EXPLORING THE IMPACTS OF DROUGHTS AND THE SKILLS GAP ON SMALLSCALE LIVESTOCK FARMERS IN SELECTED AREAS OF KWAZULU-NATAL, SOUTH AFRICA

by

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"We never know the worth of water till the well is dry".

(Thomas Fuller)

ABSTRACT

Small-scale farming plays a pivotal role in poverty reduction and enhancement of living standards within impoverished rural communities. However, in South Africa, persistent drought conditions continue to imperil the operations, income, and livelihoods of small-scale farmers. It is imperative to conduct extensive research to mitigate the ecological and economic impacts of drought, a pressing concern in this region. Despite their resilience, small-scale livestock farmers have been challenged by the increasing severity of drought, as exemplified by the 2015 drought. This adversity exposed their lack of preparedness and essential skills, compelling us to examine and address these critical deficiencies.

The primary aim of this research is to assess the effects of droughts on small-scale livestock farmers in South Africa and to determine the crucial skills necessary for improving their preparedness and resilience in the face of drought-related challenges. The study employed a mixed-method research approach that included focus group discussions, key informant interviews, audio-visual materials, and semi-structured questionnaires. The study focused on the Okhahlamba and uLangalibalele Municipalities in the KwaZulu-Natal province using random purposive sampling to select 150 small-scale livestock farmers actively engaged in livestock production.

The main research findings revealed significant socio-economic and environmental impacts of droughts on small-scale livestock farmers in South Africa. Livestock farmers reported income loss (98.7%) due to reduced agricultural production, compromised food security, and heightened vulnerability due to slow government assistance processes. Moreover, 52% of livestock farmers reported an increase in livestock mortality rates, 72% maintained that productivity declined, while 56.7% reported that animal health deteriorated. Furthermore, 92% and 74.7% reported reduced water availability and quality as a result of droughts respectively. Lastly 60% of the livestock farmers agreed on elevated feed costs, 93.3%, on grazing land degradation, and 98.6% on loss of vegetation due to droughts. Moreover, droughts exacerbated incidents of theft and social conflicts driven by competing interests within the community, such as hunter- burning pastures used for livestock grazing.

Additionally, the study uncovered a low level of drought preparedness among small-scale livestock farmers with inadequate skills, resources, and tools. They lacked confidence in their ability to cope with drought, emphasising the need for training interventions. The essential skills identified for

improved drought preparedness and resilience included business management, livestock, drought, and grazing land management skills.

In conclusion, this research underscores the pressing need for targeted training and support programmes to equip small-scale livestock farmers with the skills necessary to effectively confront the ecological and economic impacts of drought. Efforts such as relief programs and feed supplements can help farmers cope with drought but resources for drought preparedness need improvement. Collaborative efforts and tailored training programs are essential for building sustainable and resilient agricultural communities. Climate awareness initiatives, weather monitoring stations, and blending traditional and modern farming practices are recommended. Government intervention is encouraged in strategic meetings involving small-scale farmers to address challenges.

Training programs, especially for young farmers, need to focus on scientific, technological, and cultural skills. Collective approaches like village meetings and joint farming can help farmers share knowledge and adopt cost-effective drought response methods. Management structures should be established in drought-prone communities for long-term mitigation measures. Assistance programs, investments in mechanization, and price floor schemes are recommended to stabilize the agricultural sector. More courses and training materials should be provided by training institutions like AgriSETA for livestock farmers and extension officers to enhance skills and knowledge.

DEACLARATION

I, Othaniel Shabalala hereby declare that:

i. The research, except where otherwise indicated, is my original.

ii. This thesis has not been submitted for any degree or examination to any other university.

iii. This thesis does not contain other persons' data, pictures, graphs, or other information, unless specifically acknowledged as being sourced from those persons.

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Othaniel Shabalala

As a candidate's Research Supervisor, I agree with the submission of this thesis for examination.

Signed..... ..... **Date**..... 16 November 2023

Denver Naidoo (Supervisor)

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LIST OF ABBREVIATIONS

Agri SETA: Agricultural Sector Education and Training Authority
Co GTA: Department of Cooperative Governance and Traditional Affairs

CRDP: Comprehensive Rural Development Programme

DAFF: Department of Agriculture Fishery and Forestry

DRR: Disaster Risk Reduction

DWS: Department of Water and Sanitation

EA: East Africa

ECP: Eastern Cape Province

EM DAT: The International Disaster Database

ENSO: El Nino southern oscillation

FAO: Food and Agricultural Organisation

GDP: Gross Domestic Product

GNP: Gross National Product

IKS: Indigenous Knowledge System

IDP: Integrated Development Plan

IPAP: Industrial and Policy Action Plan

IPCC: Intergovernmental Panel on Climate Change

ITCZ: Intertropical Convergence Zone

IWRM: Integrated Water Resources Management

KZN: KwaZulu-Natal

LED: Local Economic Development

LSU: Large Stock Units

NCCGP: National Climate Change Green Paper

NCCRWP: National Climate Change Response White Paper

NCCR: National Climate Change Response

NDMA: National Disaster Management Act

NDMC: National Disaster Management Centre

NDP: National Development Plan

NGO: Non-Governmental Organisation

NGP: National Growth Plan

OLM: Okhahlamba Local Municipality

REID: Rural Enterprise and Industrial Development

RMPO: Red Meat Producers Organisation

SA: South Africa

SAWS: South African Weather Service

SMART: Specific Measurable Achievable Realistic Timely

SPSS: Statistical Package for Social Sciences

SSA: sub-Saharan Africa

SST: Sea Surface Temperature

UKZN: University of KwaZulu-Natal

UNCCD: United Nations Convention to Combat Desertification

WCD: West Coast district

CHAPTER 1: PROBLEM AND ITS SETTING

1.1 Introduction

Drought poses a significant challenge to the agricultural sector, particularly impacting livestock farmers. Research has shown that drought can lead to a decrease in crop yields, affecting the availability of feed for livestock (Leng & Hall, 2020). Smallholder livestock farmers are especially vulnerable to agricultural drought, with studies indicating that only a small percentage of them demonstrate resilience to such conditions (Maltou & Bahta, 2019). The impact of drought extends beyond crop production to water availability for livestock, further complicating the challenges faced by farmers (Kamruzzaman et al., 2019).

Livestock farmers in drought-prone regions struggle to maintain their herds due to limited water and forage availability. Drought can result in a decline in the quality and quantity of pastureland, impacting the nutritional needs of livestock (Wu et al., 2021). Additionally, the economic consequences of drought on livestock farmers are significant, as reduced feed availability can lead to increased costs for supplementary feeding or even forced sales of livestock (Adhikari, 2018). Studies in various regions emphasize the long-lasting effects of drought on the agricultural sector, underscoring the necessity for effective drought monitoring and adaptation strategies to enhance resilience among livestock farmers (Bahta, 2021).

Moreover, the repercussions of drought on agriculture go beyond immediate production losses, affecting the broader ecosystem and socioeconomic activities. Drought can have adverse effects on water resources, food production, and economic sectors reliant on agriculture (Alahacoon et al., 2021). Livestock farmers, who already operate within narrow profit margins, are particularly susceptible to the cascading impacts of drought on markets, prices, and overall agricultural productivity (Katiyatiya et al., 2022). The severity of drought on agriculture has been exacerbated by climate change, with studies indicating an increase in the frequency and intensity of drought events in recent years (Haghighi et al., 2020).

Drought significantly impacts the agricultural sector, with a specific focus on livestock farmers who encounter challenges related to feed availability, water scarcity, economic losses, and overall resilience. Effective drought monitoring, adaptation strategies, and support systems are imperative

to mitigate the adverse effects of drought on livestock farming and ensure the sustainability of agricultural practices in drought-prone regions.

1.2 Background

The role of agriculture in Sub-Sharan Africa is vital, as it provides livelihoods to most people and proves to be the most lucrative source of GDP. For example, Agriculture stands as the primary economic driver in the nation, contributing 55.2 percent in 2019 and 56.6 percent of the GDP in 2020. It represents the most substantial sector within Sierra Leone's economy, employing 62 percent of the nation's workforce and generating 22 percent of its export earnings (IFAD, 2023). The majority of Africa's impoverished population relies on agriculture, notably small-scale farming, as their main source of sustenance. The advancement and prosperity of the agricultural sector hold significant sway over efforts to enhance food security and alleviate poverty across numerous African nations. As climate change intensifies worldwide, the significance of small-scale farmers in safeguarding food and nutrition security, as well as fostering sustainable rural development in Africa, grows increasingly pivotal. Africa necessitates environmentally sustainable and resilient farming systems to furnish nutritionally adequate food and guarantee food security for its most vulnerable inhabitants. (Hlophe-Ginindza & Mpandeli, 2021).

The livestock sector serves as a significant pillar in South Africa's agriculture, greatly enhancing the welfare of rural communities in poverty. This is because livestock production, such as cattle and sheep farming, fulfils crucial roles in providing food, strengthening household economies by offering draft power, organic fertilizer, and fuel. Livestock fulfils various needs and objectives sought after by farmers with limited resources, playing a multifaceted role in the lives of the poor (Mbatha, 2021).

However, farmers encounter numerous hurdles in their efforts towards successful livestock production such as infrequent rainfall availability. Water, being essential for life, forms the cornerstone of development. As a consequence of apartheid-era policies, small-scale farmers were relocated to barren environments. Most rural small-scale farmers, marked by limited literacy and underdevelopment, cannot afford modern farming facilities. Unlike commercial farmers who can invest in boreholes, rural small-scale farmers rely on rainfall to irrigate their crops. This situation exacerbates during droughts. Small-scale farmers in these communities suffer from reduced food production and income due to the impact of global warming, which leads to insufficient rainfall.

Consequently, food insecurity becomes a challenge for both the farmers and their communities (Matlakala, 2021). Drought, particularly in the middle of the season, characterized by low and unpredictable rainfall, poses significant uncertainty and agricultural production risks in sub-Saharan Africa (Mango, 2018).

The SA government has also been deeply involved in agriculture since the introduction of democracy, which recognised agriculture as a significant pillar of economic growth. The state has developed many frameworks and policies on all levels of governance - the local, national, and provincial - to ensure an all-encompassing and cohesive economy in terms of race and other demographic elements. These frameworks include the National Development Plan (NDP), National Growth Plan (NGP), Comprehensive Rural Development Programme (CRDP), Industrial and Policy Action Plan (IPAP), and Rural Enterprise and Industrial Development (REID). Agriculture is considered the main industry for local development by most rural municipalities-based judging on its inclusion in the National Framework for Local Development (LED) for the attainment of the following goals: building diverse and innovation-driven local economies, developing inclusive economies, and enterprise development and support (South Africa, Department of Cooperative Governance and Traditional Affairs [CoGTA], 2017).

A large amount of literature is available on the effects of drought on agricultural production across SA (Talanow, 2021). Nevertheless, most of these studies focused primarily on the impacts of drought on individual types of farmers, such as subsistence and small-scales or large commercial farmers, without considering its effect on agricultural skills for the whole sector. Agricultural drought management in SA has been addressed by other researchers. Other studies have focused on agricultural drought management in SA (Baudoin et al, 2017; Anderson et al., 2020; Meza et al, 2021). Information on the negative impact of drought on agricultural losses and food availability is usually part of the drought narrative, but questions relating to the skills gap and the training needs of farmers and key professionals in SA's agricultural sector in relation to drought preparedness and mitigation are still not answered or are decoupled from routine drought risk assessments. A drought skill assessment could make it easier for farmers to be more resilient against droughts, providing them with the necessary skills to achieve and reduce the adverse effects of droughts (Ruwanza et al., 2022). To determine the knowledge gaps of small-scale livestock farmers regarding drought management, it is important that such an assessment guides the

development of retraining programmes for developing new competencies in climate risk management and enhancing resilience within the agricultural sector. This will foster the design of appropriate policy interventions for agricultural drought management.

1.3 Problem Statement

Small-scale livestock farming serves as a crucial avenue for poverty reduction and enhancement of living standards in impoverished rural communities, as noted by Bukhoshini & Moyo (2023). However, in South Africa, persistent drought poses a significant threat to the operations, incomes, and livelihoods of small-scale farmers.

The impact of drought extends to small-scale farmers in South Africa, particularly those engaged in livestock farming within impoverished rural communities. This includes farmers, their families, and the broader agricultural workforce dependent on this sector for employment.

The problem predominantly affects rural areas of South Africa, where small-scale livestock farming is prevalent. Specifically, this study focuses on selected areas of KwaZulu-Natal, where the effects of droughts on small-scale farmers require detailed examination.

Drought, as a recurring natural hazard, poses an ongoing challenge to small-scale livestock farming in South Africa. The study aims to address the current state of affairs, acknowledging the persistent threat posed by droughts to farmers' operations and livelihoods.

Drought, characterized by precipitation deficiency over prolonged periods, results in water scarcity, crop and livestock losses, socioeconomic disruption, ecological imbalances, and potential threats to human life. With projections indicating increased drought occurrences and reduced rainfall, the impact on livestock production and associated economic sectors, such as agriculture, becomes disproportionately severe.

The significance of the issue is underscored by the pivotal role of livestock farming in supporting approximately 500,000 jobs, including direct employment by milk producers and the creation of additional jobs within the milk processing value chain. Furthermore, there exists an information gap concerning the effects of droughts and the skills required by small-scale livestock farmers to cope effectively. Bridging this gap is essential for developing resilience strategies and facilitating appropriate training to mitigate the impact of droughts on this vulnerable demographic.

1.4 Aim

To investigate the impacts of droughts and the skills gap within SA small-scale livestock farmers

1.5 Specific objectives

- To describe the drought phenomenon and its impact on small-scale livestock farmers.
- To identify the skill gap and training needs of small-scale livestock farmers concerning drought preparedness and mitigation in SA, Kwa-Zulu Natal.

1.6 Research question

What are the impacts of droughts and the skills gap that exists among small-scale livestock farmers in Kwa-Zulu Natal?

1.6.1 Research sub-questions

- What are the droughts and their impacts on small-scale livestock farmers in KwaZulu-Natal (KZN)?
- What are the skills of small-scale livestock farmers and their lack of drought preparedness in KZN?
- What training does small-scale livestock farmers need to be equipped with to improve their resilience to drought?

1.7 Importance of study

Determining the impact of droughts on the South African agricultural sector will aid policymakers in formulating appropriate policy interventions to sustain small-scale livestock farmers against the impact of droughts and climate change, which threatens the farm and household economy, food and nutrition security, economic growth, human survival, and living standards of farmers. More so, findings will help expose and bridge the gap between farmers and knowledge about climate change and droughts, which will equip them with better plans and early warning systems to address the challenges of droughts. Livestock farmers play an important role in fighting food insecurity and production; hence, it is justifiable to examine at this matter and address it. This study aims to contribute to the existing literature on climate change response practices undertaken in Africa and SA and researchers would find the work useful for further research. Government interventions

have been limited in supporting farmers with disaster measures to cushion the impacts of droughts on them, mainly because of the existing insecurity of programmes and lack of teamwork between stakeholders. More interdisciplinary studies and robust study designs are needed. Consequently, knowledge of livestock farmers' vulnerability to drought is essential for the development of applicable policies for drought reduction by developing drought- resilient strategies; mitigation practices can help improve livestock survival and adaptation and improve future livestock improvement (Mare et al., 2018; Tadesse, 2018).

1.8 Study limits

The study will be conducted within the province of KZN; therefore, the findings cannot be generalised to other provinces. Moreover, the study is limited to small-scale livestock farmers in Bergville, Winterton, and Estcourt. Therefore, conclusions, findings, and recommendations are relevant to livestock farmers in the area because the area has unique environmental characteristics, such as demographic qualities, climatic conditions, and ecological processes. The study will not cover the entire uKhahlamba region, as this will be incredibly costly. The study could further investigate the expertise key agricultural professionals such as extension officers possess in order to assist livestock farmers cope with droughts.

1.9 Definition of terms

Agricultural droughts occur when soils are dry owing to a drastic decline in precipitation levels, intense but sporadic rainfall events, or extreme evapotranspiration (Vu et al., 2015).

Climate Change is a change in the state of the climate that can be identified by changes in the mean and/or variability of its properties and persists for an extended period, typically decades or longer (IPCC 2012).

Commercial Farming utilises farming practices to raise crops and raise cattle to sell them in markets and make money (Singh & Bangarwa, 2015).

Droughts can be defined as below-average water availability in a particular region for an extended period (Hanel et al., 2018).

El Nino Southern Oscillation is the dominant and most consequential climate variation on Earth and is characterised by the warming of equatorial Pacific Sea surface temperatures (SSTs) during the El Niño phase and cooling during the La Niña phase.

Food Security refers to the ability of individuals to obtain sufficient food on a day-to-day basis. exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life." (FAO 2022)

Food Insecurity lack regular access to enough safe and nutritious food for normal growth and development and an active and healthy life (FAO, 2019)

Hydrological drought refers to a water deficit in the water cycle, resulting in very low streamflow in rivers and lakes, reservoirs, and groundwater (Van Loon, 2015).

Indigenous Knowledge System refers to the composite set of knowledge and technologies existing and developed around specific conditions of populations and communities indigenous to a particular geographic area (Masoga & Shokane, 2019)

Meteorological Droughts are linked to precipitation deficiencies in (Wu et al., 2017).

Mitigation is the lessening of the potential adverse impacts of physical hazards (including those that are human - induced) through actions that reduce hazards, exposure, and vulnerability. (IPCC, 2012).

Resilience The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, capacity for self-organisation, and capacity to adapt to stress and change (Pachauri & Reisinger, 2008).

Socioeconomic Drought has to do with the supply of and demand for an economic good like water, which can include features of meteorological, agricultural, and hydrological droughts (Shi et al., 2018).

Subsistence Farming farmers produce and rear livestock to meet the needs of their families. Surplus produce is sold to nearby markets (Surbhi, 2020).

Vulnerability is the degree to which a system is susceptible and unable to cope with climate variability and extreme weather events as well as the sensitivity and the adaptive capacity of the system to this variability (Mehran et al., 2015).

1.10 Assumptions

Droughts harm the agricultural sector in SA. Livestock farmers are directly affected by this phenomenon because water is the number one priority for grooming livestock, and they lack the skills of livestock farmers. The interviews conducted during data collection will be active for a shorter period per participant to ensure that participants do not lose interest. It is assumed that the survey participants in this study were not deceptive with their answers, and that the participants answered questions honestly and to the best of their ability. Since the interviewees were debriefed about the data collection that was to be conducted before the actual collection of the data and reassured of the privacy of their identities it was expected that they would be honest with their responses.

1.11 Dissertation outline

Chapter 1 presents an introduction and background to the study, research questions and objectives, the problem statement, importance of the study, study limits, assumptions, and definitions of terms. Chapter 2 reviews the literature on the economic, social, livestock, and environmental impacts of drought on small-scale livestock farmers. This chapter further discusses the impacts of the 20152018 droughts on livestock and agricultural productivity of KZN. Moreover, the chapter examines the role of livestock farming in KZN and the impact of droughts on the state of food security for small-scale livestock farmers. In addition, this review discusses the coping strategies adopted by small-scale livestock farmers in other provinces to cope with droughts, including soil, water, rangeland, crop, livestock, and business management skills. Finally, the chapter reviews the government's involvement in assisting small-scale livestock farmers in coping with droughts and other natural disasters. Chapter 3 describes the study area and the methodology employed to collect and analyse the data. Chapter 4 presents results and discussions of the impact of droughts on small-scale livestock farmers and the skills that farmers possess to cope with droughts. The chapter ends with a discussion of the training that small-scale livestock farmers need to prepare for and cope efficiently with drought conditions. Chapter 5 provides a summary of the conclusions and recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The literature review chapter's outline: Firstly, a discussion of droughts and the impact of drought on SA's agricultural sector and the small-scale livestock sector in particular. Thereafter is the discussion of the coping strategies that small-scale livestock farmers adopt in the face of drought, a review of the skills of small-scale livestock farmers, and lastly, a summary of the chapter.

2.2 Definition and characteristics of small-scale livestock farming

There are two major classifications of agriculture that separate farmers, which are commercial and subsistence agriculture. Subsistence farmers produce crops for local consumption whereas commercial farmers produce for moneymaking purposes. Subsistence farmers produce and rear livestock to meet the needs of their families. Surplus produce is sold to nearby markets. As the name implies, commercial farming and agribusiness utilise farming practices to raise crops and raise cattle for the purpose of selling them in markets and making money. The main characteristic evident in commercial farming is the intense use of sophisticated inputs for increased productivity. For example, fertilisers, insecticides, seeds, pesticides, etc. This type of farming concentrates on producing crops and livestock that are high in demand (Singh & Bangarwa, 2015).

Small-scale livestock farming refers to a system of animal production characterised by relatively small herd sizes and landholdings. It is typically practiced by individual farmers or families on a small-scale, often in rural or peri-urban areas. Small-scale livestock farming encompasses various animal species, including cattle, sheep, goats, pigs, and poultry, and involves diverse production systems such as grazing, stall-feeding, or mixed systems. The primary objectives of small-scale livestock farming are often to meet household food needs, generate income, and contribute to local food security. The scale of production, limited resources, and reliance on traditional knowledge and practices are key characteristics of this farming system (Pienaar and Traub, 2015).

Small-scale livestock farming is characterised by its close integration with local socio-cultural and economic systems. It often involves traditional farming practices that have been passed down through generations, incorporating indigenous knowledge and cultural values. These systems are often highly adaptive to local conditions, taking advantage of the available natural resources and

utilising locally adapted livestock breeds. Small-scale livestock farmers typically rely on a combination of resources, including communal grazing lands, crop residues, and locally available feed sources. They often engage in mixed farming, integrating livestock with crop production, allowing for nutrient cycling and mutual benefits. Additionally, small-scale livestock farming is often labour-intensive, with family members actively involved in day-to-day operations (Cele, 2020)

Small-scale livestock farming is characterised by its multifunctional nature, contributing to both economic and social objectives (Khapayi & Celliers, 2016). Beyond providing food and income, small-scale livestock farming plays a crucial role in rural livelihoods, providing employment opportunities and serving as a safety net during times of economic hardship. It contributes to cultural identity, social cohesion, and the preservation of traditional practices and knowledge. Moreover, small-scale livestock farming often promotes sustainable land management practices, such as rotational grazing and agroforestry, which can have positive environmental impacts, such as soil conservation and biodiversity preservation. These diverse functions make small-scale livestock farming an integral part of rural development strategies and contribute to the resilience and sustainability of local communities (Czekaj et al., 2020).

2.3 Overview of droughts in Africa and South Africa

In a recent study, Ngcamu and Chari (2020) reported that droughts pose a high risk to people's nutritious food security across sub-Saharan Africa. However, the past, actual, and future states of drought, along with their historical trends, impacts, mitigation, and prospects, are still poorly covered across the entire continent. Meanwhile, an extensive understanding of droughts across Africa is necessary for decision- and policymaking for both regional and continental organizations.

Each drought event has a visible impact on East Africa's economy, poses threats to lives, and degrades the natural environment. As an example, recent drought episodes of 2010/2011 and 2016 created a food shortage for over 10 million people, leading to the loss of lives and livelihoods (Uhe et al., 2017). Haile et al. (2020a, b) reported increased drought frequencies in Eritrea, parts of Ethiopia, South Sudan, Sudan, and Tanzania, while Rwanda, Burundi, and parts of Uganda experienced smaller droughts in the second half of the twentieth century. The study also reported that a longer-timescale drought (SPI 6) persisted longer than the short-timescale droughts. Future projections of drought also paint a grim picture, as drought events are likely to increase by 16%,

36%, and 54% under the low, medium, and high emission scenarios, while extreme droughts are expected to cover a larger area (Haile et al. 2020a, b; Tan et al. 2020). Most studies point to ENSO as the primary factor causing seasonal drought, with El Niño (La Niña) episodes enhanced (suppressed) in the region.

In West Africa drought events have caused numerous deaths and destroyed property, hampering development and economic growth in the region, as farming activities in the region are largely dependent on rainfall. The plight of the affected population attracted the attention of international aid organizations as well as the scientific community, which have encouraged research activities aimed at understanding the characteristics of the extreme in terms of causal mechanisms and future prospects. Moreover, drought is a recurrent phenomenon in the Northern African (NA) region, causing civilizations to collapse and mass migrations. In the past four decades, drought episodes in NA have gradually become more widespread and prolonged, with worrying socio-economic and environmental effects (Ayugi et al., 2022).

Drought is among the most destructive natural disasters in Southern Africa, with the region experiencing an escalation in the spatial extent of drought since the 1970s. Rainfall unpredictability in Southern Africa has been connected with atmospheric circulation configurations and interchanges in easterly and westerly flows, the connections between tropical and temperature structures, and the difference in pressure systems over Marion and Gough Island. Prolonged heat waves and droughts are interconnected, in most cases, by the prevalence of fundamental anticyclonic circulation over the country. A study on drought characteristics within the twenty-first century showed that ENSO caused over 66% of the extreme drought occurrences in Southern Africa (Ayugi et al., 2022).

The ENSO SST effect on dry conditions in Southern Africa was examined by Gore et al. (2020), who revealed a weakening effect of El Niño and a strengthening effect of La Niña on the Walker circulation, resulting in drier and wetter conditions, respectively. It was reported that the El Niño and La Niña conditions altered the moisture flux circulation, thus impacting the drought characteristics over the southern region of Africa.

In Africa, population growth has become a serious concern, leading to a scarcity of natural resources, and worsening socio-economic development (Ahmadalipour & Moradkhani, 2018; Ahmadalipour 2018). Drought impacts have led to poor soil fertility, affecting agricultural

productivity in most sub-Saharan African countries. Environmental stresses emanating from drought vulnerability are the leading cause of biodiversity losses in most African agro ecosystems (Horn & Shimelis, 2020; Abdelmalek & Nouiri, 2020). For instance, South and West African countries have experienced severe drought impacts on their environment, which included the deracination of the region's vegetation from their prototype biomes, significant loss of biodiversity, and plant mortality (Lawal et al., 2019).

At present, some parts of Southern and Eastern Africa have witnessed a rapid decrease in precipitation, and critical irrigation supply is on the verge of collapse due to a lack of environmental monitoring and assessments by stakeholders (Ayugi et al., 2020). Moreover, Mediterranean areas have experienced severe impacts such as water scarcity stress, rainfall variability, and decreased agricultural production, which may worsen under the perceived climate change prognosis (Abdelmalek & Nouiri, 2020).

South Africa (SA) is generally classified as a semi-arid and water-stressed country, with the average yearly rainfall being 550mm which is below the global average of 860mm per annum, and an annual mean temperature of 18, more rainfall being received in summer months (November till March) in the eastern part of the country while the Southwestern part receives it in winter months (May till August). Nearly 91% of the SA territory is arid to semi-arid, with only 10% of the land generating half of the annual runoff (Meza et al., 2021). SA has been frequently affected by droughts in the last four decades. Major drought periods include 1982–1984, 1991–1992,1994–1995, 2004–2005, 2008–2009, 2015–2016, and the most recent in 2018–2020 (Mahlalela et al., 2020).

Droughts experienced in SA have been closely related to climate change and the El Nino phenomenon which warms up the water surfaces in the eastern tropical Pacific Ocean. Agriculture has proven to be an immediate sector to be affected by drought in SA which has caused a fall in crop production. In addition to reduced crop yields is a decrease in livestock production since the deficit in water causes poor pasture growth which means less food for livestock to graze on. Water reservoirs on the other hand are continuously declining attributable to decreased and irregular rainfall received throughout the country (Botai et al., 2016).

SA represents one of many countries where disasters are reported but no national database on loss and damage has yet been established. Quantification of impacts due to major disaster events is

often conducted only by individual sectors such as agriculture or water affairs (Barbara G. Schreiner, 2018). Due to the lack of a comprehensive, standardised, and hazard-specific loss and damage monitoring system, the National Disaster Management Centre (NDMC) of SA confirms that reporting for the Sendai Monitor at the national level is currently not feasible for the country (NMDC, 2019). Agriculture plays an important source of income and livelihood in Eastern Cape, for at least 35% of the households in mainly rural areas. The whole province was affected by the 2015/2016 drought in SA. Most of the households depend on agriculture compared to other provinces, representing a huge rainfall gradient ranging from 250mm to 1000mm per year (Walz et al., 2020). In October 2019, Eastern Cape was declared a drought disaster region following aggravated water shortages in many urban and rural areas. Overall, the results suggest that the rainfall gradient across the province is weakening, at least in spring. Most of the decreasing rainfall trend seems to result from a reduction in the number of rainfall days but not in heavy rainfall days (defined as more than > 10 mm per day) (Mahlalela et al., 2020).

In SA, droughts of various severity are frequent, and they have been proclaimed multiple times in the northern, western, and southern areas of the nation throughout the past century (Zwane, 2019). Even though much research has been done on the effects of drought on agriculture (Masipa, 2017; Rakgwale & Oguttu, 2020), SA is still susceptible to drought because of an overreliance on dryland farming and a lack of expertise in drought management in the agricultural sector (Kom et al., 2022). Communities plagued by poverty and underdevelopment are more negatively impacted by drought (Caleni, 2017). From 2000 to 2018, the agriculture industry in SA experienced some of the effects depicted in Figure 2.4. Between 2005-2006 and 2015-2016, there was a significant decline in the volume index of food production, horticulture, and field crops. While horticulture, animal, and food production had a considerable reduction in 2015–2016, field crop yields experienced the biggest decline in both times. These patterns line up with the years that SA declared the drought a national emergency.

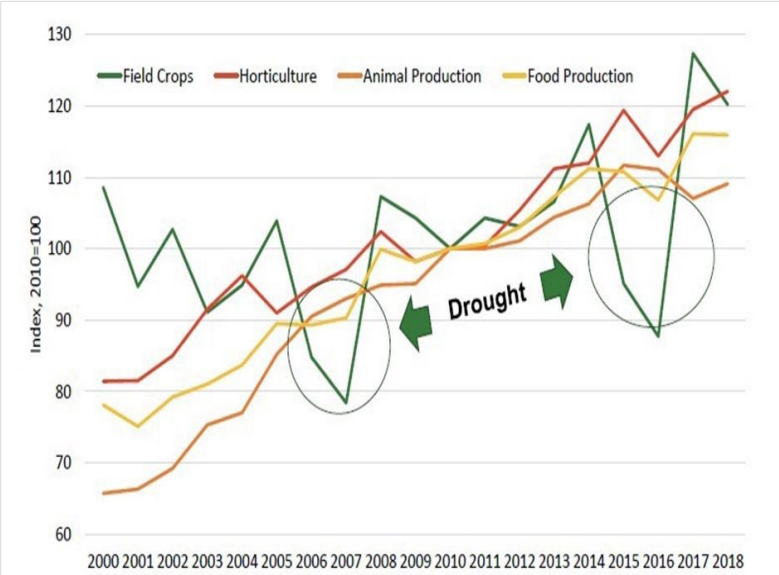

Figure 2.4: Volume index of agricultural production in SA. *Source: AgriSA, 2019*

2.4 Definition of droughts

Drought is a complicated occurrence that can have a variety of effects on society and the natural environment, including short-term lower agricultural production, social conflicts, and environmental deterioration (Lottering et al., 2021). The overreliance of agriculture on water availability makes the impacts of droughts on agriculture more compounded compared to other sectors (Matlou et al., 2021). They act as risk multipliers, contributing to further risk and human security challenges such as land loss, persistent poverty, displacement and migration, and competition for increasingly scarce natural resources (Omotayo, 2019). Droughts in SA have had a substantial influence on the agricultural sector, as well as terrible consequences for the economy, the environment, and millions of people (Elum et al., 2017).

The SA agricultural sector is considered dualistic, comprising commercial and small-scale sectors (Majaha, 2023). Small-scale farmers are further classified as small commercial (i.e., emerging) or subsistence (Zwane, 2019). There are around 40,000 commercial farmers, 220,000 developing farmers, and over 2 million subsistence farmers in the agricultural sector (Talanow et al., 2021). The agricultural sector employs approximately 880,000 people, 91% of whom are unskilled (Stats SA, 2017). Subsistence farmers are the most vulnerable to drought, followed by small commercial farmers and large-scale commercial farmers (Meza et al., 2021). To successfully manage and cope

with droughts, there needs to be an effective collaboration among stakeholders like policymakers and skilled professionals (i.e., particularly disaster managers, extension workers, researchers, farmers, and the private sector) (Warner et al., 2017). Therefore, the objective of this chapter is to discuss the drought phenomenon, the impacts of droughts, and the skills implications amongst small-scale livestock farmers concerning drought preparedness and management in Kwa-Zulu Natal, SA.

Droughts are different from other natural disasters and are challenging to understand and predict due to their multifaceted character which is comprised of several properties including frequency, duration, and intensity (Leng et, 2015). Moreover, its definition varies with its specific impact on society or the environment because it is an applied concept (Wilhite, 2016). They are among the costliest natural disasters affecting a significantly great number of people globally by disturbing water availability and agricultural production (Grillakis, 2019). East Africa experiences frequent droughts however, the region struggles to predict the disaster due to a poor forecasting capacity, and different natural and human induced factors. This has significantly affected the environment and the socio-economic health of the societies in the area (Gebremeskel Haile et al., 2019).

