. An ethical clearance was also obtained from the University of Pretoria (reference number (NAS293/2020).



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## 3.4 Sampling Procedure

The study made use of data that was collected through questionnaire by Dr Zantsi for the purpose of his Ph.D. dissertation. The Eastern Cape province was selected among provinces with a high density of smallholders, the random sampling procedure was used at the village and household levels (Zantsi et al., 2020). Random sampling was used to ensure that results obtained from the sample are approximate to what would have been obtained if the entire population had been measured (Shadish et al., 2002). StatsSA (2016) states that the Eastern Cape is one of the three provinces that house more than 60 percent of smallholders in the country. Literature was used to select the three districts, and according to Aliber et al. (2009), smallholders in the Eastern Cape are concentrated in the districts of Amathole, Chris Hani, and OR Tambo. At the village level, random sampling was applied. A questionnaire, which was designed in English and translated into isiXhosa, was used to collect the information from household heads willing to participate in the study (Zantsi et al., 2020). Following guidance in van Averbeke and Mohamed (2006), households were included if they had sold at least 20% of their products in the previous season.

The survey included 379 commercially oriented smallholders who were farming in the three district municipalities selected in the Eastern Cape province. The province was selected because it is one of the livestock hubs in the country (Goni et al., 2018). The distribution of the sample across the districts has not been rendered homogeneous because of the lack of resources required to achieve this. Table 4.1 below sets out a description the sample. The survey covered all types of farming activities in the sampled districts; however, for this study, only livestock-farming households were filtered to form this sample of 379 potential participants.

### 3.4.1 Description of the sample size

Table 3.1 below illustrates the samples size used in the study, and how the sample size has been divided among the three district municipalities situated in the Eastern Cape province. A total of 379 emerging smallholder farmers were randomly selected. Of these, 175 were in the ADM – 55 in Mbashe, 50 in Mnquma, 30 Ngqushwa, and 40 in the Raymond Mhlaba Local Municipalities. Another 84 were in the OTDM, specifically in the King Sabata Dalindyebo Local Municipality and 120 in the CHDM – 80 in the Enoch Mgijima Local Municipality, and 40 in the Sakhisizwe Local Municipality (Zantsi *et, al.*, 2020).



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**Table 3.1: Sampling size**

| **EASTERN CAPE PROVINCE** | |
|---|---|
| District Municipality | Sample size |
| Amathole | 175 |
| Chris Hani | 120 |
| OR Tambo | 84 |
| Total | 379 |

## 3.5 Model Specification Issues

### 3.5.1 Diagnosis of outliers

The ESB (2013) defines an outlier as an observation that appears to deviate noticeably from the other observations in the sample. Outliers may indicate bad data, such as data that has been incorrectly coded. Outliers may also indicate interesting observations in other cases; hence, they should be diagnosed and a decision made on whether they should be kept or eliminated from the sample. According to Mbonane (2018), it is critical to identify potential outliers because extreme observations can influence the results of statistical analyses.

### 3.5.2 Treatment of missing variables

Owing to the use of multidimensional variables, the presence of missing variables was expected in this data set. For example, this study includes crop farmers who may or may not also have livestock. As a result, these crop farmers would not have been available to provide information about their ancillary livestock activities. Most statistical packages provide several methods for dealing with missing values, such as substituting the means for missing values.



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### 3.5.3 Collinearity diagnosis

If there is a strong linear relationship between regressors, there is multicollinearity in the data. Collinearity is classified as accurate or standard, depending on the scale used. If one of the regressors is a complete line function of the remaining regressors, there is a direct collinearity (or one of them). On the other hand, most multicollinearity occurs when one of the regressors is closely associated, but not well, with the other regressors (García-Pérez José et al., 2020).

Multicollinearity magnifies the arbitrary errors of common coefficients. Generalised errors, on the other hand, suggest that the coefficients of other independent variables may be found to be not significantly different from zero. The variance inflation factor (VIF) is one way to measure multicollinearity because it measures how much the coefficient of variance is measured when the forecasts are correlated. VIFs will all be 1 if there are no associated features. There is no multicollinearity between retreaters when the variance inflation factor (VIF) is equal to one, but if the VIF is greater than one, the retreat may be equally correlated. VIFs of 5 to 10 show high potential relationships (Akinwande et al., 2015).

Multicollinearity tests were performed on all independent variables to determine Variance Inflation Factor (VIF) and tolerance values. The VIF for all independent variables was below the 10.00 limit, and tolerance values were greater than 0.10. This indicates that there was no multicollinearity between the independent variables used in this study (see Appendix A).

## 3.6 Analytical Tools and Framework

The collected data was analysed through using descriptive statistics, a probit retrieval model, and a flow regression model. Distribution tables, waves, percentages, and methods were among the descriptive statistics used. The socio-economic, household and agricultural aspects of fair heads are presented using descriptive statistics. The STATA package was used for model analysis in the preliminary analysis.

## 3.7 Model Specification

In the Probit regression, the cumulative standard normal distribution function $\Phi(\cdot)$ is used to model the regression function when the dependent variable is binary, that is, we assume

$$E(Y|X) = P(Y=1|X) = \Phi(\beta 0+\beta 1X).$$



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$\beta 0 + \beta 1X$ in (11.4) plays the role of a quantile z. Remember that

$$\Phi(z) = P(Z \leq z) \text{ , } Z \sim N(0,1)$$

Such that the Probit coefficient $\beta 1$ in (11.4) is the change in z associated with a one unit change in X. Although the effect on z of a change in X is linear, the link between z and the dependent variable Y is nonlinear since $\Phi$ is a nonlinear function of X.

