ANALYSING DROUGHT RISK PREPAREDNESS BY SMALLHOLDER LIVESTOCK FARMERS: AN APPLICATION OF PROTECTION MOTIVATION THEORY IN BLOUBERG LOCAL MUNICIPALITY, LIMPOPO PROVINCE

by

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MINI-DISSERTATION Submitted in partial fulfilment of the requirements for the degree of

Master of Science

in

AGRICULTURE (AGRICULTURAL ECONOMICS)

in the

FACULTY OF SCIENCE AND AGRICULTURE

(School of Agricultural and Environmental Sciences)

at the

UNIVERSITY OF LIMPOPO

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2022

ABSTRACT

Understanding the factors that influence farmers' decisions to take preventive measures against natural hazards provides insight that can be used to develop user-specific interventions to support their adaptation processes. The use of Protection Motivation Theory in analysing climate risk adaptation behaviour is driven by the increase in climate change, which is projected to increase the frequency and severity of climate-related risks such as heatwaves, floods, and droughts. Given the importance of livestock in rural communities, information about their adaptation must be prioritised; yet, this is not the case, as most climate change adaptation research focus on crop production.

The main aim of the study was to analyse the drought risk preparedness of smallholder livestock farmers in the Limpopo Province's Blouberg Local Municipality. The study's specific objectives were to identify and describe the socioeconomic characteristics of smallholder livestock farmers in the Blouberg Local Municipality, as well as to determine the drought coping and adaptation strategies used by them and to evaluate the protection motivation theory components influencing that coping and adaptation behaviour.

The study collected primary cross-sectional data from 130 smallholder livestock farmers in the Blouberg Local Municipality using a semi-structured questionnaire. The farmers' drought risk coping and adaptation strategies were described using descriptive statistics, while multiple linear regression was used to test whether protection motivation theory variables influence the adaptation and coping choices of smallholder livestock farmers in Blouberg Local Municipality.

According to the findings, smallholder livestock farmers in Blouberg Local Municipality use four measures on average to protect their livestock against drought. With an R^2 adjusted of 0.70, protection motivation theory variables explain 70% of the variation in farmer protection motivation. Perceived risk probability, perceived severity, perceived self-efficacy, and perceived costs were significant variables associated with farmers' protection motive. It is recommended that interventions meant to increase drought risk

resilience of the farmers should prioritise early warning signals to increase perceived probability of the farmers, create platforms for information exchange to increase perceived severity, teach farmers methods practically to increase perceived self-efficacy and keep the price of utilising measures low to decrease perceived cost.

Keywords: Smallholder livestock farmers, drought coping and adaptation strategies, protection motivation theory

ACKNOWLEGEMENTS

All thanksgiving is directed first and foremost to God, because everything under the sun exists because of His grace. Grace prompted me to travel this journey, grace blessed me with the people who helped me along the way, and grace ensured that this work was completed.

I am grateful to the supervisor of this study, Prof JJ Hlongwane along with the co-supervisors; Prof A Belete and Prof KK Ayisi. Thank you for the support, guidance and patience. You have instilled in me an immense sense of pride in the work we produced.

I would not be where I am today without the support of family during my studies. My parents, Mokgatjane Christina Seanego and Sydney Elias Seanego, as well as my siblings Ramokone Shiela Seanego, Kwena Molebogeng Iris Seanego, Makwena Perfect Calvin, and Mabusa Charity Seanego, your love and support carried, pushed and saved me. *Kea leboga Bakgalaka.*

I am particularly grateful to the Risk and Vulnerability Science Centre (RVSC) for funding my studies; may you continue to open your doors when other students knock.

Without the participation of the smallholder livestock farmers of Blouberg Local Municipality, particularly those who consented to be interviewed for this study, this research would be futile. *Ke lebogile go menagane balimiruwi ba Blouberg, thekgo ya lena e se ka fiwa nna feela, le ba bangwe le ba potepote ge ba hloka thušo ya lena.*

DECLARATION

I declare that the mini-dissertation hereby submitted to the University of Limpopo for the degree of Master of Science in Agriculture (Agricultural Economics) has not been previously submitted by me for the degree at this or any other university; that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.

Seanego, KC (Ms) 25 April 2022

DEDICATION

This work is dedicated to my anchors; my parents, Mokgatjane Christina Seanego and Sydney Elias Seanego, as well as my sister, Ramokone Shiela Seanego.

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ARC	Agricultural Research Council
BFAP	Bureau for Food and Agricultural Policy and Integrated Value Information Systems
DAFF	Department of Agriculture Forestry and Fisheries
FAO	Food Agriculture Organisation
FPC	Perceived cost
FPCE	Perceived control efficacy
FPM	Farmer's Protection Motivation
FPP	Perceived probability
FPSE	Perceived self-efficacy
FPSV	Perceived severity
HLPE	High Level Panel of Experts
IPCC	Intergovernmental Panel on Climate Change
Stats SA	Statistics South Africa
SWMB	Sustainable Waste Management Behaviours
USA	United States of America

CHAPTER ONE

INTRODUCTION

1.1 Background

Climate-related risks such as floods, heatwaves, and droughts are expected to occur more frequently and with greater intensity as a result of climate change, according to the Intergovernmental Panel on Climate Change (IPCC) (IPCC, 2007; Rapholo, 2018). Droughts have been more frequent and severe in recent years in several regions, including the Mediterranean, West Asia, South America, Africa, and North-Eastern Asia (IPCC, 2019). Climate change has an impact on various sectors of development, with agriculture being one of the worst affected (Ndiritu, 2021).

Drought is nothing new in Southern Africa (O'Farrell *et al*., 2009; Rapholo, 2018). Southern Africa has been subject to extreme weather events with the most common being floods, large storms, droughts and wildfires which are expected to increase in the 21st century (Davis-Reddy and Vincent, 2017). Drought affects 37.44% of South Africa's rural communities (AgriSA, 2019). Due to these conditions, farmers in rural areas with limited resources must constantly adjust their production to compensate for the risk of drought.

Drought's impact can be divided into two categories: direct and indirect. Direct effects include decreased crop, rangeland, and forest productivity; increased livestock and wildlife mortality rates; increased fire hazard; and decreased water levels, while indirect effects include decreased income for farmers and agribusinesses, increased food and timber prices, increased unemployment due to farmers and agribusinesses laying off workers, and decreased government tax revenue (Wilhite *et al*., 2007; Rapholo, 2018).

Drought has an indirect impact on livestock productivity through forage availability and quality, as well as a direct impact on livestock productivity through dehydration and nutrient deficiency (BFAP, 2016). Drought-related effects on livestock include increased incidences of specific diseases, livestock deaths, altered herd structure, and the

collapse of livestock markets, which reduces livestock farmers' bargaining power (Ifejika-Speranza, 2010).

Smallholder livestock farming creates pathways out of poverty, food insecurity and unsustainable livelihoods because it provides varying functions for rural communities as a livelihood strategy (Maziya *et al*., 2019). In South Africa, agriculture is often generally considered as being categorized into two types; commercial agriculture and communal/subsistence agriculture. Communal agriculture mainly consists of smallholder crop-livestock mixed faʳming characterised by low levels of productivity and low capital investments (Cholo, 2017). Smallholder farmers are described as farmers owning small plots of land and who tend to hold livestock both for household food and for nutritional security Udo *et al*. (2011) as cited by (Mampane, 2019).

It is estimated that about 300 million people in sub-Saharan Africa depend on livestock for livelihoods and food (HLPE, 2016). In South Africa, livestock production is the primary land use option in many rural areas of Limpopo Province Dovie *et al*., (2006) as cited by (Cholo, 2017). Smallholder farmers keep livestock for both commercial and non-commercial purposes (Ndoro *et al*., 2014; Maziya *et al*., 2019). For example, livestock is utilised as a source of income, kept for nutritional purposes or serve as a bank for emergencies, store and measure of wealth, draught power and for socio-cultural practices such as dowry, funerals and cultural ceremonies. Livestock production also contributes more than 40% of the South African Agricultural Gross Domestic Product (GDP) (ARC, 2016; Mampane, 2019).

Protection Motivation Theory was originally developed to predict people's engagement in health risk prevention Rogers (1983) as cited by Janmaimool (2017) but it has since been applied to several other contexts, including natural hazards such as drought (Bubeck *et al*., 2013). Protection Motivation Theory proposes that individual decisions to engage in preventative actions when confronted with risks such as drought are made based on threat appraisal and coping appraisal.

The threat appraisal consists of perceived risk probability which is the perception of the farmer with regards to drought being a risk that exists and could occur, perceived

severity of the adverse consequences which is the farmer's perception of how severe the effects of a drought could be on the operations of the farm, should it occur. The coping appraisal consists of perceived control efficacy which is the farmer's perception of how effective coping and adaptation strategies could be to assist in lessening the effects of drought, perceived self-efficacy is how capable the farmer believes he/she is in applying coping and adaptation strategies and the perceived cost of preventative actions which are the perceived costs the farmer has concerning the adoption of drought risk coping and adaptation strategies.

This study uses drought coping and adaptation strategies as a proxy for understanding preparedness for drought risk by smallholder livestock farmers. This is an approach that was adopted from Ifejika-Speranza (2010). The actual and past coping and adaptation behaviour of the smallholder farmers to drought risk along with their perceptions of drought and its possible effect on their farming operations and thus their livelihoods will constitute how prepared they are for droughts that may occur in future.

1.2 Problem statement

Livestock rearing is an essential element of many impoverished people's rural livelihood strategies since it provides food, drought power, and cash to supplement income. Smallholder farmers in rural areas have limited resources and rely mostly on agriculture for food security and a living, they are also more vulnerable to climate change and vulnerability (Twumasi and Jiang, 2021).

Despite the significant role that livestock farming plays in the lives of rural people in developing countries, there have been few studies exploring their actual coping and adaptive behaviour to drought risk (Nicholas and Durham, 2012; van Duinen *et al*., 2015). Furthermore, little research has been conducted on the psychological mechanisms that facilitate or constrain the coping and adaptation behaviour of farmers in developing nations (Truelove *et al.,* 2015; Pakmehr *et al.,* 2021).