More so droughts are often confused with aridity which refers to an ever-present climatic characteristic of a particular geographical area or with water scarcity; that is, a condition whereby available water resources are inadequate to complement long-term average requirements (Nairizi, 2017). Drought occurrences vary from place to place and have different impacts on socioeconomic areas, the environment, and segments of the water cycle, which has made it difficult for the research community to agree on a uniform definition of droughts (Otkin et al., 2018). However, droughts can be defined as the existence of below-average availability of water in a particular region for an extended period (Hanel et al., 2018). It can also be defined as a natural disaster caused by abnormally low precipitation over a prolonged period which then causes an impermanent deficit in water availability (Leng et al., 2015).

Droughts can lead to significant detrimental effects on societies by affecting various aspects of human life like agriculture, food security, and the environment (Golian et al., 2014). Therefore, it is necessary to understand this phenomenon for management purposes, should more extreme events re-emerge like the 2015/2016/2018 droughts in South Africa. As per the projections based on the increased extent, occurrence, and severity of droughts, it is pivotal to document and inform

the scientific community and policymakers on the underpinnings of drought, its numerous consequences, and adaptive mitigation strategies perceived by small-scale livestock farmers.

2.4.1 Types of droughts

Droughts are a result of a complex interaction between (i) natural precipitation shortages, or extreme evapotranspiration over different time cycles and spatial extents, and (ii) the demands of human and environmental water use that may be accelerated due to poor governance, planning, and distribution. There are four types of droughts, each of them having unique spatiotemporal characteristics. First is meteorological or climatic drought, second is agricultural, third is hydrological drought, and last is socio-economic (Wang et al, 2016).

Meteorological droughts are linked with deficiencies in precipitation (Wu et al., 2017). They generally lead to the origination of the other three types of droughts which are agricultural, socioeconomic, and hydrological droughts after they accumulate for a prolonged time (Guo et al., 2020). It is characterised by a period of months to years with abnormally below-low precipitation (Vu et al., 2015).

Agricultural droughts occur when soils are dry due to a drastic decline in precipitation levels, intense but sporadic rainfall events, or extreme evapotranspiration (Vu et al., 2015). It occurs when the moisture in the soil is lower than the minimum moisture required by plants by studying the behaviour of plants during growth and the characteristics of soil moisture (Liu et al., 2016). Moreover, agricultural drought has proven to be the most influential contributor to social instability in particular regions with unpredictable politics (Kelley et al., 2015).

Hydrological drought refers to the deficit of water in the water cycle resulting in very low streamflow in rivers and lakes, reservoirs, and groundwater (Van Loon, 2015). It is the shortage of surface and subsurface water and is considered as the most crucial due to the primary relationship it has with the society which includes irrigation and urban water supply (Zhu et al., 2016).

Socio-economic drought is the inability of water resources to meet the demands of providing economic utility. It occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply thereby harming people's lives. It is the correlating supply and demand of goods and services, meaning that the supply of particular goods and services

like water and electricity that depend on weather may be affected and the drought may cause a shortage in the supply of these economic goods (Mehran, 2015).

In addition, droughts can be explained in different forms such as characteristics of droughts and vulnerability to drought. Furthermore, droughts can be described based on their area and the effects at that time. The two major types of drought definitions are conceptual and operational. Conceptual definitions clarify the meaning of drought and the impacts thereof, whereas operational definitions clarify the starting and terminal points of a drought and the level of austerity of a drought (Muthelo, 2018). For example, a conceptual definition of drought-related to farming could define droughts as a protracted period of deficient precipitation resulting in extensive damage to crops, and a consequential loss of yield. No one-size-fits-all operational definition of drought exists, which is the main reason why policymakers, resource planners, and other stakeholders have more trouble recognising and planning for drought than they do for other natural disasters (NDMC, 2023).

Regarding agriculture, an operational definition might compare daily precipitation values to evapotranspiration rates to determine the rates of soil moisture depletion. Thereafter these relationships in terms of drought effects on plant behaviour (growth and yield) at various stages of crop development (NDMC, 2023). Figure 2 below shows the transfer of drought and the interaction between the types of droughts and explains the relationship between the various types of droughts and the duration of the drought event. Depending on the timing of the rainfall insufficiency, drought usually takes three or even more months to develop.

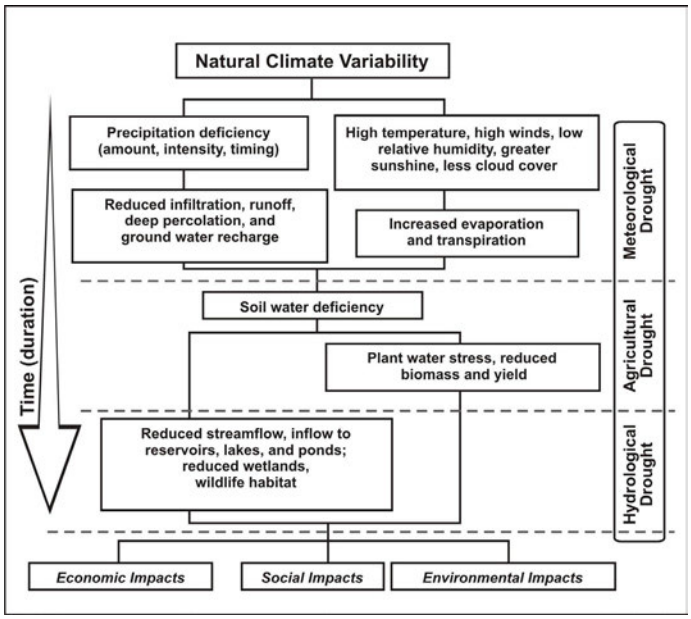

Figure 2.1: The relationship between various types of droughts and the duration of drought events *Source: National drought Mitigation Centre (2014).*

2.5 Causes of drought

Various factors can promote the occurrence of droughts, namely, precipitation deficits, the increase in temperature which causes an intensification in evaporation, soil moisture, and evapotranspiration feedback, and lastly the upsurge in wind speed which intensifies evaporation and hence decline in the water (Karlie, 2020). East Africa (EA) has diverse droughts due to the dissimilar geological factors it is comprised of and regional oceanic movements and coastal influences (Lyon, 2014; Ayana, 2016). Droughts in EA are significantly affected by regional movements including, tropical easterly jets, low level Westerlies, localised convergence, monsoons, and the Turkana jet. The topography of EA is complex resulting in a complicated and diverse climate (Lyon, 2014 & Fenta et al., 2017). In addition to these, human activities such as deforestation for creating farmlands, grazing land, and human settlement impose direct and indirect stimuli on drought occurrences resulting in uncertainty in the categorisation and forecasting of droughts (Muller, 2014; Hao & Singh, 2015).

However, the main natural contributing factors that cause drought occurrences are the El Nino Southern Oscillation (ENSO) and the SST anomaly as illustrated in Figure 1 below (Roux, 2016). During El Nino the SSTs rise in the equatorial region of the Pacific Ocean causing a circulation of the atmosphere and ultimately rainfall and temperatures in particular regions shown in Figure 3 and 4 below (Cai et al., 2018). The global El Nino (9-12 months) phenomenon brings with it warm climatic conditions, while La Niña (1-2 years) brings cold climatic conditions. It does so as a result of fluctuating temperatures along the equator of the Pacific Ocean and massive air pressure changes (Lakhraj-Govender & Grab, 2019). Scholars have observed, even though this is not a rule, that the El Nino phenomenon is often associated with dry and below-normal rainfall conditions while La Niña has normal or above-normal rainfall conditions (Karlie, 2020).

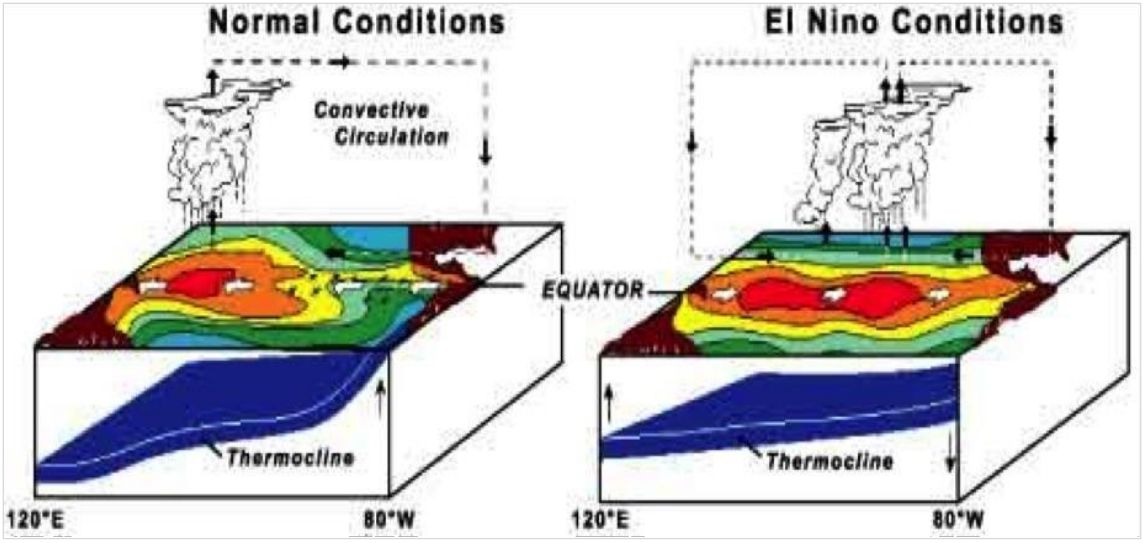

Figure 2.2: Normal condition vs El Nino conditions Source: Roux, 2016

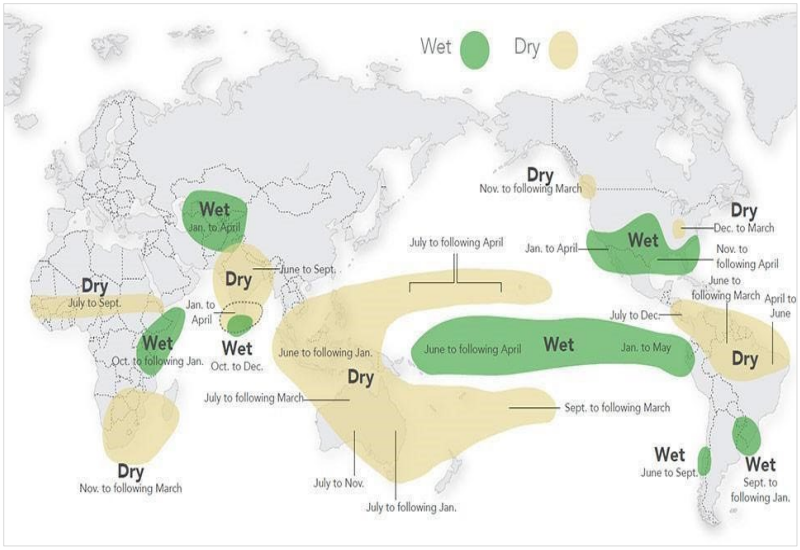

Figure 2.3: Relationship between ENSO index and rainfall Source: http://wwwfao.org/elnino/en/

Drought occurrences in EA are closely intertwined with the complexity and heterogenous nature of ENSO, SSTs, and land-atmosphere feedback (Eischeid et al., 2014; Hua et al., 2016; Masih et al., 2014). EA is connected with climate variations in the Indian Ocean, the Intertropical Convergence Zone (ITCZ), La Niña, the Mediterranean Sea, the Atlantic Ocean, and the complex geology. These factors have a direct and indirect impact on the occurrence of drought over EA (Lyon, 2014). The rising temperature of the Indian Ocean is another component that leads to drought in EA, this phenomenon causes a decline in precipitation and geological storage of water

ultimately resulting in droughts (Schubert et al., 2016). The climate of EA countries is influenced by multiple factors as mentioned above and exacerbated by the complex topography that is in the region which ultimately plays a huge role in the occurrence of drought.

In addition to the aforementioned factors that contribute to drought occurrences is the anthropogenic factor. Which also plays a significant role in drought occurrence. The anthropogenic effects include land use change, land degradation, deforestation, firing, and mining (Ordway et al., 2017). In addition to these are human activities including, expansion and cultivation of land and grazing land, overutilisation of water resources, new settlements and urban expansion, and investments in the construction of large-scale development projects have an impact on droughts. Studies have shown that water withdrawals, particularly for irrigation purposes have been on the rise globally, which in turn can exacerbate the competition for unsustainable natural resource exploitation and lead to drought (Huang et al., 2018). Human activities resulting in deformed land surfaces are the major factors altering hydrological processes leading to droughts. The increasing temperature of the Indian Ocean is also attributable to human beings which causes precipitation and soil moisture deficits, therefore worsening droughts (Schubert et al., 2016). Therefore, it is crucial to consider human influences as an integral part of drought management to have a well-informed understanding of droughts.

2.6 Drought's Wider Impact: A Holistic Examination of its Effects

Droughts, as natural disasters, encompass a spectrum of far-reaching consequences. Their impacts are deeply rooted in four critical domains: the economy, society, ecology, and agriculture. Understanding the multi-dimensional effects of drought is essential in developing strategies for mitigation and adaptation.

2.6.1 Economic Impacts of Droughts

Droughts have a vast impact on many sectors that rely on water to thrive, this includes the economic sector. The severity of the impacts of any disaster including droughts reflects on the changes it causes to the Gross National Product (GNP) and Gross Domestic Product (GDP). Studies related to GDP show that the effects of droughts on the economy often surface over time after a drought occurrence. Preceding the 1984 droughts in sub-Saharan Africa was a 9%, 118%,

and 17% decrease in the GDP for Mali, Niger, and Ethiopia, respectively (Nairizi, 2017). The droughts that occurred in Iraq in the year 1999-2000 accounted for a $1605 million loss which in turn caused a 4.4% decrease in the country's GDP (Bm & Im, 2015). The economic impacts of droughts depend on the country's stage of economic development. Countries that are least developed experience higher shocks than those that are less dependent on agriculture for economic prosperity.

Countries in the sub-Saharan have been challenged by droughts in many sectors due to their significant dependence on agriculture for economic growth. SA has experienced the following detrimental effects on its' economy; decreased land prices, loss of agricultural-dependant industries, increased unemployment rates from drought-related declines, rigidity within financial institutions regarding credit risks, and stress in reducing economic losses (Department of Local Government, 2015). Low rainfall, low capacity of range lands to support grazing, and shortage of drinking water for livestock resulted in negative impacts on commercial farming between 1991/1992 in SA. Despite the minimal input agriculture has on theSA GDP it plays a critical role in creating wealth for rural areas providing more than 1 million job opportunities. TheSA government spent R285 million on drought relief in the years 2007 and 2008 (Bm & Im, 2015).

Table 2.1: Economic impacts of droughts

Economic impacts	**Effects**
Lowered trade per dealers	High rates aimed at agri-business produces
Lack of food and energy	Severe increases in rates; high prices in imported goods and services
Severe loss in crops, no food and income	High expenses in purchasing food
Poor growth and quality of livestock	Low price for livestock
Poor water supply	High rates of transport
High level of retrenchments and loss of financial support and properties	Extending poverty; high level of of unemployment
Lack of tourism attraction and less financial boost	High level of capital deficit
High level of financial advances	High level of debts; more credits for monetary organisations

Source: Mothapo, 2020.

2.6.2 Social Impacts of droughts

Droughts can also be the main contributors to worsening conflicts over scarce resources, particularly water. Social impacts refer to aspects such as public safety, conflicts between water consumers, decreased standard of life, unequal distribution of the effects, and disaster relief and migration. The latter is the main significant problem in many societies since those that migrate to other places hardly ever return despite the decreasing intensity of droughts, this then results in the deficiency of human resources in rural areas, also known as the brain-drain (Muthelo, 2018). Natural changes introduced by droughts often cause havoc within societies concerning access, tenure, and conflict of interest regarding resource management within and between communities and states. These conflicts occur more frequently during droughts. Societies that are impoverished and side-lined tend to resort to using violence when facing difficult climatic conditions due to the limited availability of opportunities and a feeling of injustice (Gautier et al., 2016). Table 1 depicts a summary of the social impacts of droughts. Societies experience and react to droughts differently depending on the level of economic development they are at, therefore studying societies uniquely is necessary to develop conducive strategies for livestock farmers to cope with droughts.

Table 2.2 Social impacts of drought

SOCIAL IMPACTS	**EFFECTS**
Lack or poor distribution of resources (food and water)	Migration, resettlement, conflict between water users
Increased quest for water	Increased conflict among water users
Marginal lands become unstable	Poverty and unemployment
Reduced grazing quality and crop yield	Overstocking; reduced quality of living
Retrenchments	Reduced or no income
Food insecurity	Malnutrition and farming; civil strikes and conflict
Increased pollutant concentration	Public health risks
Inequitable drought relief	Social unrest and distrust
Increased forest and range fires	Increased threat to human and animal Life
Urbanisation	Social pressure and reduced safety

Source: Mothapo, 2020.

2.6.3 Ecological Impacts of droughts

Droughts have a direct impact on the ecosystem due to the direct dependence of natural resources on water. These result in degradation of air and water quality, flora and fauna species, forest and range fires and wildlife habitats, degradation of landscape quality, loss of biodiversity, and soil erosion. Other areas may end up being permanently deformed while others experience short-term changes and soon the habitat returns to a normal state (Muthelo, 2018). Remote sensing has shown that annual rainfall amount is directly proportional to the production of aboveground plant biomass. The western side of Africa experienced a decrease in species richness along with tree density and plant cover due to the drought occurrence between 1970 and 1980. Moreover, droughts affect non-timber forest products, grass cover on rangelands, and productivity, as seen in northern Senegal. A complete deformation of an ecosystem occurred in Lake Faguibine in Mali due to droughts. Ghana faced health issues like bilharzia and diarrhoea as droughts reduced the availability and the quality of water, and further hindered livelihood practices such as herding, beer brewing, dry season cultivation, and fishing. Lastly, droughts can also result in electric power cuts by decreasing available water in hydroelectric dams as seen in Ghana (Gautier et al., 2016).

Table 2.3: Ecological/Environmental impacts of droughts

Environmental impacts	**Effects**
Destruction of natural habitats	Harm of biodiversity
damaged forests, crop, and range land productivity	Reduced income and food shortages
Low levels of water	Less accessibility to water
poor cloud cover	Plant scorching
High temperatures during daytime	Improved fire hazards
high evapotranspiration	Increased crop wilting
Increased dust and sandstorms	Improved soil erosion as well as increased air pollution
Lesser soil productivity	Desertification and soil degradation (topsoil erosion)
Decreased water resources	Lack of irrigation and drinking water
Reduced water quality	More waterborne diseases; increased salt concentration
Increased incidences of animal diseases and mortality	Loss of income and food; reduced breeding stock
Soil desiccation	Increased soil ‘blow activities’
Degradation of landscape quality	Permanent loss of biological productivity of the landscape
Species concentration near water	Increased vulnerability to predation

Source: Mothapo 2020.

2.6.4 Agricultural Impacts of droughts

Agriculture and drought are two significant issues that are closely linked, particularly in EAs. Agriculture constitutes approximately 40% of the EAsn GDP (FAO, 2014). EA agricultural land has decreased due to droughts while the population has doubled within two decades, unless farmers develop in conjunction with this demand, they may be faced with displacement, division, and degradation in the face of diminishing rainfed agriculture due to drought. The main cause of the famine that occurred in Somalia in the year 2011 (see Table 4) was drought causing insufficient rainfall (Grillakis, 2019). The main outcomes of agricultural drought include lowered income for farmers, hunger, migration, heightened unemployment rates, and increased food prices (Sivakumar et al., 2014). The major reason for the latter implication of drought is the rise in farm inputs. Farmers may decide to withdraw from investing in a particular commerce such as staple crops like maize, due to marginal revenues being lower than the marginal costs of production. This ultimately jeopardises the local supply of food and therefore, increasing prices worsening food insecurity (Muthelo, 2018). Droughts have a direct impact on agriculture because this industry directly depends on water for it to thrive and therefore it is important for farmers to be equipped with drought management plans and strategies.

Drought knows no size of farming; it affects both small-scale and large-scale farming. There is evidence that the sub-Saharan countries are already feeling the effects of climate change. There are eight ways that the impact of climate change affects Africa and the sub-Saharan countries, according to research published by 350 Africa.org (n.d.). It was established that water sources were drying up, resulting in considerable conflict between the users and that livestock like sheep and goats were dying from a shortage of pasture. SA is likewise impacted by the effects of climate change. Commercial farming did not have enough fodder for its cattle; thus, livestock were given potato seedlings to graze on since they were not being sold due to the drought (Swart, 2016). Although it is suggested that climate change is having a negative impact on livestock, Rust and Rust noted that some of the issues in livestock cooperatives were brought on by conflicts brought on by ineffective leadership or the emergence of opportunistic views by specific cooperative members. Rust and Rust outlined four potential causes: modifications to livestock feed, problems with grain availability and price, effects on forage crop production and quality on livestock pastures, changes in livestock diseases and pests, and the direct results of extreme weather events

on animal health, growth, and reproduction. Furthermore, changes in the nutritional environment may be the primary cause of the indirect effects of climate-driven change on animal output (Zwane, 2019).

The effects of climate change cause pastures to degrade and become of lower quality, which in turn affects the quality of animals and, ultimately, the meat. Infected feed that animals eat can occasionally have an impact on the quality of the meat. Changes in temperature and precipitation may cause diseases and parasites to spread to new areas or increase the frequency of pests and diseases. Animal productivity is decreased and animal mortality is increased by pests and diseases (Zwane, 2019). Moreover, the rise in temperatures which ultimately causes droughts can lead to increased heat stress which has deleterious effects on livestock. The Government of Western Cape (2017) reported a sale of approximately 30,000 cattle due to the inability of farmers to feed their herds and a high number of animals slaughtered within the beef cattle herds.

Table 2.4: Summary of drought events recorded from 1900 to 2017.

Country	Drought years	Number of drought episodes	Number of deaths	Number of people affected (Million)	Economic loss (USD)
Burundi	1999, 2003, 2005, 2008, 2009, 2010	6	126	3.1	Not available
Djibouti	1980, 1983, 1988, 1996, 1999, 2005, 2007, 2008, 2010	9	0	1.2	Not available
Eritrea	1993, 1999, 2008	3	0	5.6	Not available
Ethiopia	1965, 1969, 1973, 1984, 1987, 1989, 1997, 1998, 1999, 2003, 2005, 2008, 2009, 2012 and 2015	15	402,367	77.1	1,492,600
Kenya	1965, 1971, 1979, 1983, 1991, 1994, 1996, 1999, 2004, 2005, 2008, 2010, 2012, 2014 and 2016	15	196	50.2	1500
Rwanda	1976, 1984, 1989, 1996, 1999, 2003	6	237	4.2	Not available
Somalia	1964, 1969, 1973, 1980, 1983, 1987, 1988, 1999. 2004, 2005, 2008, 2010, 2012, 2014 and 2016	15	19,673	18.4	Not available
South Sudan	2010, 2016	2	0	7.9	Not available
Sudan	1980, 1983, 1987, 1990, 1991, 1996, 1999, 2009, 2012 and 2015	10	150,000	31.5	Not available
Tanzania	1967, 1977, 1984, 1988, 1990, 1996, 2003, 2004, 2006, 2011	10	0	12.7	Not available
Uganda	1967, 1979, 1987, 1998, 1999, 2002, 2005, 2008, 2010	9	194	5.0	1800
EA		100	572,793	216.9	1,495,900

Source: (Gebremeskel Haile et al., 2019)

2.7 Impacts of Climate Change on Droughts and Livestock Farmers

Experts claim that climate change will most likely disturb approximately all sectors of society and the environment, from energy, socio-economic services, and biological systems, to water resources. It refers to a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or due to human activity (IPCC, 2012). More so regardless of the uncertainties of the intensity of the knock-on effects of climate change, it is without a doubt that the regions that will be severely affected are those situated in geographical locations that are prone to natural disasters. These areas are often part and parcel of the poorer states with limited resources for adaptation and refining their ability to be resilient during unfavourable seasons (Tuana & Cuomo, 2015).

Climate change and droughts are posing profound challenges to African society, experts claim that the conditions are not going to get any better. Africa is expected to suffer more serious consequences with more severe weather events which will cause pandemics, hunger, and displacement of local community citizens (Tumushabe, 2017). It is estimated that more than 2 billion people worldwide have been affected by droughts in the 20th century which has resulted in 11 million deaths (Grillakis, 2019). Droughts have been the major cause of water shortages and deterioration of water quality. Agriculture has also been affected by droughts with a decrease of 33% of land per capita in EAs. Livelihoods that rely on agriculture for thriving are struggling from the lack of food resources because of low crop biomass (Gebremeskel, 2019).

Climate Change is steadily becoming a major challenge for development worldwide and subSaharan Africa has proven to be the worst to be affected because of fewer resources and coping strategies. The region has had its fair share of exposure to droughts, floods, storms, and heat waves (Archer et al., 2021). SA, in particular, is expected to experience more hot days with few cold and frost days, annual rainfall will be reduced and unevenly distributed across the region, with the south coast experiencing higher rainfall (Scholes, 2021). The complete dependence of agriculture on climate causes significant impacts on the sector (Mpandeli et al., 2015).

Exacerbating this matter is the fact that agriculture plays an essential role in the economy of SA, contributing 3% of its GDP (Nyoni et al., 2015). SA is blessed with a diversity of livestock species

with an estimated 12.8 million cattle, 19 million sheep, 1.8 million goats, and 1.5 million pigs (DAFF, 2019). The abundance of livestock in this region plays a significant role in providing livelihoods for the disadvantaged and landless labourers (Vetter et al., 2020). However, due to climate change and the magnitude of the sector in SA, the effects on livestock farmers are expected to be long-lasting (S. J. Lottering et al., 2021).

Due to the frequency, intensity, and duration of droughts, droughts are expected to rise because of climate change ultimately causing an increase in human and economic toll (Vetter et al., 2020). Livestock farmers in SA are frequently experiencing death rates, slow growth rates, and a decline in milk production due to climate change (Maluleke et al., 2020). Small-scale traditional farmers hold more than half of the livestock population in SA and have limited resources. Therefore, it is of utmost importance to improve the resilience and efficiency of livestock managed communally. Moreover, livestock has the potential to strengthen resilience to climate change, as it tends to be more resilient than crop-based systems (Oduniyi et al., 2020).

SA is as vulnerable to climate change as many other developing countries. Water is the immediate medium through which the effects of climate change are being experienced in SA according to the National Water Resource Strategy (DWA, 2013). Climate change increasingly changes precipitation patterns causing more severe storms, floods, and droughts, alteration of soil moisture and runoff, increased evaporation, and temperature changes in aquatic systems, which ultimately reduces water quality and availability. Since 2015 SA has been experiencing droughts causing crop losses, water restrictions, and impacting food and water security (DEA, 2017). Consequently, SA has the responsibility to maintain sustainable growth in economy and transformation which is stipulated in the National Climate Change Response White Paper (NCCRWP) and the NDP.

2.8 Impacts of droughts on livestock farmers in SA

The interaction of natural events and the demand farmers place on the water supply results in a drought impact on farmers. Impacts can range from social, environmental, and economic. Social impacts refer to effects such as public safety, health, disputes between consumers of water, reduced quality of life, inequitable distribution of impacts, disaster relief, and population migration. Increased population in urban areas intensifies pressure on infrastructure leading to more poverty. Environmental impacts include decreased water and air quality, flora and fauna, degradation of landscape quality, loss of biodiversity, and soil erosion. These biological disturbances may lead to

temporary or permanent reformation of landscapes. For example, wildlife habitat may be degraded due to loss of wetlands and rivers, however after the drought period terminates many species recover from this temporary abnormality. Whereas soil erosion, which degrades landscapes may lead to a more permanent loss of biodiversity (Muthelo, 2018).

In SA, the agricultural sector is experiencing severe impacts due to droughts. Droughts are having an immense impact on the SA agricultural sector. The sector is the largest consumer of water in SA, accounting for almost 60% of the entire water demand. Concurrently the livestock sector has the largest contribution towards the total agricultural GDP accounting for 48% of SA's agricultural output in terms of value.SA droughts are closely related to El Nino years, which is the main cause of the severe droughts in 2015/16. While SA is typically a net exporter of food, the 2015/16 drought turned the country into a net importer. Moreover, this specific drought event led to increased unemployment and substantial water restrictions in many regions of the country (Walz et al., 2019).

The livestock sector in SA is characterised by several constraints that prohibit effective, efficient, and profitable production. The constraints include low literacy especially in small-scale farmers (Marandure et al., 2017), which acts as a barrier between farmers' adoption of advanced technology and transformation for improved outputs (Myeni et al., 2019). Furthermore, farmers face constraints when it comes to accessing farm information, particularly concerning farm management, disease outbreaks, and cattle nutrition. The lack of support services for small-scale livestock farmers exacerbates the poverty conditions in rural areas. Therefore, access to clear and concise farm information to farmers can improve the development and farm growth of livestock farmers (Baker et al., 2015). Extreme weather events severely affect both the commercial and small-scale sector (Mare et al., 2018). In the year 2015 the total agricultural production decreased by 8.4% due to drought (Agri SA, 2016). Small-scale farmers showed more severe consent regarding extreme weather events as they experienced much more advanced impacts due to their higher vulnerability (Nkadimeng et al., 2022).

Drought reduces the availability of agricultural cultivable land (Masipa, 2017). Farmers use this area to produce food, notably crops, which are the foundation of rural agricultural economics (Mdungela et al., 2018). The effects of droughts are unevenly distributed amongst farmers with subsistence farmers being more severely affected. This is attributable to socio-economic difficulties such as water shortages, food price hikes, revenue declines, job loss, heightened

poverty, food insecurity, and malnutrition (Ngcamu & Chari, 2020). Drought affected around 700 000 people in rural areas between 2003-2005, as water sources dried up, and crops and livestock died (S. J. Lottering et al., 2020) Most of these farmers did not have access to monetary services, nor did they have the expertise or professional skills (Ashraf et al., 2020). Drought causes farmers to abandon their companies, either temporarily or permanently, and migrate to neighbouring regions in quest of better work possibilities (Kom et al., 2020). SA witnessed high internal migration rates of around 2.3 million individuals during the droughts of 2004-2006 and 2009-2010, which represents 5% of the country's population (Mastrorillo et al., 2016)

In addition to the aforementioned effects, droughts can cause mental health problems such as anxiety and depression among farmers (Agri SA Research, 2019). On the 29th of December 2015 a commercial cattle farmer aged 34, committed suicide in the Eastern Cape province of SA because the effects of the drought had simply been too much for him to handle (Chabalala, 2016). Another farmer in the Northern Cape was diagnosed with depression after losing 400 sheep and 50 springboks in the 2015-2016 drought, according to him it was the worst drought he had ever experienced in 45 years of farming (Agri SA, 2016). Droughts increase operational and input costs resulting in tightened farm financial cash flow. Figure 7 depicts trends in agricultural debt, farm assets, and debt as a percentage of assets, between 2011 and 2016, with droughts playing a significant role in the total debt. The debt of the South African agricultural sector summed up to R125 billion (Agri SA, 2019).

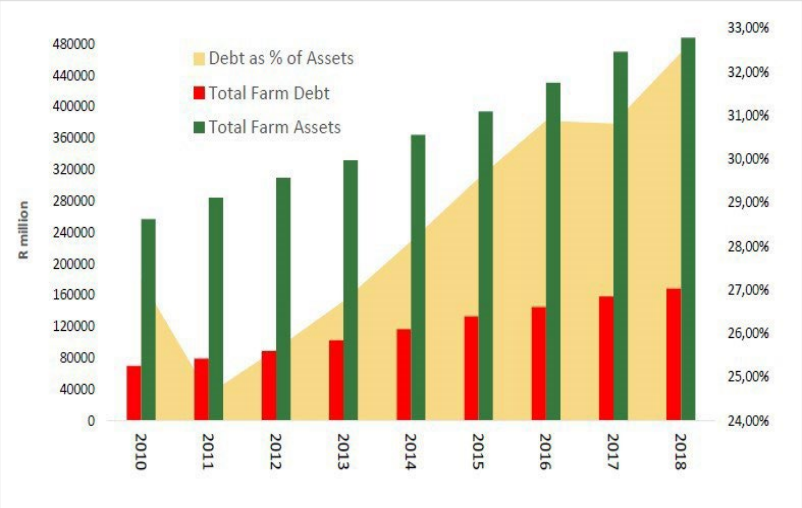

Figure 2.5: Agricultural debt, farm assets, and debt as a percentage of assets *Source: Agri SA, 2019*

In a 2015 AgriSA study, around 70% of farmers reported financial difficulties, and 50% said they had to lay off employees as a result of the protracted drought (AgriSA, 2016). Araujo et al. (2016) report that there were 2,000 permanent and temporary job losses in the wine business in 2016 and an R37 million decrease in agricultural income. The Sugarcane Growers Association lost 6,500 seasonal jobs as a result of lower sugar cane yield brought on by the drought (AgriSA, 2016). The drought also affected companies that buy feeds, equipment, fertilisers, seeds, cattle, monetary institutions, and other chemicals, among other agricultural goods and services (Agri SA Research, 2019). As an example, according to a 2016 study from theSA agricultural Machinery Association, yearly sales of tractors and combine harvesters decreased by 11% and 30%, respectively (AgriSA, 2016). Due to the decline in seed sales, seed manufacturers faced losses, and these seed inventories had to be disposed of because they were no longer suitable for reselling in the production season that followed. Super maize meal (i.e., milled maize grain), a basic food for the majority of South Africans, increased by 41% for a 5 kg bag in 2016 (Stats SA, 2020) as a result of the drought's ripple effects.