Since the dependent variable is a nonlinear function of the regressors, the coefficient on X has no simple interpretation.

### 3.7.1 Household demographics

#### *3.7.1.1 Gender*

The gender variable indicates whether a household is headed by a man or a woman. According to Kennedy and Peters (1992), "the gender of the household is important because it influences the household's ability to source income."

Females are more likely than males are to participate in subsistence crop farming in rural areas (FAO, 1995). Women-headed rural households are typically smaller than male-headed households are, making it more difficult to increase output per land unit by increasing the amount of labour added per unit of land (Gthnji et al., 2011).

#### *3.7.1.2 Age*

This is the actual age of the head of the household. According to Obi and Pote (2012), younger farmers are expected to be more technically limited than older farmers who are perceived to have gained more experience in farming and resources. As a result, it is hypothesised that increasing age has a negative impact on market access. The older farmers in the study by Obi and Pote (2012) were assessed to be more efficient, and this was possible because they had gained more experience with cotton production. Another reason could be that older farmers have more resources at their disposal, such as capital and cattle (Mushunje et al., 2003).



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#### *3.7.1.3 Number of years spent in school*

The number of years that the household spent in school was recorded in this variable. It is expected that a lack of education would have a negative impact on the agricultural processes under study. As a result, it is hypothesised that there is a positive relationship between education and market access (Obi & Pote, 2012). Farmers become more knowledgeable about effective land use as their education level rises, resulting in increased land utilisation (Musemwa et al., 2013).

#### *3.7.1.4 Household size*

In this study, the household size is defined as the number of people residing in the household. Obi and Pote (2012) contend that a greater number people in the household might increase the dependency ratio, thus affecting investments and savings. A larger household, on the other hand, might imply increase labour availability, which boosts farm production in communal agriculture's labour-intensive farming systems.

#### *3.7.1.5 Household income*

This variable represents the total amount of money that a household receives in rands per month. Household income can come from social grants, remittances, non-farm income, fruit sales income, or a combination of these. According to Thangata et al. (2002), higher-income households are more likely to participate in technology adoption, as compared with lower-income households, because the former would be able to hire labour or purchase farm inputs, if they were constrained in these areas.

This variable allows us to determine whether or not the household heads are employed. This variable captures a household's various sources of income and whether or not this income has a positive impact on rural livelihoods. The variable is divided into four dummy variables: government grants, pensions, salary/wages, and others. Other options include remittances from family members and selling excess produce. Non-farm employment undertaken by members of a household has an adverse impact on agricultural practices because these households would



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not devote enough time to agriculture because of their inability to work on the farm (Lien et al., 2010).

## 3.8 Farm Characteristics

### 3.8.1 Total farm income

The total amount of money received by the head of a household in rands per year from the sale of products is represented by this variable. This total includes the number of cattle, sheep and goats sold at various prices. Multiplying the numbers of cattle, sheep and goats sold by the respective prices of each type of animal is the process used to calculate this variable. Lastly, the total sum received from the sales of the cattle, sheep and goats is added to the total on-farm income.

### 3.8.2 Market access

This variable in the study focuses on whether respondents have access to markets, and whether those markets are formal or informal in character. Access to profitable markets is an important factor in the success of smallholder farmers. This necessitates the development of systems, such as market information, market intelligence and effective farmer organisations, which are responsive to the needs of farmers. However, owing to numerous constraints and barriers, smallholder farmers in most developing economies struggle to participate in markets (Ngqangweni et al., 2016).

### 3.8.3 Total number of livestock kept

In this study, this variable is continuous, and it includes the total number of cattle, sheep and goats owned by a household head. “Higher use of supplementary feeding (adoption of technology) is associated with larger heard sizes” (Janssen & Swinnen, 2019).



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## 3.9 Description of the Dependent Variable

Table 3.2 below sets out the dependent variable chosen for this study, which is the use of supplementary feeding. This variable is a dummy variable, and the question is whether a respondent used supplementary feed for livestock, with the available answers being either 'yes' = 0, or 'no' = 1.

**Table 3.2: Description of choice of the dependent variable**

| Dependent Variable | Variable Label | Variable Description |
|---|---|---|
| Do you supplementary feed your livestock? | supp_use | Make use of supplementary feeding: Yes = 0, No = 1 |

## 3.10 Description of the Independent Variable

This study's independent variables are described in Table 3.3 below. These are the factors that determine the use of supplementary feeding among commercially orientated smallholder farmers. The table presents the variable labels and the coding of the variables. The variables include the household head characteristics, which are age, gender, the total number of household size, the number of years spent in school, the and main source of income. The farming characteristics are the status of the communal grazing land, the total number of livestock owned by the household head, access to the market, the reason for raising livestock, the total number of bags of feed purchased, and total farm income.