This study had the intention of filling this gap in the literature by utilizing Protection Motivation Theory. Protection Motivation Theory was employed in this study to analyse

the coping and adaptation behaviour of smallholder livestock farmers to drought. This would assist to provide information on what motivates them to use the coping and adaptation strategies which they do. The purpose of this study was to analyse the drought risk preparedness of smallholder livestock farmers in the Blouberg Local Municipality of Limpopo Province, South Africa.

1.3 Rationale of the study

Data from 106 studies conducted in 23 different countries was used by van Valkengoed and Steg (2019) to conduct a meta-analysis study to examine how 13 motivational factors relate to various climate change adaptation behaviours. According to the meta-analyses, Protection Motivation Theory may be a relevant theory to explain farmers' adaptation behaviour to climate change because key components such as risk probability, control efficacy, and self-efficacy were important predictors of intentions to engage in climate change adaptation behaviour.

Protection Motivation Theory was employed in the works of Luu *et al*. (2019), Bagagnan *et al*. (2019), and Jainmamool (2017) to analyse the pro-environmental behaviour of farmers, and the theory was found to be suitable in explaining farmer behaviour in the context of adopting pro-environmental strategies.

According to Nicholas and Durham (2012), as cited by van Duinen, Filatova, Geurts and van der Veen (2015), despite the literature indicating a need for research on farmers' actual adaptation behaviour to aid in the development of well-targeted policies, such research is lacking, particularly in developing countries. This study intends to fill a gap in the literature by analysing the factors impacting smallholder livestock farmers' coping and adaptation behaviour to drought risk using Protection Motivation Theory.

1.4 Scope of the study

1.4.1 Aim of the study

The study aimed to analyse smallholder livestock farmers' preparedness for drought risk in Blouberg Local Municipality, Limpopo Province.

1.4.2 Objectives of the study

The objectives of the study were to:

i. Identify and describe the socio-economic characteristics of smallholder livestock farmers in Blouberg Local Municipality;
ii. Determine the drought coping and adaptation strategies employed by smallholder livestock farmers in Blouberg Local Municipality; and
iii. Evaluate the Protection Motivation Theory components influencing the coping and adaptation behaviour of smallholder livestock farmers in Blouberg Local Municipality.

1.4.3 Research hypothesis

The research hypothesis was that the components of the Protection Motivation Theory have no influence on the drought coping and adaptation behaviour of smallholder livestock farmers in the Blouberg Local Municipality.

1.5 Organisational structure

This mini dissertation is divided into five chapters. Chapter 1 contains the study's introduction, which includes the study's background, problem statement, the scope of the research, and research hypothesis.
Chapter 2 is a literature review, which comprises a review of previous studies undertaken by other researchers in the same field as this one.

Chapter 3 discusses the methodology used in this study, including the study area, data set, and analytical technique, as well as the study's limitations.

Chapter 4 presents the study's findings and interpretations, while Chapter 5 comprises the study's summary, conclusions, and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The section entails a review of literature on smallholder livestock farmers' drought coping and adaptation behaviour from different sources. Comprehensive definitions of key concepts are provided, as well as a review of studies relevant to smallholder livestock farmers' behaviour during drought and Protection Motivation Theory.

2.2 Definition of key concepts

2.2.1 Drought

Drought is difficult to define because there is no universally accepted definition. According to Whilhite *et al*., (2005), the various definitions of drought often depend on the user's perspective as well as the specific regions, impacts, and sectors being assessed. Phaduli (2018) asserts that definitions of drought vary by location due to the many climatic and meteorological factors that may have caused the drought.

According to Gudlhuza (2018), drought is defined as a period of abnormally dry weather that is sufficiently prolonged due to a lack of precipitation as compared to the expected rainfall, resulting in an inability to meet the demands of human activities and the environment if extended over a season or a longer period.

Drought is classified into four categories: meteorological, hydrological, agricultural, and socioeconomic. A unifying feature of the many types of drought is that they all occur from a lack of precipitation, resulting in water scarcity for some activity or group of people (Mkhabela *et al*., 2010; Madzivhandila, 2015).

Botai *et al.,* (2016) as cited by Mabule and Baloyi (2019) indicate that drought is often characterized as a natural hazard that commences gradually but whose impacts are

complex and felt through many sectors of the economy including water resources, agriculture, and the natural ecosystem. This reiterates the far-reaching impact that droughts have on the economy and the natural environment.

This study draws its definition of drought from that of Gudlhuza (2018), Mkhabela *et al*. (2010) and Madzivhandila (2015). It defines drought as a period of prolonged dry weather as a result of a deficiency in precipitation that results in a prolonged water shortage for livestock production activities.

2.2.2 Smallholder farmers

There is no universally approved definition of the smallholder farmer. Rapsomanikis (2015) articulates that a threshold farm size of two hectares or less is often used as a measure of classifying a farm as a smallholder. Udo *et al*., (2011) and Mampane (2019) describe smallholder farmers as farmers owning small plots of land and who tend to hold livestock both for household food and for nutritional security, but it is not clear what a “small plot of land” really is. Furthermore, the terms smallholder and small-scale are used interchangeably in some literature which creates problems in reaching a consensus about a universal definition (Maziya *et al.,* 2019; Rapsomanikis, 2015; Kirsten and van Zyl, 1998).

Kirsten and van Zyl (1998) caution against simply classifying smallholder farmers based on land size, but to consider that classifying a farm as small is relative to the ecological region, soil quality and particular farming industry. A two-hectare family farm located in a rural area where soil quality is low and water is scarce and an irrigated family farm located in a peri-urban area with good soil cannot both simply be classified as smallholder because differences exist in the ecological and demographic conditions, as well as economic and technological factors of the two farms.

Kirsten and van Zyl (1998) define a small farm as one situated in former homelands whose scale of operation is too small to attract the provision of the services necessary to significantly increase its productivity using outdated and unproductive methods on small plots of land. This definition of small-scale farmer suggests that the farm of a

smallholder is situated in the former homelands and the farmer requires assistance to significantly increase the productivity of his/her operations, thereby necessitating external intervention or support.

The characterisation of the smallholder farmer by Kirsten and van Zyl (1998) was then expanded upon post-democracy in South Africa to include beneficiaries of land reform (Zantsi *et al*., 2019; Cousins, 2010). This definition proposes that for one to be characterised as a smallholder farmer, one must be a black farmer situated in former homelands or a beneficiary of land reform (Zantsi *et al*., 2019).

Rapsomanikis (2015) utilised the middle-sized farm as a threshold to identify smallholder farmers. The middle-size farm is determined by making an ordered list of the farms in the country from smallest to largest and choosing the farm size at the middle as the threshold to identify smallholders. The middle-sized farm threshold varies from one country to another because it takes into consideration country-specific conditions, which shape the size of farms and their distribution. This method also assumes that half of the total land in a country is cultivated by smallholders, and the other half by other farmers.

This study drew its definition of smallholder farmer from that of Zantsi *et al*. (2019) and defined smallholder livestock farmers as black livestock farmers situated in a former homeland or beneficiaries of land reform.

2.2.3 Coping and adaptation strategies

Adaptation is defined as a farmer's action to mitigate the effects of future droughts or to better cope with the repercussions of drought (Adger *et al*., 2006). This definition does not differentiate coping strategies from adaptation strategies but encompasses adaptation as the collective term used to describe the actions taken in coping with future drought situations.

Coping and adaptive responses are the categories of local responses to climate variation, of which coping responses are short-term, unplanned and reactive responses to immediate threats, while adaptive responses are proactive, preventive and

anticipatory changes done over long periods to moderate the impacts of recurrent threats (Davies, 1993; Berkes and Jolly, 2002; Rapholo, 2018).

This study defines coping strategies as the immediate actions taken by farmers to react to drought conditions and adaptation strategies as those strategies that the farmer has adopted in anticipation of responding to future drought situations.

2.3 Review of previous studies

2.3.1 Drought and its impact on livestock production

Drought has two kinds of impacts, according to Wilhite *et al*. (2007): direct and indirect. Reduced crop, rangeland, and forest productivity; increased livestock and wildlife mortality rates; increased fire hazard; and reduced water levels are all direct consequences. Indirect impacts include decreased farm income, increased food and timber prices, increased unemployment as a result of farmers and agribusinesses laying off workers, decreased government tax revenues as a result of decreased expenditures, increased crime as a result of increased unemployment and increased food prices, and a shortage of farm production.

Drought impacts on livestock production include pasture growth and quality, availability of commonly used water resources, as well as the increased incidences and distribution of certain livestock diseases (BFAP, 2016; Ifejika-Speranza, 2010; Republic of Kenya: Ministry of Environment and Natural Resources, 2002). According to Ahmed *et al*. (2019), in a study that used a cross-sectional survey across 10 districts in Tanzania's northern region to investigate the impact of drought and livestock disease on farmer welfare, it is estimated that drought and livestock diseases account for roughly 10% - 15% of losses in herd value and an estimated 80% loss in household income of the livestock keepers. Furthermore, small-stock was found to be at higher risk of disease-associated mortality while cattle were more vulnerable to drought, which suggests that a shift from cattle production to small-stock may be an adaptation strategy in drought-prone areas.

According to 240 farmers who participated in a study conducted by Habtamu *et al*. (2018) in Ethiopia, the major impact of the 2015/16 drought was crop failure, drying of water resources, livestock loss, famine, poor health of humans and animals, an increase in food prices, and a decline in livestock prices, all of which resulted in a decline in household income. Cattle were also mentioned as the most common livestock loss among farmers. Cattle population decreases were highlighted in its mean population size decreases from 2004 to 2016, while small-stock population increased during the same period, which the authors suspected was indicative of the substitution of large ruminants for small ruminants as a strategy of adapting to climate change conditions.