2.9 Impacts of droughts on livestock farmers in KwaZulu-Natal

Amongst other natural disasters like floods, hurricanes, tornadoes, and earthquakes, agricultural droughts are the costliest and most devastating on the planet. Drought affects the livelihood of farmers and economies, especially in third-world countries. A single drought event can decrease a global GDP by 0.8% (Kim et al., 2019). The highly limited access to resources by Africa places the continent in a vulnerable state making it difficult for it to adapt to the effects of agricultural droughts. This natural disaster causes 80% of economic losses and disturbs the resilience of agriculture by lowering the well-being of society as well as economic and environmental resources (Bahta & Myeki, 2021). Small-scale farmers including livestock farmers depend on natural resources like rainfall to thrive, which are primarily affected by climate change occurrences such as droughts. However, there are other factors that worsen the effects of droughts on livestock farmers such as recurrent disasters, poverty, limited formal safety nets, adaptive capacity, resources, and weak infrastructure (Shiefrew et al., 2014 & Myeki & Bahta, 2021).

The long-lasting impacts of droughts are felt in many sectors, including public water supply, energy production, tourism, and agriculture, the last often being the most heavily affected sector (Meza et al., 2021). Accompanied by an increase in temperatures in SA is a rise in sporadic rainfall

patterns and frequent droughts. The dependence of SA on climate-sensitive economic sectors like agriculture makes it vulnerable to the effects of climate change. Agriculture directly relies on climate variables such as rainfall, temperature, and evaporation, which have been predicted to change due to climate change (Mare et al., 2018). All nine provinces in SA have had an average rainfall of 608mm per year since 1904. However, in 2015 the country received an average of 403mm on the year which is lower than the lowest annual rainfall ever received by the country which was 437mm in 1945 (Africa Check, 2016). In the years 2015-2016, KZN recorded abnormally low rainfall conditions from October to June (less than 500mm per year) and back to normal rainfall conditions from July to September (less than 800mm per year).

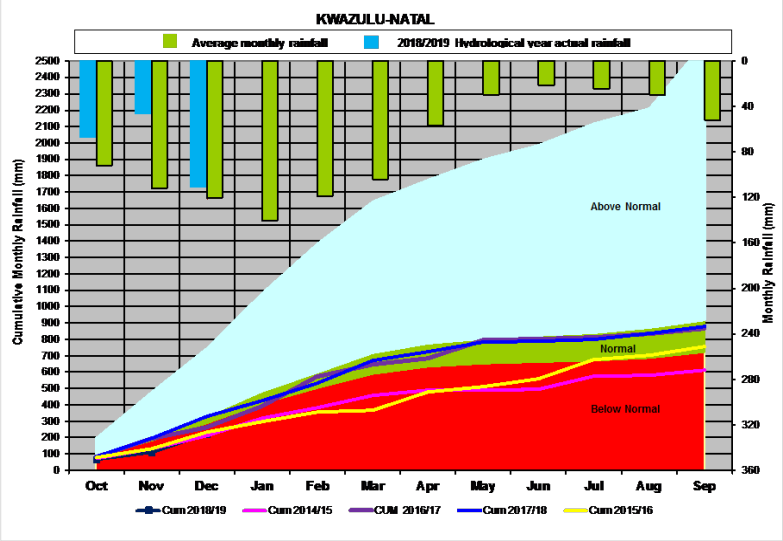

Figure 2.6: Monthly rainfall and cumulative monthly rainfall (mm/year) for KZN. *Source: Department of Water and Sanitation 2019*

The main sector affected by drought in SA was agriculture, extreme heat crippled the production of summer crops such as maize that could be planted in various areas. The state of food security of the country was immensely affected because staple products such as sorghum, groundnuts, sunflower, and soya could not be produced. Furthermore, livestock had little or no water to drink, which ultimately increased food prices. One of the most severely affected provinces was KZN with the lack of storage facilities being the main reasons why the impacts were exacerbated in this region (Africa Check, 2016). The years 2015-2016 had an extreme El Nino event in SA which caused the most catastrophic drought in recorded history. According to the International Disaster Database (2017), the drought in SA caused economic damage of up to $250 million (Mare et al.,

2018). In total, the drought caused an estimated 15% decrease in the livestock herd in South Africa, with KZN recording a loss of 40,000 cattle by the end of 2015 (Agri SA, 2016).

2.10 Role of small-scale livestock farming to food security in KwaZulu-Natal (KZN)

SA, 2015 was recorded as the hottest year in history since 1904, resulting in an 8.4% decrease in agricultural production which directly affected 32 million people. Therefore, droughts are among the main threats affecting agricultural productivity and household food security (Masipa, 2017). In SSA, almost two in three people who live in rural areas solely rely on rainfed agriculture to sustain their livelihoods and as a source of income (Dumenu & Obeng, 2016). Drought affects food security in multiple ways, ranging from direct effects on crop production due to altered rainfall patterns as well as indirect effects on food availability through its impact on the economy, agricultural demand, and income distribution (Masipa, 2017). For example, findings from Masipa indicate that droughts in SSA led to poor crop yield which saw the region importing approximately 7 million tonnes of cereal per annum and this number is projected to increase to 143 million tonnes by the year 2080 (Masipa, 2017).

The main source of livelihood and income for SA households is small-scale farming. Approximately 13 million people are supported by small-scale farming through 4 million farms, which occupy close to 30% of arable land in the country (Mpandeli et al., 2015). Small-scale livestock farming in SA plays a crucial role in rural livelihoods, food security, and economic development. Food security, as defined by the FAO, is a state in which all people perpetually have physical, social, and economic access to enough, safe, and nutritious foods that satisfy their dietary needs and food preferences for an active and healthy life (FAO, 2019). The agricultural sector, including livestock farming, contributes significantly to the country's GDP and provides employment opportunities, particularly in rural areas (FAO, 2014).

Small-scale livestock farmers, often operating on limited resources and landholdings, make up a substantial portion of the sector. They engage in various livestock production systems, including cattle, sheep, goats, and poultry, and their farming practices are shaped by factors such as climatic conditions, cultural traditions, and market dynamics. Small-scale livestock farming contributes to household income diversification, as well as the production of meat, dairy products, and other byproducts for local consumption and trade (Mbatha, 2021). It is important to understand the

challenges faced by small-scale livestock farmers to develop targeted interventions and support mechanisms that can enhance their resilience and promote sustainable agricultural development.

Zooming into KwaZulu-Natal, a province in SA, small-scale livestock farming holds particular significance. KwaZulu-Natal is characterised by diverse agroecological zones, ranging from humid coastal areas to more arid inland regions, which influence livestock production systems and the availability of natural resources. The province is known for its significant cattle population, with a rich tradition of Zulu pastoralism and a strong cultural connection to livestock farming. Small-scale livestock farmers in KwaZulu-Natal face multiple challenges, including limited access to land, water scarcity, climate variability, and market constraints. The impacts of droughts on livestock farming are particularly pronounced in the region, affecting livestock health, productivity, and overall farm viability. Addressing the specific challenges faced by small-scale livestock farmers in KwaZulu-Natal is crucial for promoting sustainable agricultural practices and improving rural livelihoods in the province (Vetter et al., 2020).

Moreover, small-scale livestock farming in KwaZulu-Natal is influenced by the broader socioeconomic and political context of the province. Historically, there have been disparities in land ownership and access, with marginalised communities often facing challenges in securing land tenure and resources for livestock farming. Efforts have been made to address these inequalities through land reform programmes and policies aimed at empowering small-scale farmers. However, there are still significant gaps in access to extension services, training programmes, and financial support, which further exacerbate the skills gap within the sector. Bridging the skills gap and enhancing the resilience of small-scale livestock farmers in KwaZulu-Natal requires a holistic approach that integrates climate-smart practices, market access, and targeted support mechanisms to ensure the long-term sustainability of the sector (Vetter et al., 2020).

2.11 Key challenges faced by small-scale livestock farmers in KwaZulu-Natal.

Theoretically, small-scale farmers in SA have been facing challenges that stem from transactional costs and lack of information. The cost of constructing infrastructure to keep and transport livestock, as well as the deleterious condition of roads and lack of information regarding when and how auctions operate and the quality expected, are a few of the issues confronting small-scale farmers. In addition to these challenges are sociological challenges which are difficult to

comprehend. For example, it is difficult to introduce market-oriented interventions to farmers who keep and use their livestock based on cultural motivations. Policymakers and researchers struggle to establish strategies that maintain critical cultural practices that define community identities while concurrently advocating economic markets. The main reason for this is that external agents find it difficult to understand cultural practices and often market principles clash with these cultures. This ultimately results in a double-edged issue which consists of firstly a possible lack of theoretical understanding and secondly failure to fulfil adequate solutions by state agencies (Mbatha, 2021).

Even though what appear to be logical policy proposals have been made in the literature over time, the obstacles they encounter have remained largely unchanged. The difficulties can be divided into two categories: those encountered in production and those encountered in marketing. They remain in place even though small farmers possess more than a third of all livestock in the country. This indicates that a large portion of the population suffers because of the lack of progress. For example, community regions account for 10% of total herd marketing, whereas commercial farmers account for 25%. According to the findings of the ECP study on cattle marketing the developments in the province are a small-scale version of those nationally (Mbatha, 2021).

Moreover, the small-scale livestock sector has a plethora of livestock farmers which results in difficulty in managing livestock, developing businesses, and low carrying capacity of communal grazing land as compared to fewer farmers with larger herds. This has a detrimental effect on the health of Large Stock Units (LSU) raised per hectare of land. The low quality of stock owned by many farmers raises transaction costs for purchasers, who must spend more time seeking excellent quality stock from an abundance of possible sellers. As a result, many production difficulties are interwoven with marketing challenges and must be addressed methodically. These issues all play a role in preventing small livestock farmers from accessing the market (Mbatha, 2021).

In addition, small-scale farmers face multiple constraints including soil unproductiveness, limited input access, illiteracy, and poor infrastructure and access to markets. However, the heaviest challenge small-scale farmers have emphasised is climate variability which threatens their vulnerability. Even though climate variability is a natural phenomenon it still threatens livelihoods through increased occurrences of extreme rainfall and temperature events. SA has experienced this phenomenon through an increased inclination towards delayed and early cessation of rainfall

resulting in a shorter production period, more droughts, floods, and increased temperatures (Mkuhlani et al., 2019). Moreover, studies project that by 2100 the southern African region temperatures are expected to rise to 4° (Serdeczny et al., 2016). On the contrary, rainfall is projected to decrease by 10-20% with increased climate variability within the next 50 years in southern Africa (Uamusse et al., 2020) Climate variability is expected to have much more severe effects on households that lack resources and are in arid and semi-arid agroecological regions (Singh et al., 2014). For the past two decades, the southern African region has lost up to 50% of its maize yield annually due to increased rainfall variability (Ray et al., 2015). If temperatures continue to increase crops such as tea, that require optimal temperature to thrive may no longer grow well (Ochieng et al., 2021).

The agricultural census of 2017 maintained that the large-scale agricultural sector comprised 40,122 farms, while small-scale farming comprised more than 300, 000 units. The household survey of 2019 further stated an additional 2.3 million households practiced subsistence agricultural production (Stas SA, 2020). Albeit the excess of small-scale against large-scale farmers, they are considered insignificant contributors to the national food production. Studies have shown that small-scale farmers' productivity is significantly lower than that of large-scale, however, they still play a pivotal role in local food systems (Cervantes-Godoy, 2015). Small-scale farmers and large-scale farmers face several production challenges as shown in Table 5.

At the field scale, small and large-scale farmers face synonymous biophysical constrictions. Small-scale farmers suffer several management related challenges at the farm scale, which are worsened by climate change with more frequent extreme climatic events such as fires, flooding, and recurring droughts (Figure 1). For small-scale farmers, however, management is the most crucial factor in reducing productivity. Moswetsi stated in their review that better management practices could narrow the significant gap between farmer yields and biophysical potential (Moswetsi et al., 2017). Theft is a typical barrier for both small-scale and large-scale farmers on a regional basis. Furthermore, the gradualness of government administration limits farmer output in several ways. Households often have exclusive use rights to arable land and community use rights to grazing land. Small-scale farmers do not have private property rights; instead, the land is held by the state and controlled by conventional authorities, making long-term farm investment unappealing.

Constraints for large-scale farmers emerge as delays in the processing of water licences as well as uncertainties in land reform initiatives (Mathinya et al., 2022).

Table 2.5 Production constraints faced by small-scale farmers and large-scale farmers.

			Farmers	
Scale	**Type of constraint**	**Nature of constraint**	**Small-scale**	**Large-scale**
Field	Biophysical	Climatic	Drought Floods Fires	Drought Floods Fires
		Soil	Degradation Fertility Moisture	Degradation Fertility Moisture
		Agronomic	Pests and diseases Weeds	Pests and diseases Weeds
Farm	Management	Knowledge/skill	Animal nutrition Post-harvest storage Input calibration Production efficiency Technical skill	
	Social	Social	Culture/Tradition	
		Labour	Affordability	Skills
		Capital	Access	Insurance
	Entrepreneurial		Trading acumen	
Region	Economical	Market	Access	Subsidies/tariffs World markets
	Social		Theft	Theft
	Political	Government	Tribal laws Water infrastructure	Land reforms Water policies Labour laws

Source: (Mathinya et al., 2022)

2.12 Coping strategies and skills of livestock farmers to droughts

Studies project that global warming, climate change, and weather variability will increase the occurrence, intensity, and geographical degree of droughts (Liu & Chen, 2021). Third-world countries experience more harsh effects on human society, natural ecosystems, and agricultural

production due to the high percentage of populations reliant on agriculture (Mishra et al., 2021). In 2015/16, the South African livestock industry recorded a 30, 40, and 20% decrease in sheep and goat flocks, and cattle herds respectively (Agri SA, 2016). For governments and small-scale farmers to be able to reduce vulnerability and improve resilience there needs to be a high expenditure on improving drought preparedness and mitigation strategies (Bahta & Myeki, 2022). A study conducted by Holman concluded that strategies developed to cope with or improve drought recovery had minimal contribution to increased resilience against future droughts due to the reactive and crisis-driven actions dominant within the strategies (Holman et al., 2021).

Developing countries including SA have shown evidence of increasing vulnerability to drought despite the implementation of *ex-post* crisis management as a response to drought (i.e., reactive approach) (Ahmadalipour et al., 2019; Svoboda et al., 2015). The ex-post strategy is commonly adopted by the government and includes the identification of the crisis followed by post-drought relief provision and aid to the most affected people and areas (Shiferaw et al., 2014). This response method is expensive to implement, complex, untimely, and unsuccessfully executed, focuses on concurrent needs, and neglects improvement of resilience to future droughts (Meza et al., 2021). On the contrary, ex-ante risk management (i.e., proactive approach) refers to adaptation measures adopted or applied in advance to cope with future drought and their negative effects (Shiferaw et al., 2014) Majority of the studies focus on crops, grass, yield, meat productivity, milk, wool, and the fertility of large livestock. The livestock sector has limited studies therefore more research must be done on adaptation coping strategies and resilience to agricultural drought in SA for the sustainability of the livestock sector.

Adaptation refers to improving resilience and reducing households' vulnerability when responding to agricultural drought impacts. It is the ability of economic, social, and environmental systems to fine-tune to change and cope with the outcomes of agricultural drought (Bahta & Myeki, 2021). Sustainable agriculture, including livestock, occurs when the degree of agricultural production is preserved and kept within the capacity of an ecosystem. Resilience thinking, on the other hand, refers to the process of researching how to maintain a system's operation during unfavourable conditions, in this case, agricultural drought (Duru & Therond, 2014).

Farmers have various adaptation strategies that they adopt to cope with droughts. Figure 6 shows that selling livestock is the most common adaptation and coping strategy accounting for 20.96% of households selling their livestock in the Northern Cape. On the contrary 20.2% of the households used alternative land use, such as horticulture, as a coping mechanism, 19.81% stored food, 16.67% asked for animal feed (that is aid from the government /department of Agriculture supplied fodder or vouchers to buy fodder), 5.2% pursued employment, 5.71% migrated, 4.97% farmed with drought-tolerant breeds, 3.22% secured relief grants, 1.79 used their savings and investments, and 0.95% leased their farms (Bahta & Myeki, 2021).

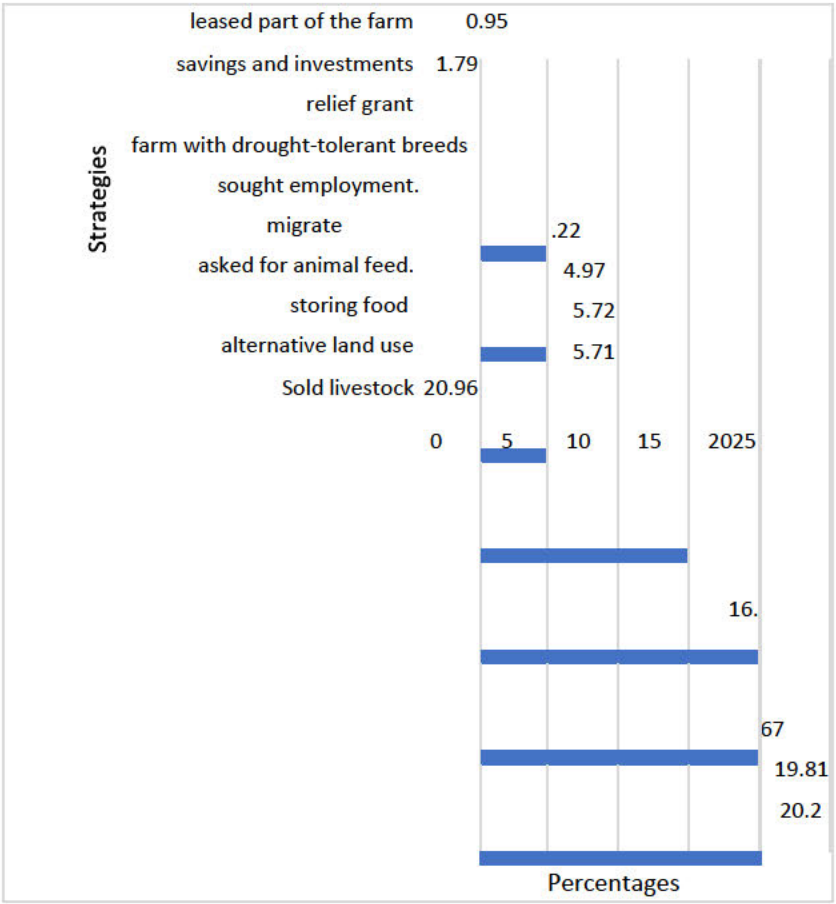

Figure 2.7: Households' adaptation and coping strategies *Source: Bahtha and Myeki 2021*

In addition to the coping strategies mentioned above small-scale farmers in Western Cape have other sources of water they use for agricultural purposes. These usually include rivers, dams, boreholes, and municipal piped water (Figure 7), however, on the West Coast of the Western Cape dams are the primary source that small-scale farmers depended on during the 2015-2018 droughts (Pili & Ncube, 2022). Farmers who used municipal water supplies had to resort to groundwater

drilled by the Department of Water and Sanitation. Crop farmers from the West Coast District (WCD) used canals, gravity irrigation, solar and electric water pumps, drip irrigation, and stock water systems. Both crop and livestock farmers used borehole water in the WCD with a handful of crop farmers reporting high salinity in the water making it unusable for irrigation purposes. Moreover, both livestock and crop farmers had to purchase water and fodder and hire transport or use wheelbarrows to transport water from dams and rivers for livestock to drink and for irrigation, as detailed in Figure 8. Farmers also mentioned communal support played a pivotal role in coping with agricultural droughts in the area (Olwethu & Bongani, 2022).

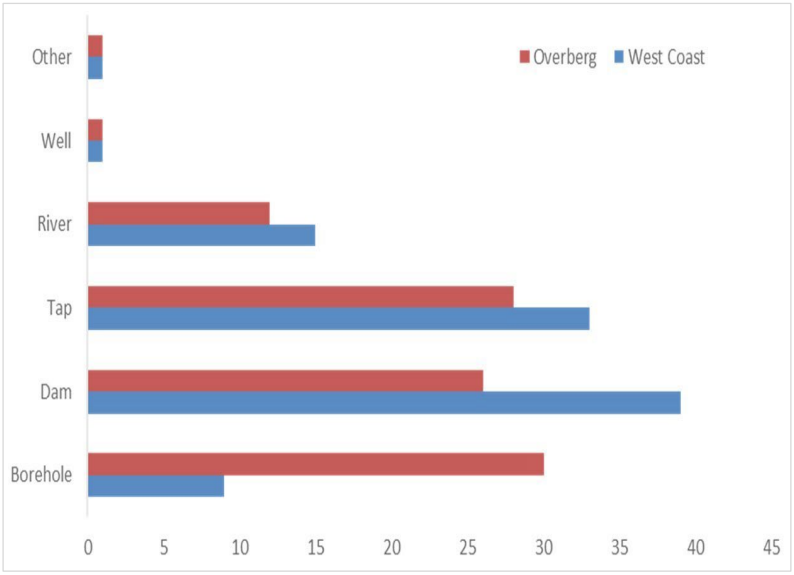

Figure 2.8: Small-scale farmers sources of water for agricultural use in the West Coast of Western Cape *Source: Pili and Ncube 2022*

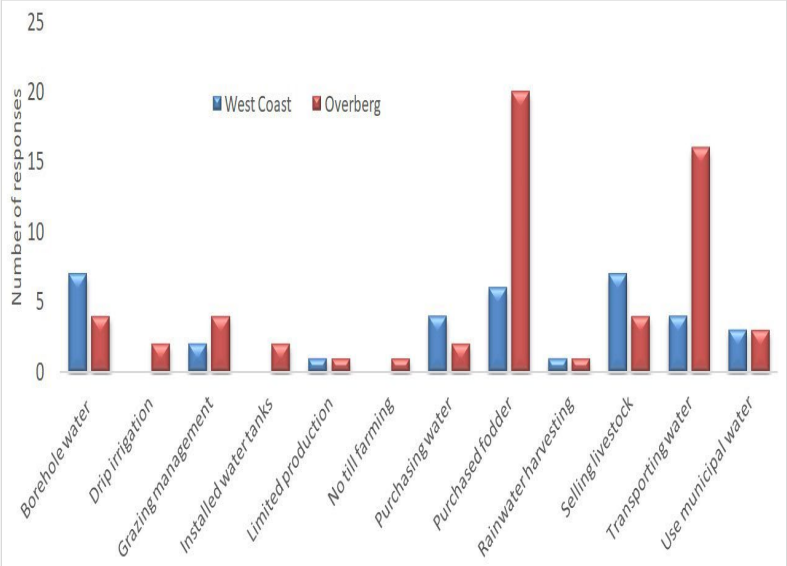

Figure 2.9: Small-scale farmers' agriculture water coping strategies. *Source: Pili and Ncube2022*

2.13 Government intervention in droughts for livestock farmers

The effects of droughts in the year 2015 and 2016 were severe, accounting for 2.7 million households experiencing water shortages, reduced agricultural productivity, and water restrictions (Bhatta et al., 2015). Albeit the fact that SA has well-recognised legislation for disaster risk reduction (National Disaster Management Act, 2022), the state government did not implement any strategy to plan for droughts on time (Baudoin et al., 2017). There are numerous reasons contributing to the low ability of livestock farmers to adapt to drought, including lack of access to financial resources, lack of knowledge and managerial skills, and poor extension support (Bahta et al., 2016). Farmers often engage in reactive responses to drought rather than anticipatory due to the high cost and time-demanding nature of proactive responses, which makes the aforementioned strategies unconducive for small-scale farmers (S. J. Lottering et al., 2020). However, farmers are more likely to adopt anticipatory responses if they have access to credit, simple and cost-effective strategies, and liaison with extension officers (Raghuvanshi, 2017).

In SA a dual agricultural economy subsists, where a well-established commercial sector exists as well as a small-scale sector, both having unique vulnerabilities and responses to drought (Meza et al., 2021). Small-scale farmers are more prone to drought mainly due to limited adaptive ability,

poor governance, and limited availability of relevant expertise on drought management among farmers and agricultural professionals (Baudoin et al., 2017). Drought has had a major impact on the agricultural sector's labour force (Zhu et al., 2021). The agricultural sector's labour force reached its peak of 5.6% in the year 2015 from 4.86% in 2010 (Statista, 2021). However, there has been a gradual decrease since 2015, due to drought, the use of sophisticated technology replacing workers (Sihlobo, 2018), limited wage fluidity due to legalised minimum wages, and regulations and policies restraining exports (DAFF, 2010).

In order to improve the resilience and productivity of agriculture the skills labour force needs to be improved, these skills are referred to as scarce (i.e., skills in demand) or critical skills at a given time (Grobler et al., 2020 & Muremela et al., 2021) Table 1 below showcases the skills in demand in SA's agricultural sector and the skills gap in the commercial and small-scale subsectors. Scarcity of these skills may be caused by the following reasons: budget constraints, trouble attracting and retaining skilled individuals from isolated areas, lack of qualified specialists, drive towards technology training, skills poaching in the industry, ageing of qualified specialists, emigration of skilled individuals, and non-navigable locations of training facilities (AgriSETA, 2020a)

The occurrence of droughts has had a great impact on the availability of skills as unemployment surges when productivity is reduced along with business success (Schreiner et al., 2018). The structure of the SA labour market has shifted within the agricultural sector towards increased demand for highly skilled workers (Festus et al., 2016). The occurrence of droughts calls for a high number of skilled professionals required to sustain agricultural production as producers steer towards the use of novel knowledge, technology, skills, and innovation. Drought heightens the stress for a larger workforce, job seekers, and novel agricultural and drought management skills to alleviate its economic, social, and environmental impacts (AgriSETA, 2020b). The livestock sector does not fall short of the stresses brought about by agricultural drought as it profoundly depends on its skilled workforce to promote sustainable food security and employment creation (Katiyatiya et al., 2022).

The SA government has obligated itself to aid upcoming and small-scale farmers by promoting integrated water resource management policies. These policies will help achieve the Sustainable Development Goal target 6 which is to "ensure availability and sustainable management of water

and sanitation for all". Drought monitoring and early warning systems, vulnerability and risk assessment, and drought risk mitigation measures are the three pivotal constituencies that a proactive approach to improving drought resilience depends on (United Nations Convention to Combat Desertification (UNCCD), 2016). SA's proactive approach has changed over time extending from disaster risk reduction (DRR) legislation (i.e., National Disaster Management Act 57, 2022) (Vogel and van Zyl, 2016) to policy documents, assessments and strategies which include the 2004 National Climate Change Response Strategy, the 2010 National Climate Change Green Paper and 2011 National Climate Change Response (Baudoin et al., 2017).

The ex-ante strategy (proactive approach) concurred with the aims of the National Disaster Management Act which included creating effective awareness and preparedness in the agricultural sector, redefining the roles of drought support programmes, and clarifying the responsibilities of the government and all stakeholders (Jordaan, 2017). However, these proactive approach strategies have not been effective due to the lack of financial resources and human expertise to manage drought. Therefore, based on these challenges concerns have been raised regarding the availability of knowledge and skills on drought management among farmers and agricultural professionals including extension officers and scientists (Baudoin et al., 2017) and (Makaya et al., 2020).

2.14 Skills gap among small-scale livestock farmers

Droughts pose significant challenges to small-scale livestock farmers, impacting their livelihoods, agricultural productivity, and overall well-being. In the context of small-scale livestock farming, droughts can result in reduced water availability, scarcity of forage and pasture, increased feed costs, and decreased livestock health and productivity (Vetter et al., 2020). These adverse effects can lead to economic losses, food insecurity, and increased vulnerability among farmers. Furthermore, droughts can disrupt the natural resource base, affecting the availability of water sources and grazing land, which are vital for livestock production. Therefore, understanding the impacts of droughts on small-scale livestock farming is crucial for developing appropriate strategies and interventions that enhance the resilience and adaptive capacity of farmers in mitigating the negative consequences of drought (Mare et al., 2018).

The skills gap further compounds the challenges faced by small-scale livestock farmers in drought prone areas. Small-scale farmers often lack access to training, technical knowledge, and resources

necessary to effectively manage livestock farming under drought conditions. The skills gap manifests in areas such as drought-resistant livestock management, efficient water usage, feed management, climate-smart farming practices, and adaptation strategies. Insufficient skills and knowledge hinder farmers' ability to adapt to changing climatic conditions, exacerbating the impacts of drought on livestock farming systems. Bridging the skills gap is crucial for equipping farmers with the necessary tools, information, and techniques to make informed decisions and implement sustainable practices that enhance their resilience and mitigate the negative effects of drought (Majaha, 2023).

The significance of addressing both droughts impacts and the skills gap in small-scale livestock farming lies in ensuring the long-term viability and sustainability of the agricultural sector. Small-scale livestock farming plays a vital role in rural economies, livelihoods, and food security. By addressing the challenges posed by droughts and the skills gap, interventions can improve the adaptive capacity and resource management practices of farmers, leading to increased productivity, income generation, and overall well-being. Furthermore, enhancing the skills and knowledge of farmers can facilitate the adoption of climate-smart practices, better water and feed management, and the development of resilience strategies. By empowering small-scale livestock farmers to cope with droughts and acquire the necessary skills, the agricultural sector can become more resilient, productive, and sustainable in the face of climate change and other challenges (Baudoin et al., 2017).

There is broad agreement that the SA government has long offered aid in the event of an agricultural calamity, but that the country's drought relief efforts have been insufficient and poorly carried out (Baudoin et al., 2017). Even though SA has one of the best drought risk management laws in the world (National Disaster Management Act, 2002), this is the case. As a natural occurrence, the drought itself is not a problem; rather, SA's reliance on drought risk crisis management is the problem (Liebenberg et al., 2015). There is currently little consistency in government-supported drought preparedness and mitigation activities due to policy ambiguity and a lack of coordination across many stakeholder groups (Mare et al., 2018). The impact of droughts over the past two decades suggests that SA's main issue is a shortage of skilled professionals and livestock farmers who comprehend the drought management phenomenon (Bahta et al., 2016).

There is a scarcity of qualified agricultural professionals with experience in managing droughts, including agricultural scientists, technicians, engineers, research and development officers, extension officers, disaster management officers, and consultants, with some roles deemed difficult to fill (AgriSETA, 2018). Drought risk monitoring and early warning systems, vulnerability and risk assessment, and drought risk mitigation methods are the three fundamental pillars of drought risk resilience and mitigation (United Nations Convention to Combat Desertification (UNCCD), 2013). Therefore, when preparing and planning for droughts with stakeholders including farmers, agricultural extension officers, disaster management experts, agriculturists, and the commercial sector, these components should be given importance. Improved data, research, skill development, and collaboration should be used to assist the formulation of national policies targeted at mitigating the effects (risks) of drought. Agricultural drought management is evolving, and a well-planned approach is now necessary. The three pillars of drought risk management, as well as the steps and abilities needed for the agricultural sector, are shown in Table 6.

Table 2.6: Agricultural drought preparedness and mitigation action fields and skills

Drought monitoring and early warning systems	Drought vulnerability and risk assessment	Drought risk mitigation measures
• Drought situation assessment • Drought forecasting improvement • Access to reliable/ timely data • Awareness raising programmes • Identification and monitoring precipitation levels and weather condition through climatic parameters such as streamflow, groundwater levels, reservoir and lake levels, and soil moisture as well as a comprehensive • Assessment of current and future drought and water supply conditions • Incorporation of local indigenous knowledge systems into the information system	• Assessing risk profile of communities/ regions e.g., subsistence farmers, rainfed and irrigated • Agriculture condition of crops, livestock, and environment • Finding reasons for vulnerability of the communities/ regions and mitigation measures to address these risks • Assessing severity of droughts potential impact • Mapping drought hotspots • Assessing the coping capacity of communities affected by drought	• Increase water supply • Decrease water demand • Water harvesting • Water sources protection • Development of water sources such as dams, and wells • Utilisation of groundwater reserve sources • Water rationing/allocation • Land and water resources balancing • Restoration of pastures • Enhancement of irrigation schemes • Implementation of Integrated Water Resources Management (IWRM) such as mitigating upstream downstream user conflicts, greater coordination between water users, communities, and sectors • Crop insurance • Management of livestock production within the landscape: relocation of herds, nomadic migration, use of special reserved areas • Conservation agriculture • Capacity building and policy • Diversification of farmer livelihoods through social protection, cash-transfer programmes or improving access to markets and rural services

Source: United Nations Convention to Combat Desertification (2016)

It is pivotal that all livestock farmers including small-scale commercial, and subsistence farmers have livestock management skills in South Africa. A farmer should be adept at managing grazing land, analysing the situation, and making necessary arrangements, strategies, and resolutions. In the case where a pasture has been significantly reduced and there is less feed, a farmer should be aware of when to reduce the stocking rate and the succeeding appropriate method (Keesstra et al., 2018). Techniques employed by South African farmers in the Karoo region include the building of spreader banks for moisture conservation in pastures, rotational grazing, the adoption of ecological principles to maintain rangelands, and stocking rates based on rangeland carrying capacity Ncube and Lagardien (2014).