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**Table 3.3: Description of independent variables**

| Independent Variable | Variable Label | Variable Description |
|---|---|---|
| ***Household head characteristics*** | | |
| Age of household head | age_hh | Age of head of household in years (25–44 = 0; 45–54 = 1; 55–64 =3; 65 & above = 4) |
| Gender of household | gender_hh | Gender of household (1 = male, 0 = female) |
| Total number of household size | total_hhm | Number of family members (headcount) |
| Number of years spent in school | highest_level_educ | Number of years spent at school (years in school count) |
| The main source of income | main_source_inc | Government grants – 0; Selling of livestock & livestock products –1; Salaries or wages – 2; Other – 3 |
| ***Farming Characteristics*** | | |
| Status of communal grazing land | grazing_land | Good – 0, Bad – 1 |
| Total number of livestock owned by the household head | total_livestock | Number of sheep, goats, and cows (headcount) |
| Access to market | market_access | Yes – 0; No – 1 |
| Reason for raising livestock | raising_livestock | The main source of income – 0; Main source of income – 1 |
| Total number of bags of feed purchased | total_bags_p | Total number of bags purchased (count number of bags) |
| Total farm income | farm_income | total annual income from selling livestock and livestock products |



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## 3.11 Hypothesis of Relationship with Smallholder Farmers using Supplementary Feeding

Table 3.4 below sets out theoretical expectations, based on a literature review of the variables used in the analysis for the factors influencing technology adoption, which in this study represents the use of supplementary feeding. The variables include the household head characteristics, which are age, gender, the total number of household size, the number of years spent in school, and the main source of income. The farming characteristics are the status of the communal grazing land, the total number of livestock owned by the household head, access to the market, and total farm income.



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**Table 3.4: Hypothesis of relationship with farmers using supplementary feeding**

| Independent variables | Independent variables | Dependent variable – use of supplementary feeding/adoption of technology | Source of hypothesised relationships |
|---|---|---|---|
| ***Household characteristics*** | | ***Interest decision*** | |
| Age of head of household | age_hh | − | Van den Berg (2013) |
| Gender of the head of household (males) | gender_hh | + | Ngarava, et.al, (2020) |
| Total number of household size | total_hhm | − | Danso-Abbeam (2014); (Ali, 2013); (Wan, 2014) |
| Number of years spent in school | highest_level_educ | + | Ngarava et al. (2020) |
| The main source of income | main_source_inc | + | Oduniyi et al. (2020) |
| ***Farming Characteristics*** | | | |
| Accesses to markets | market_access | + | Sikhweni & Hassan (2014) |
| Total farm income | farm_income | +/− | Hailu et al. (2014) |
| Total number of livestock owned by the household head | total_livestock | +/− | Sikhweni & Hassan (2014) |



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## 3.12 Limitations of the Study

This study investigates the use of supplementary feeding among commercially orientated small-scale farmers in the Eastern Cape. Hence, it focuses on the identification of the factors that influence supplementary feeding use among commercially oriented smallholder farmers. The study made use of secondary data, therefore it made use of data that was of available.

## 3.13 Chapter Summary

This chapter presented the research methods that were used in this study. The study made use of secondary data that was collected in the Eastern Cape Province in three districts, namely the Amathole District Municipality, the Chris Hani District Municipality, and the OR Tambo District Municipality. These districts house the majority of smallholder farmers in the Eastern Cape. This chapter also discussed the dependent and independent variables, as well as the theoretical expectations, based on the variables used in the analysis. A binary logistic regression method was used to identify the factors that influence the use of supplementary feeding among commercially oriented smallholder farmers.



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# CHAPTER 4:
# DESCRIPTIVE STATISTICS, CHARACTERISTICS OF THE SAMPLED FARMERS

## 4.1 Introduction

The previous chapter discussed the methods that were used to produce the descriptive, statistical and empirical results of the study. This chapter presents and discusses the descriptive analysis undertaken in this study. In the subsequent sections, Section 4.2 discusses the demographics of the sampled farmers. Section 4.3 describes the economic characteristics of the sampled farmers. The challenges faced by the sampled farmers are presented in Section 4.4. The subsequent section, Section 4.5, describes the use of supplementary feed by the sampled farmers. The chapter then concludes with a summary of the discussions presented in the chapter sections.

## 4.2 Demographics of the Sampled Farmers

In South Africa, the socio-economic background of the smallholder farming households is peculiar and different from that of commercial farmers because their setting is different. Smallholder farming is intrinsically linked to household characteristics because it is not separated from farming operations, as is the case in commercial farming (Vink, 1986; Low, 1986; Makhura, 2002). For example, labour time is usually pooled from the household and other resources such as money to finance production. From the literature reviewed in Chapter 3, the variables explained below are hypothesised to be significant in explaining supplementary feeding in commercially oriented smallholder farmers. The variables are described in the following sub-sections.

### 4.2.1 Gender of household head

As shown in Table 4.1 below, males head 69.13 percent of households, while females head 30.87 percent of households. This is no surprise in the smallholder farming setting, since livestock farming tends to be associated with men in most rural communities. This could be linked to cultural values and beliefs. These results are not far from the results that were found by Ngarava et al, (2020), who reported that 70% of the respondents in that study had a male-headed household.



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**Table 4.1: Gender of household head**

| Gender | Freq. | Percent | Cum. |
|---|---|---|---|
| Male | 262 | 69.13 | 69.13 |
| Female | 117 | 30.87 | 100.00 |
| Total | 379 | 100.00 | |

Source: Own compilation from survey data

### 4.2.2 Age of household head

Table 4.2 below shows that 14.78% of the farmers who responded are between ages of 25 and 44, 21.11% are between 45 and 54 years, and 27.97% are between 55 and 64 years, while the majority of the respondents are 65 years old and above, at 36.15%. These results do not deviate much from the statistics given in South Africa's general household surveys and agricultural household surveys, which also reveal that a vast majority of farming households in South Africa are pensioners, with a very little of the youth being engaged in farming activities. Part of this status quo could be attributable to the fact that the youth conduct farming operations under their parents' households and therefore are not household heads, and that the fact that they are occupied in wage labour to finance smallholder production. Younger farm managers are known to adopt new technologies much more easily, compared with their older counterparts, and as such, it might be expected that they would apply supplementary feeding. However, that might depend much on household income. The respondents were, on average, 59 years old. The youngest participant was 24 years old, and the oldest was 65. These results are not far from the Agricultural Household Survey (2016), which reported an average age range of 45–54. Sinyolo et al. (2016) found similar results (mean smallholder age was 56 years) in KwaZulu-Natal.