In the context of South Africa, Schreiner *et al*. (2018) note that as a result of feed shortages, farmers tend to destock by slaughtering or culling more animals to manage the required rations for their animals, there is also an increase in the number of animal deaths due to drought and increased vulnerability to diseases caused by poor nutritional condition.

According to AgriSA (2019), approximately 70% of respondents in their survey who had livestock as their main commodity indicated that water availability was under severe stress, fodder availability was very limited, and 70% of respondents indicated that they struggle financially and find themselves in a weak financial position. The general state of pastures was also found to be worse than projected, raising the risk of veld fires. More over half of the respondents in AgriSA's (2019) study also reported having depression, anxiety, or other behavioural health issues as a result of the stress caused by drought conditions.

2.3.2 Coping and adaptation strategies of livestock farmers

Yung *et al*. (2015) conducted a study to investigate ranchers' responses to prolonged drought in Montana, USA, as well as the relationship between their climate change beliefs and drought adaptation strategies. It was discovered that ranchers in Montana

used both short-term and long-term strategies, which primarily involved tradeoffs between building ecological resilience by reducing herd sizes and investing in rangeland health and building financial resilience by maintaining herd sizes and overgrazing to sustain family income. Short-term coping strategies also appeared to increase ranchers' debt (e.g., securing debt to purchase hay that would be expensive due to drought), decrease income (e.g., reducing herd size), and otherwise limit future alternatives (e.g., overgrazing to cater to herd size and selling land). Long-term strategies included diversifying operations, lowering inputs, and planning for future droughts (e.g. digging deeper wells, switching to drought-tolerant grass variants).

Ifejika-Speranza (2010) studied the livelihood strategies employed by agro-pastoralists in Kenya's Makueni district during non-drought and drought periods and discovered that the same strategies were adopted in both contexts; however, certain strategies were simply intensified during the drought period. The strategies used to cope or adapt to water shortages included walking longer distances with the herd to access water, digging shallow wells in river beds, purchasing water, and watering livestock at home, whereas the strategies used to adapt to pasture or forage scarcity included migration/walking longer distances with the herd to access distant pastures, grazing livestock in protected areas/on government lands, and giving livestock to kin, destocking and intensify grazing in common-pool resources.

2.3.3 Protection Motivation Theory

Protection Motivation Theory (PMT) was designed to provide psychological constructs that explain how people deal with health risk protection choices (Rogers, 1983). PMT is a conceptual framework that seeks to explain elements that may predict risk-aversion behaviours (Janmaimool, 2017). Since then, the theory has been applied to a variety of risk management scenarios, including environmental risks and natural hazards (Bubeck *et al*., 2013; van Duinen *et al*., 2014; Keshavarz and Karami, 2015; Janmaimool, 2017; Rapholo, 2018; van Valkengoed and Steg, 2019; Luu *et al*., 2019). According to the Protection Motivation Theory model as described in the literature, when confronted with risk, people choose to protect themselves from the risk based on coping appraisal

(perceived control efficacy, perceived self-efficacy, and perceived cost) and threat appraisal (perceived probability and perceived severity), which results in protection motivation, which influences behaviour (Rapholo, 2018).

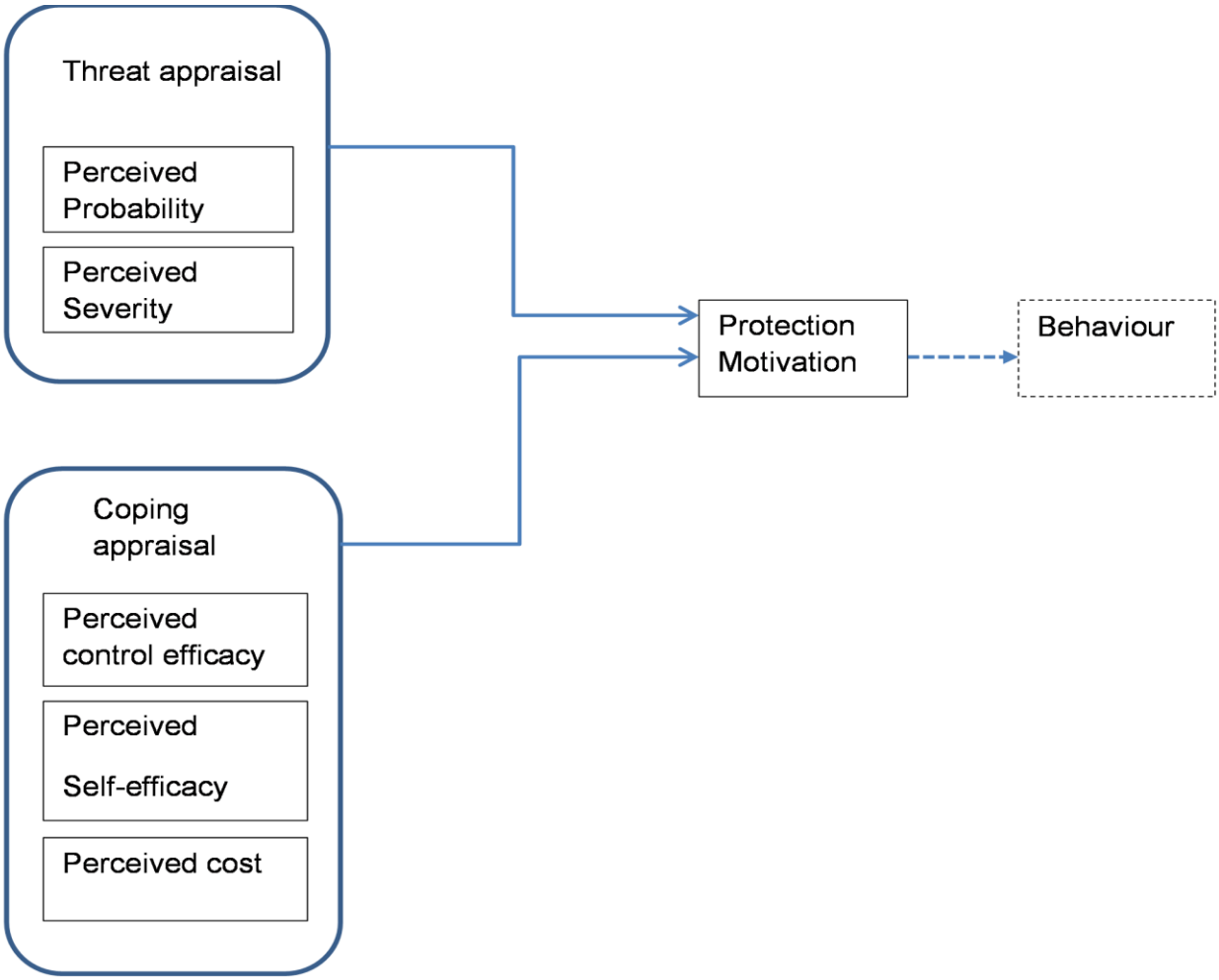


Figure 2.1 Protection Motivation Theory Model adopted from Rapholo (2018) and Keshavarz and Karami (2016)

The farmer's perception of the risk and whether it could occur to his or her operation is referred to as perceived risk probability. A high perceived risk probability is likely to result in a greater need to protect (Rapholo, 2018). The perceived severity of the negative consequences is the perception of how severe the consequences of the risk could be on farm operations if it occurs (Truelove, Carrico and Thabrew, 2015). Risk-

aversion behaviour is expected to be influenced positively by perceived severity. Perceived self-efficacy is the farmer's belief in his or her own ability to employ coping and adapting strategies, and it is expected to have a positive influence on protection motivation. The perceived cost of preventative actions is the farmer's perception of the costs of implementing strategies that could aid in developing resilience or coping and adapting to drought, and it is expected to have a negative relationship with protection motivation (Keshavarz and Karami, 2016).

Protection Motivation Theory has been utilised to analyse the pro-environmental behaviour of farmers in various research, such as the one conducted in Vietnam by Luu *et al*. (2019), which employed structural equation modelling to analyse farmers' intention to adapt to climate change. The study modelled a regional and three local structural models for farmers' climate change adaptation intentions and discovered that farmers have higher adaptation intentions when their perception of risk caused by climate change is high when the incentive to adapt is high, the farmers have performed an adaptation assessment, the farmers have practical adaptation ability, and their habits are in line with adaptation while farmers are less likely to adapt if they deny climate change risk, practise wishful thinking or believe in fate.

Keshavarz and Karami (2016) used a Bayesian network and a Partial Least Squares (PLS) path model to examine the relationship between farmers' pro-environmental behaviour during a drought, and their findings revealed the existence of a significant relationship between perceived vulnerability, response efficacy, perceived severity, response costs, perceived vulnerability, self-efficacy, income, and social environment with pro- environmental behaviour during a drought,.

Bagagnan *et al*. (2019) conducted a study in the Gambia to test whether Protection Motivation Theory could be used to explain farmer implementation of water management techniques. Multiple linear regression was used in the study, which found that perceived severity, perceived self-efficacy, internal barriers, and cost of

implementation were factors that were substantially connected with farmers' protection motivation to use water management techniques.

Janmaimool (2017) investigated the adoption of individuals' engagement in sustainable waste management behaviours (SWMBs) in Bangkok using the Protection Motivation Theory. It investigated the link between different sustainable waste management behaviours and PMT variables using multiple linear regression. The analyses revealed that respondents' self-efficacy could explain all types of SWMBs, whereas response efficacy was not a significant predictor of all behaviours, perceived severity was only significant for waste disposal and reuse and recycle behaviours, and perceived probability of being impacted by pollutants could only explain reuse and recycling behaviours. Janmaimool (2017) discovered that the importance of protection motivation variables for the same set of persons varies depending on the behaviour under investigation.

van Valkengoed and Steg (2019) conducted a meta-analysis using data from 106 studies (90 papers) conducted in 23 different countries to examine the connection of 13 motivational factors to various adaptation behaviours. The study discovered that descriptive norms, negative affect, perceived self-efficacy, and the outcome efficacy of adaptive actions were the most strongly associated with adaptive behaviour, and it concluded that Protection Motivation Theory may be a viable theory to explain adaptive behaviour. According to the study, research has been overly focused on investigating experience and risk perception, flooding, and hurricanes, while other motivating factors and hazards have gone understudied. This study intends to address a gap in the literature by studying the adaptive behaviour of smallholder livestock farmers during drought utilising Protection Motivation Theory motivators.