Furthermore, other livestock management coping mechanisms include the utilisation of water restrictions and deprivation measures, succulent feeds, water stress relievers, expenditure on water supply improvements, and efficient water accounting and auditing. Farmers ought to know which cattle breeds are more tolerant to drought conditions in their respective regions. In the Northern Cape's drought-prone Karoo region, farmers use drought-tolerant breeds including Angora goats and Doper sheep, while other farmers resorted to springbok and ostrich farming (Ncube, 2018). In addition to this, creating fodder banks and using supplemental feed can both be used to fight drought.

Moreover**,** farmers ought to have access to monetary institutions such as the Industrial Development Corporation and Land Bank. These organisations can provide drought-related financing as well as business management assistance to farmers. These organisations, for example, provide drought relief funding, concessionary disaster relief money, and multi-peril and hail crop insurance during droughts (Zwane et al., 2015). The South African Weather Service (SAWS) publishes drought early warning system data to farmers to help them plan proactively for drought (Ndlovu et al., 2020). Farmers should be able to read applications such as the Temperature Humidity and Enthalpy Heat Indices via the SAWS, which allow them to monitor humidity and temperatures and provide information on intense system heat stress situations (Baudoin et al., 2017).

Governments began to recognise the value of creating drought contingency plans over the past ten years (Baudoin et al., 2017). Unfortunately, the lack of financial and human capital necessary to create thorough drought plans has slowed down progress in drought preparedness (Githae et al.,

2020). Planning for a drought entail creating a strategy, making it known to the public, and raising awareness. A drought readiness strategy is very helpful in getting ready for anticipated climatic changes (Gebremeskel Haile et al., 2019). Drought planning involves a substantial amount of expertise from professionals including environmental and hydrological specialists, public and environmental health specialists, social scientists, climate scientists, rural development facilitators, and agricultural journalists (CoGTA, 2005). To make wise judgements and successfully implement drought management methods, agriculture professionals need to have the necessary skills in drought preparedness, mitigation, and emergency response (FAO, 2019). To lessen or alleviate the effects of drought, prevent potential post-drought disputes, and enhance operational and institutional responses, the government, business partners, and the public must be included in drought planning (Katiyatiya et al., 2022).

2.15 Summary

Droughts experienced in SA have been closely related to climate change and the El Nino phenomenon which warms up the water surfaces in the eastern tropical Pacific Ocean (LakhrajGovender & Grab, 2019). Agriculture has proven to be an immediate sector to be affected by drought in SA which has caused a fall in crop and livestock production. In SA, drought management is based on an ex-post (crisis management) approach, which is inefficient, slow, and poorly planned among relevant parties such as the Department of Agriculture, Disaster Management Centre, SAWS, Agricultural Research Council, higher educational institutions, farmers' organisations, farmers, private sector, and financial institutions (Meza et al., 2021). Drought preparation planning professionals' inputs are highly appreciated in decision-making and policy framework creation because they work with the government and private sectors to assist farmers in the case of drought. Overall, farmers and agricultural professionals require knowledge and skills to plan, prepare for, and mitigate drought to sustain agriculture production, which can be obtained through training and awareness platforms provided by the government and/or private organisations (Sharafi et al., 2021).

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter will delve into the methodology employed in this study. It commenced with an overview of the study setting, followed by a description of the research design. The data collection methods, sampling techniques, sampling population, and analytical approaches utilized in the study will also be explicated, accompanied by the rationale for their inclusion. The primary objective of this study was to investigate the impact of droughts and the skill gap among KwaZulu-Natal (KZN) livestock small-scale farmers.

3.2 Description of the study area

The study's data collection took place in the Okhahlamba Local Municipality (OLM), situated in the northern region of KZN Province. This region encompasses a diverse geography, including the renowned Drakensberg Mountains, serving as an international border with Lesotho. The OLM comprises three traditional authorities, namely Amangwane, Amazizi, and Amazwazi, and includes the towns of Winterton and Bergville. It is divided into 15 wards, covering a total surface area of approximately 3,343.63 km² (IDP, 2017).

As illustrated in Figure 3.1 land use map, the OLM exhibits a blend of commercial and subsistence farming, though the legacy of apartheid-era segregation policies has geographically separated these activities. Small-scale farmers, primarily engaged in maize, vegetable, and livestock production, occupy marginal areas in the foothills of the Drakensberg Mountain chain, characterized by low fertility lands (Elleboudt, 2012). Notably, despite only 22% of the economically active population being involved in crop production (OLM, 2012), a significant 55% of households on communal lands are engaged in livestock farming, with a primary focus on cattle, goats, and sheep (Elleboudt, 2012). In this region, crop-livestock farming systems are common, with cattle being sent uphill during the cropping season and the entire land serving as grazing land in the winter off-season (Elleboudt, 2012). The area also experiences harsh climatic conditions, including intermittent prolonged droughts and low winter temperatures interspersed with snowfall, necessitating supplementary animal feeding. Consequently, livestock extension services play a crucial role in transforming the area's livestock sector.

Food insecurity is prevalent in the municipality, with over 43% of residents lacking formal income, and 28% earning between R1-R400 per month, while only 11% earn between R801-R1600 (Integrated Development Plan, 2017). The OLM's economy relies heavily on agriculture, tourism, and wholesale trade as major contributors (IDP, 2017). It features a dual agricultural system, with both commercial and small-scale farmers (IDP, 2017). Over 50% of households in the area, numbering 15,091, are involved in farming, with 45% exclusively engaging in animal farming, 40% practicing mixed farming, and 14% specializing in crop production. Small-scale farmers primarily focus on cattle ranching, maize, dry beans, and vegetable production (Statistics SA, 2011). Despite having over 23% of its land suitable for arable production and great potential for irrigation development, a lack of skills, expertise, and knowledge remains a critical impediment to agricultural development in the OLM (IDP, 2017). The OLM's location in relation to other municipalities in KwaZulu-Natal is depicted in Figure 3.1.

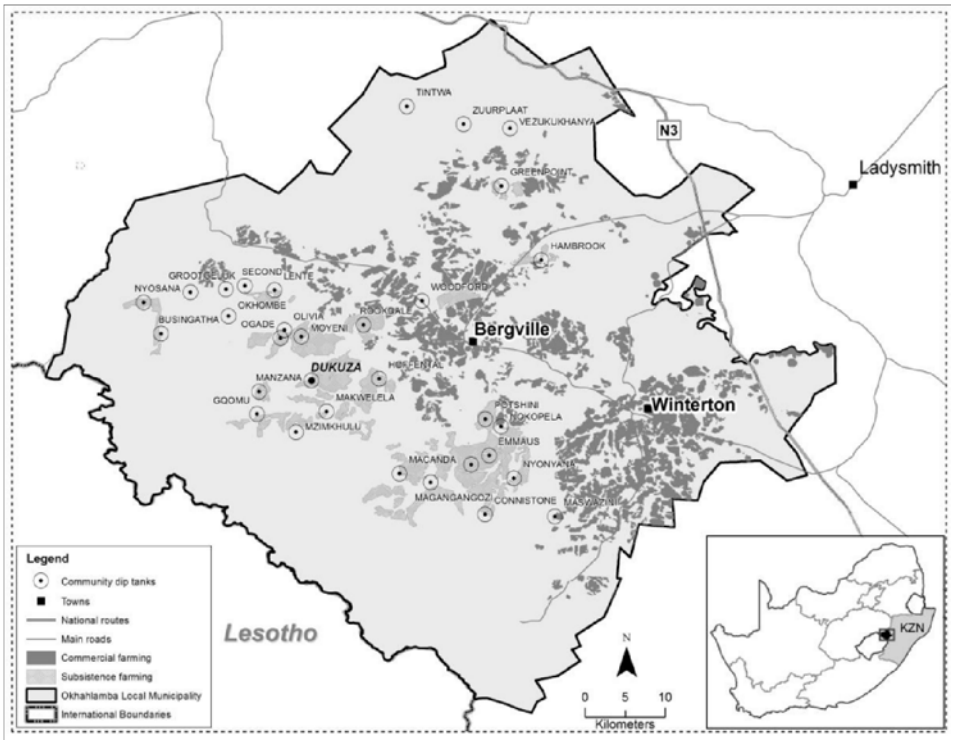

Figure 3.1: Land use map of the OLM. *Source: Authors- based on land cover shapefiles provided by the Ezemvelo KwaZulu-Natal*

Bergville

It is relatively a small town that is located at the foothills of the Drakensberg Plateau. Bergville is generally a humid area with annual rainfalls reaching 650 to 1200 mm and an average minimum temperature of 19 degrees Celsius to an average maximum of 28 degrees Celsius (Vilakazi et al., 2019). Precipitation is likely to increase along with temperatures resulting in greater atmospheric demands for water, subsequently increasing the risk of periodic and severe flood events. Even though the water quantity in the rivers, dams, and groundwater will increase which is positive there will also be negative impacts in terms of increased erosion and a detrimental effect on water quality. Soils in Bergville are mostly rich in iron with a high degree of appropriateness for cultivation, and slopes are moderate to gentle. The soil is balanced in SA, silt, and clay and the rock content is low (Zungu et al., 2020). The precise location of the village is at 28°43′59.88″S and 29°22′0.12″E, with an altitude of 1,145 m (Vilakazi et al., 2019).

Bergville's plant life consists of a variety of trees and shrubs including thornveld and broadleaf bushveld in the riverbanks and rugged geographical area in the eastern part of the district. As a result of high levels of rainfall commercial forestry is commonly accompanied by arable and plinthic soils with moderate to gentle slopes. Commercial and subsistence farming practices are common; involving the production of irrigated maize and soybeans, whereas communal farming involves growing maize on rainfed fields, cattle ranching, and small-scale production of dry beans and vegetables. Even though the area has the potential to develop small-scale commercial farming, there is a great deal of skills, expertise, and knowledge deprivation that needs to be observed and tackled. In addition to this overgrazing and livestock, theft is of major concern as they negatively affect the productivity of farming in this area (Vilakazi, 2017).

Estcourt

Estcourt is a town situated in the uThukela District of the KwaZulu-Natal Province of South Africa, characterized by farming as its primary economic activity. Several large bacon and processed food factories are located in the vicinity of the town, making it a significant contributor to the region's economy. The N3 freeway passes close to the town, offering excellent connectivity to other parts of the country. It is approximately 80km from Pietermaritzburg and 40km from Ladysmith, making it highly accessible at both the local and regional levels. Strategically located, Estcourt is an important center for trade and commerce in the region.

Estcourt is the second largest urban area in the district, and its threshold extends beyond the boundaries of the uMtshezi Municipality to almost the entirety of the Imbabazane region. Due to its close proximity to the Okhahlamba region, the potential impact of services and economic benefits will be further explored (IDP 2015/2016). The town is recognized as a Primary Agriprocessing Hub, and it holds a significant role in the economy as a major commercial node for the uThukela District (IDP 2020/2021).

During the Apartheid era, Esctourt was a predominantly White and Asian town, while the nearby Wembezi township was home to a large African population. In 1995, these two areas were incorporated into a transitional local council prior to the establishment of the uMtshezi Municipality. According to the IDP (2008/2009), the estimated population of the uMtshezi Municipality in 2008 was 57,189 African population, 1,726 Coloured population, 6,155 Asian population, and 324 White population.

Estcourt typically receives a yearly rainfall of approximately 589mm, with the majority of precipitation occurring primarily during midsummer. The monthly distribution of average daily maximum temperatures reveals that the average midday temperature range for Estcourt varies from 18.7°C in June to 26.4°C in January (Figure 3.4). The region experiences its lowest temperatures during June, with an average low of 1.7°C during the night, as reported by the IDP (2020/2021). The most commonly planted crops in the Estcourt area are maize, soya beans, and dry beans.

Figure 3.2: Inkosi Langalibalele Local Municipality (KZN237): Estcourt Source: https://municipalities.co.za/map/1237/inkosi-langalibalele-local-municipality

Winterton

Winterton is a small town located along the banks of the Tugela River in the foothills of the Drakensberg mountains, in the province of KwaZulu-Natal, South Africa. It was established in 1905 as Springfield, when the Natal Government built a weir across the Little Tugela River. The town serves as a key gateway to the Central Drakensberg regions, including the Champagne and Cathkin Valleys and Cathedral Peak. It is situated on the R74, which connects it to Bergville and the N3, as well as the R600, which connects it to Ladysmith and the Central Drakensberg. (Drakensberg Accommodation and Experiences).

Winterton is a low-key service, housing, and administrative center within the Municipality, which is relatively well-established and provides a range of services and facilities. It is also a key agricultural area. The encouragement of small-scale tourism development in the surrounding area is recommended (IDP 2015/2016). The town has an existing Town Planning Scheme that guides land use and development within the town. Winterton is highly accessible, with the R74 (Primary Corridor) running through the town and the R600 also providing access. It is linked to Bergville by the R74 and to Cathkin Park via the R600 (IDP 2015/2016).

3.3 Research design

In this study, a descriptive research design was employed, using a mixed methods approach that combines qualitative and quantitative methods to enhance the validity and credibility of findings. Qualitative data included open-ended responses, while quantitative data consisted of closed-ended questions in questionnaires. The study followed a convergent mixed methods approach, collecting and integrating both types of data simultaneously in the interpretation of results (Schoonenboom & Johnson, 2017).

The employment of a descriptive research design involved several key steps: defining research objectives, choosing data collection methods, selecting a sampling technique, gathering data, and analyzing the results (Akhtar, 2016). The choice of a mixed method research design was well-suited for this study due to the complex nature of the research problem. This approach was selected for its completeness, complementarity, hypothesis generation and testing, resolution of contradictory findings, and triangulation.

Completeness ensured that the research problem and sub-problems were fully addressed by collecting, analysing, and interpreting both qualitative and quantitative data. Complementarity allowed each approach to compensate for the limitations of the other. Qualitative data provided insights for forming hypotheses about cause-and-effect relationships that could subsequently be tested through quantitative research. It also helped in making sense of seemingly inconsistent quantitative results. A crucial aspect of the mixed method approach is the integration stage, where convergence, or triangulation, is used to strengthen the study's conclusions. Converged data enhances the validity of research findings, while the diverse data types contribute to a more comprehensive understanding of the phenomenon under investigation (Myers & Powers, 2017).

A research design is an essential element in the research process, offering a structured framework that guides data collection, measurement, and analysis. It evolved in the 1960s to address the complexities of decision-making in the world of management (Akhtar, 2016). A well-designed research plan minimizes bias and facilitates effective data collection and analysis. Research designs come in various types, including exploratory, explanatory, experimental, and descriptive research designs. Descriptive research is particularly useful for characterizing existing phenomena, providing information about specific communities, groups, or individuals, and answering questions like "what," "who," "where," "when," and "how" (Akhtar, 2016).

3.4 Sample Population

The agricultural industry encompasses numerous subsectors, and it would be impractical to focus on all farmers due to the substantial labour and resources required, as well as the significant amount of time needed to complete such an endeavour. Therefore, the study concentrated on one sector of the industry, specifically livestock farming. Livestock farmers are responsible for economically managing animals for the purpose of human consumption and acquiring additional goods such as milk, wool, and skin. The chosen study area is characterized by a geological composition that is conducive to grazing and forestry, and its agricultural potential is limited (IDP, 2015).
Nevertheless, the study focused on livestock farmers in the region.

3.4.1 Target population

The study concentrated on the livestock farming sector, which is a significant contributor to the economy. Livestock farmers manage animals for the purpose of human consumption and other

valuable products such as milk, wool, and leather. The chosen study area is characterized by steep terrain, making it suitable for grazing and forestry, but not suitable for large-scale agriculture. According to the IDP (2015), the majority of the local population practices livestock farming. The study focused on small-scale livestock farmers in the region.

It is essential to focus on the selection of small-scale farmers when investigating the impact of drought, as these farmers are particularly vulnerable to its effects, and their experiences can significantly differ from larger-scale counterparts (Harvey et al., 2018). Small-scale farmers, often managing smaller plots of land with limited resources and reduced access to capital, tend to rely heavily on subsistence farming and face fewer alternatives for income generation (Thoai et al., 2018). Drought poses a multitude of challenges to these farmers, including decreased crop yields, constrained access to essential water resources, and grazing land shortages for their livestock, potentially pushing them into cycles of food insecurity and poverty (Mango et al., 2018).

Incorporating small-scale farmers into a study on the impact of drought is crucial for achieving a comprehensive understanding of the distinct consequences they face and the diverse coping mechanisms they employ. By doing so, researchers can shed light on the unique vulnerabilities and resilience strategies of this demographic, which may differ significantly from those of larger commercial farms. This nuanced knowledge can play a pivotal role in the development of targeted policies and programs aimed at mitigating the adverse effects of drought on agriculture and rural communities.

Recognizing the specific needs and challenges of small-scale farmers within the context of drought resilience efforts not only bolsters the sustainability of these vital food production systems but also contributes to the overall resilience and well-being of rural communities. Thus, focusing on small-scale farmers in research and intervention initiatives is both a matter of necessity and a means of fostering more equitable and effective drought mitigation strategies.

3.4.2 Sampling Technique

The study employed a nonprobability sampling method, specifically the purposive technique, to select a target population of livestock small-scale livestock farmers in the agricultural sector of KwaZulu-Natal. This approach is used when the researcher's existing knowledge or preconceived theories influence the selection of study participants, and not all elements have an equal chance of

being selected. The study aimed to investigate the impacts of droughts on the agricultural sector and has chosen this method to identify farmers who meet the study's purpose. To further validate the quantitative process of the research, a random approach was used to select the farmers to be interviewed. As per Teddlie & Tashakkori (2009), random purposive sampling combines elements of probability and non-probability sampling methods, where probability sampling is advantageous for quantitative research and non-probability sampling for qualitative research within a research framework. The key advantage of random purposive sampling lies in its incorporation of the strengths of both random and purposive sampling techniques. It entails selecting a random sample of a few units from a significantly larger target population (Kemper, Springfield & Teddlie, 2003). The random purposive sampling is suitable for this study as it focuses only on small-scale livestock farmers.

n: is the sample.

ee^2: is the margin of error?

N: is the population

3.5 Sample size

To get a well-represented population in the three study areas, the sample size with a known confidence and risk level was computed using the Cohran (1977) technique. Table 3.1 below shows the confidence levels as well as Z-values.

$$S = \frac{ZZ^2 PP(1-PP)}{MM^2}$$

S= Sample size of the overall population

Z= Z score

P= population proportion (estimated to be 50%=0.5%)

M= margin of error (estimated to be 5%=0.05%)

Z is the selected critical value of the desired confidence level (1.645)

Table 3.1: Confidence intervals and their corresponding Z-values

Confidence levels	Z –values
90%	1.645
95%	1.960
99%	2.576

The confidence level considered is the 90% confidence level.

$$S=\frac{(1.645^2)\times 0.5\times(1-0.5)}{0.05^2}$$

S= 214

The total population of livestock farmers in Bergville/Winterton= 400

The total population of livestock farmers in Estcourt= 600

Therefore, the total population of both study areas= 1000

Sample percentage of livestock farmers in Bergville/Winterton =400/1000 x 100 = 40%

Sample percentage of livestock farmers in Estcourt = 600/1000 x 100 = 60%

Table 3.2: Sample size

Study areas	Population	Total number of respondents to be surveyed
Bergville/ Winterton	400	40% x 214 =86
Estcourt	600	60% x 214 = 128
Total	1000	214

In conducting this study on the impacts of droughts and the skills gap among South African small-scale livestock farmers, the researcher initially aimed to collect data from a sample size of 214 participants as outlined in Table 3.2. However, due to several practical and logistical challenges encountered during the research process, the researcher was unable to achieve this target sample size. The explanation for the decision to collect data from 150 participants and the justifications for this adjustment are as follow:

- One of the primary reasons for collecting data from a smaller sample size was resource constraints. The comprehensive nature of this study, which involved extensive data collection efforts, including surveys, interviews, and field visits, posed challenges in terms

of financial resources and time constraints. Achieving a sample size of 214 would have required additional resources, which were not available within the scope of this study.

- Another factor contributing to the smaller sample size was the specific characteristics of the target population. South African small-scale livestock farmers are distributed across various regions with diverse environmental conditions and farming practices. Given the inherent challenges of reaching and engaging with this dispersed population, obtaining a larger sample was logistically challenging.

- To ensure the validity and reliability of the findings, it was essential to prioritize data quality over quantity. By focusing on a smaller sample size, the researcher was able to invest more time and effort into each participant, ensuring that data collection and analysis were thorough and accurate.

While the adjusted sample size of 150 participants falls short of the initial target, it is important to emphasize that the decision was made after careful consideration of the aforementioned constraints. This smaller sample size still provides valuable insights into the research questions and objectives of this study. The researcher believes that the data collected from this sample is representative of the population and have yielded meaningful findings that contribute to the understanding of the impacts of droughts and the skills gap among South African small-scale livestock farmers. Additionally, the researcher acknowledges the limitations associated with the smaller sample size and encourage future research endeavours to build upon the findings with larger and more diverse samples when resources permit.

3.6 Data collection

Data were collected in Bergville and the Estcourt town hall over a period of ten days. The choice of the town hall for meetings proved to be both cost-effective and timely for both the farmers and the researcher, thus justifying its utilization. The data collection team consisted of the researcher and two other postgraduate students. Due to time constraints and the availability of participants, four rounds of questionnaires were administered in groups.

The secretaries from the Livestock Farmers Association facilitated the conducting of questionnaires by co-facilitating with the enumerators. Assistance was provided to illiterate and

elderly participants to aid in understanding and completing the questionnaire. Subsequently, the remaining questionnaires were administered to households not represented in the group sessions, requiring approximately five days to complete.

Following this, data from focus group discussions were collected over two days, followed by key informant interviews conducted at the sports centre and town hall. Participants for the questionnaires were identified with the assistance of the local extension officer and the secretaries of the Livestock Farmers Association, selecting individuals based on their involvement in smallholder livestock farming. Additionally, the extension officer aided in identifying key informants based on their roles within the community.

Permission to conduct interviews with key informants was granted by the village chief, who communicated the principles of anonymity and voluntary participation to the group. Key informants interviewed included the president, secretary-general, and treasurer of the Livestock Farmers Association, the extension officer, and executive members of the association.

Both qualitative and quantitative approaches, along with their respective tools, were employed for data collection, including Participatory Rural Appraisal methods such as Focus Group Discussions, surveys, key informant interviews, and semi-structured questionnaires. These research tools are briefly described in the subsequent section.

3.7 Quantitative and Qualitative tools

The study utilized a mixed method approach, incorporating both quantitative and qualitative data collection tools as denoted below. The researcher gathered and analyzed data, integrated findings, and drew inferences using a combination of both methods in one study. The employment of the mixed method approach serves to validate the researcher's study justification through the use of both qualitative and quantitative data, and it provides a more comprehensive and complete representation of the study's interests by answering questions that cannot be answered by either method alone (Almalki, 2016).

The qualitative method is a broad approach used to study and approximate the phenomenon under investigation. This method encompasses various investigative methodologies for acquiring data, including participant observer research. Qualitative research is considered authentic as it involves observing variables in their natural setting and collecting information through open-ended

questions that enable the interviewee to fully express themselves rather than simply answering "yes" or "no" (Gerring, 2017).

The utilization of quantitative methods in research primarily involves the application of numerical analysis to quantify data, primarily in the form of numbers or percentages. Conversely, the employment of qualitative research methods necessitates the comparison of responses obtained from the distributed questionnaire, given that the questions are identical. The quantitative research method is geared towards the quantification and analysis of variables to derive outcomes. In this regard, specific statistical techniques were employed to address queries such as those pertaining to the magnitude, frequency, identity, character, location, and time frame of a given phenomenon (Apuke, 2017).

The utilization of a quantitative approach enables the problem to be precisely measured and evaluated through the examination of the interrelations between variables. The quantitative method involves the assignment of numerical values to the variables, which can then be subjected to statistical analysis (Creswell, 2014). To achieve this, a semi-structured questionnaire was employed in the quantitative approach. According to Teddie & Tashakkori (2009:24), “descriptive statistical analysis is the analysis of numeric data for obtaining summary indicators that can efficiently describe a group and relationship among variables within that group” using SPSS; data was coded and entered for descriptive statistical analysis of frequencies, means, correlations, percentages.

3.7.1 Questionnaire

Questionnaires are an instrument employed in survey research for collecting qualitative data. In this investigation, questionnaires were utilized to gather information regarding the effects of drought on livestock farmers, as well as mitigation and adaptive strategies implemented.

Additionally, the questionnaire was utilized to explore agricultural production and the adaptation strategies of livestock farmers in relation to the impacts of drought through interviews.

When creating a questionnaire, the researcher initially established the objectives that the study aimed to address. These objectives were specific and relevant to the overall aim of the study. Following this, the researcher recruited respondents for a quantitative research study using a recruitment questionnaire, to identify eligible participants for a focus group discussion.

To ensure accuracy and impartiality within the questionnaire, the questionnaire ensured that the questions are free from bias and that the questions were worded in a clear and unambiguous manner. To achieve this, the researcher provided interviewers with a briefing on the questions and ensure that they understand the intended meaning of the questions. In addition, the researcher provided a glossary of terms to respondents during open-ended interviews to ensure that they understand the meaning of any technical terms used in the questions. To organize the questions effectively, the questionnaire should start with the most general topics and progress to the more specific ones (Krosnick, 2018).

The use of a questionnaire is crucial during an interview process, as it enables the interviewer to avoid repeating the same question multiple times. This helps to maintain the clarity and accuracy of the responses provided by the respondents and prevents confusion or misunderstandings. Flow charts were used to keep track of the questions, which made it easier for the interviewer to follow the interview script and ensured that all necessary questions were asked.

The type of questions that were asked during the interview was determined in advance, as this had a direct impact on the type of information that is collected. Open-ended questions are those that do not have a pre-determined set of answers and require the respondent to provide their own insights and opinions. In contrast, closed questions have a limited range of possible answers, such as yes or no, and require the respondent to choose from a specified set of options. The type of data to be collected should also be known, as this will inform the type of analysis that is conducted on the collected data (Brace 2018).

Moreover, questions were written in a way that enabled respondents to understand the questions, that is, the respondent should not feel threatened, intimidated, or challenged by the questions. Questions should avoid ambiguity at all costs as this will confuse the respondent. After writing the questions the researcher proofread the questions and arranged the questionnaire for capturing accurate data. The researcher then piloted the questionnaire regardless of whether the questionnaire is new or has been used before. It was imperative that the questionnaire was pre-tested for the following reasons: to ensure that: the questions sound right, interviewers and respondents understand the questions, there are no ambiguous and leading questions, respondents can answer the questions, provided response codes are sufficient, respondents participate throughout, the interviews flow properly, the questions answer the brief, made mistakes are pinpointed and lastly

to measure the time taken by each interview. Lastly, researcher should ensure that they follow the ethical laws of fieldwork when conducting interviews (Brace, 2018).

3.7.2 Pre-testing of questionnaire

The pre-testing of the questionnaire was conducted on a small cohort of small-scale livestock farmers residing in the Bergville village. This process served to estimate the amount of time required to complete the questionnaire, as well as to verify whether the questions addressed the research objectives. Additionally, pre-testing assisted in identifying any difficult questions that required further clarification and familiarized the enumerator with the questionnaire (Creswell & Vicki, 2017).

3.7.3 Qualitative approach and tools

The qualitative approach is a method of inquiry that aims to comprehend the significance people attribute to problems, as posited by Creswell (2014). This approach employs various research tools, such as a participatory rural appraisal tool, focus group discussions, key informant interviews, and audio-visual. A detailed discussion of these tools is presented in the following section.

3.7.4 Key informant interviews

Informant interviews were carried out to obtain a diverse range of perspectives and to gather reliable information from individuals who possess expertise and are well-informed about the drought and the livestock farming community, based on their roles and involvement in the community. Key informants included local leaders, the executive committee of the small-scale livestock farmers associations, and an extension officer. The selection of key informants was facilitated by secretaries of the livestock associations collaborating with small-scale livestock farmers.

3.7.5 Focus group discussions

A Focus Group Discussion (FGD) is a qualitative research methodology used to gather in-depth insights, perspectives, and attitudes of participants regarding a specific topic or issue (Creswell & Vicki, 2017). FGDs typically involve a small group of individuals discussing the subject under the guidance of a facilitator. The group size, which usually ranges from six to twelve participants, is

carefully chosen to balance manageability and effective engagement, ensuring that all participants have the opportunity to express their views (Creswell & Vicki, 2017).

In this study, three FGDs were conducted, each comprising 6 to 10 small-scale livestock farmers. The decision to conduct only three focus groups was based on achieving thematic saturation and avoiding redundancy in new information, as additional groups did not significantly contribute to the study's findings.

Ethical considerations were paramount during the FGDs, with participants thanked for their time and informed of the voluntary nature of their participation. The discussions commenced with a warm greeting, an overview of the topics, and an introduction to the study's objectives. Probing questions were used to initiate the conversation, allowing participants to become comfortable and ensuring an equal opportunity for everyone to share their thoughts.

Throughout the FGDs, predetermined questions guided the discussion, and participants were encouraged to share their experiences and insights. Confidentiality and anonymity of the participants were carefully maintained. The discussions were audio-recorded, transcribed, and analyzed thematically to identify key themes and issues relevant to the study's objectives. The FGD findings complemented data from key informant interviews and added to the overall accuracy and reliability of the research.

The initial discussion centered on the impact of droughts on livestock farmers and the coping strategies adopted by these farmers. The second part of the discussion focused on the existing skills of farmers and the skills they felt a need to be trained in.

3.8 Validity

Validating data, results, and their interpretation is a fundamental aspect of research, whether one is engaged in quantitative or qualitative research (Creswell & Vicki, 2017).

Quantitative research places meticulous emphasis on data quality, specifically focusing on the accuracy of scores obtained from measurement instruments and the validity of inferences drawn from quantitative analyses. Upholding internal validity necessitates a thorough consideration of potential factors that could compromise the study, such as participant attrition, selection bias, and participant maturation. Additionally, external validity, which concerns the generalizability of

findings to a broader population, requires careful attention to sources of error in the research design, including selection bias and participant attrition (Creswell & Vicki, 2017).

In qualitative research, validation is centred around confirming the accuracy of information collected through various methods. Techniques like member-checking involve researchers verifying their findings with participants. Triangulation, on the other hand, encompasses the gathering of data from multiple sources to corroborate findings. Reporting disconfirming evidence and seeking input from peer experts in qualitative research further enhance data validity (Creswell & Vicki, 2017).

This study prioritized maintaining validity. The research questions and data collection instruments were thoughtfully designed to capture the intricate details of drought impacts and the skills gap being investigated. Furthermore, a comprehensive literature review was conducted to align the study with established knowledge and theories in the field, thereby bolstering the study's validity by building on well-established concepts.

3.9 Reliability

Quantitative reliability refers to the consistency and stability of scores obtained from participants over time. To ensure the reliability of scores, statistical procedures such as internal consistency and test-retest comparisons should be used to explore the data (Creswell, 2014). In qualitative research, this process is referred to as intercoder agreement, and involves several individuals coding a transcript and comparing their work to determine if they have arrived at the same codes and themes or different ones. The coders will identify text passages that they have all coded and use a predetermined coding scheme to determine if they assigned the same or different codes to the text passage.

For reliability, the researcher focused on consistent data collection and analysis procedures, trained the research team rigorously to follow standardized protocols, minimizing the potential for errors or biases during data collection. Additionally, the researcher used well-established measurement scales and statistical methods to analyse the data, promoting the reliability of the study's findings. Regularly reviewing and refining the research design and instruments, as well as seeking feedback from peers and experts, were key strategies in maintaining both validity and reliability throughout the study. These efforts ensured that this study research provided a trustworthy and accurate

understanding of the challenges faced by South African small-scale livestock farmers in the context of droughts and skills gaps.

3.10 Data analysis

The analysis of the data was conducted utilizing a convergent mixed methods design. In this approach, both qualitative and quantitative data are examined separately before merging their interpretations. The method employed for merging the data included side-by-side comparison and data transformation. As suggested by Creswell (2014), in the former, the researcher initially analyses the quantitative statistical results and then discusses the qualitative results that either support or refute the statistical findings. In the latter, the researcher converts qualitative data into quantitative variables and subsequently combines the two datasets. A detailed discussion of the analysis of both qualitative and quantitative data can be found in the following sections.