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**Table 4.2: Age of household head**

| Age of household head in years | Freq. | Percent |
|---|---|---|
| 25-44 | 56 | 14.78 |
| 45-54 | 80 | 21.11 |
| 55-64 | 106 | 27.97 |
| 65 and Above | 137 | 36.15 |
| Total | 379 | 100 |

Source: Own compilation from survey data

### 4.2.3 Total number of household size

A typical household in this study sample had five family members, on average. The number of people ranged from one to twenty-three. On average, two of the five family members were adults and two were children. In some cases, the household consisted solely of the husband or wife. These results are not far from those of Danso-Abbeam (2014), who reported that the household size distribution of cocoa farmers in that study area indicated that farmers had household sizes ranging between two (2) and fourteen (14), with a mean household size of six (6). This is greater than the national mean household size of 4.0.

**Table 4.3: Total number of household size**

| Variable | Observations | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|
| Total number of household size | 379 | 5.163588 | 2.382619 | 1 | 17 |

Source: Own calculations from survey data

### 4.2.4 Number of years spent in school

The length of time spent in school determines the educational level of a smallholder farmer.



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The level of education attained is a vital factor because it influences the farmer's attitude toward the understanding and acceptance of new technologies (in this case, supplementary feeding). As illustrated in Table 4.4 below, a smallholder farmer spent 8 years in school, on average, which is high school level, without reaching the matric examination level. The minimum number of years spent at school was 0, indicating that the smallholder farmer had never attended school. The highest number of years spent at school is 19, which indicates that the smallholder farmer had attained tertiary education. Respondents who spent a greater number of years at school (tertiary and high school) were making more use of supplementary feeding than the farmers who had spent fewer years at school, or had no formal education, did. This is consistent with the study by Ellis (2016), who found that educated farmers were more willing to adopt new technology, as compared with uneducated and less-educated farmers.

**Table 4.4: Number of years spent in school**

| Variable | Observations | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|
| Number of years spent at school | 379 | 8.142857 | 4.67511 | 0 | 19 |

Source: Own calculations from survey data

## 4.3 Economic Characteristics of Sampled Farmers

### 4.3.1 Main source of income

While smallholder farming requires lower financial capital, as compared with commercial agriculture, the fact remains that it does need some level of financial capital. Table 4.5 below displays the primary sources of income received by the heads of the households under study. The following is the coding of the main sources of income: 0 = government grants, which include child grants, disability grants and older person grants; 2 = selling of livestock and livestock products; 3 = income from salaries and wages; and 4 = income from other sources, including remittances from family members working in urban areas, sales of crops and of products that are not agriculturally related. The study results suggest that the combined average household income is just over R30 000 annually, and about R2500 monthly. However, the



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difference from the mean shown by the standard deviation is much higher, reflecting unequal incomes among smallholder household heads. Given the fact that a food basket costs about R2000 per month, according to the National Agricultural Marketing Council estimations (depending on family size), this suggests that the income used to purchase feed could be squeezed into this R500, which has other demands on it such as purchasing animal remedies, donating church tithes, and so on. This is shown in Table 4.5 below by the number of smallholder households who supplement their animals' feed, which is just above 30%. According to Zantsi et al. (2020), the social grant recipients mostly comprise poor and low-income households. In this regard, the cost of using supplementary feeding would be too much to bear for low-income households for several reasons.

**Table 4.5: Main source of income**

| Main Source of Income | Freq. | Percent | Cum. |
|---|---|---|---|
| Government Grants | 159 | 41.95 | 41.95 |
| Selling of Livestock & Livestock Products | 78 | 20.58 | 62.53 |
| Salaries and Wages | 74 | 19.53 | 82.06 |
| Other | 29 | 17.94 | 100 |
| Total | 379 | 100 | |

Source: Own compilation from survey data

### 4.3.2 Total farm income

Farm income is a critical factor in determining the ability to afford supplementary feeding (technology adoption) such as fodder, maize, and so on. A typical household in the study areas earned R24 000.00 per year, on average. The minimum amount received by a household head per annum was R2000.00. The difference arises because of the total number of livestock the household has, as well as the access to markets. Owing to the lack of access to markets, the total farm income is negatively affected, since the household will not be able to sell their livestock and livestock products. Kouame and Komenan (2012) reported that the age of farmers, farming experience, household size, farm income and farm size had a significant influence on farmers' adoption of technology.



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**Table 4.6: Total farm income**

| Variable | Observations | Mean | Min | Max |
|---|---|---|---|---|
| Total farm Income | 379 | 24000.61 | 2000 | 2611000 |

Source: Own calculations from survey data

### 4.3.3 Total number of bags purchased

In this study, this variable is continuous and provides the number of supplementary bags of fed that smallholder farmers purchased in the period under study. Table 4.7 below indicates that, on average, a smallholder farmer purchased 4 bags, with the minimum number of bags being purchased being 0, while the maximum number of bags purchased was 30. This is justified by the fact that not all smallholder farmers make use of supplementary feeding. According to Zantsi et al. (2020), social grant recipients are mostly poor and comprise low-income households. In this regard, the cost of purchasing bags of supplementary feed would be too much for low-income households to bear for several reasons.