2.5 Summary of the literature

The chapter defined key concepts pertinent to the study and reviewed previous literature. Drought literature, its impact on livestock production, and drought coping and adaptation strategies employed by smallholder livestock farmers were discussed.

Studies that used Protection Motivation Theory to investigate farmers' adaptive behaviour when faced with risk received special attention. There are studies from all over the world that used the theory in climate change-related risks; however, there are gaps in the literature for studies conducted in the context of South Africa. As a result, the study was introduced to fill an information gap and to stimulate further research.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The chapter describes the study area, which is the local municipality of Blouberg, the data set utilised by the study, the analytical technique used by the study, and examples of Likert scale items used by the study to collect the necessary information.

3.2 Description of the study area

Blouberg Local Municipality is situated in the northwestern boundary of the Republic of South Africa in Limpopo Province. It is situated 95 km from Polokwane, and it shares its boundaries with Botswana and Zimbabwe, with the Limpopo River serving as the border between the municipality and the two neighbouring countries. The municipality has 12719 households that are involved in livestock production (StatsSA, 2016). Blouberg Local Municipality is a semi-arid area that is prone to drought; it receives an average annual rainfall of 410 mm, the monthly average of maximum temperatures for the area ranges from 22°C in July to 31°C in February (Department of Rural Development and Land Reform, 2016).

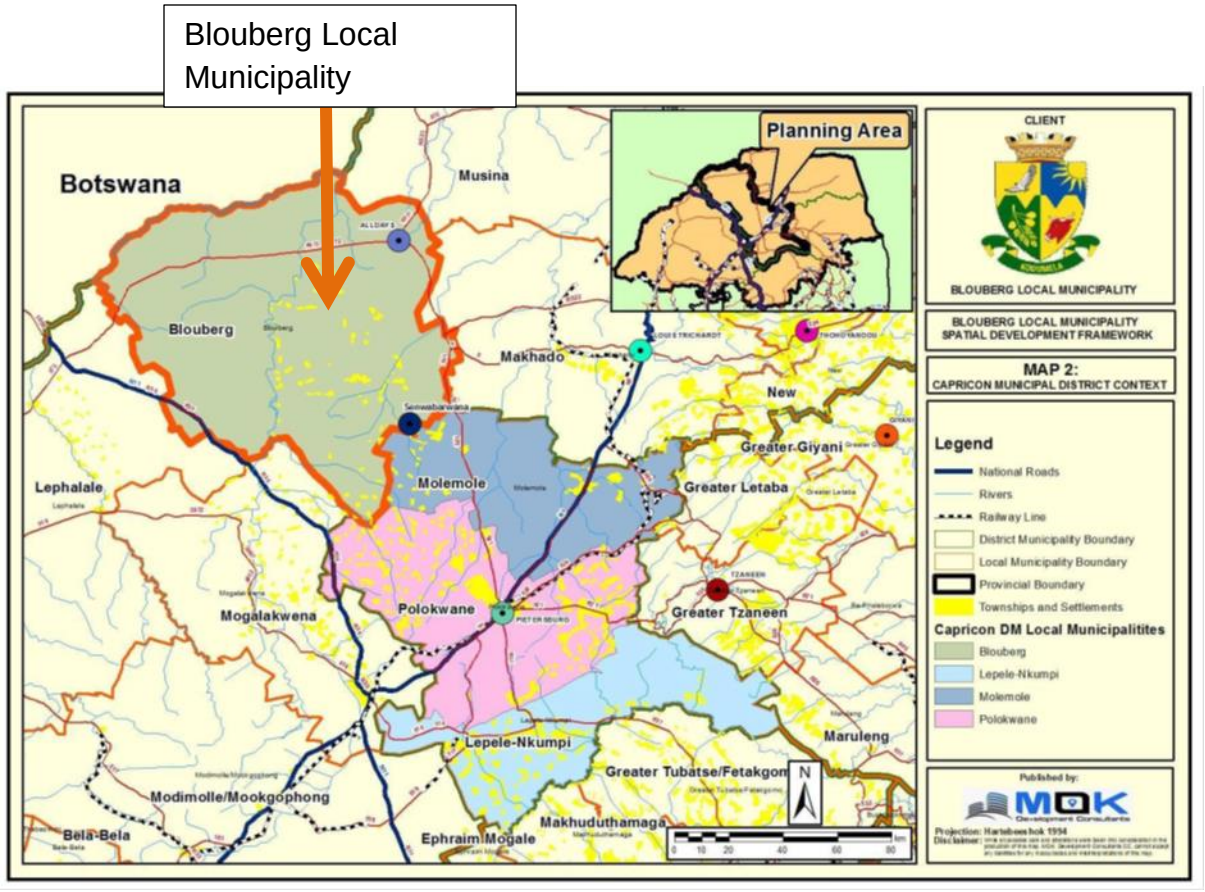


Figure 3.1 Blouberg Local Muncipality and its sister municipalities in Limpopo Province.

Source: Blouberg Local Municipality, 2019

3.3 Research design, sampling procedure and data collection method

A quantitative research approach was applied in the study. Quantitative studies, according to Gudlhuza (2018) collect data that is measured in numbers in a standardised and uniform format which is analysed using statistical methods. Blouberg Local Municipality has 12719 smallholder livestock households, according to StatsSA (2011). However, the author was unable to locate a recent and thorough list of the sampling unit which are the smallholder livestock farmers in the Blouberg Local Municipality. Due to time constraints and the uncertainty around restrictions pertaining to Covid 19 protocals, the use of purposive sampling to provide the target sample size of 130 smallholder livestock farmers was necessitated.

Primary cross-sectional data (data that is collected from first-hand sources at one point in time) was collected through face-to-face interviews and telephonic interviews with 130 smallholder livestock farmers using a semi-structured questionnaire. 40 respondents were interviewed face-to-face while 90 respondents agreed to telephonic interviews and were interviewed over the phone. The telephonic interview was the preferred method of data collection for the author as it was a way of taking precautionary measures against the transmission of Covid-19 by limiting the physical interaction of the author, enumerators and the respondents. Respondents were from the villages of Senwabarwana, Berg-en-dal, Driekoppies, Alldays, Indermark, Gemarke, My darling, Swartwater, Papegaai, Sekhung, Madibeng, Devilliarsdale, Mokhurumela, Tolwe, Ga Rammutla-A, Ga Rammutla B, Ga-Molele and Ga-Mankgodi. The questionnaire was designed to collect information about socioeconomic variables, drought coping and adaptation strategies applied by the smallholder farmers and the questions related to Protection Motivation Theory.

3.4 Analytical techniques

3.4.1 Descriptive statistics

Descriptive statistics were used to address the first and second objectives of this study, which were to identify and describe the socioeconomic characteristics of smallholder livestock farmers in Blouberg local municipality, and to determine the drought coping and adaptation strategies used by smallholder livestock farmers in Blouberg local municipality, respectively. Pearson correlation was utilised to determine the associations between the independent and dependent variables. Averages, frequency tables, graphs, and percentages are used to display descriptive statistics results.

3.4.2 Multiple linear regression

To address the third objective, multiple linear regression was used to evaluate the motivational factors impacting the coping and adaptation behaviour of smallholder livestock farmers in the Blouberg Local Municipality. Multiple linear regression analysis comprised of the independent variables with statistically significant correlation

coefficients. Farmers' adaptation motivation was measured as the sum of their adoption and coping measures. Other studies have taken this approach (Bubeck *et al*., 2013; Poussin *et al*., 2014; van Duinen *et al*., 2015). As a result, the dependent variable indicates the number of coping and adaptation measures that have been used. The independent variables were measured using suitable 5-point Likert scales, and the mean scores for each variable were computed.

The multiple linear regression model:

$$Y = b_0+b_1X_1+b_2X_2+b_3X_3+\dots +b_nX_n+ \varepsilon_i$$

Where: Y is the mean of farmers protection motivation; b0 is the intercept term; b1 - bn are the Regression coefficients; X1 – Xn are the explanatory variables, and εi is the disturbance term.

The specified multiple linear regression model:

$$Y_i \text{ (FPM)} = b_0+ b_1\text{FPP}+ b_2\text{FPS}+ b_3\text{FPCE}+ b_4\text{FPC}+ b_5\text{FPSE}+ \varepsilon_i$$

Table 3.1: Table describing variables

	Variables	Example of some survey Items	Response categories
Dependent variable			
Y (FPM)	Adaptation motivation (Number of coping and adaptation strategies implemented by the farmer)	Which of the following drought coping and adaptation strategies do you practice? Add any not on the list o Sell animals to reduce herd size o Supplementing feed o Rent pasture land o Feed cash crops to animals	Actual number of coping and adaptation strategies implemented
Independent variables			
FPP	Perceived probability (Farmer's perception of the likelihood of drought occurring)	What is the possibility that drought will impact your livestock production within the next 5 years?	1- Very low 2- Low 3- Moderate 4- High 5- Very high
FPSV	Perceived severity (Farmer's perception of the severity of drought consequences)	How much financial damage do you expect for your farm when a drought occurs?	1- Very low 2- Low 3- Moderate 4- High 5- Very high
FPCE	Perceived control efficacy (Farmer's perception on the effectiveness of specific coping and adaptation strategies)	How effective do you consider the coping and adaptation measures mentioned?	1- Very ineffective 2- Ineffective 3- Moderate 4- Effective 5- Very effective
FPC	Perceived cost (Farmer's perception of the costs involved in implementing risk reduction strategies)	How costly do you consider the coping and adaptation measures in terms of time/effort/money/ convenience?	1. Not costly at all 2. A little costly 3. Moderate 4. Costly 5. Very costly