3.11 Qualitative data analysis

Analysing data qualitatively involved the process of making sense of text and image data, which involved segmenting, dissecting, and then reassembling the data. This procedure also included the simultaneous execution of multiple tasks, such as generating memos from previous interviews. Unlike quantitative research, where the researcher collects and analyses the data, then produces a report, qualitative research involved discarding certain parts of the data. The use of qualitative computer software programs, such as Google Earth, can also aid in the analysis by creating maps and visualizing locational attributes.

The qualitative analysis involved organising and preparation of raw data for analysis. The researcher went through all the data, reading field notes, listening to audio records. The data was then classified and sorted according to each research objective. Coding of data followed where relating ideas were organised into themes. The themes were used to generate detailed information for analysis and presented in a chronological narrative based on significance to the research question. Quotations, figures, and tables were also used to complement the discussed themes. Contrasting views were also considered and presented in the findings. Document analysis was used to identify and compare trends and changes between findings generated by the study of pre-existing data generated by other previous studies and government documents.

3.12 Quantitative data analysis

Data analysis involved the utilization of the Statistical Package for Social Sciences (SPSS) version 23.0, in addition to manual coding and the application of descriptive statistics and frequencies. The data collected was subjected to an in-depth analysis to determine the effect of climate change on livestock farmers, with the assistance of Microsoft Excel 2016. Frequencies will be calculated to achieve this objective.

3.13 Ethical considerations

The researcher made a formal application for ethical clearance in accordance with the guidelines prescribed by the University of Kwa-Zulu Natal for conducting research in local communities. The autonomy of participants will be safeguarded through the provision of an informed consent form, which outlines the nature of the research, the voluntary nature of participation, confidentiality, and any limits on confidentiality. Participants will be free to withdraw from the research at any time, and permission will be sought from local authorities before data collection commences. The researcher obtained ethical clearance from the University of Kwa-Zulu Natal's committee and sought permission to conduct research in the community from all local leaders. All information retrieved from participants was kept confidential, unless the participant agreed to its disclosure, and participation was completely voluntary. An appendix containing an ethics approval letter with a protocol number, informed consent documents, and site authorization letters are included to protect both the participants and the institutions involved.

3.14 Data Management

Research data can be stored in multiple formats, including electronic storage, physical storage, and hybrid storage. Regardless of the chosen storage method, it is imperative to ensure the security of the data to prevent unauthorized access, loss, or damage. Depending on the sensitivity of the data, appropriate security measures, such as encryption, access controls, backups, and firewalls, were implemented. Moreover, hard copy questionnaires, surveys, and interviews are stored in a secure location, under lock and key, at the Department of Food Security, University of KwaZulu-Natal, Pietermaritzburg campus.

3.15 Disposal of Research Data

Responsible and ethical disposal of research data is of utmost importance. Depending on the nature of the data, there are several methods of disposal to consider, such as:

1. Deleting electronic data: If the data is stored electronically, deleting it from the storage device or system is a commonly used method of disposal.
2. Shredding physical data: If the data is stored in hard copies, shredding the documents, or destroying them in a manner that renders them unreadable is a commonly used method of disposal.
3. Secure data destruction: In certain instances, specialised services may be employed to destroy data securely, such as companies that utilise industrial shredders, incineration, or magnetic destruction.

Upon the conclusion of the study, the research data will be transferred to the Department of Food Security for long-term retention, not exceeding five years. The completed questionnaires will be disposed of by the Administration Department (MIG) of the school through shredding. It is imperative that researchers thoroughly destroy all data, regardless of the disposal method employed, to prevent any possibility of recovery. Furthermore, it is essential to consider ethical considerations, such as avoiding the destruction of data to conceal misconduct or fraud.

3.16 Research feedback

Reporting Feedback: The traditional method of providing feedback is through written reports that summarize the study's results, including key findings, conclusions, and recommendations. Researchers may also opt to present their findings through a presentation, such as a PowerPoint or a live talk, which allows for interaction and discussion between the researchers and the audience. Additionally, publishing in peer-reviewed journals is an option, ensuring that the study has undergone rigorous evaluation by experts in the field before publication.

3.17 Summary

Mixed methods research is often necessary when both quantitative and qualitative data are required to address a research problem. This type of research involves collecting, analysing, interpreting, and integrating both quantitative and qualitative data into a cohesive whole (Leedy & Ormrod 2019). In this study, a mixed methods research design will be utilized to conduct the research. The

study will take place in OLM, which is situated in the Northern region of KwaZulu-Natal province. As shown in Figure 3.1, the area is home to both commercial and subsistence farming, although they are geographically separated by the legacy of the segregationist apartheid regime (IDP 2017). The specific sites chosen for the study are Winterton, Bergville, and Estcourt, which are neighbouring towns with a primary economic focus on agriculture (IDP 2020/2021).

The current study utilized a descriptive research design, incorporating a mixed method approach that combines both qualitative and quantitative methods to ensure maximum credibility and validity, and to generate findings that are understandable (Leedy & Ormrod, 2019). The study focused on livestock farmers in the agricultural sector in SA, using non-probability sampling to investigate the impacts of droughts on the sector (Etikan, 2016). The mixed method approach was employed, utilizing both quantitative and qualitative data collection tools, such as questionnaires and key informant interviews.

To ensure the accuracy and credibility of the findings, the researcher must convey the steps they will take in their studies. This was achieved through methods such as member-checking, triangulation, reporting disconfirming evidence to participants, and seeking feedback from knowledgeable peers (Creswell, 2014). The data was then analyzed both qualitatively and quantitatively using software such as NVIVO and SPSS, respectively.

CHAPTER 4: RESULTS AND DISCUSSION

This chapter presents the results of the descriptive analysis on the impacts and skills gap of small-scale livestock farmers in relation to drought preparedness, mitigation, and adaptation. The analysis encompasses the demographic and socio-economic characteristics of the small-scale livestock farmers surveyed, their experiences with drought, their perceptions of drought, and the skills they employ and require to effectively manage and cope with droughts. The descriptive analysis entails the utilization of percentages, frequencies, and means in presenting the findings.

4.1 Socio-economic profile

Table 4.1: Socio-economic Characteristics of Respondents

Variable	Frequency	%Total
Gender		
Male	137	91.3
Female	13	8.7
Total	150	100
Age		
18-29	3	2.0
30-39	14	9.3
40-49	33	22.0
50-59	36	24.0
60+	64	42.7
Total	150	100
Highest education level		
No formal schooling	12	8.0
Primary	42	28.0
Secondary	83	55.3
Tertiary	13	8.7
Total	150	100
Marital status		
Married	104	69.3
Widowed	4	2.7
Divorced	2	1.3
Separated	3	2.0
Never married.	37	24.7
Total	150	100

Farming experience in years		
1-5	26	17.3
5-10	29	19.3
10-20	42	28.0
More than 20 years	53	35.3
Total	150	100
Employment status		
Employed	17	11.3
Unemployed	66 4	44.0
Farmer	55	2.7
Pensioner	8	36.7
Prefer not to say.		5.3
Total	150	100

Table 1 presents an overview of the socioeconomic characteristics of the study participants. It is noteworthy that the livestock sector in the study areas is largely composed of individuals aged 60 and above, who account for 42% of the population. This predominance of older adults in farming may be attributed to retirement or retrenchment from urban employment, a common trend in rural areas (Goni et al., 2018). The results shown by the table in age distribution in the sampled small-scale farmers, reveal that there were more aged people involved in farming than youths in both municipalities.

Aging farmers may experience health issues or physical limitations that affect their ability to work in agriculture. This can impact productivity if farmers are unable to perform tasks effectively or if they require more frequent breaks or accommodations. As older farmers retire or pass away, there may be challenges in passing on their farms to the next generation. Without proper succession planning, farms may be abandoned or sold, leading to disruptions in agricultural productivity. An aging population may hinder innovation and technological advancement in agriculture. Younger generations are often more adept at adopting and utilizing new technologies, so a decline in the younger workforce could slow down the pace of innovation in the agricultural sector. A decline in agricultural productivity due to an aging population can have economic implications at both the local and national levels. Reduced agricultural output can lead to higher food prices, increased imports, and decreased income for farmers, which can affect overall economic growth and development.

Fichtner, 2018 suggests that the issue of aging societies is prevalent not only in developed nations but also in developing ones. However, the most pronounced impact of an aging population is felt in production agriculture. This sector relies heavily on labour-intensive tasks, and farm operators typically skew older compared to the broader workforce. Older workers generally exhibit lower productivity levels than their younger counterparts. Additionally, factors such as small land holdings, large family sizes, and higher off-farm wages tend to steer younger and middle-aged individuals toward non-agricultural employment. Consequently, older farm operators often wish to retire from farming, and decisions regarding retirement and succession on family farms are closely linked. Many older farm operators find themselves without successors, leading to deliberations about the future use of their farmland—whether to lease it, employ labour, or engage in profit-sharing arrangements by pooling resources with others. Therefore, elderly operators lacking successors are confronted with the dilemma of farmland utilization. (Zou, 2018).

Milovanovic (2020) contends that contrary to trends in most Western nations, an aging population is likely to yield positive economic outcomes in Asian countries. This is because it often prompts heightened government expenditure, which in turn tends to spur economic growth. However, in developing nations, urbanization and population aging have adverse effects on food security. Numerous scholars have investigated the repercussions of urbanization and aging on agricultural producers. Some have observed that urbanization leads to the migration of rural inhabitants to cities, resulting in an uptick in urban populations and a decline in both the quantity and calibre of agricultural labour.

The aging of the agricultural workforce diminishes its physical vigour, constraining production capacity, and exacerbating the abandonment of cultivated lands. (Li et al., 2018a). This poses a significant threat to the productivity and existence of the livestock farming sector in the Okhahlamba region. Furthermore, small-scale livestock farming is crucial in ensuring food security, economic growth and good social welfare in the region which is at risk considering the ageing population dominating the sector.

The low level of involvement of youths in agriculture could be because they find agriculture unattractive and prefer to search for jobs in other sectors. The dominance of older farmers in the farming system could be an advantage in terms of wealth experience and social capital in the system. However, the farming system could also be ladened with a state of stillness (Victor et al.,

2019). Moreover, the lack of youth involvement in agriculture, driven by a preference for less labour-intensive urban jobs (Fourie et al., 2018), contributes to this age distribution. In some cases, adults relocate to rural areas to start farming after retiring from formal employment, a practice observed both in Africa as a continent and in South Africa (Belle et al., 2017).

The phenomenon of young people migrating to urban areas in pursuit of better economic prospects is often referred to as the "youth in agriculture problem" (Rakgwale & Oguttu, 2020). It is noteworthy that there is a unfavourable perception, particularly among African youth, regarding agriculture as a viable career or livelihood strategy (Rakgwale & Oguttu, 2020). Furthermore, the bureaucratic ownership of land, either by the state or traditional authorities, poses another obstacle to participation of in farming by limiting their ability to secure financial aid for agricultural ventures (Rakgwale & Oguttu, 2020).

In the uThukela District, which encompasses Bergville, Estcourt, and Winterton, the youth population, defined as those under 35 years of age, comprised less than 11% of the total population (Jepthas & Swanepoel, 2019). According to Khowa (2021), research has shown that the youth are more successful farmers than their older counterparts. This can be attributed to their higher level of education and better adaptation to climate change. Educated young farmers are more likely to understand and apply agricultural drought coping strategies (Khowa, 2021). Additionally, young farmers are more adaptable to new farming technologies and methods than older farmers (Vetter et al., 2020). Therefore, there is a need to explore ways to encourage farming among the youth. During focus group discussions, it was suggested that incorporating agriculture into school curricula could be an effective strategy for promoting farming to the youth.

Marital status was found to exert a considerable impact on the degree of involvement in farming activities. The majority of the respondents were married (69%), and this was observed to provide married household leaders with greater autonomy in making decisions regarding agricultural droughts, with the support of their spouses. This finding is consistent with previous research, which has indicated that unmarried young adults often perceive themselves as less accountable for the farming enterprise (Tan et al., 2015).

Furthermore, married farmers often have the advantage of resource pooling within the household. With a spouse, they can combine their labour, financial resources, and assets, which can help them better withstand the economic and agricultural shocks caused by drought. For example, if one

partner's crop fails, the other partner's income or resources can compensate (Ojo et el., 20220). In addition, Marital status can influence how labour is allocated on the farm. In a married household, tasks can be divided more efficiently, allowing for better management of the farm during drought periods. For instance, if one partner is tending to crop, the other may focus on livestock or alternative income-generating activities (Badstue et al., 2020).

Per the study conducted the majority of farmers, at 44%, reported being unemployed, followed by pensioners at 36%. Only 11% of the participants reported being employed. The high percentage of unemployed small-scale farmers presents a significant challenge in terms of income generation. The reliance on agricultural activities as the primary or sole source of income for these unemployed farmers is further compounded during droughts, which can negatively impact productivity and yields. In addition, the impact of drought includes rural unemployment due to its effects on agriculture and livestock. (Singh et al., 2022). The lack of alternative employment opportunities outside of farming increases their vulnerability to economic shocks caused by droughts. Unemployed individuals and pension recipients may not have significant savings or financial to draw upon during a drought. This lack of a financial safety net can make it difficult to cover unexpected expenses or invest in drought-resistant farming practices (Holland et al., 2017). It's important to recognize that the impact of unemployment and reliance on pension grants during drought can vary depending on factors such as the availability of other income sources, the adequacy of pension payments, and the overall socio-economic context. Addressing these vulnerabilities may require a combination of government support, community assistance programs, and efforts to enhance the resilience of individuals and households through skill development, access to credit, and social safety nets.

The study highlights that 36% of the small-scale farmers are pensioners, which suggests that a considerable proportion of the small-scale farming community is reliant on pensions as a source of financial support. While pensions provide a stable income stream, they may not always be sufficient to cover the additional costs and investments required to mitigate the impacts of drought, such as purchasing drought-resistant seeds, irrigation equipment, or supplemental feed for livestock. Drought-induced financial stress can exert pressure on the limited financial resources of pensioners, potentially affecting their overall well-being (Fintel & Pienaar, 2022).

The low percentage of small-scale farmers who reported being employed outside of agriculture (11%) highlights the limited diversification of income sources within this group. Diversification is a crucial strategy for enhancing resilience in the face of climate-related shocks, such as drought (Harvey et al., 2019). Farmers with alternative sources of income can better withstand the economic challenges posed by drought because they are not solely dependent on agricultural earnings. Conversely, those without supplementary income streams are more vulnerable to the adverse effects of drought on agricultural production (Fintel & Pienaar, 2022). These employment dynamics underscore the importance of government policies and support systems in assisting small-scale farmers affected by drought. Policymakers and agricultural authorities should consider implementing measures that address the economic vulnerabilities of unemployed and pensioner farmers during drought periods. Such measures may include targeted financial assistance, access to low-interest loans, or training programs to enhance farming skills and income diversification.

Education emerged as a crucial aspect of resilience against climate shocks such as agricultural drought. Individuals with higher levels of education were less susceptible to such events and had a greater capacity to adapt (Majaha, 2023). Therefore, it is imperative to educate and equip farmers with the necessary knowledge to enhance their resilience (Majaha, 2023). According to the study, 17% of livestock farmers had 1-5 years of farming experience, 19% had 5–10 years of experience, 18% had 10–20 years of experience, and 35% had more than 20 years of experience in farming.

Lastly, the data reveals a gender disparity in livestock farming, with 91% of livestock farmers being male and only 8.7% female. Drought impacts men and women differently in livestock farming due to gendered power dynamics and access to assets. Gender disparity in livestock farming is a significant issue, particularly in the context of drought. Studies have shown that women in smallholder livestock farming face challenges such as limited access to resources, lack of decision-making power, and cultural barriers (Lindie et al, 2021; Ndlovu et al., 2021; Abiyot et al., 2019). Traditional gender roles and patriarchal systems often limit women's involvement in decision-making processes related to drought risk reduction (Ringetani, 2021). However, the impact of drought on gender roles and access to resources is not uniform. Recurrent droughts have been found to increase women's workload, decision-making power, and income-earning opportunities in some cases (Mapedza et al., 2019). It is crucial to address these gender disparities and empower women in livestock farming to enhance their resilience to drought. Policy

interventions should focus on improving women's access to resources, credit, and training, as well as challenging traditional gender norms and promoting gender equality in decision-making processes.

Based on the information provided in Table 4.1, the demographic characteristics of the livestock farmers in the study areas have a significant impact on their agricultural practices. The data highlights the age, education, marital status, employment status, and gender distribution among farmers. These insights are critical in comprehending the challenges and opportunities in the agricultural sector and devising interventions that specifically target the needs of the farmers to enhance their resilience and encourage youth involvement in farming. The information presented in Table 4.1 is of utmost importance in developing effective policies and programs to support the agricultural sector.

4.2 Perception of drought by small-scale livestock farmers

The perception of drought by small-scale farmers is a crucial aspect of understanding the challenges they face in agriculture. Drought, a prolonged period of insufficient rainfall leading to water shortages, has a profound impact on these farmers and their livelihoods. Their perception of drought encompasses not only meteorological or hydrological aspects but also socio-economic and psychological dimensions. Small-scale farmers often rely heavily on rain-fed agriculture and lack the resources and infrastructure available to larger commercial operations, making them particularly vulnerable to the effects of drought.

For these farmers, the perception of drought goes beyond the mere absence of rainfall; it includes concerns about crop failures, reduced yields, food insecurity, and economic hardships. This perception is informed by their intimate connection to the land and their dependence on seasonal weather patterns. Additionally, small-scale farmers tend to use local knowledge and traditional indicators to predict and respond to drought, such as changes in animal behaviour, plant growth, or the colour of the sky.

Understanding how small-scale farmers perceive drought is essential for devising effective policies and strategies to mitigate its impact and enhance their resilience. To shed more light on this topic, the data represented in the following table 4.5, which outlines key findings related to the perception of drought among small-scale farmers.

Table 4.2: Perception of drought by small-scale livestock farmers

Variables		**Frequency**	**Percentage**
Experienced drought	Yes No	149 1	99.3 0.7
Duration of drought	1-6 months 1-5 years 5-10 years 10-20 years More than 20 years	117 28 3 1 1	78 18.7 2.0 0.7 0.7
Occurrence/intensity of drought	Never Rarely Sometimes Very often	4 71 60 15	2.7 47.3 40 10
	Seasonal Yearly	120 30	80 20
Cause of drought	Lack of rain Dry dams and rivers A lot of rain but dry soils No irrigation system	128 26 14 32	85.3 17.3 9.3 21.3
Source of knowledge of drought	News Training Internet Extension officer Conference Local elders Government entity Newspaper Radio NGO	119 8 8 10 19 51 10 38 82 4	79.3 5.3 5.3 6.7 12.7 34 6.7 25.3 54.7 2.7
Impact of drought	Death of livestock	140	93.3
Drought relief importance	Strongly agree	119	79.3
Feed supplement important	Strongly agree	123	82
Resources available to support drought preparation	Yes No	47 103	31.3 68.7

The overwhelming majority of respondents (99.3%) have experienced drought. This indicates that drought is a common and recurrent issue among small-scale livestock farmers, and it has likely become a part of their farming reality.

The duration of drought experienced by farmers varies. The highest percentage of respondents (78%) faced drought for 1-6 months, suggesting that short-term drought events are relatively

common. A smaller percentage faced longer durations of drought, with 18.7% enduring drought for 1-5 years, and even fewer experiencing drought for 5-10 years, 10-20 years, or more than 20 years. This distribution highlights the diversity of drought experiences among farmers, from short lived events to prolonged periods of water scarcity.

The data reveals that drought is not a rare occurrence for these farmers. A substantial portion (47.3%) reported experiencing drought "rarely," while 40% experienced it "sometimes," and 10% faced drought "very often." Only a small fraction (2.7%) stated that they had "never" experienced drought. The presence of seasonal (80%) and yearly (20%) drought occurrences further illustrate the frequent nature of this climatic challenge in the region.

The majority of respondent's attribute drought to a lack of rain (85.3%), which is a common perception given that insufficient rainfall is a primary driver of drought. Other factors mentioned include dry dams and rivers (17.3%), a lot of rain but dry soils (9.3%), and the absence of an irrigation system (21.3%). These perceptions align with the typical causes of drought in regions with irregular rainfall patterns. The key informant interviews and focus groups demonstrate that rural areas and communities did not fall into much conflict with each other because everyone understood that droughts are a natural phenomenon and cannot be controlled by humans. However, other informants attest that drought can cause turmoil within communities, as they did between hunters and livestock farmers. Hunters burn pastures to create better hunting conditions as a wilderness with less vegetation cover is navigable for hunters and leaves no hiding spots for prey.

Farmers receive information about drought from various sources. The most common source is news (79.3%), indicating that farmers rely on media outlets for updates on weather conditions and drought-related information. Training (5.3%), the internet (5.3%), extension officers (6.7%), conferences (12.7%), local elders (34%), government entities (6.7%), newspapers (25.3%), radio (54.7%), and non-governmental organizations (2.7%) also contribute to farmers' knowledge about drought. Extension officers work closely with the farmers and may be able to supply additional information regarding mechanization in the emerging farmer sector, which may be unintentionally omitted by the farmers, as well as providing a different perspective in relation to the mechanization program implementation (Bastian et al., 2019). This diversity of information sources highlights the importance of multi-channel communication strategies for disseminating drought-related knowledge and support. Agricultural information usually reaches rural farmers via extension

workers, community libraries, radio, television, films, agricultural pamphlets, and state and local government agricultural agencies (Fourie, 2018). Moreover, the extension officer interviewed indicated that they provide extension advice to farmers in various commodities within the KZN Province particularly Bergville and Estcourt, which include grain and pastures, livestock (cattle, sheep, pigs, goats, and poultry), and vegetables. However, it is disturbing that only 6.7% of the livestock farmers receive their drought information from extension officers who by appointment are the sole proprietors (professionals) and distributors of knowledge. In addition, as shown in

The impact of drought on livestock is substantial, with 93.3% of respondents reporting the death of livestock. This high percentage underscores the severe consequences of drought on livestock farming, including significant economic losses and threats to food security. Similar findings are reported by Ncube (2018), where farmers in the Karoo described the drought as low rainfall, a decrease in water availability, reduced grazing quality and quantity, dying vegetation and animals, food, and feed shortages.

A large majority of respondents strongly agree on the importance of drought relief (79.3%) and the importance of feed supplements (82%). This strong agreement highlights the critical role that relief efforts and supplementary feeding play in helping farmers cope with the adverse effects of drought. It also emphasizes the importance of timely and effective interventions during drought events. These supplements from the government keep their livestock more resilient to droughts. Feed supplements ensure that livestock are well fed and have sufficient nutrients to withstand the deficiency in nutrients in pastures and grazing land during droughts. During the rainy season, pastures are more abundant and of higher nutritional quality; while, during the dry season, pastures are of lower nutritional quality, with high fibre and low protein content, resulting in lower productivity of livestock (Abebe, 2017). A significant number of respondents (31.3%) indicate that resources are available to support drought preparation, while the majority (68.7%) feel that such resources are lacking. This finding suggests that there is room for improvement in providing farmers with the necessary resources and support to enhance their preparedness for drought.

4.3 Impacts of droughts

Droughts have major effects on a country's economy and its population. These impacts are more pronounced in populations residing in developing countries with much higher levels of poverty

and inability to access basic human needs. The themes from the focus group discussions highlight the multifaceted and far-reaching impacts of droughts on small-scale livestock farmers in KwaZulu-Natal (KZN). These impacts affect not only the economic well-being of farmers but also their livelihoods, the environment, and the social fabric of their communities. Understanding these impacts is crucial for developing effective strategies to support and build resilience among small-scale farmers facing the challenges of drought.

Table 4.3: A summary of the impacts of droughts on Small-scale Livestock Farmers

Theme	**Discussion**
Livestock impacts	High level of mortality livestock. The unavailability of feed led to high levels of malnutrition in the livestock. Increased vulnerability of livestock to diseases. Lack of water weakens livestock exposing them to pests. Inadequate feeding leading to reduced productivity. Increased vulnerability to theft. Decreased fertility Increased heat stress level.
Environmental impacts	Decreased vegetation cover. Increased rate of soil erosion Increased fire breakouts. Decreased underground water availability. Heightened rate of gully formation. Land degradation Increased water scarcity Decreased water quality Dam siltation and drying up. Crop growth failure Soil fertility decreases
Economic Impact	Reduced market value of livestock Loss of income Inability to purchase feed. Increased cost of feed, medicine, and nutritional supplements
Social impacts	Uneven distribution of water sources Lack of food Conflict and tension within the community Increased theft Discrimination and hostility in the livestock market

Droughts have emerged as a critical and pressing concern for small-scale farmers in KZN, South Africa. The region has experienced prolonged dry spells, and respondents overwhelmingly acknowledge the devastating economic effects of these climatic events. This discussion sheds light on the multifaceted impacts of droughts on small-scale livestock farmers, drawing insights from a focus group and relevant research findings.

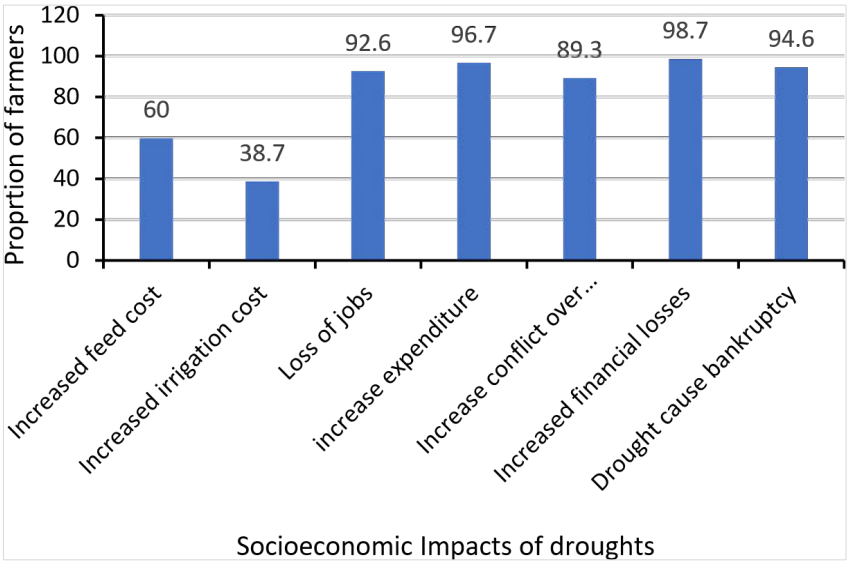

Figure 4.1: Socio-economic impacts of droughts on small-scale livestock farmers

4.3.1 Socio-economic Impacts of droughts

Drought, a recurrent and widespread climatic phenomenon, has profound implications for the wellbeing of individuals, communities, and entire regions. The socio-economic ramifications of drought are multifaceted, ranging from agricultural losses and food security to water scarcity, human health, and the stability of local economies. In this results discussion section, a comprehensive analysis of the socio-economic impact of drought, drawing upon empirical data and research findings to elucidate the intricate web of consequences that ensue from prolonged periods of drought.

4.3.1.1 Livelihood Impact

The study revealed that the impact of droughts extends beyond economic concerns to deeply affect the livelihoods of small-scale farmers in KZN. An alarming 92.6% of respondents reported job losses as a consequence of droughts. This finding indicates that not only do droughts jeopardize the financial stability of small-scale farmers, but they also disrupt employment opportunities within farming communities. Moreover, almost all respondents, at 98.7%, reported experiencing

increased financial losses during drought periods. This statistic highlights the significant financial strain endured by small-scale farmers as they grapple with the enduring consequences of drought. Small-scale farmers in the studied area face a multitude of challenges, exacerbating their vulnerability to drought. These challenges include poor grazing conditions, water scarcity, resource shortages, land disputes, and other factors. According to Matlou and Bahta (2019), the majority of these small-scale farmers lack the ability to cope with drought. Factors such as insufficient financing, limited government support (including training and feed assistance during droughts), land ownership constraints, and more contribute to their vulnerability to agricultural drought (Matlou & Bahta, 2019).

Increased vulnerability has negative effects on the small-scale farmers' putting more constrain on the daily farm operations. Increased vulnerability among small-scale farmers can have farreaching effects on their livelihoods, often exacerbating existing challenges and creating new obstacles (Shikwambana & Malaza, 2022). At the farm/household level, climate change impacts may reduce income level and stability, through effects on productivity, production costs or prices. Such variations can drive sales of productive capital, such as cattle, which reduces long-term household productive capacity. (Malhi et al., 2021). According to the FAO (2015) exposure to risks lowers incentives to invest in production systems, often with negative impacts on long-term productivity, returns and sustainability. Reductions and risks to agricultural income have also been shown to have effects on household capacity and willingness to spend on health and education. Evidence from recent analyses of the impacts of various types of weather anomalies on farm income indicates that the impacts are greatest for the poorest farmers (FAO, 2015). Small-scale farmers often rely on their own produce for sustenance. When their crops fail or livestock die due to increased vulnerability, it can lead to food shortages within their households. This not only affects their physical well-being but also hampers their ability to work effectively (Fan & Rue, 2020) Small-scale farmers may resort to borrowing money to cope with the immediate financial challenges caused by vulnerability. High-interest loans can lead to a cycle of debt, making it difficult to invest in their farms or repay the borrowed money, further perpetuating their vulnerability (Caparas & Melati, 2023).

4.3.1.2 Natural Resource Management and Conflict

Droughts in KZN also have implications for resource management and communal dynamics. An appreciable 89.3% of respondents reported increased conflicts over communal natural resources during drought periods. This finding underscores the potential for competition over dwindling resources to generate tensions within communities. Drought-induced conflicts among livestock farmers have been observed in several regions. Studies have shown that climate change, leading to more frequent and intense droughts, can perpetuate poverty and fuel civil conflict. In Somalia, for example, a rise in temperature and subsequent livestock price shocks have been found to increase the incidence of violent conflict among pastoralist and agro-pastoralist livelihoods (Pinar and Eklund, 2023; Adaawen et al., 2019. Similarly, in the semi-arid northern Negev region of Israel, a severe drought led to both conflict and cooperation between Muslim Bedouin herders and Jewish agricultural settlements. Violence occurred when some Bedouins migrated to more fertile areas, while cooperation and assistance were practiced in the northern Negev, including grazing on damaged crops in return for payment (Amit and Feitelson, 2016). These findings suggest that drought can contribute to conflicts among livestock farmers, but the outcomes can vary depending on the specific socio-environmental context.

4.3.1.3 Impact on Food Availability and Traditional Practices

Drought has a significant impact on food availability and traditional practices. The impact of droughts on food availability for livestock small-scale farmers' families cannot be overemphasized. According to a farmer in the focus group during the drought season, the lack of water to grow crops and feed the livestock resulted in the inability to obtain milk from their cattle. This predicament is further compounded by the fact that small-scale farmers who rely on livestock for subsistence are unable to provide sufficient food for their families, particularly during the Christmas period when families come together to celebrate holidays. Climate change is causing droughts to become more severe, leading to low crop yields and increased risk of food insecurity (Anon, 2023)

The South African rural communities depend more on subsistence farming as a primary strategy to improve their livelihood. Most South Africans make their living in rural areas where subsistence farming remains a key role player in improving their livelihood (Mbatha et al. 2021). Eighty percent of the food produced in sub-Saharan Africa is produced by smallholder farmers and these

farmers are also the largest employers for the local labour force in these countries. This is partly because poverty is still a major challenge in sub-Saharan Africa and also because the agricultural sector also contributes a large share of the GDP and employment. Agriculture employs between 60 and 90% of the total labour force in sub-Saharan Africa (Ginindza, 2020).

However, the livestock animals are raised to meet multiple objectives of subsistence farmers (Onyango et al.2015). The animals are managed not only for monetary benefits, but also for socioeconomic benefits, including hide, manure, source of medium-term savings insurance against crop failure, means of diversifying investment, as well as to perform social and cultural functions (gifts, christening ceremonies) (Weyori et al.2018).

As a result of the lack of rainfall, pasture fodder species regenerate less quickly, reducing their availability and quality for livestock to eat, and driving up the cost of fodder. Moreover, rising temperatures caused by climate change led to the spread of vector-borne diseases and the emergence of novel diseases, which further impact the health of livestock. For small-scale farmers who rely on the production of pastoral animals as a means of subsistence, the loss of livestock can result in a shortage of family food. Livestock plays a critical role in food security, providing manure for crop production, serving as a safety net in regions where crops are difficult to grow, and being a major source of the calories and proteins needed for a nutritious diet (Lottering et al., 2020).