**Table 4.7: Total number of bags of feed purchased**

| Variable | Observations | Mean | Min | Max |
|---|---|---|---|---|
| Total no of bags purchased | 379 | 4.313984 | 0 | 30 |

Source: Own calculations from survey data

### 4.3.4 Total number of livestock kept

In this study, an average smallholder farmer would own a total of 89 livestock. This figure constitutes the total number of cattle, sheep and goats owned. The minimum number of livestock owned by smallholder farmers is 5, and the maximum number is 432. Supplementary feeding is generally associated with large herds; however, in this study, this is not the case, as



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these are smallholder farmers face challenges regarding capital. This indicates that the more livestock a farmer has, the lower the chances would be of using supplementary feed, as a much capital would be required to purchase the feed. Sikhweni and Hassan (2014) found that an increase in the number of cattle owned by an individual farmer led to an increase in volume of cattle sales, and hence in his or her income, and this would influence the use of supplementary feeding.

**Table 4.8: Total number of livestock**

| Variable | Observations | Mean | Std, Dev | Min | Max |
|---|---|---|---|---|---|
| Total number of livestock | 379 | 88.91821 | 68.85908 | 5 | 432 |

Source: Own calculations from survey data

### 4.3.5 Reasons for raising livestock

In this study, this variable is a dummy variable: the extra source of income = 0, main source of income = 0. Table 4.9 below shows that 63.85% of the smallholder farmers under study were raising and selling livestock products to obtain an extra source of income, while 36.15% of the farmers were raising livestock and selling livestock as their main source of income. This is justified by the fact that the majority of the smallholder farmers under study were above 65 years old, and their main source of income was derived from government grants. The constraint of lack of market access also limits smallholder farmers to having to depend on selling livestock and livestock products as a main source of income. According to Sikhweni and Hassan (2014), “an increase in the number of cattle owned by an individual farmer led to an increase in sales volume and income. Other variables included factors such as family size, input cost, accessibility to local markets and rainfall. This implied that ownership of larger herds was a key factor influencing farmers’ capacity to generate income from selling in organised markets”.



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**Table 4.9: Reasons for raising livestock**

| Reason for raising livestock | Freq | Percent |
|---|---|---|
| Extra Source of Income | 242 | 63.85 |
| Main Source of Income | 137 | 36.15 |
| Total | 379 | 100 |

Source: Own calculations from survey data

## 4.4 Challenges Faced by Livestock Farmers

### 4.4.1 Access to markets

Marketing agricultural products and commodities by smallholder households could be an indication of income generation derived from agriculture. The percentages of households who have a market for their livestock and livestock products are shown in Table 4.10 below. According to the study findings, the vast majority of the smallholder farmers do not market their livestock or livestock products. These results are not far from what Sikhweni and Hassan (2014) found: "small-scale cattle farmers in rural areas face many challenges which reduce their ability to generate higher incomes from the cattle they own. These challenges include: lack of access to land and water, lack of access to marketing channels".

**Table 4.10: Access to livestock markets**

| Do you have access to markets? | Freq. | Percent | Cum. |
|---|---|---|---|
| Yes | 103 | 27.18 | 27.18 |
| No | 276 | 72.82 | 100 |
| Total | 379 | 100 | |

Source: Own calculations from survey data



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### 4.4.2 Status of communal grazing land

In this study, this variable is a dummy variable: 'good' = 0, 'bad' = 1. It reflects the perceptions of smallholder farmers regarding the status of the communal grazing land. Table 4.11 below shows that 67.55% of the farmers perceived the communal grazing land as 'bad', and 32.5% perceived the communal grazing land as 'good'. This is justified by the fact that the Eastern Cape province had been facing drought at the time the study questionnaires were administered. These results are not far from the results of Klinck et al. (2022), who reported that farmers in their study revealed a causal chain, where 'drought' was reported to translate into two major downstream consequences: a lack of forage availability.

**Table 4.11: Status of grazing land**

| Status of grazing land | Freq | Percent |
|---|---|---|
| Bad | 256 | 67.55 |
| Good | 123 | 32.45 |
| Total | 379 | 100 |

Source: Own calculations from survey data

## 4.5 Use of Supplementary Feeding by Sampled Farmers

Table 4.12 below shows that less than 50% of the three districts in the Eastern Cape make use of supplementary feeding. This is justified by the fact that the majority of the heads of the households under study rely on government grants, as shown in Table 4.5 above. This indicates that most of the farmers could not afford to purchase supplementary feeding for their livestock. According to Zantsi et al. (2020), the social grant recipients are mostly poor and comprise low-income households. In this regard, the cost of using supplementary feeding would be too much for low-income households to bear for several reasons.



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**Table 4.12: Use of supplementary feeding**

| Do you supplementary feed your animals? | Freq. | Percent |
|---|---|---|
| Yes | 177 | 46.70 |
| No | 203 | 53.30 |
| Total | 379 | 100 |

Source: Own calculations from survey data

## 4.6 Chapter Summary

This chapter has presented the descriptive statistics of this study. The results show that most of the smallholder farmers are males, who accounted for 69.13% of the population. Some 63.55% of the farmers who participated were between the ages of 55 and 64. The results indicate that the main source of income of the majority of the smallholder farmers is derived from government grants. These grants include older person, disability, and child support grants.

The descriptive analysis shows that most of the smallholder farmers under study in the Eastern Cape in the three districts surveyed do not make use of supplementary feeding. The analysis shows that only 46.70% of the sampled smallholder farmers make use of supplementary feeding. The analysis also shows that most of the smallholder farmers face challenges, such as lack of access to markets and the bad state of the communal grazing land.