FPSE	Perceived self-efficacy (Farmer's perception of own ability to implement specific risk reduction strategies)	To what extent do you consider yourself to be capable of taking suitable action to protect your farm against the consequences of drought?	1. Not very capable 2. Not capable 3. Moderately capable 4. Capable 5. Very capable

Source: Author's compilation

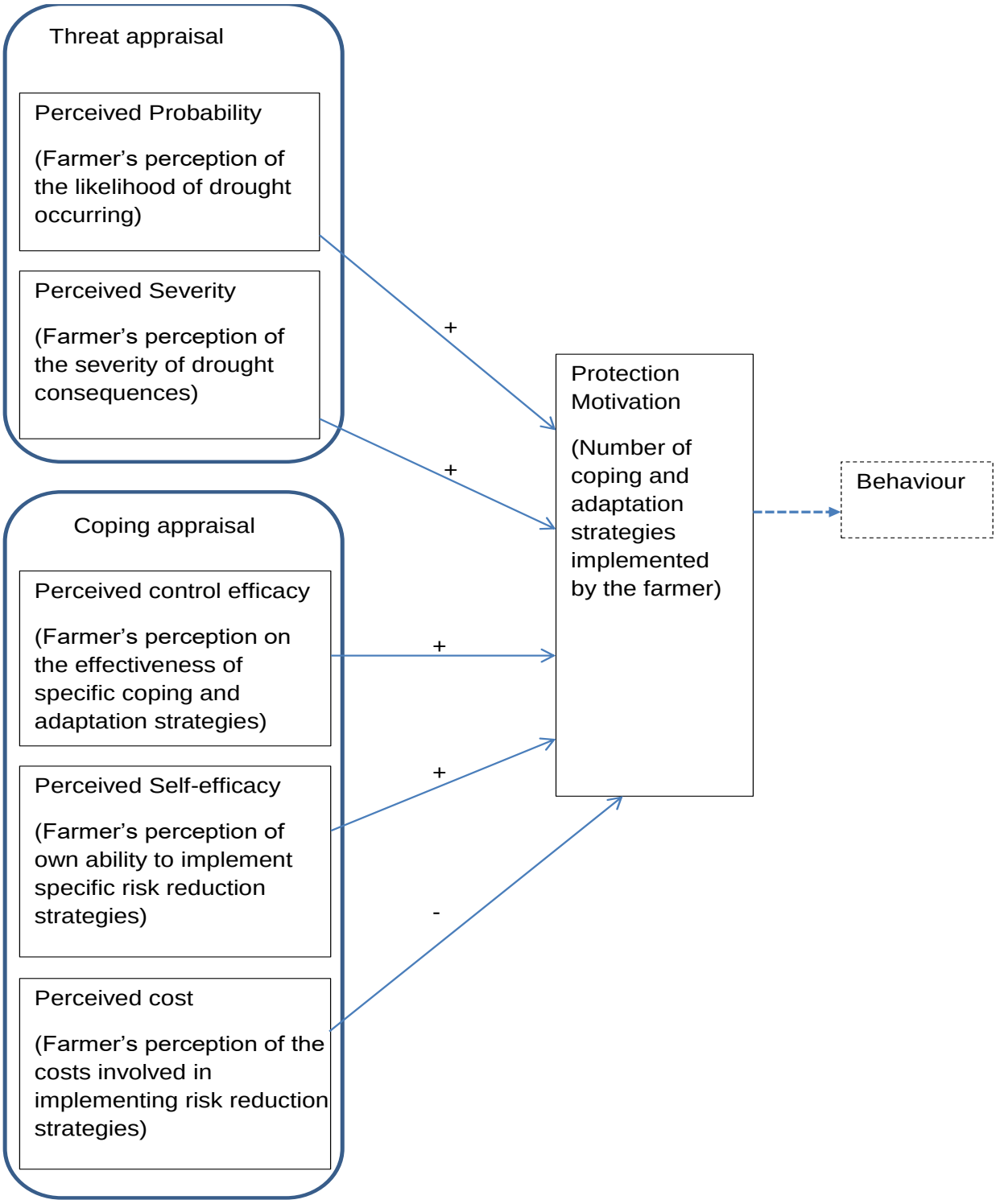


Figure 3.2 Conceptual framework for Protection Motivation Theory

Source: Author's compilation

3.5 Conclusion

The chapter described the study area, which is Blouberg Local Municipality. Information about the data collection and the analytical techniques utilised by the study were also outlined.

CHAPTER FOUR

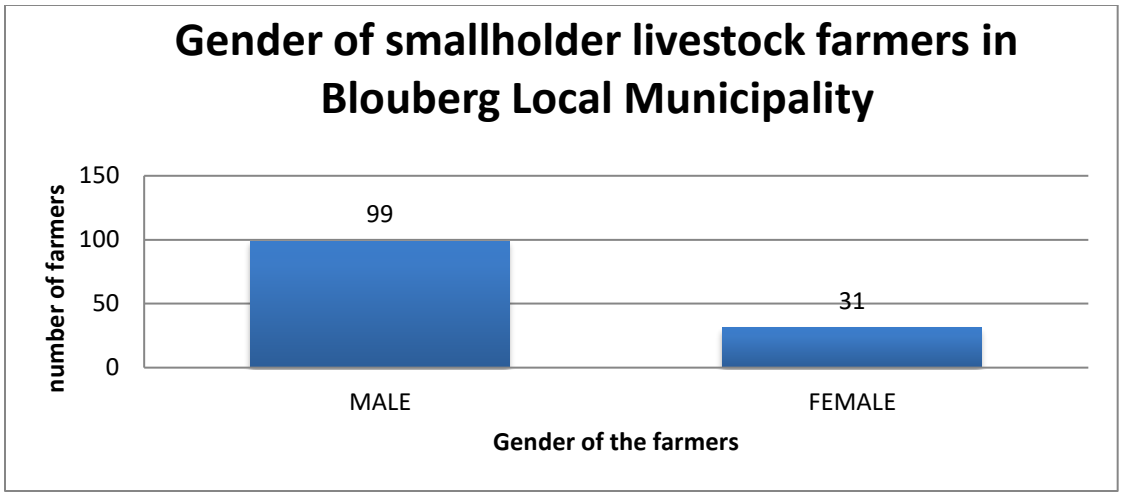
RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the main findings of the study and provides a discussion of the results. It presents the socio-economic characteristics of the smallholder farmers and the findings of the study from the analysis. The chapter further discusses the extent to which the research hypothesis posed to the study has been addressed by the analysis.

4.2 Socio-economic characteristics of smallholder livestock farmers in Blouberg Local Municipality

The study sample consisted of people who identified as livestock owners and were smallholder livestock farmers in the Blouberg Local Municipality. The study sampled 130 respondents, and all of their questionnaires were correctly filled out and included in the data analysis. According to descriptive statistics, 31 of the respondents were female and 99 were male (figure 4.1); the average household size was five members (Table 4.1). The farmers who participated in the study ranged in age from 22 to 78 years old, with an average age of 51. (Table 4.1). The farms surveyed had an average of four labourers (household labour and hired labour); among the respondents, 76 (58%) were married, 35 (27%) were single, 13 (10%) were widows/widowers, and 6 (5%) were divorced (Figure 4.2). For the financial year 2019/2020, the average farm income from livestock sales was R65348.08 (Table 4.1).



Source: Author's survey, 2020

Figure 4.1: Gender of smallholder livestock farmers

According to figure 4.1, 99 (76.2%) of the 130 livestock farmers who participated in the survey were male, while 31 (23.8%) were female. This demonstrates that livestock production is a male-dominated farming enterprise in the Blouberg Local Municipality.

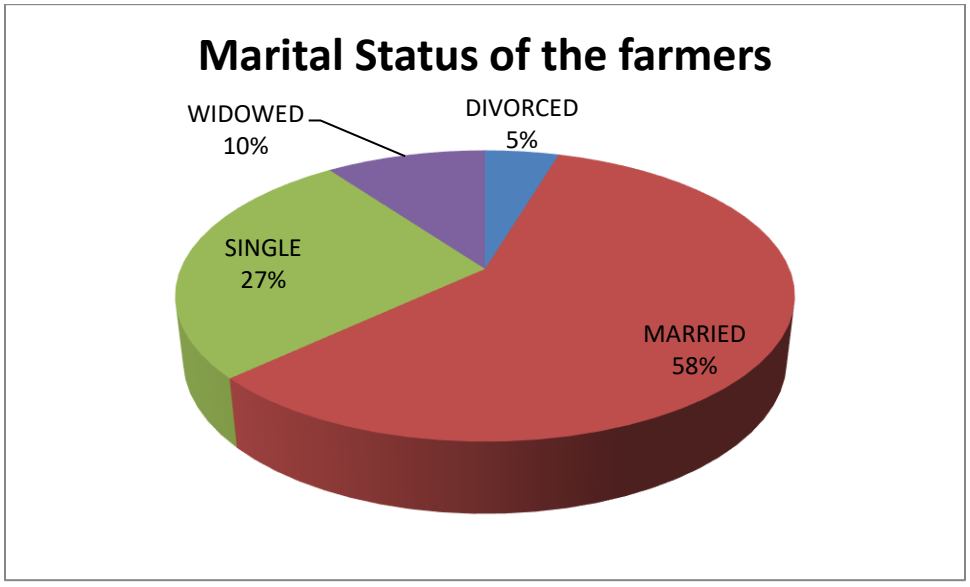
Table 4.1: Statistics of farm income, age and household size and farm labour of smallholder livestock farmers

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age of Farmer	130	22	78	50.85	14.719
Total Farm labour	130	1	9	3.80	1.663
Farm Income (R)	130	2500	516000	65348.08	62909.207
Household Size	130	1	10	5.23	1.523

Source: Author's survey, 2020

Table 4.1 above summarises descriptive statistics on the age, farm labour, farm income, and household size of the study's smallholder livestock farmers. The farmers' minimum age was 22, and their maximum age was 78 with an average age of around 51 years and a standard deviation of 14.7, indicating that the data is spread away from the mean, showing a substantial variation in the age groupings of the farmers surveyed. The average age of the farmers contradicts the findings of Zantsi *et al*. (2019), who discovered that the average age of smallholder farmers is 58 years, as well as Aliber and Hart (2009), who found that smallholders, in general, had an average age of 55 to 59 years.