The reduction in milk production from cattle due to the lack of food availability negatively affects the well-being of families. Moreover, droughts can lead to conflicts between different groups, such as hunters and livestock farmers, over shared resources such as grazing land and water. Farmers have also reported an increase in crime and livestock theft during droughts, as thieves take advantage of isolated animals that wander off due to the scarcity of resources. The rise in livestock theft during droughts highlights the challenges that farmers face in protecting their livestock. This aspect plays a vital role in understanding the broader consequences of droughts on these farmers. Firstly, the economic impact cannot be understated, as livestock theft results in significant financial losses for these small-scale farmers. Stolen livestock represent an asset, and quantifying these losses is an essential part of assessing the overall impact of droughts on their livelihoods (Maluleke et al., 2021).

Furthermore, the skills gap within this farming community is intimately tied to the issue of livestock theft. Many small-scale farmers may lack the necessary knowledge and capabilities to effectively protect their livestock during droughts when the animals are more vulnerable. By exploring how the skills gap contributes to the vulnerability of livestock to theft during droughts, one can gain insights into the specific challenges these farmers face, shedding light on a critical area of improvement. The rise in livestock theft during droughts also has social and security implications. It can lead to increased tension and conflicts in rural communities, and understanding the social dynamics and the role of crime during these challenging times is integral. mitigation strategies (Bahta et al., 2016).

The aforementioned results of the current study coincide with those of Bahta et al. (2016), who reported an increase of 25.3% in stock theft during the drought years, with a stock theft rate of 78.16%, as compared to the normal years when the rate was only 52.8%. One respondent expressed that after losing his entire herd of cattle (27), he lost enthusiasm for the care of his remaining sheep and goats. He also ceased medicating them as he previously had. It is essential to remember that incidents of stock theft, farm attacks, and theft of non-livestock items tend to increase during times of drought. This aligns with the findings of Dzimba and Matooane (2016), who reported that droughts have severe consequences, such as displacing the majority of individuals employed in the non-livestock agricultural sector. Many of these individuals may resort to livestock theft to survive (Bahta et al., 2016).

The issue of climate change and its effects on global food security is of utmost importance in the twenty-first century. With the increasing population and the need to produce sufficient food, the strain on the environment is growing. The Food and Agriculture Organization of the United Nations (FAO) defines food security as a state in which all individuals have access to sufficient, safe, and nutritious food (FAO, 2017). The lack of water is a crucial factor in successful crop production and is limited during droughts. As a result, it is imperative to further study the impact of droughts on small-scale livestock farmers, particularly in relation to the vulnerability of rural communities and the potential for theft and conflict. Moreover, more research is needed on the strategies used by community leaders and officials to resolve conflicts and how these can be improved. The effects of droughts on small-scale livestock farmers are summarized in Table 4.2 above.

4.3.2 Economic Impact of Drought

Droughts have emerged as a critical concern for small-scale farmers in KwaZulu-Natal (KZN), with respondents overwhelmingly agreeing on its devastating economic effects. A staggering 94.6% of surveyed farmers believe that droughts inevitably lead to bankruptcy, highlighting the severe financial challenges brought about by prolonged dry spells in the region. Furthermore, a striking 96.7% reported increased expenditure during droughts, underscoring the significant resource allocation required to mitigate the detrimental impacts of drought. This aligns with Mathinya et al. (2022) observation that small-scale farmers often experience heightened poverty levels during drought years, primarily due to increased debt accumulation, which is commonly used to enhance productivity. An illustrative quote from a livestock farmer in a focus group vividly captures the economic hardships caused by droughts.

"A drought is just plain bad news all around – you lose stuff, like your animals, money, and crops. When we were going through that dry spell, I had to sell some of my cattle at those livestock auctions. But you know what? They didn't fetch much. Those poor cows had shed so much weight because there wasn't enough food during the drought. They were so weak they couldn't even make it to the auction stage!"

Drought-related livestock mortalities can result in severe economic losses for farmers. As drought conditions develop, attempts to sell livestock are often unsuccessful due to the reluctance of owners to deplete their capital assets under stress. This is further compounded by uncertainty in drought forecasting, which can lead to disastrous consequences. By the time livestock are marketed, their body condition is typically poor and the numbers are too large to be readily absorbed by marketing channels, resulting in very low prices, lack of sales, and eventually, death (Vetter et.al., 2020). The primary reason for this significant financial loss is likely the lack of drought preparedness among farmers.

The majority of individuals in the Southern Africa region rely on livestock farming as a source of income. Droughts can cause poor grass regeneration, water scarcity, and heat stress in animals (Scholtz, 2016). These weather conditions have an immediate impact on the development of palatable grass species, reducing the regeneration of pasture fodder species and decreasing the supply and quality of fodder for cattle use, which in turn raises fodder prices. Droughts can also negatively impact animal health, as rising temperatures can cause the spread of vector-borne

diseases and the emergence of novel diseases. As a result, small-scale farmers who rely on pastoral livestock production as a source of income often face food shortages due to livestock losses (S. Lottering et al., 2020). In light of these findings, it is clear that livestock farmers in the study are vulnerable to droughts and were negatively affected by them in the year 2015-2016. Further research is necessary to understand the vulnerability of small-scale livestock farmers to droughts at a household level.

4.3.3 Environmental Impacts of Droughts

Droughts have a significant impact on the natural environment, directly affecting the agricultural sector, which heavily relies on natural resources. Figure 4.2 showcases the environmental impacts of droughts on natural resources in the area studied. Farmers' responses indicate several significant trends. The most prominent impact reported by farmers during droughts is a reduction in vegetation, with 98% of respondents highlighting this issue. Additionally, approximately 93.3% of farmers identified land degradation caused by overgrazing as a significant impact of droughts. Moreover, droughts have led to a reduction in water availability, affecting 92% of the surveyed farmers. Furthermore, a considerable portion of farmers, approximately 76.7%, reported reduced availability of feed during droughts. Droughts have also had an impact on water quality, with 74.7% of respondents indicating a decline in water quality. While still significant, a slightly smaller percentage (51.3%) of farmers reported a reduction in both the quality and quantity of available feed.

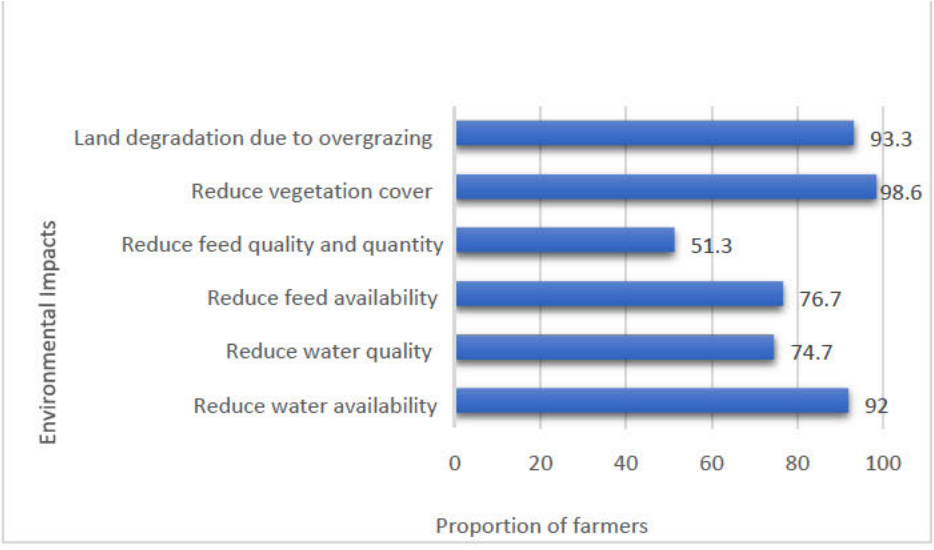

Figure 4.2 Environmental impacts of droughts on small-scale livestock farmers

Drought events have caused irreversible environmental damage, including biodiversity loss, water security risks, decreased soil fertility, increased wind erosion, reduced plant fertility, higher disease incidence, insect invasions, increased fire occurrences, and canopy losses. Consequently, drought has far-reaching effects on various aspects of life, including reduced quality of life, food insecurity, migration, societal fragmentation, heightened water demand, restricted access to education, especially in developing nations (Sharafi et al., 2020; Sharafi et al., 2021).

Farmers directly experience the impact of droughts through a reduction in vegetation cover on grazing land. Drought conditions result in reduced rainfall and less water for grass growth, ultimately affecting the availability of grazing resources. Furthermore, drought decrease underground water levels due to increased evaporation and disrupted water cycles, leaving less time for vegetation recovery and exacerbating land degradation, including gully formation. This degradation renders the land unsuitable for crop cultivation and poses injury risks to livestock navigating such terrain. Severe vegetation loss is evident, and this situation can lead to the culling of animals when injuries become too severe (Nieuwoudt, 2019).

The data from Figure 4.2 highlights the severe and multifaceted impacts of drought on natural resources in the studied area. These impacts encompass both the environment and the resources crucial for agricultural activities. The high percentages of respondents reporting reductions in vegetation, land degradation due to overgrazing, reduced water availability, and diminished feed availability and quality emphasize the substantial challenges posed by droughts in this region.

4.3.3.1 Land degradation

Drought has a significant impact on land degradation among smallholder livestock farmers. The data from the study reveals that a notable proportion of small-scale livestock farmers, specifically 93.3%, perceive land degradation as a significant environmental impact of drought. These finding sheds light on an aspect of drought's consequences that extends beyond immediate crop loss and directly affects the agricultural landscape, aligning with the broader aim of this study, which is to investigate the impacts of droughts on small-scale livestock farmers.

Land degradation is a multifaceted issue, often initiated or exacerbated by prolonged drought conditions. It encompasses a range of processes, including soil erosion, loss of soil fertility, and changes in vegetative cover, which can lead to a decline in overall land productivity. For smallscale

farmers heavily reliant on their land for sustenance and income, land degradation represents a severe threat to their long-term agricultural sustainability. Studies show that agricultural drought leads to a decline in rainfall, resulting in soil erosion and loss of fertile topsoil (Bahta and Myeki, 2022). This loss of soil quality affects agricultural production and exacerbates food insecurity among smallholder farmers (Yadeta and Negasa, 2018).

In the context of the study's aim, this finding underscores the importance of addressing not only immediate impacts but also the long-term consequences of droughts on the agricultural sector. Understanding that a significant percentage of small-scale farmers perceive land degradation as a consequence of drought is an essential step in developing comprehensive strategies to mitigate these effects and enhance resilience. The coping strategies adopted by farmers during drought include reducing livestock numbers, buying supplementary feed, and drilling boreholes (Rakgwale et al., 2020). However, these strategies are not always sufficient, and many farmers struggle to cope with the drought conditions (Klinck et al., 2022).

Furthermore, the connection between drought, land degradation, and the skills gap within smallscale livestock farming becomes apparent. Small-scale farmers may lack the knowledge and resources to implement sustainable land management practices, further exacerbating the problem (Tully et al., 2015). Therefore, addressing the skills gap within this farming sector is not only critical for improving day-to-day operations but also for ensuring the long-term health of the land in the face of climate-related challenges like drought. To mitigate the impact of drought on land degradation, interventions such as training farmers in livestock fodder production and soil and water conservation practices have been recommended.

The perception of land degradation as an environmental impact of drought by 93.3% of smallscale farmers highlights the complexity of challenges they face. This finding reinforces the relevance of the study's aim, which is to investigate the impacts of droughts and the skills gap within small-scale livestock farmers. It underscores the need for comprehensive interventions and support systems that consider both immediate and long-term consequences, with an emphasis on sustainable land management practices to combat land degradation and enhance the resilience of these farmers in the face of future drought events.

4.3.3.2 Reduce vegetation cover.

The data from our study indicates a striking consensus among small-scale livestock farmers, with a substantial 98.6% of respondents identifying "reduce vegetation cover" as a significant environmental impact of drought. This finding provides a key insight into the challenges faced by these farmers and is directly aligned with the central aim of the study, which is to investigate the impacts of droughts and the skills gap within this specific sector.

Reduced vegetation cover is a critical indicator of drought-related environmental stress. Prolonged drought conditions can lead to the depletion of soil moisture and subsequent loss of plant life, significantly affecting the forage available for livestock and the overall health of the agricultural ecosystem (Godde et al., 2021). The near-unanimous agreement among the surveyed farmers on this issue underscores the severity of the problem and highlights the consistency of perception among this group.

Drought events have a significant impact on plant development, leading to a substantial decrease in the growth rate and biomass accumulation of plants. Drought significantly disrupts plant photosynthesis (Jha & Srivastava, 2018). In India, the frequency of heat waves notably increased during drought years. Consequently, this severely harmed crop health, leading to a significant reduction in crop yield (Bandyopadhyay et al., 2015). Heat waves affect crop production by elevating air and land temperatures. Crops exposed to extreme heat may perish rapidly due to excessive evapotranspiration and insufficient moisture supply.

In the context of this study's aim, this finding holds significant implications. The high prevalence of reduced vegetation cover as a perceived impact of drought suggests that many small-scale livestock farmers in the study area are dealing with a common challenge. To address this issue effectively, interventions and strategies should focus on both immediate responses to drought conditions and long-term resilience-building.

Furthermore, the study's aim to investigate the skills gap within this sector becomes pertinent when considering the impact of reduced vegetation cover. Small-scale farmers must possess the knowledge and skills to implement sustainable land and livestock management practices to mitigate the effects of reduced forage availability. These skills are vital in ensuring the well-being

of livestock and the economic viability of farming operations during drought events (Majaha, 2023).

The widespread perception of "reduce vegetation cover" as a significant environmental impact of drought among 98.6% of small-scale farmers highlights the urgency and importance of the study's aim. It underscores the need for targeted interventions and support systems to address the immediate and long-term consequences of drought on small-scale livestock farmers. Furthermore, it emphasizes the essential role of skill development and knowledge transfer in equipping farmers to cope with the challenges of reduced vegetation cover and enhance their resilience in the face of recurring drought events.

4.3.3.3 Reduce feed availability.

The data from the study reveals that a significant proportion, specifically 76.7%, of small-scale livestock farmers have experienced "reduced feed availability" as a direct result of environmental impacts, particularly drought. This finding underscores the considerable challenges faced by these farmers and directly aligns with the core aim of the study: to investigate the impacts of droughts and the skills gap within small-scale livestock farming.

Reduced feed availability is a critical concern for livestock farmers, as it directly affects the wellbeing and productivity of their animals. Drought-induced forage and fodder shortages result in reduced nutrition for livestock, which can lead to decreased growth rates, lower milk production, and overall compromised animal health (Peñuelas et al., 2017). The high prevalence of this concern among surveyed farmers underscores the severity of the issue and highlights its widespread impact.

Droughts represent a severe and increasing risk for the livestock sector as they can reduce yields of hay and feed grain (Schaub & Finger, 2020). Primarily, drought diminishes livestock production by reducing available forage. This shortage of forage can elevate the costs of supplementary feeding or necessitate herd reduction. Prolonged drought patterns often lead to an unusually high number of cattle being sold at auction facilities, causing a temporary local decrease in market animal value (Scasta et al., 2016). Consequently, these market trends, induced by drought, make it financially challenging to rebuild after herd reduction since a larger number of replacements are needed at a higher direct opportunity cost. Additionally, drought diminishes forage quality,

decreasing crude protein levels by approximately 3% for every one-inch reduction in monthly precipitation (Scasta et al., 2016).

In the context of this study's aim, this finding holds significant implications. It signifies that many small-scale livestock farmers in study area are grappling with a shared challenge: maintaining adequate nutrition for their animals during drought events. To address this issue effectively, interventions and strategies should not only consider immediate responses to drought conditions but also focus on building long-term resilience within the sector.

The study's aim to investigate the skills gap within small-scale livestock farming becomes highly relevant in the context of reduced feed availability. Small-scale farmers need the knowledge and skills to implement effective livestock management practices that account for feed scarcity during droughts. This includes understanding alternative feed sources, implementing rotational grazing, and making informed decisions about herd size and composition to ensure the welfare and productivity of their livestock.

The substantial proportion of small-scale farmers, 76.7%, experiencing "reduced feed availability" as a result of environmental impacts highlights the pressing nature of the study's aim. It emphasizes the need for targeted interventions and support systems to address the immediate and long-term consequences of drought on small-scale livestock farmers. Furthermore, it underscores the vital role of skill development and knowledge transfer in equipping farmers to cope with the challenges of feed scarcity and enhance their resilience in the face of recurring drought events.

4.3.3.4 Water Quantity and Quality

The study findings show that 74.7% of farmers experienced a decrease in water quality, while 92% reported a decrease in water availability during droughts. Recent years have witnessed more frequent and intense droughts, resulting in reduced water quantity and quality. Droughts have not only been studied for their impact on water quantity but also for their effects on water quality. Water quality deterioration restricts its usability and accessibility. Droughts affect water supply and quality by causing soil moisture scarcity and reducing water stored in reservoirs, ultimately impacting agricultural production, natural ecosystems, and societies worldwide (Łabędzki, 2016; Mosley, 2015).

The cumulative effects of drought on small-scale farmers in the studied area are multifaceted and severe. These findings underscore the need for comprehensive measures to address the economic, environmental, and social repercussions of drought events, especially in regions heavily reliant on agriculture. Initiatives should focus on drought resilience, sustainable resource management, and improved water resource management strategies to mitigate the impacts on both livelihoods and the environment. Additionally, enhancing farmers' knowledge and skills in managing crops and selecting drought-resistant plant species is vital for future drought preparedness and adaptation.

The findings align with previous research and observations in the field. Similar to the current study, Lottering et al. (2021) noted that farmers in uMsinga, KwaZulu-Natal, rated water scarcity and rangeland deterioration as the primary environmental problems during droughts. This consistency in findings underscores the persistent and widespread impact of droughts on natural resources in the region.

Furthermore, the data corroborates the broader context of drought-related challenges in South Africa. The mention of drought's decimating effect on the agricultural industry in the Northern Cape Province, as reported by the Department of Agriculture, Forestry, and Fisheries (DAFF, 2018), highlights the severity of these events and their prolonged consequences. The scarcity of forage and water for cattle production has not only affected the livelihoods of farmers but also put significant pressure on the agricultural business in affected areas

4.3.4 Impacts of droughts on livestock.

Drought is a formidable challenge for livestock farmers, and the data presented in figure 4.3 vividly illustrates the multifaceted and far-reaching consequences it brings.

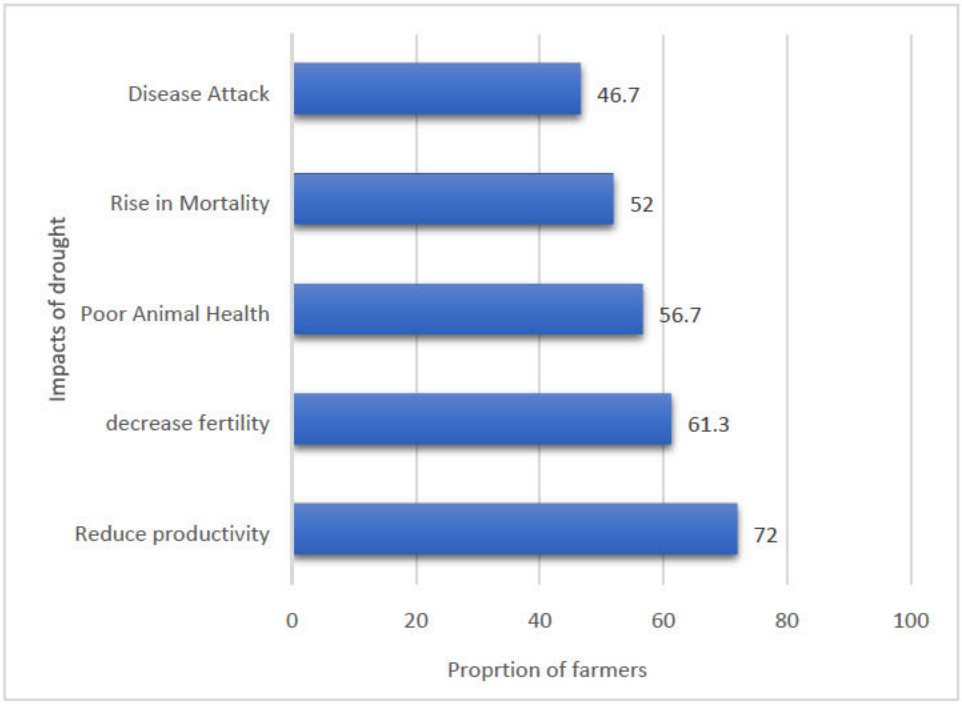

Figure 4.3: Impacts of droughts on livestock.

Disease Attack (46.7%), nearly half of the respondents reported an increase in disease attacks among their livestock during droughts. This phenomenon can be attributed to the weakened immune systems of animals and the conducive environment droughts create for disease proliferation. Disease outbreaks not only harm individual animals but can also lead to broader economic losses for farmers (Hirakawa et al., 2017).

Rise in Mortality (52%), the fact that over half of the respondents noted a significant rise in livestock mortality during droughts is particularly concerning. Elevated mortality rates can result in substantial economic losses, as farmers lose valuable assets. Drought-induced stress, inadequate nutrition, and the scarcity of water all contribute to the increased mortality (Lees et al., 2019).

Poor Animal Health (56.7%), more than half of the farmers reported a decline in the overall health of their livestock during droughts. This decline in animal health can manifest in various ways, including reduced weight gain, diminished reproductive performance, and an increased susceptibility to diseases. It poses a direct threat to livestock productivity and, consequently, to farmers' livelihoods (Godde et al., 2021).

Decrease in Fertility (63.1%), a significant majority, approximately two-thirds of respondents, observed a decrease in fertility among their livestock during drought periods. Reduced fertility has long-term repercussions, affecting the growth and sustainability of herds. It can lead to reduced calf or lamb production, impacting future generations of the herd (Polsky & Keyserlingk, 2017).

Reduced Productivity (72%), the most prevalent impact reported was a decrease in livestock productivity, with 72% of respondents affected. Reduced productivity encompasses various aspects, including lower meat and milk production. This reduction in output can directly impact farmers' income, making it harder for them to sustain their operations (Botai et al., 2016).

In sum, the data from this graph highlight the severe challenges that livestock farmers face during drought events. Droughts create a perfect storm of adverse conditions, including water scarcity, poor forage availability, and increased disease risk, which collectively contribute to these detrimental impacts on livestock (Godde et al 2021). To mitigate these challenges, farmers must employ effective drought management strategies, such as providing supplementary feed and water, improving disease prevention measures, and enhancing overall herd health management. Additionally, governmental and agricultural support systems play a crucial role in helping farmers cope with the challenges posed by drought, ensuring the resilience of the livestock sector and the livelihoods of those who depend on it (Bahta & Myeki, 2021).

Drought events have a profound impact on livestock, affecting both animal health and overall production in agricultural sectors. During the 2016 drought in KwaZulu-Natal, regions characterized by overgrazing and soil erosion experienced a significant surge in animal deaths (Vetter et al., 2020). This livestock mortality is often exacerbated by depleted grazing resources, leafless trees, and scarce drinking water. Animals, weakened by the drought, are forced to travel long distances between water sources and areas with remaining vegetation (Vetter et al., 2020). The vulnerability extends to breeding cows, ewes, young calves, and even male animals, with cattle and goats suffering particularly high mortality rates. Farmers often resort to moving livestock to other areas or purchasing hay bales, but these measures frequently prove too late to save their cattle. The animals' weakened condition and difficulty adapting to unfamiliar feed compound the challenges faced by livestock owners, who sometimes only consider selling off their livestock when the animals are already too thin to sell or slaughter.

The economic consequences of livestock losses are significant, as they affect the income sources of many households. In 2015, South Africa experienced an 8.4% decline in agricultural production attributed to drought, with the livestock industry bearing a substantial brunt, including a 15% reduction in the national herd stock. KwaZulu-Natal alone recorded 40,000 cattle mortalities by the end of 2015 (Mare et al., 2018; Myeki & Bahta, 2021). Drought-induced livestock hardships manifest in various ways, including poor productivity, decreased fertility, deteriorating animal health, and a rise in livestock mortality rates. The dusty environment caused by drought conditions also contributes to the spread of contagious diseases among livestock, notably lung infections.

Furthermore, inadequate grazing during droughts leads to widespread nutrient deficiencies among livestock, resulting in low conception rates, retained afterbirths, subpar colostrum production, and weakened immune systems (Bahta & Myeki, 2022). These detrimental impacts emphasize the critical importance of implementing effective drought management strategies, including timely actions to safeguard livestock health and productivity.

4.4 Socio-economic challenges faced by livestock farmers in response to drought.

The data provided in the table 4.3 sheds light on the various challenges faced by small-scale farmers, offering insights into the most pressing issues they encounter. Understanding the challenges farmers face during droughts is necessary for the development of innovative and adaptive measures within livestock farmers as this will enhance their ability to cope with droughts.

Table 4.4: Socio-economic challenges faced by livestock farmers in responding to droughts.

$LSFChallenges Frequencies

		Responses		**Percent of**
		N	**Percent**	**Cases**
Challenges facing livestock farmers	LACKACCESSWATER	108	23,3%	73,0%
	HIGHFEEDCOST	96	20,7%	64,9%
	LACKKNOWLEDGE	98	21,2%	66,2%
	LIMITEDACCESSTOFINANCE	83	17,9%	56,1%
	LACKINFRASTRUCTURE	78	16,8%	52,7%
Total		463	100,0%	312,8%

a. Dichotomy group tabulated at value 1.

The data table 4.3 provides a clear overview of the challenges facing livestock farmers, shedding light on the relative significance of these issues within the livestock farming community. Among the challenges, the most frequently mentioned issue is the "Lack of Access to Water," with 108 responses, constituting 23.3% of the total cases. This high percentage reflects the pressing and prevalent issue of water access in the industry. Access to water is undeniably essential for livestock farming, impacting animal well-being and productivity, as well as the overall sustainability of the sector.

Closely following is the challenge of "High Feed Costs," with 96 responses, representing 20.7% of the total cases. Within the dichotomy group tabulated at value 1, this challenge is present in 64.9% of cases. High feed costs can significantly impact the financial viability of livestock farming operations, a concern that weighs heavily on many farmers. Addressing this challenge is vital for increasing profitability and ensuring the sector's sustainability.

Another significant challenge is the "Lack of Knowledge," with 98 responses, making up 21.2% of the total cases. This challenge is cited in 66.2% of cases within the dichotomy group tabulated at value 1. The skills gap among livestock farmers, characterized by a lack of knowledge, can hinder effective farming practices, negatively impacting livestock welfare and overall productivity. Therefore, promoting education and training among farmers is crucial to address this challenge.

The "Limited Access to Finance" and "Lack of Infrastructure" challenges, with 83 and 78 responses, respectively, are also substantial concerns among livestock farmers. These challenges can impede the development and growth of the livestock sector. Limited access to finance affects the financial stability of farmers, while the lack of infrastructure hampers technology adoption and overall development in the industry. Furthermore, the high transport costs that farmers often face present a significant challenge, as it impacts their ability to effectively market their livestock. As transport links farmers to markets and customers, its availability is crucial to the management of production systems, as unreliable transport can result in delayed delivery of products (Khapayi & Celliers, 2016:3).

In the context of South African small-scale livestock farmers, it's essential to recognize the interconnectedness of these challenges with the impacts of droughts. Droughts, a recurring issue in many regions, exacerbate the "Lack of Access to Water" challenge, making water scarcity a

particularly acute problem during dry periods. Additionally, droughts elevate "High Feed Costs" due to decreased forage availability, making purchased feed a necessity, further straining smallscale farmers' financial resources.

Moreover, the skills gap, represented by the "Lack of Knowledge" challenge, is exacerbated by droughts. Farmers need specialized knowledge and skills to adapt to and mitigate the effects of drought, including strategies for water conservation, livestock nutrition during periods of scarcity, and overall drought preparedness. Bridging the skills gap through training and education is essential for small-scale livestock farmers to improve their resilience and adaptability in the face of climate-related challenges.

In summary, the data presented in the table highlights the critical challenges facing livestock farmers, including access to water, high feed costs, and a lack of knowledge. These challenges intersect with the impacts of droughts and the skills gap among South African small-scale livestock farmers. To address these issues, a multi-faceted approach involving drought preparedness, education, and resource support is essential for ensuring the sustainability of small-scale livestock farming in the context of a changing climate. This data should guide policymakers and stakeholders in developing targeted interventions to support these farmers and promote the growth of the industry. Additionally, understanding the role of the dichotomy group tabulated at value 1 would provide further insights into the data and its implications.

According to Bahta et al. (2016), communal farmers are particularly susceptible to drought due to a lack of resources, limited access to financial institutions and insurance, imperfect market systems, overgrazed and highly degraded land, inadequate knowledge and managerial skills, and poor extension support. Although farmers receive assistance from extension officers and animal health technicians in vaccinating livestock, the availability of information on drought preparedness is not as reliable. Furthermore, the key informants noted that the government aid during droughts is limited and insufficient to meet the needs of farmers.

Communal farmers and an extension officer have expressed their dissatisfaction with the execution of drought relief programs. Furthermore, farmers and key informants have indicated a perceived lack of adequate support from the government in drought risk reduction efforts. They argue that past promises of drought support have not been fulfilled to a large extent.

"We did not receive any aid from governmental organisations. The help that was promised could not be fulfilled sufficiently due to time and inefficiency of the government administration processes."

Drought support, intended to provide relief to affected individuals, often reaches recipients late, if at all. In some cases, drought relief is disbursed even when the dry period has ended. Albeit the fact that SA has well-recognized legislation for disaster risk reduction (National Disaster Management Act, 2022), the state government did not implement any strategy to plan for droughts on time (Baudoin et al., 2017). There are numerous reasons contributing to the low ability of livestock farmers to adapt to drought, including lack of access to financial resources, lack of knowledge and managerial skills, and poor extension support (Bahta et al., 2016). Demonstrating this issue is a quote from the focus group discussion where livestock farmers clearly stated that government aid was either untimely or non-existent at all.

Access to credit is a crucial enabler for the success of small-scale farmers, and it significantly enhances their ability to prepare for and cope with droughts. Despite the numerous interventions implemented by government and non-governmental organizations to increase credit facilities for small-scale farmers in rural areas, access to credit remains limited (Rabbi et al., 2019). The current study also confirms this, with 96% of small-scale farmers in the Bergville and Estcourt areas lacking access to credit services. The limited access to credit during droughts has significant negative effects on small-scale farmers, and the study conducted by Jiri (2019) highlights that access to credit improves household resilience to agricultural drought. Farmers with access to credit can purchase enough feed and medication for their livestock, thereby improving their resilience to agricultural drought. These findings imply that farming households with access to credit or assistance from other institutions, such as agricultural private organizations or banks, are more likely to improve their resilience to agricultural drought than farming households without access to credit or any other form of credit. It is concerning, therefore, that the majority of farmers in this study lack access to credit facilities, making them vulnerable to climatic shocks such as droughts, which could negatively impact their food security.

Water remains a vital resource for farming, with small-scale farmers in the study areas facing considerable limitations in their access to water sources. Only 14% of the respondents had access to water through boreholes, while 39% collected water from dams. This suggests that these

livestock farmers are still vulnerable to drought conditions and may be adversely affected by any future droughts. The farmers from the focus groups reported that water sources, except for boreholes, were closely monitored by water user authorities, such as commercial farmers with private property, and that farmers had to pay to obtain and use water from dams.

Although boreholes were available to respondents, not all of the farms' boreholes were operational. Respondents reported that they were forced to transport water from their households to the farm, which resulted in additional production costs (due to the petrol used for transportation). This increase in costs for livestock farmers made it even more challenging for them to manage during periods of drought (Matlou et al., 2021).

Each drought event has a visible impact on East Africa's economy, poses threats to lives, and degrades the natural environment. As an example, recent drought episodes of 2010/2011 and 2016 created a food shortage for over 10 million people, leading to the loss of lives and livelihoods (Uhe et al.,2017). Haile et al. (2020a,) reported increased drought frequencies in Eritrea, parts of Ethiopia, South Sudan, Sudan, and Tanzania, while Rwanda, Burundi, and parts of Uganda experienced smaller droughts in the second half of the twentieth century. The study also reported that a longer-time scale drought persisted longer than the short-timescale droughts. Future projections of drought also paint a grim picture, as drought events are likely to increase by 16%, 36%, and 54% under the low, medium, and high emission scenarios, while extreme droughts are expected to cover a larger area (Haile et al.2020a, b; Tan et al.,2020).

The elevated cost of water has rendered small-scale farmers in the Western Cape, South Africa, particularly susceptible to the adverse effects of drought. During periods of drought, the availability of water becomes scarce due to low rainfall, depleted rivers, and the reduction in water supply to the agricultural sector by the authorities. This poses a significant challenge to small-scale farmers, as they are unable to sustain agricultural production without an adequate water supply. A study conducted by Mnyaka (2018) found that many small-scale farmers in the Western Cape were forced to abandon their farming activities due to a limited water supply. As a result, farmers were compelled to discontinue agricultural production and seek alternative sources of income to support their families. This was particularly evident in the Worcester-Roodewal-Donderhoek (WCD) region, where several young and successful farmers were forced to relinquish their agricultural

pursuits. One of the longest-standing farmers in the district was forced to relocate as he was no longer able to cope with the recurring droughts.