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# CHAPTER 5:
# EMPIRICAL RESULTS

## 5.1 Introduction

This chapter provides the empirical results derived from the model used in this study, and presents a discussion of the results, based on the literature review. It begins with an analysis of a pairwise correlation for the continuous variables that are used in the probit empirical model. The variable selection hypothesised relationships and descriptive statistics results have been discussed in the previous chapter.

## 5.2 Pearson Pairwise Correlation for the Additional Continuous Variables added to the Model

Table 5.1 below illustrates the results of the pairwise correlation assessed on the socio-economic variables under study: gender, age, total household income, and the highest level of education attained. The production variables include the total number of livestock numbers owned by a household, the total number of bags of feed purchased, and the total farm income. The correlation between income and age is significant and negative, implying that older household heads earn less than their younger counterparts do; however, the correlation is weak. Furthermore, there is no significant correlation between the number of livestock owned and the age of the household head. Moreover, even the marketing of livestock does not correlate significantly with household head age. However, there is a significant but inverse relationship between household income and the number of cattle owned. Generally, there is a positive correlation between the ownership of livestock variables, suggesting that owning one has a positive outcome, except for owning lambs and cattle. The marketing of livestock and the ownership goats and cattle have a positive and significant correlation. However, correlation does not imply a causal effect. Next, we will turn to the empirical model for understanding causal effect.



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**Table 5.1: Pearson pairwise correlation**

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| (1) gender | 1.000 | | | | | | |
| (2) age | 0.015 | 1.000 | | | | | |
| (3) total_hhm | 0.010 | 0.022 | 1.000 | | | | |
| (4) total_livestock | -0.071 | -0.044 | -0.004 | 1.000 | | | |
| (5) total_bags_p | 0.051 | 0.013 | -0.096 | 0.2838 | 1.000 | | |
| (6) farm_income | -0.022 | -0.012 | -0.017 | 0.399 | 0.330 | 1.000 | |
| (7)highest_level_educ | -0.034 | -0.424 | -0.095 | 0.018 | 0.005 | 0.059 | 1.000 |

## 5.3 Socio-Economic Factors Influencing the Use of Supplementary Feeding

A probit model was used to identify the socio-economic factors that influence the decision to use supplementary feeding. This model is used to estimate the likelihood of a binary response based on one or more independent variables. Before running the probit model, a multicollinearity test was run to ensure that there is no multicollinearity between the independent variables. All independent variables had a variance inflation factor (VIF) less than 10.00, and the tolerance values were greater than 0.10. According to Hair et al. (2012), because all of the variables had a very low VIF, multicollinearity did not exist between the independent variables used in this study (see Appendix A).

The dependent variable is binary (‘yes’ = 0, ‘no’ = 1). The dependent variable was supplementary feed use. The model is specified as:

SUP_USE =f(GENDER,AGE, TOTAL_HHM, TOTAL_LIVESTOCK, FARM_INCOME, HIGHEST_LEVEL_EDUC, GRAZING_LAND, MAIN_SOURCE_INC, MARKET_ACCESS).

This indicates that the probability of using supplementary feed is determined by a set of



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explanatory factors. The empirical results of the probit estimations of the factors that have a significant influence on the use of supplementary feeding are presented in Table 5.2 below. The model correctly predicted 65.25% of the observations, with a significant chi-squared of 58.20.

Four variables were found to significantly influence the decision to use supplementary feeding. The variable, total number of household members, was significant at 10%. The results indicate that there is a negative relationship between the total number of household members and the use of supplementary feeding. The total number of household members decreases the probability of using supplementary feed. This is in line with Obi and Pote's (2012) observation, that an increased household size might increase the dependency ratio, thus affecting savings and investment. This implies that smallholder farmers must divide their household income between purchasing food for their families and supplementary feeding for their livestock. Therefore, the higher the number of household members is, the lower the amount of supplementary feeding is that would be used or purchased.

The variable total number of livestock was significant, at 5%. The results indicate that a higher total number of livestock (cattle, sheep and goats) owned by the household head would increase the probability of the use of supplementary feeding. This means that the higher the number of livestock a smallholder farmer has, the more likely they are to purchase supplementary feeds. This would occur whether the household head makes use of supplementary feeding or not. The results suggest that most of the livestock smallholder farmers make use of supplementary feeding. This might be explained by the fact that cattle are bulk grazers, and in winter, when feed shortages are most severe, they require supplementary feed. Evidence from communal livestock farmers in KwaZulu-Natal has confirmed that cattle comprise the livestock most severely affected by drought (Vetter et al. 2020). Conversely, sheep flocks tend to be much larger, and graze across large areas. Unlike cattle, sheep and goats are not only grazers but are also browsers – browsing on shrubs and other trees. Accordingly, during feed shortages, they browse and tend to be smaller flocks than sheep flocks, which might explain why they are not significant determinants of supplementary feeding among smallholders.

The next important factor in the use of supplementary feeding is total farm income. The total farm income variable was significant, at 1%. The results indicate that an increase in the total farm income would increase the probability of using supplementary feeding. This is supported by the point that Kouame and Komenan (2012) found that a farmer's age, income from farm



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activities, farming experience, the size of household size, and the size of the farm all had a significant impact on farmers' choice in adopting technology among Ivorian cocoa farmers.