Total farm labour was on average four labourers, lending credence to Zantsi *et al*. (2019)'s contention that communal livestock production has the potential to create jobs in rural areas. On average, there were five family members in each household. The farm income for the 2019/2020 financial year was a minimum of R2500, a maximum of R516000, and a mean of R65348.08 with a standard deviation of 62909.2 points, indicating a wide range in farmer income levels. This corroborates Zantsi *et al*. (2019)'s finding that smallholder farmers have a wide range of farm income levels.



Source: Author's survey, 2020

Figure 4.2: Marital status of the smallholder livestock farmers

In terms of marital status, out of the 130 farmers surveyed, 76 (58%) were married, 35 (27%) were single, 13 (10%) were widows/widowers, and 6 (5%) were divorced.

Table 4.2: Farmer's main occupation

Is farming the farmer's main occupation?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Farming is the main occupation	60	46.2	46.2	46.2
	Farming is not the main occupation	70	53.8	53.8	100.0
	Total	130	100.0	100.0	

Source: Author's survey, 2020

In terms of the main occupation of the farmers interviewed, 60 (46.2%) stated that farming was their primary occupation, while 70 (53.8%) stated that farming was not their primary occupation (See figure 4.2 above). Out of the 70 farmers who stated that farming was not their primary occupation, 45.59% listed trading as their main occupation, 42.65% were public servants, 10.29% worked for private companies, and 1.47% listed craftsmanship/artisan as their main occupation (Figure 4.3) below. The finding that livestock farming is the main occupation of 46.2% of the farmers interviewed is significant, indicating that livestock production is an important livelihood strategy for rural farmers.

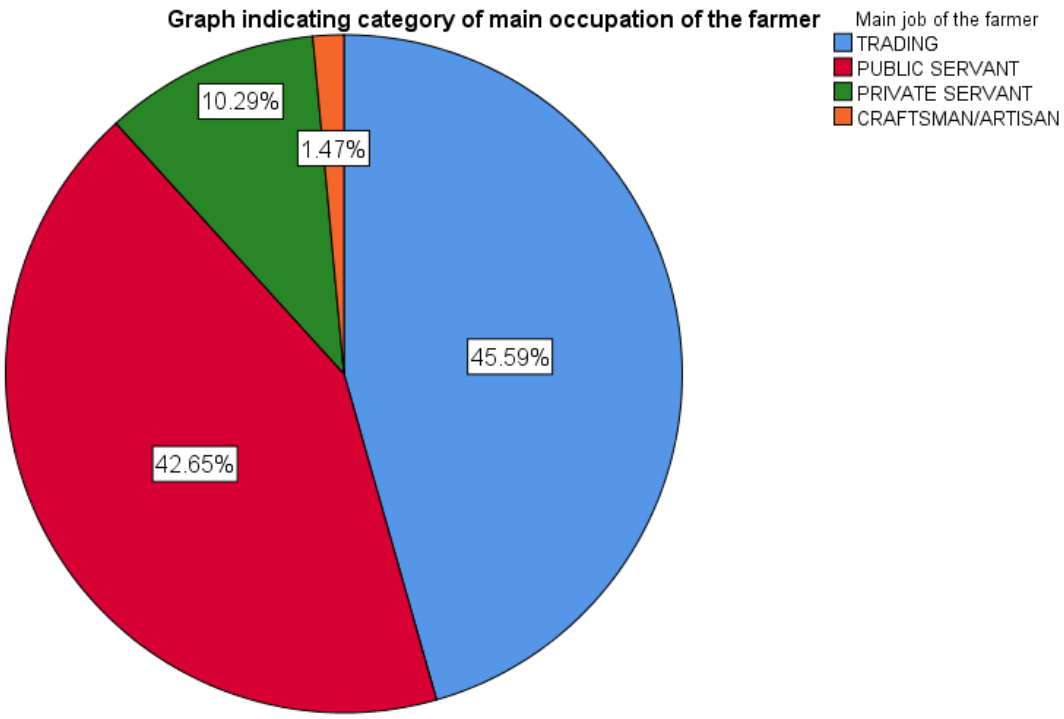


Figure: 4.3 Category breakdown of main occupation of farmers

Source: Author's survey, 2020

4.3 Protection Motivation of Blouberg Local Municipality smallholder livestock farmers

The measures which smallholder livestock farmers in Blouberg Local Municipality practice to protect their operations from drought risk include utilising drought-tolerant breeds, destocking, renting pasture land, early weaning of livestock young and supplementing feed through buying pellets, making and storing own pellets, planting and storage of grasses (hay), harvesting and storing indigenous grasses, processing and storage of maize leaves and stalk and leaves of herbaceous plants, chopping down branches of indigenous trees and incorporating chicken manure into feed.

The smallholder livestock farmers interviewed for the study used a minimum of one measure and a maximum of six measures to adapt to drought risk (Table 4.3). The average number of measures used by the farmers was 4 (Table 4.3). This is an indication that smallholder livestock farmers in Blouberg Local Municipality were on

average utilising multiple measures to protect their livestock from the effects of drought and used both proactive and reactive measures in their response to drought conditions. The reactive measures mainly involved utilising various ways of supplementing feed during the drought period, destocking, renting pasture land, early weaning and buying pellets. The proactive includes using drought-tolerant breeds, making and storing own pellets, planting and storage of hay and the processing and storage of maize leaves and stalks during harvest season. This is in contrast to the findings of Ifejika-speranza (2010), who discovered that rural livestock farmers mostly apply reactive drought responses that intensify the exploitation of natural resources.

Table 4.3: Descriptive statistics of farmers' Protection Motivation

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
FPM	130	1	6	4.12	1.292
Valid N (listwise)	130				

Author's survey, 2020

Pearson correlation was run on Farmers' Protection Motivation and the Protection Motivation Theory variables (FPP, FPS, PPSE, FPCE, and FPC) to describe the strength of the association between them. Table 4.4, Table 4.5, Table, 4.6, Table 4.7 and Table 4.8 below illustrate the Pearson correlation results for the dependent variable and each of the independent variables.

Table 4.4 below shows that the correlation coefficient between FPM and FPP is significant at 0.01% with a correlation coefficient of 0.729. It suggests that there is a strong, positive linear association between FPM and FPP.

Table 4.4: Correlations of Farmers' Protection Motivation and Farmers' Perceived Probability

Correlations of FPM and FPP			
		FPP	FPM
FPP	Pearson Correlation	1	.729**
	Sig. (2-tailed)		.000
	N	130	130
FPM	Pearson Correlation	.729**	1
	Sig. (2-tailed)	.000	
	N	130	130
**. Correlation is significant at the 0.01 level (2-tailed).			

Author's survey, 2020

Table 4.5: Correlations of Farmers' Protection Motivation and Farmers' Perceived Severity

Correlations of FPM and FPS			
		FPM	FPS
FPM	Pearson Correlation	1	.722**
	Sig. (2-tailed)		.000
	N	130	130
FPS	Pearson Correlation	.722**	1
	Sig. (2-tailed)	.000	
	N	130	130
**. Correlation is significant at the 0.01 level (2-tailed).			

Author's survey, 2020

Table 4.5 above shows that the correlation coefficient between FPM and FPS is significant at 0.01% with a correlation coefficient of 0.722. It suggests that there is a strong, positive linear association between FPM and FPS.

Table 4.6: Correlations of Farmers' Protection Motivation
and Farmers' Perceived Self-efficacy

Correlations of FPM and FPSE			
		FPM	FPSE
FPM	Pearson Correlation	1	.750**
	Sig. (2-tailed)		.000
	N	130	130
FPSE	Pearson Correlation	.750**	1
	Sig. (2-tailed)	.000	
	N	130	130
**. Correlation is significant at the 0.01 level (2-tailed).			

Author's survey, 2020

Table 4.6 above shows that the correlation coefficient between FPM and FPSE is significant at 0.01%, with a correlation coefficient of 0.750. It suggests that there is a strong, positive linear association between FPM and FPSE.

Table 4.7 below shows that the correlation coefficient between FPM and FPP is not significant with a correlation coefficient of 0.163. It suggests that there is a weak, positive linear association between FPM and FPCE.

Table 4.7: Correlations of Farmers' Protection Motivation and Farmers' Perceived Control efficacy

Correlations of FPM and FPCE			
		FPM	FPCE
FPM	Pearson Correlation	1	.163
	Sig. (2-tailed)		.064
	N	130	130
FPCE	Pearson Correlation	.163	1
	Sig. (2-tailed)	.064	
	N	130	130

Author's survey, 2020

Table 4.8: Correlations of Farmers' Protection Motivation and Farmers' Perceived Cost

Correlations of FPM and FPC			
		FPM	FPC
FPM	Pearson Correlation	1	-.549**
	Sig. (2-tailed)		.000
	N	130	130
FPC	Pearson Correlation	-.549**	1
	Sig. (2-tailed)	.000	
	N	130	130
**. Correlation is significant at the 0.01 level (2-tailed).			

Author's survey, 2020

Table 4.8 above shows that the correlation coefficient between FPM and FPC is significant at 0.01% with a correlation coefficient of 0.-549. It suggests that there is a moderate, negative linear association between FPM and FPC.

The variables which showed significant associations with FPM were FPP, FPS, FPSE and FPC, while FPCE showed a weak association. The variables with significant associations were then fit into the Multiple Linear Regression model, and FPCE was excluded because it showed a weak association.