The focus group respondents and key informants underscored the scarcity of resources, infrastructure, tools, and machines essential to cope with droughts and natural disasters. According to the farmers, many droughts prediction, preparedness, and mitigation methods require equipment and infrastructure that is not readily available to them, hindering their ability to implement certain practices effectively. Vetter (2020) and Martin (2016) have reported that predicting the timing, duration, and magnitude of drought remains difficult, and the magnitude of livestock losses and livelihood impacts are also contingent on other climatic, ecological, and socio-economic factors (Vetter 2020). The complexity of factors contributing to drought impacts renders it challenging for livestock farmers and their support systems to anticipate and prepare for droughts (Martin et al. 2016). Most farmers resort to utilizing indigenous knowledge and traditional skills and strategies to cope with droughts. Given this, it is worth exploring ways to incorporate indigenous knowledge into scientific knowledge to bridge the gap between these domains. Connolly et al. (2016) emphasized that "weak institutional support can have devastating consequences for people's food security and livelihoods."

Livestock farmers have emphasized the importance of training and education for farmers in various aspects of drought preparedness and management. This encompasses training on livestock medication, water harvesting and storage, weather forecasting, understanding droughts, and soil erosion prevention. Farmers' education and training are seen as crucial tools for improving their ability to cope with droughts. However, there is a concern about the lack of education among farmers, which is apathy towards informational assistance. This was revealed through interviews and focus groups, where farmers tended to be apathetic towards formal classes or informational assistance, which may impact their ability to access valuable knowledge and skills. As such, the agricultural organization of the state and other stakeholders must devise innovative and novel ideas for teaching and engaging with farmers regarding drought preparedness and mitigation.

4.5 Livestock farmers' drought management skills

Table 4.6 data provides valuable insights into the skills and responses employed by small-scale farmers when facing agricultural drought. Understanding how farmers manage and mitigate the

impacts of drought is crucial for developing effective strategies to enhance their resilience in drought-prone regions.

Table 4.5: Farmers' agricultural drought management and mitigation skills/response

Drought management skill/response	**Frequency**	**Percentage**
Rotational grazing (moving livestock to better pastures)	134	89
Water storage	66	44
Drilled a borehole	14	14
Applied for funding	18	12
Collect water from the dam	59	39
Destocking	86	57
No action	99	66

The most prominent trend in the data is the high utilization of rotational grazing as a drought management skill or response. A significant 89% of respondents reported employing this practice. Rotational grazing involves the systematic movement of livestock to different pastures, a practice deeply rooted in indigenous knowledge systems (IKS). This traditional approach serves to safeguard land health, allowing it to recover and regenerate, ultimately preserving the long-term viability of pastures. Movement of livestock to areas with better grazing and purchasing livestock feed can help farmers cope with drought (Mothapo, 2020).

Moreover, the statement underscores the proactive stance of farmers in managing their livestock during times of scarce forage, which is a testament to their acute awareness of sustainable grazing practices. This awareness aligns with IKS, where traditional knowledge passed down through generations has often emphasized the importance of balanced land use and its role in livestock management. The use of natural grazing with supplementary lick, such as mineral licks and salt blocks, to compensate for nutrient deficiencies during droughts also reflects indigenous wisdom in adapting to challenging environmental conditions. These findings further confirm studies such as that of Bukhosini and Moyo (2023), which concluded that small-scale farmers move livestock to better grazing areas, change grazing lands, and purchase livestock supplements as some of their drought adaptation strategies. In essence, the crucial role of indigenous wisdom in fostering sustainable agricultural practices, maintaining land health, and ensuring the livelihoods of local

communities. It underscores the importance of recognizing and respecting the ancestral knowledge that has guided these practices for generations.

Indigenous knowledge systems have, for centuries, been deeply intertwined with local ecosystems and their responses to adverse conditions. This deep connection to the environment allows indigenous communities to make informed decisions about resource utilization. The reference to the diversification of natural grazing capabilities in different locations aligns with the core tenets of IKS, where in-depth knowledge of local ecosystems enables sustainable resource use, which is essential for cattle production. In KwaZulu-Natal, SA, recent studies indicate that small-scale farmers highly depend on indigenous knowledge such as livestock movement practices to respond to drought (Makhado et al., 2014; Masinde, 2015). Small-scale farmers in the Free State and Eastern Cape provinces use indigenous knowledge systems to forecast drought by observing the size and shape of the moon, the behaviour of birds, animals, and reptiles, and daily weather patterns. This strategy is primarily used in deep rural areas to understand current and upcoming weather events. The behaviour of animals and the shape of the moon can also be used to indicate the extent or the expected impacts of drought (Bukhosini & Moyo, 2023).

Furthermore, studies show that indigenous knowledge systems are a vital component of measuring and predicting the future impacts of natural disasters among small-scale farmers (Makhado et al., 2014; Masinde, 2015). These indicators include assessing variations in the timing and sound of winds, the quality and appearance of fur on livestock, the appearance of termites and their mounds, the appearance of certain species of birds and the colour of their feathers, the absence of molehills, the flowering of certain trees, the appearance and size of stars, and higher than normal temperatures (Bukhosini & Moyo, 2023). Local farmers in SA and Kenya employed indigenous knowledge to forecast seasonal weather and precipitation patterns, figure out the direction and speed of the wind, safeguard grains for planting purposes, and put in place various traditional farming support systems to reduce the adverse impacts of climate change on their farming operations (Apraku et al., 2021).

Higher rainfall areas can diversify their farming enterprises by including a field crop as a production enterprise to reduce production risk. The precise extensive feeding system used during periods of severe drought will thus differ between provinces, as well as between different areas within the same province, but it ultimately boils down to two systems: extensive natural grazing

with supplementary licks, or a system in which additional feed or a full feed ration is supplied because natural grazing is insufficient (Mare et al., 2018).

Approximately 44% of respondents indicated that they utilize water storage as a drought management technique. This practice involves collecting and storing water during times of abundance for use during droughts. Adequate water storage is vital for ensuring a consistent water supply for both crops and livestock during dry spells. This response signifies a level of preparedness among farmers who recognize the importance of securing water resources, which are critical for agricultural sustainability.

A smaller percentage of farmers, 14% and 12% respectively, reported drilling boreholes and applying for funding as drought management actions. Drilling boreholes can provide a reliable source of water, reducing dependence on external water sources. Applying for funding suggests that some farmers seek financial assistance to cope with drought-related challenges, indicating an awareness of available support mechanisms. These responses show that a portion of farmers are exploring alternative water sources and financial aid to bolster their resilience during droughts.

Thirty-nine percent of respondents reported collecting water from dams as a drought management strategy. This method is reliant on available water bodies and may be a short-term solution during dry periods. It demonstrates farmers' adaptability in accessing water resources when traditional sources are inadequate. However, it also highlights the challenges posed by water scarcity, as farmers need to resort to unconventional methods to secure water for their agricultural activities.

Fifty-seven percent of farmers mentioned destocking as a response to agricultural drought. Destocking involves reducing the number of livestock to match available forage and water resources. This practice prevents overgrazing and helps preserve the health and well-being of the remaining animals. It also aligns with sustainable livestock management practices during drought conditions. This may be an indication of farmers having no plan to cope with drought. Farmers also cooperated through a stokvel to raise money and support each other during droughts. A farmer from the focus group stated that they sold all their livestock to avoid a 100% loss of their herds. These findings confirm studies such as that of Mohmmed et al. (2018), which established that small-scale farmers switch from farming to non-farming activities during drought (Mohmmed et al., 2018).

Perhaps the most concerning aspect of the data is the high percentage (66%) of farmers who reported taking no action in response to agricultural drought. This could indicate a lack of awareness, resources, or access to effective drought management strategies. It may also reflect the challenges faced by farmers in making informed decisions during drought periods.

The data reveals a range of responses employed by small-scale farmers to manage and mitigate the impacts of agricultural drought. While some farmers exhibit proactive measures like rotational grazing, water storage, and borehole drilling, a significant portion still struggles to take effective action or access necessary resources. To enhance the resilience of small-scale farmers, there is a need for increased support, education, and awareness programs that empower them with a wider array of drought management skills and resources. These efforts should aim to improve preparedness, reduce vulnerabilities, and ultimately enable farmers to navigate the challenges posed by agricultural drought more effectively.

In addition to the findings of this study, other adaptation skills comprised acquiring water from the municipality, buying water for basic human needs and for livestock to drink, applying for and accessing funding to cover drought expenses, selling livestock at cheaper prices, crop variation, using pump engines, and travelling long distances to fetch water.

One of the main methods farmers use to protect their pastures and soils during droughts is planting more crops and other types of vegetation because this method is affordable and requires less technicality. Farmers use manure for fertilisation, crop planting to cover soil, and providing feed for cattle. Livestock farmers also use private organisations as a safety net to manage and prepare for drought. For example, a key informant from the interviews stated that the Wildland's Nature Reserve organisation helps to protect the soil through the controlled burning of grass and the use of herbicides for vegetation control. The quote below illustrates the collaboration between small-scale farmers and other private organizations to cope with and prepare for droughts.

"With the assistance of the Wildland's nature reserve organization, we were able to protect the soil by burning the grass while it was wet, we used herbicides to burn some areas of vegetation which allowed us to control the fire."

Moreover, farmers move their livestock to other areas to minimise overgrazing and damage to the soil and to increase the availability of plant biodiversity. This decreases soil moisture loss and

improves plant biodiversity. Drought damage will be reduced if the plants are in good health. Irrigation on planted pastures can help to cope with drought, but as an alternate form of mitigation, the difficulty is that water sources are few in many locations (Mothapo, 2020).

Table 4.6: Summary of the drought and agricultural management skills that farmers possess.

Key skills	Discussion
Grazing management skills	Relocating livestock to other less affected pastures to avoid overgrazing. Burning pastures in a controlled method Use of herbicides and pesticides to protect and control vegetation.
Water management skills	Collecting water from dams and rivers with tractors, vans and wheelbarrows Storing water in tanks Use of traditional knowledge such as observing the moon to predict rainfall and water availability. Dig wells
Business management skills	Farmers decide to sell their livestock as a financial management strategy during drought. Collaboration with conservation organisations and NGOs to cope manage drought. Adopting a method of raising money called a Stokvel. Farmers raise money by collectively contributing monetarily.
Livestock management skills	Destocking by selling livestock. Self-made bales used to feed livestock. Buying drought resilient breed of livestock Move cattle and other livestock to less distressed land.
Soil management skills	Farmers plant crops as a method of covering and protecting the soil from degradation. Planting drought-resistant crops to protect the soil. Alien invasive removal programme.

4.6 Importance of knowledge and skills possession by livestock farmers

Figure 4.4, 50% of the farmers reported that it is extremely important for farmers and professionals such as extension officers to have the necessary skills and knowledge to prepare for and mitigate the impacts of drought, while 36.7% stated that it is very important, 2% were neutral on the matter, 10% said it is somewhat important and only 1.3% said it is not important. This is a matter of

concern because the results show that there is a disconnect between the extension officers and the livestock farmers that needs to be addressed. This further suggests that more research needs to be conducted on the competitiveness of key professionals such as extension officers in the agricultural sector and the methods used to share information by extension officers.

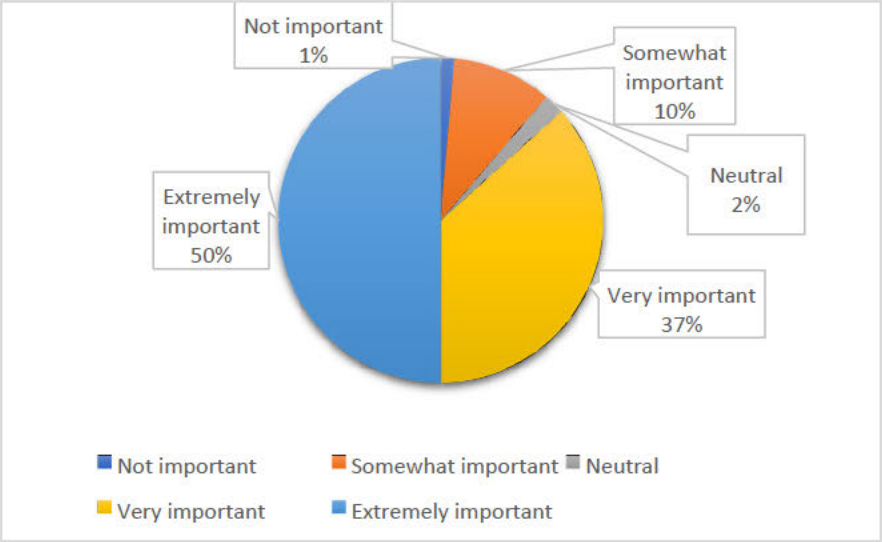

Figure 4.4: Importance of knowledge and skills possession by farmers and professionals in the agricultural sector

Figure 4.5 showcases the level of confidence that farmers have with regard to their ability to prepare for and mitigate the impacts of droughts. Forty-four percent of the livestock farmers reported that they are not at all confident in their ability to prepare and cope with droughts, 9% stated that they are confident, 33.3% were neutral (not sure), 4.7% said they are moderately confident and 9.3% affirmed that they are very confident in their ability to cope with droughts.

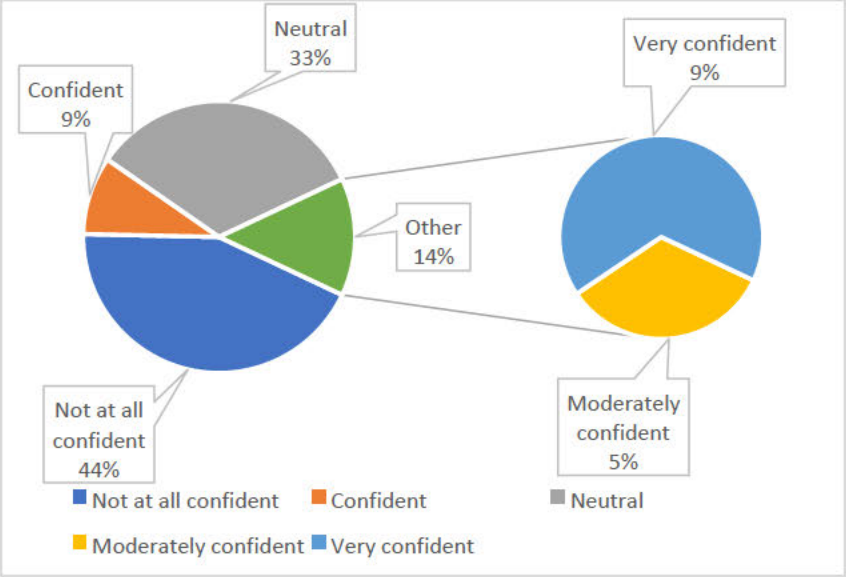

Figure 4.5: Level of confidence of farmers in their ability to prepare and cope with droughts.

The pie chart provides a snapshot of the level of confidence among small-scale farmers in their ability to prepare for and cope with droughts. This data offers valuable insights into the psychological and emotional aspects of how these farmers perceive and approach the daunting challenge of drought.

The most notable trend that emerges from the data is the prevalent lack of confidence among a significant portion of small-scale farmers when it comes to dealing with droughts. Specifically, a striking 44% of respondents reported that they are "Not at all confident" in their capacity to face droughts, while an additional 33% indicated that they feel "Neutral" about their preparedness. This combined percentage of 77% signifies a substantial cohort of farmers who either harbour doubts or remain uncertain about their ability to grapple with the impacts of drought.

Conversely, the data also sheds light on a smaller yet noteworthy segment of farmers who exude confidence. Nine percent of respondents stated that they are "Confident," while another 9% expressed being "Very confident" in their ability to manage drought. A minor proportion, constituting 5%, falls into the category of "Moderately confident."

The high percentage of farmers expressing low confidence or neutrality in their preparedness for and ability to cope with droughts suggests a prevailing sense of vulnerability and apprehension within this group. These sentiments might be rooted in past experiences dealing with drought

related challenges, limited access to essential resources, and the uphill battle to secure their livelihoods during these climatic events.

On the other hand, the presence of farmers who report confidence (9%) and strong confidence (9%) in their ability to handle drought could be attributed to various factors. These farmers may have benefited from prior experiences where their drought management strategies proved successful, or they may have better access to resources and support networks. Additionally, a positive outlook and a willingness to adapt could be driving their higher confidence levels.

Addressing the issue of low confidence among small-scale farmers requires a comprehensive approach. This includes education and training initiatives that equip farmers with the knowledge and skills needed to effectively prepare for and navigate droughts. Such programs should focus on sustainable farming practices, risk mitigation strategies, and guidance on how to access available resources.

Moreover, ensuring that farmers have access to vital resources like drought-resistant seeds, financial assistance, and livestock feed is essential for boosting their preparedness and self-assurance (McCarthy, 2021). These resources can play a pivotal role in helping farmers weather the challenges posed by drought. Effective communication channels for weather forecasts, early warning systems, and drought-related information can empower farmers to make informed decisions. Access to timely and relevant information is pivotal in bolstering their confidence and enabling them to take proactive measures in response to changing weather patterns (Muthelo et al., 2019).

According to Odubote & Ajayi (2019), to protect the livelihoods of smallholder farming households, particularly women and youth, it is necessary to minimize their exposure to climate change risks. This can be achieved through the promotion of Climate-Smart Agriculture (CSA) practices. Some specific measures that can be taken include improving smallholder farmers' access to stress tolerant maize seeds, providing them with weather and agronomic information, and increasing their uptake of weather index insurance through private sector investment. Additionally, promoting diversified livelihood opportunities for farmers through integrated crop-livestock farming systems can also be beneficial. These actions aim to reduce the vulnerability of smallholder farmers and ensure the sustainability and resilience of their farming practices (Odubote & Ajayi, 2019).

Recognizing and addressing the psychological impact of recurrent droughts is equally important. Building resilience among farmers and providing emotional support can enhance their overall confidence and mental well-being. This holistic approach acknowledges the emotional toll that drought can take on individuals and communities (Lester et al., 2022). Economic factors that affect social outcomes indirectly encompass challenges such as reduced productivity due to hardship and stress, declining population, social connections being disrupted, services lost within the community, and the emotional impact of witnessing damage to livestock, crops, soil, and natural vegetation (Edwards et al., 2019). Severe weather occurrences like droughts can harm both physical and social health. They lead to immediate loss and trauma, worsen pre-existing mental health problems, disrupt livelihoods, impact finances, employment, and income, result in lasting trauma after the event, and create uncertainty and worry about the future. (Lansbury Hall & Crosby, 2022).

The data underscores a pressing need to empower small-scale farmers in drought-prone regions, not only through the provision of practical resources but also by addressing the knowledge gap and the emotional impact of drought. By fostering confidence among farmers and equipping them with the tools needed to prepare for and withstand droughts, we can cultivate more resilient farming communities capable of navigating the challenges posed by climate variability**.**

4.7 Farmer's drought management training needs

Figure 4.6 presents a clear trend regarding the training received by small-scale farmers in the context of drought preparedness and mitigation. Understanding the distribution of training among farmers is essential for evaluating their capacity to cope with the challenges posed by agricultural drought.

4.7.1 Training in drought preparedness and mitigation

Figure 4.6: The percentage of farmers who have received and have never received training regarding drought preparedness and mitigation.

The data shows that a substantial majority of small-scale farmers, constituting 65% of the respondents, have never received training regarding drought preparedness and mitigation. In contrast, 35% of the farmers have received such training. Training can be seen as an aspect that could contribute to farmer development (Bastian et al., 2019).

The pie chart illustrating the percentage of small-scale farmers who have received training in drought preparedness and mitigation presents a stark picture of the current state of knowledge and skill development within this community. The predominant trend is that 65% of the respondents have never received any training in these crucial areas, while the remaining 35% have had the opportunity to receive such training to cope with droughts and other natural disasters.

The data suggests that a significant portion of small-scale farmers, representing the majority, lack the formal knowledge and skills required to effectively prepare for, respond to, and mitigate the impacts of agricultural drought. This is a concerning trend because drought is a recurring and often devastating natural phenomenon in many regions, posing a significant threat to agricultural livelihoods. The farmers voiced out the absence of training provided by organisations and

extension officers specifically for droughts and drought management as one of the reasons why they have not received training. Numerous reasons contribute to the low ability of livestock farmers to adapt to drought, including lack of access to financial resources, lack of knowledge and managerial skills, and poor extension support (Bahta et al., 2016).

On the other hand, the 35% of farmers who have received training in drought preparedness and mitigation represent a positive aspect of the data. It indicates that there are existing initiatives or programs aimed at equipping farmers with the necessary knowledge and strategies to cope with drought. These trained farmers are likely to be better equipped to implement drought management practices, make informed decisions during dry periods, and potentially reduce their vulnerability to drought-related losses. The data on training received by small-scale farmers in the context of drought preparedness and mitigation prompts several important discussions and considerations. Firstly, the substantial majority of farmers without training underlines the urgent need to expand and improve training opportunities for this vulnerable group. Drought can have severe and far-reaching impacts on agriculture, affecting crop yields, livestock, and overall food security (Gebremeskel, 2019).

Without adequate training, farmers may struggle to implement best practices for water conservation, sustainable farming, and livestock management during dry periods. Therefore, there is a critical role for governments, non-governmental organizations, and agricultural extension services in developing and delivering accessible and relevant training programs (Myeni 2019). Secondly, the data emphasizes the potential benefits of training in enhancing the resilience of small-scale farmers. Training equips farmers with valuable knowledge and skills that can empower them to take proactive measures to mitigate the effects of drought. These measures may include implementing efficient irrigation systems, practicing soil conservation, diversifying income sources, and financial planning to weather periods of low agricultural productivity. Dawit and Balta (2015), who conducted a study in Ethiopia found that merely offering irrigation facilities to rural households does not ensure a decrease in poverty and food insecurity. Alongside irrigation, creating a supportive socio-economic environment, which includes access to roads, markets, credit, training, and information about innovations, is essential. Providing these resources to impoverished farmers encourages their involvement in small-scale irrigation farming, effectively reducing long-standing food insecurity and poverty. Therefore, investing in training can enhance

agricultural productivity and minimize vulnerability to losses caused by drought (Dawit & Balta, 2015).

Furthermore, partnerships and collaborative efforts among various stakeholders are essential to develop and implement effective training initiatives. These programs should be tailored to the specific needs and contexts of small-scale farmers in drought-prone regions. They should also consider reaching farmers in remote or marginalized areas, ensuring inclusivity and equitable access to knowledge and skills (Savari, 2022).

This finding implies that the contribution of all stakeholders in water resources management is clear to policymakers. The farmers' participation and water resources' users' contribution, as the main consumers of water resources, in the decisions of this sector is considered vital, as well (Savari, 2021). Farmers' participation in capacity-building and drought management projects will lead to the integration of indigenous and modern knowledge (Savari, 2021), which, in turn, will enable the effective use of drought management strategies. Lack of participation of local people and users reduces the effectiveness of relevant projects (Ho et al., 202), while their participation can lead to better decisions being made, distrust being reduced (Savari, 2022), users feeling more ownership, and the impacts of programs and interventions being increased. Participation in the exploitation, restoration, and conservation of natural resources and protection of natural areas is of great importance (Savari, 2022).

Creating awareness among farmers about the importance of training is another critical aspect. Farmers who have undergone training can serve as advocates for the value of such programs, encouraging others to participate. Additionally, it is essential to address potential barriers, such as limited resources or logistical challenges, that may hinder farmers from accessing training opportunities (Clausen et al., 2021).

The data underscores the training gap among small-scale farmers regarding drought preparedness and mitigation. Bridging this gap through well-designed, accessible, and targeted training programs is crucial for enhancing the resilience of farmers in drought-prone regions and mitigating the adverse impacts of agricultural drought on their livelihoods. Ultimately, investment in training can contribute to building more sustainable and resilient agricultural communities, better prepared to face the challenges of an increasingly uncertain climate.

4.7.2 Farmers' satisfaction with previous agricultural management training

In the examination of the findings related to farmers' levels of satisfaction with previous agricultural management training, valuable insights are gained into the effectiveness of educational programs designed to enhance farming practices. Such training initiatives play a pivotal role in equipping farmers with the knowledge and skills necessary to adapt to evolving agricultural landscapes and challenges. This discussion delves into the feedback and sentiments expressed by farmers regarding their experiences with agricultural management training. By assessing their satisfaction levels, important perspectives on the quality, relevance, and impact of these programs can be gleaned, ultimately contributing to a more informed and nuanced understanding of the role of education in sustainable farming practices and its implications for agricultural communities and food security.

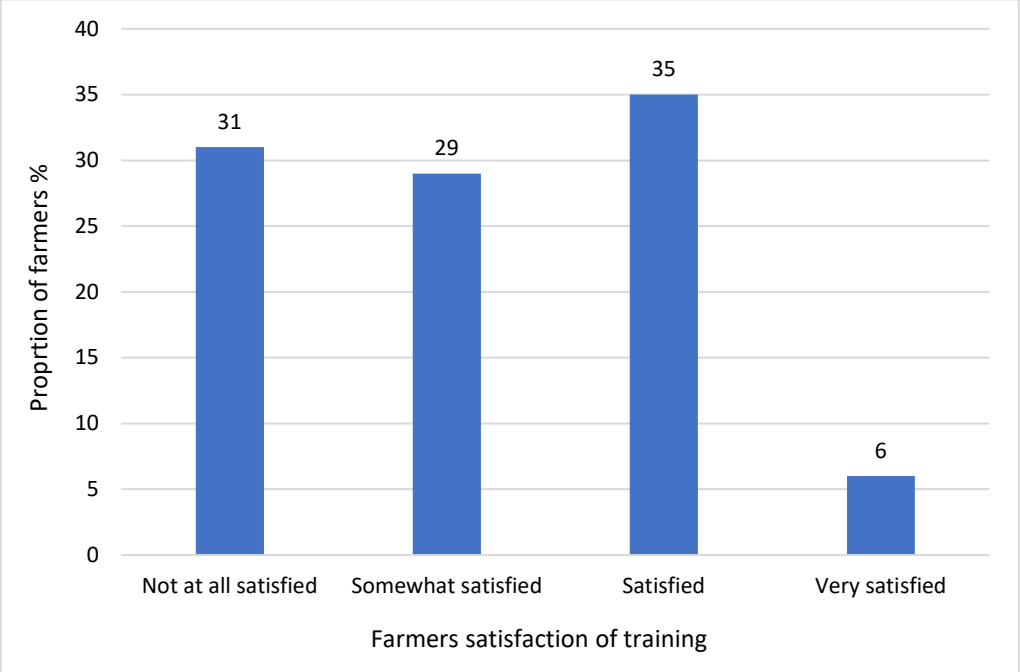

Figure 4.7: Level of farmer's satisfaction with previous agricultural management training

The bar chart illustrating the level of farmers' satisfaction with previous agricultural management training reveals a mixed but generally positive response from the surveyed small-scale farmers. The data reflects varying degrees of satisfaction, with the majority falling into the categories of "Satisfied" (35%) and "Not at all satisfied" (31%). Additionally, a substantial proportion indicated being "Somewhat satisfied" (29%), while a smaller fraction expressed being "Very satisfied" (6%) with the training they received.

The bar chart depicting the level of farmers' satisfaction with previous agricultural management training provides valuable insights into the effectiveness of training programs within the smallscale farming community. The data reveals a mixed landscape of satisfaction levels, with each category reflecting different perceptions and experiences among the surveyed farmers.

A notable proportion of small-scale farmers, namely 35% who fall into the category of "Satisfied" and 6% who are "Very satisfied," indicates that a substantial number of those who have received training have found it to be beneficial and valuable for their agricultural endeavours. It is encouraging to see that some training programs have been successful in meeting the needs and expectations of farmers, equipping them with practical knowledge and skills that are perceived as valuable for their farming practices. These satisfied farmers are likely to have gained insights that contributed to their resilience in the face of challenges such as drought.

While the majority of farmers were satisfied with the training received previously, the overall findings of the study suggest that these pieces of training were not enough for farmers to cope with droughts. In fact, most farmers did not have a drought management plan, indicating a need for further training in this area. Livestock farmers, in particular, require a considerable amount of training to better prepare and cope with unfavourable climatic conditions. These findings are consistent with those of Goni et al., (2018) who found that small-scale commercial farmers who have received agricultural training are more likely to have better exposure and understanding of new and improved agriculture management and production information than subsistence farmers.

Overall, while the results of the study suggest that training programs have been successful in equipping farmers with practical knowledge and skills, there is still a need for further training to help farmers better prepare and cope with droughts. These findings highlight the importance of ongoing support and training for small-scale farmers, particularly in the context of climate change and changing weather patterns. On the contrary, the fact that 31% of farmers expressed being "Not at all satisfied" with their training experiences raises important concerns. This dissatisfaction signals potential issues with training content, delivery methods, relevance to farmers' specific needs, or accessibility. It is essential to delve deeper into the reasons behind this dissatisfaction to identify areas for improvement in training initiatives. By addressing these shortcomings, it is possible to enhance the overall quality and impact of agricultural management training.

The middle ground represented by the "Somewhat satisfied" category (29%) suggests that a significant number of farmers had a moderately positive experience with their training. While they may have gained some knowledge and skills, there remains room for improvement in terms of training quality, coverage, or relevance. These findings emphasize the need for continuous efforts to refine and tailor training programs to better serve the diverse needs of small-scale farmers. However, climate change has negatively affected rural smallholder farming due to overdependence on climate sensitive rain-fed agriculture. The effects of climate change have become the most critical issue for rural smallholder farmers. Rural smallholder farmers are greatly impacted by climate change and variability, leading to reduced crop yields, crop failure, loss of assets and livelihood opportunities. To address these challenges, Ubisi recommends the use of reliable weather forecasts at the local level to guide farmers' decision-making. Further suggesting the need for efficiently documenting indigenous knowledge and creating a framework to integrate this knowledge with traditional weather forecasting systems. Another important recommendation is the establishment of an information dissemination network for weather forecasting within local municipalities. The integration of both knowledge systems is seen as crucial for farmers to make informed decisions and achieve household food security (Ubisi, 2020).

To elevate the satisfaction levels of small-scale farmers with agricultural management training, several critical considerations come to the forefront. Firstly, training programs should be tailored to the unique needs and contexts of farmers in different regions, particularly those facing the challenges of drought and climate variability. Customization ensures that training aligns with practical, on-the-ground challenges and offers actionable solutions. This could involve providing targeted education programs that focus on specific farming practices and techniques that are effective in drought-prone areas. It may also involve incorporating traditional knowledge and practices into formal education programmes to ensure a holistic approach to drought adaptation.

Moreover, the relevance of training content is paramount. It is essential that training materials address the specific issues and concerns farmers encounter in their agricultural practices, with a particular focus on drought preparedness and mitigation. This ensures that farmers leave training sessions equipped with actionable insights to address real-world challenges effectively.

Accessibility is another crucial factor. Efforts should be made to ensure that training is accessible to all farmers, regardless of their geographical location or socioeconomic status. This may entail addressing logistical barriers and making training resources available in various formats, including digital and offline resources.

Establishing feedback mechanisms is vital to gather input from farmers regarding their training experiences. This enables program organizers to identify areas for improvement and refine training programs based on direct input from participants.

Recognizing that learning is an ongoing process, training programs should consider offering follow-up sessions, updates, and opportunities for farmers to deepen their knowledge and skills over time. Continuous learning and skill development empower farmers to adapt to evolving challenges effectively.

Lastly, promoting peer-to-peer learning and knowledge-sharing among farmers can complement formal training programs. Farmers often learn best from their peers who face similar challenges, and fostering a culture of collaborative learning can enhance the practicality of acquired skills.

While there is a range of satisfaction levels among small-scale farmers with their previous agricultural management training, it is evident that training plays a pivotal role in building their resilience to drought and other agricultural challenges. Addressing the factors contributing to both satisfaction and dissatisfaction is crucial to ensuring that training programs effectively empower farmers to cope with drought and other climate-related uncertainties. Ultimately, this promotes food security and sustainable agriculture in drought-prone regions.

4.8 Skills that farmers lack with regard to drought management and preparedness

Small-scale farmers face significant challenges in their efforts to mitigate the impacts of drought on their livelihoods. These challenges are multifaceted, encompassing various aspects of farming practices, resource management, and adaptation strategies. This discussion delves into the key areas where farmers encounter skill gaps, providing insights into the critical knowledge and abilities required for effective drought preparedness. It is imperative to address these skill deficiencies, as they have far-reaching consequences not only for the farmers themselves but also

for food security and the overall resilience of agricultural communities in the face of a changing climate.