The variable, market access, was significant at 10%. The results indicate that there is a positive relationship between market access and the use of supplementary feeding. This suggests that having access to markets would increase the probability of smallholder farmers using supplementary feeding. This is justified by the point reported by Tsakok (2018) that, for farmers to be profitable and productive, they need to have good access to successful markets.



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**Table 5.2: Probit regression results**

| Supplementary Use | Coefficient | Standard Error | P >\|z\| |
|---|---|---|---|
| _Cons | -0.095 | 0.338 | 0.778 |
| Gender of household head | 0.095 | 0.150 | 0.524 |
| Age of household head | -0.073 | 0.070 | 0.296 |
| Total number of household members | -0.054 | 0.029 | 0.065* |
| Total number of livestock | 0.003 | 0.001 | 0.006** |
| Total farm income | 0.000 | 0.000 | 0.000*** |
| Number of years spent in school | -0.019 | 0.017 | 0.247 |
| Status of communal grazing land | -0.145 | 0.148 | 0.327 |
| Main Source of Income | -0.065 | 0.069 | 0.351 |
| Market Access | 0.263 | 0.159 | 0.098* |
| Prob > Chi: 0.000 | | | |
| Pseudo $R^2$ :0.117 | | | |
| Chi-Squared: 58.20 | | | |

Standard errors in parentheses

$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.001$

t-statistics based on robust standard errors

The following variables used in the mode were found to be not significant. These are the gender of the household head, the age of the household head, the number of years spent in school, the status of the grazing land, and the main source of income. However, the household head being male tended to increase the probability of using supplementary feeding. On the other hand, the remainder of these variables, namely the age of the household head, the number of years spent in school, the status of the grazing land, and the main source of income, tend to decrease the probability of using supplementary feeding.



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## 5.4 Chapter Summary

The probit regression model used in the analysis provided evidence that the socio-economic characteristics of smallholder farmers do influence the use of supplementary feeding. The total number of household members, total number of livestock kept, total farm income and market access were found to significantly influence the decision to use supplementary feeding.



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# CHAPTER 6:
# CONCLUSION, SUMMARY, AND RECOMMENDATIONS

This chapter summarises the study by setting out a summary, the conclusion, and recommendations. The recommendations could be used guide policymakers and relevant stakeholders as to how the results obtained in this study could be useful for their purposes.

## 6.1 Study Summary and Conclusion

This study has six chapters. The first chapter introduced the study topic and articulated the problem. The point of departure of this study is founded on the shortage of forage in communal grazing lands, which now seemed to be overpopulated as a result of the 1913 Land Act, which allocated a mere 13% of the land to the black majority. While black farmers, who are mostly smallholders, have benefited from land redistribution, many still farm on communal lands where grazing is shared, and management of the lands is poor – exhibiting the tragedy of the commons. Scientific evidence from the literature suggests that smallholder farmers on communal lands manage to keep more animals by applying supplementary feeding. However, it is not known what determines the making of the decision to use supplementary feeding. Therefore, this study has endeavoured to address this knowledge gap.

Chapter 3 reviewed the literature on animal feeding to gain an understanding of the process, and of the importance and extent of the animal feed industry in South Africa. From the review, we ascertained that what livestock eat has a significant impact on the performance, profitability and quality of the end products – this important information for farmers to learn about. Animal feed supplementation is the process of adding specific nutrients to animal food to increase the levels of certain nutrients in the overall diet, or to compensate for a deficiency. The South African feed industry arose in the aftermath of severe droughts and the Great Depression experienced in the 1930s. The feed industry produces a wide variety of animal feed, including feed for use by poultry, milk, beef, sheep, and pig farmers. The South African animal feed industry is divided into five main categories: pork, beef and lamb, poultry, poultry, and all other animal feeds. While it is mostly commercial farmers who make use of supplementary feeding, smallholder farmers are starting to make use of supplementary feeding as a result of the



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frequent occurrences of droughts and shortages of grazing land.

In terms of methodology, this study focused on commercially oriented small-scale farmers, who are seen as the primary "beneficiaries of the land redistribution policy". The farm household heads were chosen for this study from the Eastern Cape's major smallholder hubs in three district municipalities: Amathole, Chris Hani, and OR Tambo. The household heads were randomly selected by skipping five households when moving along the streets, if a household had sold at least 20% of its products in the previous season. While the data used in this study was derived from a larger study, which included crop farmers, this research only filtered livestock farmers to study. This data was used to implement a Probit regression model to ascertain the determinant variables for the use of supplementary feeding.

Chapter 4 and Chapter 5 provided results and discussion, and have shown that socio-economic variables, farmer characteristics, and herd size could be considered as major determinants, based on the literature reviewed. The results of the probit model indicate that the following variables determine whether a household would use supplementary feeding or not, namely the total number of household members, the total number of livestock owned, total farm income, and market access. These results could be useful for facilitating decisions among policymakers on, for example, which households should be identified for drought relief and which households should be selected for easing pressure on communal rangeland, in line with the Animal and Veld Management Programme of the Department of Agriculture and Rural Development and Agrarian Reform. The descriptive statistics results suggest that older household heads above the age of 60, who receive social grants, account for the larger group of farmers who use supplementary feeding. Accordingly, such households should be the major target for assistance. It is also recommended that market access should be improved for commercially oriented smallholders, for example through Agri-hubs.