4.4 Multiple linear regression

A multiple linear regression was run to predict farmers' protection motivation (FPM) from farmers' perceived probability (FPP), farmers' perceived cost (FPC), farmers' perceived self-efficacy (FPC) and farmers' perceived severity (FPS). These variables statistically predicted FPM, F (4,125) = 76.383, p<.0005, adjusted R^2 =.700. All independent variables were statistically significant at 95%, p<.05 for all four variables.

Table 4.9: Model summary

Model Summary		
Model	Adjusted R Square	Std. Error of the Estimate
1	.700	.707
a. Predictors: (Constant), FPP, FPC, FPSE, FPS		

Source: Author's survey

Table 4.9 above presents the model summary of the fitted multiple regression model. 70% of the variance in the dependent variable (FPM) is explained by the independent variables (FPP, FPS, FPSE and FPC) as illustrated by the Adjusted R squared (R^2) of 0.700.

Table 4.10 below suggests that the regression model is a good fit for the data. The F-ratio of F (4,125) = 76.383 shows that the independent variables (FPP, FPC, FPSE, FPS) are statistically significant in predicting the dependent variable (FPM), p=0.000 which means p<.0005.

Table 4.10: ANOVA table for Farmer's Protection Motivation

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	152.768	4	38.192	76.383	.000[b]
	Residual	62.501	125	.500		
	Total	215.269	129			
a. Dependent Variable: FPM						
b. Predictors: (Constant), FPP, FPC, FPSE, FPS						

Source: Author's survey

Table 4.11 below presents the coefficients of the model, all four variables are significant; p <0.05 for all the estimates. There exists a positive statistical relationship between Farmer's Perceived Severity (FPS) and Farmer's Protection Motivation (FPM), Farmer's Perceived Self-Efficacy (FPSE) and Farmer's Protection Motivation (FPM) as well as Farmer's Perceived Probability (FPP) and Farmer's Protection Motivation (FPM), while a negative statistically significant relationship exists between Farmer's Perceived Cost (FPC) and Farmer's Protection Motivation (FPM).

Table 4.11: Table of Coefficients

Coefficients[a]				
Model		Standardized Coefficients	t	Sig.
		Beta		
1	(Constant)		-1.029	.305
	FPS	.257	3.358	.001
	FPSE	.405	6.218	.000
	FPC	-.133	-2.232	.027
	FPP	.202	2.448	.016
a. Dependent Variable: FPM				

Source: Author's survey

The multiple linear regression model

$FPM = -0.545 + 0.257FPS + 0.405FPSE + 0.202FPP - 0.133FPC + \varepsilon_i$

According to Table 4.11, the statistical significance, along with the positive coefficient of 0.257 for Farmer's Perceived Severity (FPS) and FPM, means that smallholder livestock farmers in Blouberg Local Municipality are more likely to increase drought-protection measures if there is an increase in the perception that if a drought occurs, their livestock operations will be severely negatively affected. This finding supports what Bagagnan *et al*. (2019) and Luu *et al*. (2019) found in their studies. Farmers are more likely to take preventative measures against a risk if they perceive that the occurance of the risk would severly affect their operations.

The statistical significance of Farmer's Perceived Self-Efficacy (FPSE) and FPM, as well as the positive coefficient of 0.405 for FPSE, indicate that smallholder livestock farmers in Blouberg Local Municipality are more likely to increase drought-protection measures if their perception of their capability to implement the measures increases. This finding is inline with the finding of Janmaimool (2017) where perceived self-efficacy could explain the adoption of all sustainable waste management behaviours.

The statistically significant results and the negative coefficient value for Farmer's Perceived Cost (FPC) of -0.133 indicate that smallholder livestock farmers in Blouberg Local Municipality are more likely to increase the measures to protect their livestock from drought if they perceive that the costs to implement the measures to protect their livestock from drought are affordable. This result is similar to that of Keshavarz and Karami (2016) and Bagagnan *et al*. (2019) which found a statistically significant negative relationship between farmer's adoption and perceived cost of preventative action.

The statistically significant results of Farmers Perceived Probability (FPP) and the positive coefficient of 0.202 for FPP suggests that the smallholder livestock farmers in

Blouberg Local Municipality are more likely to increase measures to protect their livestock from drought if their perception that a drought is highly likely to occur increases. This result is inline with Rapholo (2018), a high perceived risk probability is likely to result in a greater need for the farmer to protect themselves from the risk.

The study's research hypothesis was that the components of the Protection Motivation Theory do not influence the drought coping and adaptation behaviour of smallholder livestock farmers in the Blouberg Local Municipality. The hypothesis is disproven. The results indicate that farmer's perceived probability (FPP), farmer's perceived cost of preventative measures (FPC), farmer's perceived self-efficacy (FPSE), and farmer's perceived severity of risk (FPS) have statistically significant associations with smallholder livestock farmers' protection motivation (FPM) in Blouberg Local Municipality. It further quantified the effects of the associations and found that FPP, FPS, and FPSE have a positive effect on FPM whereas FPC has a negative effect on FPM. These findings are consistent with what was expected from the literature.

4.5 Conclusion

The socioeconomic characteristics of the smallholder livestock farmers in Blouberg Local Municipality who participated in this study were presented in this chapter. The section outlined the drought coping and adaptation strategies that they employed and found that they used four measures on average. The chapter also provided evidence on the components of the Protection Motivation Theory that influenced the coping and adaptation behaviour of smallholder livestock farmers in the Blouberg Local Municipality through Pearson correlation and quantified the direction of their influences through multiple linear regression.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the study's summary, conclusions, and recommendations, as well as areas for future research. The chapter summarises the study's descriptive and empirical analysis findings and draws conclusions based on them. Following that, recommendations based on the findings are made, as well as ideas for future research.

5.2 Summary

The main aim of the study was to analyse the drought risk preparedness of smallholder livestock farmers in the Limpopo Province's Blouberg Local Municipality. The study's specific objectives were to first identify and describe the socioeconomic characteristics of smallholder livestock farmers in the municipality, then to determine the drought coping and adaptation strategies employed by smallholder livestock farmers in the municipality, and lastly to evaluate the Protection Motivation Theory components influencing the coping and adaptation strategies. The study's research hypothesis was that the components of the Protection Motivation Theory do not influence the drought coping and adaptation behaviour of smallholder livestock farmers in the Blouberg Local Municipality.

Snowball sampling was utilised to collect primary cross-sectional data from 130 smallholder livestock farmers in Blouberg Local Municipality through face-to-face interviews and telephonic interviews. A semi-structured questionnaire was utilised to collect data on socioeconomic variables, drought coping and adaptation strategies applied by smallholder farmers, and questions relating to the Protection Motivation Theory.

The first and second objectives were addressed using descriptive statistics, whereas the third objective was addressed using multiple linear regression. Descriptive statistics

of smallholder farmers' socioeconomic information revealed that 31 of the respondents were female and 99 were male; the average household size of the smallholder farmers was five family members. The farmers who participated in the study ranged in age from 22 to 78 years old, with an average age of 51 years. The farms surveyed had an average of four labourers (household labour and hired labour); 58% of the farmers surveyed were married, 27% were single, 10% were widows/widowers, and 5% were divorced. For the financial year 2019/2020, the average farm income from livestock sales was R65348.08, and 46.2% of farmers identified farming as their main occupation, while 54.8% indicated that farming was not their main occupation.

Descriptive statistics on the drought risk adaptation measures used by smallholder livestock farmers in Blouberg Local Municipality revealed that the farmers utilised a minimum of one measure and a maximum of six measures. Farmers utilised an average of four different measures. This demonstrates that smallholder livestock farmers in Blouberg Local Municipality use four measures on average to protect their livestock from the effects of drought. Smallholder livestock farmers protect their operations from drought risk by using drought-tolerant breeds, renting pasture land, early weaning of livestock young, and supplementing feed by buying pellets, making and storing own pellets, planting and storing grasses (hay), harvesting and storing indigenous grasses, processing and storing maize leaves and stalks, and leaves of herbaceous plants, chopping down branches of indigenous trees and incorporating chicken manure into feed.

Pearson correlation analysis was used to describe the strength of the linear associations between farmer protection motivation (FPM) and each of the independent variables: farmer perceived probability (FPP), farmer perceived severity (FPS), farmer perceived self-efficacy (FPSE), farmer perceived control efficacy (FPCE), and farmer perceived cost (FPC) (FPC). FPP, FPS, FPSE, and FPC all had significant associations with FPM, whereas FPCE had a weak association. The variables with significant associations were then integrated into the multiple linear regression model, with FPCE being excluded due to its weak association.

The results of the multiple linear regression model revealed that the regression model was a good fit for the data; adjusted R squared (R^2) was 0.700 and the F-ratio of F (4,125) = 76.383, indicating that the independent variables (FPP, FPC, FPSE, and FPS) were statistically significant in predicting the dependent variable (FPM). Furthermore, with $p < 0.05$ for all estimates, all four variables were found to be statistically significant, indicating a positive statistical relationship between FPS and FPM, FPSE and FPM, and FPP and FPM. However, FPC and FPM have a negative statistical relationship.

5.3 Conclusion

The objectives of the study were to:

i. Identify and describe the socio-economic characteristics of smallholder livestock farmers in Blouberg Local Municipality;
ii. Determine the drought coping and adaptation strategies employed by smallholder livestock farmers in Blouberg Local Municipality; and
iii. Evaluate the Protection Motivation Theory components influencing the coping and adaptation behaviour of smallholder livestock farmers in Blouberg Local Municipality.

According to the study's findings, smallholder livestock production in Blouberg Local Municipality is a male-dominated enterprise; 31 of the respondents were female, while 99 were male. The smallholder farmers' average household size was five family members. The farmers who participated in the study ranged in age from 22 to 78 years old, with an average age of 51 years. The average number of labourers on the surveyed farms was four (household labour and hired labour), implying that smallholder livestock farmers contribute to the creation of employment opportunities for their household members as well as hired labour. For the financial year 2019/2020, the average farm income from livestock sales was R65348.08, and 46.2% of farmers identified farming as their main occupation, while 54.8% indicated that farming was not their main occupation.