Four variables were found to significantly influence the decision to use supplementary feeding. The variable, total number of household members, was significant at 10%. The total number of livestock kept was significant, at 5%. The total farm income variable was significant at 1%. The variable, market access, was significant at 10%. The following variables used in the model were not significant. They include the gender of the household head, the age of the household head, the number of years spent in school, the status of the grazing land, and the main source of income. However, the household head being male tended to increase the probability of



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supplementary feeding use. On the other hand, the variables regarding the age of the household head, the number of years spent in school, the status of the grazing land, and the main source of income, tended to decrease the probability of using supplementary feeding. It was concluded that less than half (46.70 percent) of the surveyed farmers used supplementary feeding. The determinants of supplementary feeding use include the category of commercially oriented farmers in the Eastern Cape who own livestock and sell livestock.

## 6.2 Policy Recommendations

The majority of the smallholder farmers sampled did not make use of supplementary feeding. Most of the farmers indicated that they receive their main source of income from government grants. The lack of income is one of the major impediments to farmers that hinder the improvement in the efficiency of agricultural production and the adoption of better technologies by farmers.

As such, rural communities, particularly those involved in farming, are lagging behind the national financial inclusion process. This might suggest that there is a need for targeted inclusive finance policies and programmes to be implemented to support these farmers. The policy required should ensure that farmers have access to markets and should also facilitate a process where credit institutions are able to move away from collateral-based loan systems to an alternative that would presumably be a Government-guaranteed loan system.

This study recommends that government should provide supplementary feed for smallholder farmers with larger herds or flocks in winter, based on the household income, to benefit those in dire need of the support. This support should be implemented in conjunction with land redistribution through the Animal and Veld Management Programme by relocating farmers with larger herds to commercial farms that are purchased through the land redistribution funds. While this study provides some useful results that could facilitate policy decision making, it would have been more useful if it would have been possible to derive detailed results on how large a flock or herd should be in determining whether a household should supplement feeding to its animals. Future studies could expand in this direction.



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## 6.3 Recommendations for Further Studies

The main objective of this study was to determine the factors that influence the use of supplementary feeding among commercially orientated smallholder farmers. Three district municipalities in the Eastern Cape were selected for study. Further research could investigate the demand for supplementary feeding among commercially orientated smallholder farmers in the rest of South Africa. The willingness to make use of supplementary feeding could be estimated among smallholder farmers by making assessments based on the participation of smallholder farmers in development programmes.

This study can provide insights for future research among farmers in other regions of the country. The findings from this study can be compared with other related studies to draw inferences. A survey of a larger and more diversified population in all the regions could provide a better understanding of the use of supplementary feeding throughout the country. Furthermore, comparative studies could be conducted that might be useful for assessing the variations in the different economic, institutional, social and environmental factors that influence the use of supplementary feeding. This comparison could be done regarding smallholder farmers who make use of supplementary feeding across different regions, or regarding different farmers in a particular region. Supplementary feeding involves several stakeholders, including farmers, government institutions, and financial institutions. It is recommended that research should be undertaken on the other stakeholders, and not just the farmers, to determine their willingness to make use of supplementary feeding.



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# APPENDICES

## APPENDIX A

### Variance Inflation Factor

| Variable | VIF | **1/VIF** |
|---|---|---|
| Total Livestock | 1.25 | 0.798 |
| Total Farm Income | 1.25 | 0.798 |
| Supplementary Use | 1.15 | 0.869 |
| Market Access | 1.04 | 0.958 |
| Reason for Raising Livestock | 1.03 | 0.971 |
| Total No of Household Members | 1.03 | 0.974 |
| Status of Grazing Land | 1.02 | 0.976 |
| Gender | 1.02 | 0.982 |
| Age | 1.01 | 0.987 |
| Mean VIF: 1.09 | | |



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# APPENDIX B

## Logit regression results

| Supplementary Use | Coefficient | Standard Error | P >\|z\| |
|---|---|---|---|
| _Cons | 0.794 | 0.433 | 0.671 |
| Gender of household head | 1.202 | 0.298 | 0.458 |
| Age of household head | 0.891 | 0.102 | 0.313 |
| Total number of household members | 0.909 | 0.044 | 0.046** |
| Total number of livestock | 1.001 | 0.002 | 0.005** |
| Total farm income | 1.000 | 0.000 | 0.000*** |
| Number of years spent in school | 0.971 | 0.026 | 0.276 |
| Status of communal grazing land | 0.831 | 0.199 | 0.441 |
| Main Source of Income | 0.919 | 0.103 | 0.453 |
| Market Access | 1.497 | 0.385 | 0.099* |
| Prob > Chi: 0.000*** | | | |
| Chi-Squared: 58.66 | | | |

Standard errors in parentheses

$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.001$

t-statistics based on robust standard error



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## APPENDIX C

### Simple linear regression results

| Total No of Bags Purchased | Coefficient | Standard Error | P >\|t\| |
|---|---|---|---|
| _Cons | 0-1.773 | | 0.037** |
| Gender | 0.609 | 0.486 | 0.211 |
| Age | 0.287 | 0.209 | 0.170 |
| Total No of Household Members | -0.029 | 0.094 | 0.763 |
| Total No of Livestock | 0.004 | 0.003 | 0.132 |
| Total Monthly Farn Income | 0.000 | 0.000 | 0.005** |
| Status of Grazing Land | -0.605 | 0.479 | 0.205 |
| Reason for Raiding Livestock | 0.579 | 0.468 | 0.217 |
| Make Use of Supplementary Feeding | 8.518 | 0.477 | 0.000*** |
| Market Access | 1.057 | 0.511 | 0.039** |
| Prob > F: 0.000*** | | | |
| R-Squared: 0.5549 | | | |

Standard errors in parentheses

$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.001$

t-statistics based on robust standard error



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