Smallholder livestock farmers in the Blouberg Local Municipality used multiple methods to protect their operations from drought risk. They used drought-tolerant breeds, rented pasture land, introduced early weaning of livestock young, and supplemented feed by buying pellets, making and storing own pellets, planting and storing grasses (hay), harvesting and storing indigenous grasses, processing and storing maize leaves, stalk and leaves of herbaceous plants, chopping down indigenous tree branches, and incorporating chicken manure into feed.

With an R^2 adjusted of 0.70, Protection Motivation Theory variables explain 70% of the variation in farmer protection motivation. Protection Motivation Theory components that indicated a statistically significant relationship with smallholder livestock farmers' coping and adaptive behaviour were perceived risk probability, perceived severity, perceived self-efficacy, and perceived costs.

The study hypothesised that the components of the Protection Motivation Theory do not influence the drought coping and adaptation behaviour of smallholder livestock farmers in the Blouberg Local Municipality, and this hypothesis was rejected.

5.4 Recommendations

The study recommends that interventions aimed at supporting or empowering smallholder livestock farmers in Blouberg Local Municipality to better cope with drought should prioritise the provision of information on drought early warning signals. This is to help farmers know the probability of a drought occurring well in advance and, thus, adequately prepare for it. There should also be provision of information or platforms for exchanging information on how the drought has affected other farmers to make them aware of the severity of the drought. To gain farmers' buy-in for implementing innovative or new measures, adequate information, training and workshops on measures that farmers could use to better adapt their operations to be conducted are required, so that farmers' perceptions of their ability to implement the measures may improve. Finally, it is critical that measures be cost effective.

5.5 Area for further research

The study used a non-probability sampling method of purposive sampling, therefore a similar study employing a probability sampling technique would be an intriguing subject of future research. Similar studies could be carried out in other geographical areas of South Africa to check if the findings of this study as well apply to those areas.

Protection Motivation Theory could only explain about 70% of the variation in smallholder farmers' protection motivation behaviour, so developing a model based on Protection Motivation Theory but including socioeconomic and other behavioural variables such as attitude, subjective norm, and intention could potentially fill the gaps left by the study.

Comparative studies of livestock farmers' protection motivation across different socioeconomic markers such as gender, income level, and geographical area could also contribute substantially to the knowledge of what motivates smallholder livestock farmers to implement the drought adaptation techniques that they choose. The development of a measurement instrument to examine farmers' protection motivation to diverse risks in the South African context would also yield knowledge valuable for the study of farmers' risk adaptation behaviour.

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APPENDICES

Appendix 7.1 Questionnaire

QUESTIONNAIRE ON ANALYSING DROUGHT RISK PREPAREDNESS BY SMALLHOLDER LIVESTOCK FARMERS: AN APPLICATION OF PROTECTION MOTIVATION THEORY IN BLOUBERG LOCAL MUNICIPALITY, LIMPOPO PROVINCE

This study aims to analyse the drought risk preparedness of smallholder livestock farmers in Blouberg Local Municipality, Limpopo province. Respondent's participation in this study is voluntary, the information provided by the respondents will be kept anonymous and confidential and only used for the purpose of research; names and contact information of respondents are asked only for authentication purposes. This study will not cause physical, emotional or mental harm to the respondents.

Enumerator's name	
Questionnaire number	
Date	
Time	
Village name	
Respondent's name and surname	
Respondent's cellphone number	
Would you be willing to participate in a	Y/N

follow up interview in future?	

1. Farmer's socio-economic information

Mark appropriate box with an **X** or fill in appropriate information in spaces provided

1.1 Gender

1.Male	2.Female

1.2 Age of the farmer in years…….

1.3 Ethnic group

1.Black	2.Coloured	3.Indian	4.White	5.Other……..

1.4 Marital status

1.Single	2.Married	3.Divorced	4.Widowed

1.5 Number of years of schooling…….

1.6 Household size…….

1.7 Source of household income

1.Salary	2.Wages	3.Self employed	4.Pension	5.Social grant	6.Remittances

1.8 Is farming your main occupation?

1. Yes	2.No

1.9 If no, specify main occupation

Trading	Public Salaried job	Private salaried job	Craftsman and artisan	Other……

1.10 Number of household members who work in the farm……

1.11 Number of farm workers who are not household members……..

1.12 Total number of farm labour…….

1.13 Ownership of land

1.Title deed	2.Leased land	3. Permission To Occupy

1.14 Type of farming engaged in

1.Animal Husbandry	2. Crop production	3. Both Animal husbandry and crop production

1.15 Livestock on the farm

Livestock type	Number owned	Number of young born in previous 12 months	Main productive use (Use key 1)	Source of water (Use key 2)
1. Cattle				
2. Goats				
3. Sheep				
4. Poultry				
5. Pigs				
6. Donkey				
7. Other (Specify)				

Key 1: 1=meat; 2=milk; 3=eggs; 4=manure; 5=Ploughing; 6=transport; 7=other (specify)
Key 2: 1=River; 2=wetland; 3=Dam 4=deep well; 5= Borehole 6=other (specify)

1.16 Size of the farm…….

1.17 Methods used to sell the livestock

1.Farm gate	2.Auction	3.Agents	4.Other……..

1.18 Number of livestock sales in the past 12 months

1.Cattle	2.Goats	3.Sheep	4.Pigs	5.Poultry	6. Donkey	7. Other

1.19 What is the average pricing of livestock?

1.Cattle	2.Goats	3.Sheep	4.Pigs	5.Poultry	6.Donkey	7.Other

1.20 Number of visits by extension worker in the past 12 months…….

1.21 Services provided by extension worker

1.22 Are you a member of a farmer group/ cooperative?

1. Yes	2. No

1.23 If yes in 23, how often does the farmer group/cooperative meet?

1.24 If no, why are you not part of any farmer group/ cooperative?

1.Not interested	2.There are no farmer groups/ cooperatives around to join	3. I was a member but I withdrew due to …….....	4. Other…….

2. Farmer's protection motivation

2.1 With regards to livestock production on your farm, which of the following activities do you practice to cope and adapt to drought? Indicate with **X**, mention any not included.

1.Sell livestock to reduce herd size	
2.Purchasing drought tolerant breeds	
3.Supplement feed Type of supplement…….	
4.Renting pasture land	
5.Feeding cash crops to livestock	
6.Insurance	
7.Early weaning	
8.Other measures not mentioned above	
Total number of measures adopted	

3. Perceived probability

Indicate the level of response to the following questions with 1- Very low, 2- Low, 3- Moderate, 4- High, 5- Very high. Mark appropriate level with **X**

	1	2	3	4	5
3.1 How likely is it that a drought is a real phenomenon?					
3.2 How likely is it that a drought would occur within your lifetime?					
3.3 What is the possibility that if a drought occurs, it will impact your livestock production?					

4. Perceived severity

Indicate the level of response to the following questions where 1- Very low, 2- Low, 3- Moderate, 4- High, 5- Very high

	1	2	3	4	5
4.1 How much damage do you think the consequences of a drought will be for your livestock production?					
4.2 How much damage do you think the consequences of a drought will be for your living environment?					
4.3 How much financial damage do you expect for your farm should a drought occur?					

5. Farmer's perceived self-efficacy

To what extent do you consider yourself capable of taking the below mentioned actions to protect your farm against the consequences of drought? 1- Not very capable, 2-Not capable, 3-Moderately capable, 4-Capable and 5-Very capable

	1	2	3	4	5
5.1 Sell livestock to reduce herd size					
5.2 Using drought tolerant breeds					
5.3 Supplement feed					
5.4 Renting pasture land					
5.5 Feeding cash crops to livestock					
5.6 Insurance					
5.7 Early weaning					

6. Farmer's perceived control efficacy

Indicate the level of response to the following questions where 1- Very Ineffective, 2- Ineffective, 3- Don't know, 4- Effective, 5- Very effective

	1	2	3	4	5
6.1 How effective is selling livestock to reduce herd size as a drought coping/adaptation strategy?					
6.2 How effective is using drought tolerant breeds as a drought coping/ adaptation strategy					
6.3 How effective is supplementing livestock feed as a drought coping/ adaptation strategy					
6.4 How effective is renting pasture land as a drought coping/ adaptation strategy					

6.5 How effective is feeding cash crops to livestock as a drought coping/ adaptation strategy					
6.6 How effective is insurance as a drought coping/ adaptation strategy?					
6.7 How effective is early weaning as a drought coping/ adaptation strategy?					

7. Farmer's perceived cost

Indicate the level of response to the following questions where 1- Not costly at all, 2- A little costly, 3- Moderately costly, 4-Costly, 5- Very costly

	1	2	3	4	5
7.1 How costly in terms of time, will taking extra precautions against drought cost you?					
7.2 How costly in terms of effort, will taking extra precautions against drought cost you?					
7.3 How costly in terms of money, will taking extra precautions against drought cost you?					
7.4 How costly in terms of convenience will taking extra precautions against drought cost you?					

……..The end, Thank you……

Appendix 7.2 Consent form

Project title: Analysing drought risk preparedness by smallholder livestock farmers: An application of protection motivation theory in Blouberg Local Municipality, Limpopo Province

Project leader: **Seanego KC**

I……, hereby voluntarily consent to participate in the following project: “Analysing drought risk preparedness by smallholder livestock farmers: An application of protection motivation theory in Blouberg Local Municipality, Limpopo Province”

I understand that:

1. The research project aim has been explained to me.

2. I am participating in this study on a voluntary basis and I can withdraw my participation at any stage.

3. I will respond truthfully and my responses will be treated with confidentiality and will only be used for the purpose of the research.

4. Participation in this research will pose no harm to me.

5. I do not have to respond to any question that I do not wish to answer for any reason.

5. Access to the records that pertain to my participation in the study will be restricted to persons directly involved in the research.

6. Any questions that I may have regarding the research, or related matters, will be answered by the researcher.

7. I may only be contacted to participate in a follow up interview in future if I consent to it.

Signature of interviewee **Signature of interviewer**

_____ _____

Date_____