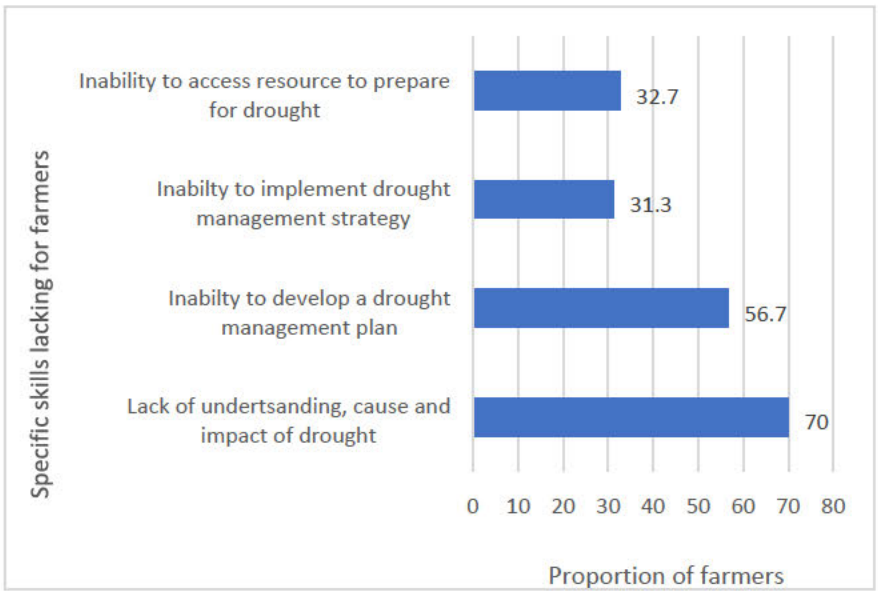

Figure 4.8: Skills that farmers lack with regard to drought management and preparedness

The bar chart figure 4.8 representing the skills that farmers lack concerning drought management and preparedness provides crucial insights into the areas where small-scale farmers face challenges and need support. The data reveals several key trends and areas of concern that require attention to enhance farmers' resilience in the face of drought.

One of the most concerning trends highlighted in the chart is the high percentage of farmers who lack an understanding of the causes and impacts of drought, standing at a staggering 70%. This finding underscores a significant knowledge gap among small-scale farmers regarding the fundamental aspects of drought. Drought is a complex natural phenomenon influenced by various factors, including climate patterns, land management practices, and local conditions. The lack of understanding about these causes and impacts hampers farmers' ability to recognize early warning signs, plan effectively, and implement suitable drought management strategies. Addressing this knowledge gap through education and training programs is paramount for improving farmers' preparedness (Alvalá et al 2019).

Additionally, 56.7% of farmers expressed their inability to develop a drought management plan. This statistic indicates that a substantial portion of farmers may not have access to the necessary

tools, knowledge, or guidance required to formulate comprehensive drought management strategies. Drought management plans are critical for outlining proactive measures, resource allocation, and response mechanisms in anticipation of drought events. The inability to create such plans leaves farmers vulnerable and ill-equipped to tackle drought effectively. To address this challenge, efforts should be directed toward providing farmers with practical guidance and resources for developing customized drought management plans. Farmers' ability to formulate drought preparedness is hampered by a lack of agricultural expertise, increasing their susceptibility to drought (Majaha, 2023).

Another significant concern is the 32.7% of farmers who face difficulties accessing resources to prepare for drought. Drought preparedness often requires investments in infrastructure, technology, and resources such as water storage facilities, irrigation systems, and feed reserves. The inability to access these resources can hinder farmers from implementing effective drought mitigation measures (Marengo et al., 2020). Access to affordable credit and financial support programs is essential to enable farmers to acquire the necessary resources and technologies to build resilience against drought. Collaboration between governmental agencies, financial institutions, and agricultural organizations is essential to facilitate access to these resources (Mogmotsi et al., 2020).

Additionally, 31.3% of farmers indicated that they struggle to implement drought management strategies. This suggests that while some farmers may have knowledge and plans in place, they encounter difficulties translating these strategies into practical actions. Effective implementation of drought management measures involves various factors, including logistical challenges, resource allocation, and timely decision-making. Farmers may benefit from training and support programs that focus on the practical aspects of implementing drought management strategies, including rotational grazing, water storage, and destocking (Owino, 2020).

To address these challenges comprehensively, a multi-faceted approach is required. Educational initiatives should be prioritized to improve farmers' understanding of drought, its causes, and its impacts. Training programs should not only focus on theoretical knowledge but also provide practical guidance on developing drought management plans and executing strategies. Financial institutions and government agencies should collaborate to enhance access to credit and resources,

ensuring that farmers have the means to implement their drought preparedness measures effectively (Savari & Shokati, 2022).

Furthermore, community-level engagement and knowledge-sharing can play a pivotal role in bridging these skill gaps. Experienced farmers who have successfully managed droughts can serve as mentors and share their expertise with others. Extension officers and agricultural support organizations should facilitate such peer-to-peer learning opportunities.

The data presented in the bar chart underscores the critical need to address the knowledge and skill gaps that small-scale farmers face in drought management and preparedness. By improving farmers' understanding of drought, providing guidance on developing management plans, facilitating access to resources, and enhancing implementation capabilities, it is possible to bolster their resilience and reduce the adverse impacts of drought on agriculture and livelihoods. Such efforts are essential for promoting food security and sustainable farming practices in drought-prone regions (Antwi-Angyei & Stringer, 2021).

4.9 Skills required by small-scale livestock farmers for drought preparedness.

Small-scale farmers in the discussion highlighted the importance of various skills for drought preparedness in their livestock livelihood practices, emphasizing the need to treat farming as a business (Khapayi & Celliers, 2016). These skills include insurance for livestock, cost-effective input systems, financial planning, and saving for emergencies. Small-scale farmers typically operate in resource-constrained environments and lack the talents required for successful business management (Tindiwensi et al., 2020). Many farmers in the study reported a lack of resources to cope with droughts, making them vulnerable to natural disasters and affecting food security and their welfare. Hence, training farmers to take a market-oriented approach in livestock farm operations is crucial.

According to the farmers the most important aspect required by farmers is education and knowledge. Farmers stressed the need to be educated and equipped with knowledge about drought preparedness and agricultural management. Education assists with skills such as record-keeping, banking, labour management, and choosing profitable enterprises and production methods. Farmers' training and education are critical, since they contribute to drought preparedness and lessen the effects of drought (Belle et al., 2017).

Livestock farmers also stressed the importance of various livestock management skills, including using adapted breeds, selling livestock, supplementary feeding, improved reproduction methods, water restriction, relocating livestock to better pastures, and medication. These skills are essential for livestock health during droughts. Equipping farmers with additional skills, such as improved reproductive methods and water stress alleviation techniques, can be instrumental in helping small-scale farmers cope with droughts (Majaha, 2023).

Furthermore, livestock farmers highlighted the need for training with regards to managing grazing land. Grazing land management is critical for agricultural productivity. Regularly assessing the land's condition helps maintain optimal stocking rates while preserving forage. Resting pasture and reducing animal numbers to prevent overgrazing are advisable (Nieuwoudt, 2019). Therefore, equipping small-scale livestock farmers with grazing management skills will enhance their resilience towards droughts and agricultural productivity.

Farmers expressed a high demand for training in water management skills, including drilling boreholes, rainwater harvesting, dam construction, and protecting water sources. Water management skills are essential for drought resilience, economic growth, and development, as water is a critical natural resource in agriculture (Nhemachena et al., 2020).

Farmers continued to emphasize training needed with regards to soil management. Soil and crop management during droughts is crucial skill for small-scale livestock farmers as soil plays a crucial role in providing grazing land to the livestock. Soil management skills include minimum tillage, mulching, composting, and intercropping, while crop management skills encompass planting drought-resistant crops, crop rotation, crop diversification, and reducing planted areas (Majaha, 2023). These findings align with previous studies emphasizing the importance of drought management skills for small-scale farmers (Lottering et al., 2021).

The discussion reveals that farmers lacked early warning systems for droughts due to financial constraints. They emphasized the need for training in early warning systems and drought preparedness, lacking confidence in their ability to plan for and implement strategies to cope with droughts (Majaha, 2023). This aligns with previous studies emphasizing the importance of early warning systems for drought management, as they are often costly and challenging for farmers to access and understand (Andersson et al., 2020).

Small-scale farmers require a diverse set of skills for drought preparedness, including business management, education, livestock management, grazing land management, water management, and soil and crop management. Early warning systems are essential but often inaccessible due to financial constraints. Training and education are crucial for equipping farmers with these skills and increasing their resilience against droughts.

4.10 Summary

The study has presented descriptive results which have revealed various socio-economic characteristics of the small-scale livestock farmers community. The community is predominantly composed of elderly individuals, with a low employment status, with the majority of farmers being pensioners and the other majority being unemployed. Furthermore, the participation of women in livestock farming is low, which is expected for a traditional community where cultural beliefs and norms still prevail. Additionally, low educational levels often result in reduced financial adaptive capacity and the ability to understand the drought phenomenon. Moreover, it increases reliance on available resources, such as IKS, to adapt to cope with droughts. The study has also found that IKS can reduce drought risks and enhance the livelihoods of farmers. However, farmers believe that relief and support from the government are vital in mitigating the impacts of droughts on their farming business, yet there is little to no support from state organs to help farmers cope with droughts. Overall, the available help is not sufficient, according to the livestock farmers.

The current drought management system in South Africa is primarily based on ex-post impact management, which is hindered by a lack of financial resources and the limited knowledge and skills possessed by farmers. Farmers were found to have no prior knowledge of droughts and were not adequately prepared to handle them. Furthermore, there is a disconnect between farmers and the extension services with regards to the dissemination of drought-related information, with farmers stating that they have never received any training, information, or knowledge on drought from extension officers.

The drought has had a significant impact on small-scale livestock farmers, resulting in high livestock mortality rates, increased feed costs, decreased water availability and quality, loss of income and jobs, and decreased food security. However, farmers have demonstrated proficiency in drought coping skills, such as rotational grazing, supplementary feeding, and livestock selling.

Despite this, all farmers interviewed had no knowledge of drought early warning systems, drought mitigation monitoring, soil management, business management, and water management.

Key informants, who possessed in-depth indigenous knowledge, livestock management, and supplementary feeding, also demonstrated resilience. However, they too faced challenges, such as forecasting weather, preparing for droughts, and managing water. It is crucial that farmers are trained and equipped with both drought management and agricultural management skills to improve their resilience and ability to handle future droughts.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The study investigated the impacts of droughts and skills gaps on small-scale livestock farmers in KwaZulu-Natal, in the Bergville, Estcourt, and Winterton areas, located in the Okhahlamba Region East of SA. The objectives of the study were to find out the impacts of the 2015-2018 droughts on small-scale livestock farmers, to determine the skills that farmers lack with regard to drought preparedness and mitigation, to identify the training that small-scale livestock farmers need in order to cope with and prepare for droughts.

5.2 Conclusion

The study examined the demographic characteristics of small-scale livestock farmers, particularly focusing on age, education, employment status, marital status, and gender distribution. It highlighted that a significant portion of farmers are aged individuals, with many being retirees from urban areas. The aging population in agriculture poses challenges such as decreased productivity, succession planning issues, and hindered innovation. Furthermore, the lack of youth involvement in agriculture can impact economic growth and food security. The study emphasized the importance of encouraging youth participation in farming through educational initiatives. Additionally, it addressed the impact of marital status on farming activities, showing that married farmers tend to have better resilience during droughts. The data also revealed gender disparities in livestock farming, with the majority of livestock farmers being male. Policymakers are urged to consider these demographic factors when implementing support measures for small-scale farmers affected by climate-related shocks.

Small-scale farmers' perception of drought is crucial in understanding the challenges they face in agriculture, as it impacts their livelihoods significantly. Their perception encompasses not only meteorological aspects but also socio-economic and psychological dimensions, as they heavily rely on rain-fed agriculture and lack resources available to larger operations. Farmers use local knowledge and traditional indicators to predict and respond to drought, such as changes in animal behaviour or plant growth. The data reveals that drought is a common issue among small-scale livestock farmers, with varying durations experienced by respondents. The majority attribute drought to a lack of rain, and farmers receive information about drought from various sources, including news, radio, and local elders. Drought has substantial impacts on livestock farming, with

a high percentage of livestock deaths reported during droughts. Relief efforts and feed supplements are deemed crucial by farmers in coping with drought effects, but there is room for improvement in providing resources and support for drought preparedness.

Droughts have severe economic and social impacts on small-scale farmers in KwaZulu-Natal, South Africa, leading to job losses, bankruptcy, and reduced livestock productivity. The lack of rainfall affects pasture regeneration, increases livestock mortality, and exacerbates conflicts over shared resources. Drought also contributes to land degradation, reduced vegetation cover, decreased feed availability, and compromised water quality and availability for farmers. These challenges highlight the urgent need for targeted interventions to address the immediate and long-term consequences of drought on small-scale livestock farming in the region. The study emphasizes the importance of addressing the skills gap among farmers to implement sustainable practices and mitigate the effects of drought on agriculture and livelihoods.

Livestock farmers face severe challenges during drought events, as indicated by data showing increased disease attacks, rise in mortality, poor animal health, decrease in fertility, and reduced productivity. Drought conditions create adverse effects such as water scarcity, poor forage availability, and higher disease risks, impacting livestock significantly. To address these challenges, farmers must implement strategies like providing supplementary feed and water, enhancing disease prevention measures, and improving overall herd health management. Governmental and agricultural support systems are also crucial in helping farmers cope with drought challenges. Drought-induced livestock hardships lead to economic losses and affect income sources, with examples from South Africa showing significant declines in agricultural production and livestock mortality rates during drought periods. Implementing effective drought management strategies is essential to mitigate the impacts on livestock health and productivity.

The data presented in the study reveals the significant challenges faced by small-scale livestock farmers, including lack of access to water, high feed costs, and limited knowledge. These challenges intersect with the impacts of droughts on South African farmers, exacerbating issues such as water scarcity and high feed costs. Access to credit is crucial for farmers' resilience during droughts, but many lacks such access. Water access remains limited for farmers, with some resorting to sources like boreholes with operational challenges. Droughts have severe economic and environmental impacts in East Africa and are projected to increase in frequency and severity.

The scarcity of resources and infrastructure hampers farmers' abilities to cope with droughts effectively. Training and education on drought preparedness are essential, but there are concerns about farmers' apathy towards formal education. Policymakers need to consider targeted interventions to support farmers and promote industry growth while addressing challenges related to drought and climate change.

The study discusses the key trend of utilizing rotational grazing for drought management among small-scale farmers, emphasizing its indigenous roots in sustainable land practices. It mentions the application of traditional knowledge systems in livestock management, such as using natural grazing and supplementary lick during droughts. Indigenous knowledge also factors into predicting weather events and adapting farming practices to climate change impacts. The text highlights various drought management strategies like water storage, borehole drilling, and destocking, along with challenges faced by farmers in accessing resources and acting during drought. The need for increased support and education programs to enhance farmers' resilience and preparedness for agricultural drought emerges as a key takeaway from the text.

The study discusses farmers' perspectives on their preparedness and confidence in dealing with drought in the agricultural sector. It highlights concerns about the disconnect between extension officers and farmers, emphasizing the need for more research. The data shows a significant lack of confidence among farmers, with 77% feeling uncertain or lacking confidence in facing drought impacts. However, there is also a smaller group expressing confidence, possibly due to past successful experiences or better access to resources. Recommendations include education, training, access to resources, and promoting Climate-Smart Agriculture for enhancing farmers' resilience. Addressing the psychological impact of droughts is crucial for overall well-being. Ultimately, empowering farmers with knowledge and resources can build more resilient farming communities to tackle climate challenges effectively.

The study examines the satisfaction levels of small-scale farmers with previous agricultural management training. Feedback from farmers provides insights into the effectiveness of these programs in enhancing farming practices and resilience to challenges like drought. The data indicates varying levels of satisfaction, with 35% satisfied, 31% not satisfied, and 29% somewhat satisfied. While some farmers found the training beneficial, there is a need for further education on drought management, especially for livestock farmers. Recommendations include tailor-made

training programs, addressing climate change impacts, and integrating indigenous knowledge for improved preparedness. Accessible, tailored, and ongoing training, along with peer-to-peer learning, are essential to enhancing farmers' skills and resilience to cope with agricultural challenges in drought-prone regions.

Small-scale farmers encounter challenges in mitigating drought impacts due to skill gaps in drought management. Key areas of concern include farmers lacking understanding of drought causes and impacts, inability to develop management plans, difficulties accessing resources, and struggling to implement strategies. Addressing these challenges requires educational initiatives, training programs, financial support for resource access, and community-level engagement. By improving knowledge, providing guidance, enhancing resources, and building implementation capabilities, farmers' resilience against drought can be strengthened, promoting food security and sustainable farming practices.

Small-scale farmers highlighted the importance of skills for drought preparedness in livestock livelihood practices, emphasizing treating farming as a business. These skills include insurance for livestock, cost-effective input systems, financial planning, and education in agricultural management. Farmers also stressed the need for training in livestock management, grazing land management, water management, and soil and crop management to cope with droughts. Lack of resources and early warning systems for droughts were identified as challenges, indicating the necessity for education and skills training to enhance farmers' resilience against droughts. Overall, a diverse set of skills and knowledge is needed to help small-scale farmers prepare for and mitigate the impacts of droughts.

The data presented highlights a significant training gap among small-scale farmers in drought preparedness and mitigation, with 65% of respondents never having received training in these crucial areas. Lack of training poses a concern as droughts can have devastating effects on agricultural livelihoods. On the positive side, 35% of farmers have received training, indicating existing initiatives to equip farmers with necessary knowledge. The data emphasizes the urgent need to expand and improve training opportunities for vulnerable farmers to enhance their resilience. Collaborative efforts among stakeholders and tailored training programs are key to addressing this training gap and building more sustainable and resilient agricultural communities.

Ultimately, investing in training can help farmers better cope with the challenges of an uncertain climate.

All farmers emphasised the lack of preparedness for droughts as a major factor contributing to the detrimental impacts on their livestock farming business. Exacerbating the negativity of the effects of droughts was the sudden occurrence of the drought. According to the farmers, there were no drought early warning systems in place to forecast the approaching droughts. The major drought management skills required by farmers were drought monitoring and early warning systems, water management, soil management, crop management, grazing/rangeland management, business management, and knowledge about the drought phenomenon as a whole. Farmers fail to access timely and comprehensive weather forecasts, resulting in annual crop and livestock losses, as decision-making is compromised. Given that the small-scale farming system sustains the bulk of the population in KwaZulu-Natal East of SA, climate education and capital investment are needed to change small-scale livestock farmers' perceptions about drought impacts on farming practices. Increased climate awareness initiatives, the establishment of village-based weather stations, and the marrying of traditional farming climate knowledge to modern practices are highly recommended to enhance resilience to climate.

The aforementioned study highlights that small-scale livestock farmers are vulnerable to the effects of natural disasters, particularly droughts. However, the participants in the study noted difficulties in obtaining assistance from various stakeholders, including extension officers. This indicates a lack of cohesive collaboration among stakeholders during natural disasters. Enhanced inter-professional collaboration could enable small-scale livestock farmers to access resources to address their challenges and develop resilience against natural disasters. Researchers advocate for government intervention in strategic meetings involving small-scale farmers, disaster management officers, and extension officers to tackle these issues.

Drought, primarily caused by insufficient precipitation, significantly impacts crop and livestock production in the communal areas of Bergville and Estcourt. Water stress is exacerbated by the absence of dams and inadequate utilization of underground water sources. Additionally, over-reliance on external sources for agricultural inputs reduces community control over agricultural activities due to delays in resource delivery. Development agencies must plan agricultural seasons well in advance to mitigate the effects of drought, including late planting and underutilization of

the brief rainy season. Drought is a prevalent climate phenomenon with severe economic, environmental, and social consequences, particularly affecting vulnerable populations. With impending climate change predictions, countries must address the underlying causes of drought vulnerability and enhance monitoring and early warning systems.

5.3 Recommendations

Continual drought and agricultural management skills training is needed for farmers and agricultural professionals, particularly small-scale livestock farmers. The SA government must enforce collaboration between small-scale livestock farmers and private institutions to improve knowledge and information sharing between stakeholders. This will equip farmers with drought knowledge and encourage the intermarriage of indigenous knowledge and modern technological methods of farming.

Urbanization trends in the coming years will exacerbate the aging issue by drawing more young people from rural areas. Various training programs should be implemented to improve scientific, technological, and cultural skills among young people to compensate for the challenges posed by aging. Policies should be tailored to increase agricultural production levels for different types of farmers, promoting large-scale production agriculture while supporting young farmers to modernize and industrialize agricultural production. The study suggests that drought-prone communities establish robust management structures to facilitate the development of long-term mitigation measures, such as irrigation schemes and proper utilization of underground water sources. These structures should coordinate and implement drought management activities to enhance community resilience.

The community's heavy reliance on indigenous knowledge increases vulnerability to drought, necessitating the integration of scientific knowledge with indigenous knowledge for effective preparedness. Collective approaches, such as village meetings, should be adopted to share indigenous knowledge and exchange ideas among farmers, benefiting both young and old farmers. Joint farming and the adoption of cost-effective drought response methods, such as water reuse, should be encouraged among small-scale farmers. Additionally, the government should design drought management schemes tailored to the needs of small-scale farmers, providing financial support, and promoting alternative farming practices resilient to harsh weather conditions.

Furthermore, improved assistance programs, public investments in agricultural mechanization, and price floor schemes are recommended to stabilize the agricultural sector and boost productivity.

More courses and training materials need to be designed for livestock farmers and extension officers. These pieces of training should be facilitated by organisations mandated for agricultural training and education in SA such as AgriSETA. This will be helpful in generating skilled farmers and professionals. With anticipated pressures on water resources and more intense and severe droughts, a paradigm shift is required. Drought-related "crisis management" that is poorly coordinated will no longer suffice. A well-planned strategy aimed at mitigating the effects of drought is required. The adoption of national drought policies focused on risk reduction, supplemented by drought mitigation plans at various levels of government, will have significant ramifications across key sectors, breeding livestock that are adaptable to the environment, adopting precise farming strategies as pronounced in the climate change reports of the Western Cape like the policy of climate change of the Western Cape.

The study proposes that drought prone communities establish vibrant management structures that would champion the development of long-term mitigation measures such as irrigation schemes and proper utilization of underground water sources in the uKhahlamba region. Such a structure should coordinate and implement drought management activities. It suffices to conclude that community members do not know what action to take in times of drought hence they are vulnerable to drought.

Minimising environmental degradation by avoiding overgrazing; keeping the correct size of the herd, managing the manure of the animals, and using adaptable seeds from crop breeding can help produce more feed for livestock. Low-income people, who depend on vulnerable subsistence agriculture, should be assisted with the correct measures, promoting drought research uptake among extension officers so that they can contribute to the body of knowledge that will mitigate or adapt to drought, developing more drought-resistant dry land crops and pastures for livestock consumption and adopting more effective and environmentally friendly farming practices, conducting education and sensitisation workshops for extension advisers to enable them to fight the effects of droughts at local and regional levels, lastly, more young people need to be encouraged to get involved in the agricultural sector and trained and educated about agricultural and drought management.

5.4 Implications for further research

Literature on the effects of droughts on communal farmers in SA is scarce, and not much reliable data is available on the effect of the 2015–2016 drought on livestock in communal areas. Not much research has been done on the preparedness of small-scale livestock farmers to cope with droughts.

Socio-economic impacts of droughts are usually a neglected dimension of drought monitoring and planning, specifically in sub-Saharan Africa. This presents a challenge as the socio-economic impacts of droughts are experienced more severely as they affect people directly. Based on the current study's findings, further research needs to be conducted on the effects of droughts on professionals such as the extension officers, and the skills that they lack, as well as the training needs that they need to be better prepared for abrupt natural disasters such as droughts. More research to identify the specific causes of youth apathy towards farming and ways in which youth can be encouraged to partake in the agricultural sector is crucial. This will enable a quicker rate of growth within the agricultural sector and promote a much more stable food security state within the rural areas.

REFERENCES

Abdelmalek, M. B., & Nouiri, I. (2020). Study of trends and mapping of drought events in Tunisia and their impacts on agricultural production. Science of the Total Environment, 734, 139311. https://doi.org/10.1016/j.scitotenv.2020.139311

Abdullah, Rabbi, F., Ahamad, R., Ali, S., Chandio, A. A., Ahmad, W., Ilyas, A., & Din, I. U. (2019). Determinants of commercialization and its impact on the welfare of small-scale rice farmers by using Heckman's two-stage approach. Journal of the Saudi Society of Agricultural Sciences, 18(2), 224–233. https://doi.org/10.1016/j.jssas.2017.06.001 Accessed 29 July 2023.

Abebe, K., 2017. Effect of climate change on nutritional supply to livestock production. Acad Res J Agri Sci Res, 5(2), pp.98-106.

Abegunde, V. O., Sibanda, M., & Obi, A. (2020). Determinants of the adoption of climate-smart agricultural practices by small-scale farming households in King Cetshwayo district municipality, South Africa. Sustainability (Switzerland), 12(1). https://doi.org/10.3390/SU12010195

Abiyot, Eliyas, Anbacha., Darley, Jose, Kjosavik. (2019). The Dynamics of Gender Relations under Recurrent Drought Conditions: a Study of Borana Pastoralists in Southern Ethiopia. Human Ecology, Available from: https://link.springer.com/article/10.1007/s10745-019-00082-y

Adaawen, S., Rademacher-Schulz, C., Schraven, B. and Segadlo, N., 2019. Drought, migration, and conflict in sub-Saharan Africa: what are the links and policy options?. Current Directions in Water Scarcity Research, 2, pp.15-31. https://doi.org/10.1016/B978-0-12-814820-4.00002-X

Adhikari, S. (2018). Drought impact and adaptation strategies in the mid-hill farming system of western nepal. Environments, 5(9), 101. https://doi.org/10.3390/environments5090101

Alahacoon, N., Edirisinghe, M., & Ranagalage, M. (2021). Satellite-based meteorological and agricultural drought monitoring for agricultural sustainability in sri lanka. Sustainability, 13(6), 3427. https://doi.org/10.3390/su13063427

Adisa, O. M., Botai, J. O., Adeola, A. M., Botai, C. M., Hassen, A., Darkey, D., Tesfamariam, E., Adisa, A. T., & Adisa, A. F. (2019). Analysis of drought conditions over major maize producing provinces of South Africa. Journal of Agricultural Meteorology, 75(4), 173–182. https://doi.org/10.2480/agrmet.D-18-00049

Agri SA Research. (2019). Agriculture Drought Report 2019 / 2020 "We are in a fincial drought!" 1–42. www.agrisa.co.za (accessed 12 February 2022).

AgriSETA Annual Report 2019|20. (2020). https://static.pmg.org.za/AgriSETA-ANNUAL-REPORT_email.pdf

AgriSETA. (2019). Agricultural Sector Skills Plan 2018-2019 (Issue August 2017). https://www.agriseta.co.za/wp-content/uploads/2021/02/PEST-CONTROL-FINALv02.pdf

AgriSETA. (2020a). Agriculture Sector Skills Plan 2020–2025 (Issue September 2010). https://www.agriseta.co.za/wp-content/uploads/2021/02/Agriseta-Agriculture-SSP_DIGITAL.pdf

AgriSETA. (2020b). Agriculture Sector Skills Plan 2021-2022. AGRI SA. 2016. Drought Response Feedback. https://pmg.org.za/files/160920agrisa.pptx. Accessed on 29 March 2023.

Ahmadalipour, A., & Moradkhani, H. (2018). Multi-dimensional assessment of drought vulnerability in Africa: 1960–2100. Science of the Total Environment, 644, 520–535. https://doi.org/10.1016/j.scitotenv.2018.07.023

Ahmadalipour, A., Moradkhani, H., Castelletti, A., & Magliocca, N. (2019). Future drought risk in Africa: Integrating vulnerability, climate change, and population growth. Science of the Total Environment, 662, 672–686. https://doi.org/10.1016/j.scitotenv.2019.01.278

Akhtar, M. I. (2016). Research Design. https://ssrn.com/abstract=2862445 Accessed 12 May 2022.

Alexander Mabunga Msipa, B., & Lombard, A. (2021). Small-scale farmers and land care workers' perceptions of land degradation and how it influences their livelihoods: an explorative study in ladybrand 15308694 A dissertation submitted in fulfilment of the requirements for

the degree Master in Social Work in the Department of Social Work and Criminology at the University of Pretoria Faculty Of Humanities. https://repository.up.ac.za/handle/2263/85844

Almalki, S. (2016). Integrating Quantitative and Qualitative Data in Mixed Methods Research—Challenges and Benefits. Journal of Education and Learning, 5(3), 288. https://doi.org/10.5539/jel.v5n3p288

Alok, Singh, Jayara., K., Indudhar, Reddy., R., L., Meena. (2022). Drought in Indian perspective, its impact on major crops and livestock and remedial measures. Environment Conservation Journal, Available from: 10.36953/ecj.021888-2154

Alvalá, R. C. D. S., Cunha, A. P. M. A., Brito, S. S. B., Seluchi, M. E., Marengo, J. A., Moraes, O. L. L., & Carvalho, M. A. (2019). Drought monitoring in the Brazilian semiarid region. Anais Da Academia Brasileira de Ciencias, 91. https://doi.org/10.1590/0001-3765201720170209

Amit, Tubi., Eran, Feitelson. (2016). Drought and cooperation in a conflict prone area: Bedouin herders and Jewish farmers in Israel's northern Negev, 1957–1963. Political Geography, Available from: 10.1016/J.POLGEO.2015.11.009

Andersson, L., Wilk, J., Graham, L. P., Wikner, J., Mokwatlo, S., & Petja, B. (2020). Local early warning systems for drought – Could they add value to nationally disseminated seasonal climate forecasts? Weather and Climate Extremes, 28. https://doi.org/10.1016/j.wace.2019.100241

Anon. (2023). Nature Based Solutions (NBS) to achieve food security and SDGs in drought prone subtropical area. Available from: 10.5194/egusphere-egu23-10930

Antwi-Agyei, P., & Stringer, L. C. (2021). Improving the effectiveness of agricultural extension services in supporting farmers to adapt to climate change: Insights from northeastern Ghana. Climate Risk Management, 32. https://doi.org/10.1016/j.crm.2021.100304

Apraku, A., Morton, J. F., & Apraku Gyampoh, B. (2021). Climate change and small-scale agriculture in Africa: Does indigenous knowledge matter? Insights from Kenya and South Africa. Scientific African, 12. https://doi.org/10.1016/j.sciaf.2021.e00821

Archer, E. R. M., Landman, W. A., Malherbe, J., Maluleke, P., & Weepener, H. (2021). Managing climate risk in livestock production in South Africa: How might improved tailored forecasting contribute? Climate Risk Management, 32. https://doi.org/10.1016/j.crm.2021.100312

Arslan, A., Mccarthy, N., Lipper, L., Asfaw, S., Cattaneo, A., & Kokwe, M. (2015). Climate Smart Agriculture? Assessing the Adaptation Implications in Zambia. Journal of Agricultural Economics, 66(3), 753–780. https://doi.org/10.1111/1477-9552.12107

Ashraf, E., Sarwar, A., Junaid, M., Baig, M. B., Shurjeel, H. K., & Barrick, R. K. (2020). An Assessment of In-service Training Needs for Agricultural Extension Field Staff in the Scenario of Climate Change using Borich Needs Assessment Model. Sarhad Journal of Agriculture, 36(2). https://doi.org/10.17582/journal.sja/2020/36.2.427.446 Accessed 28 June 2022

Aurelia Khowa, A. (2021). the contribution of goats to household food security in selected communities of KwaZulu-Natal, south Africa https://researchspace.ukzn.ac.za/handle/10413/19964

Awange, J., 2021. Lake Victoria's Water Resources. Lake Victoria Monitored from Space, pp.21-35. https://link.springer.com/book/10.1007/978-3-030-60551-3

Ayana, E. K., Ceccato, P., Fisher, J. R. B., & DeFries, R. (2016). Examining the relationship between environmental factors and conflict in pastoralist areas of East Africa. Science of the Total Environment, 557–558, 601–611. https://doi.org/10.1016/j.scitotenv.2016.03.102

Ayanlade, A., Radeny, M., Morton, J. F., & Muchaba, T. (2018). Rainfall variability and drought characteristics in two agro-climatic zones: An assessment of climate change challenges in Africa. Science of the Total Environment, 630, 728–737. https://doi.org/10.1016/j.scitotenv.2018.02.196

Ayugi, B., Eresanya, E. O., Onyango, A. O., Ogou, F. K., Okoro, E. C., Okoye, C. O., Anoruo, C. M., Dike, V. N., Ashiru, O. R., Daramola, M. T., Mumo, R., & Ongoma, V. (2022). Review of Meteorological Drought in Africa: Historical Trends, Impacts, Mitigation Measures, and

Prospects. Pure and Applied Geophysics, 179(4), 1365–1386. https://doi.org/10.1007/s00024-022-02988-z

Ayugi, B., Tan, G., Rouyun, N., Zeyao, D., Ojara, M., Mumo, L., Babaousmail, H., & Ongoma, V. (2020). Evaluation of meteorological drought and flood scenarios over Kenya, East Africa. Atmosphere, 11, 307. https://doi.org/10.3390/atmos11030307

Badstue, L., Petesch, P., Farnworth, C. R., Roeven, L., & Hailemariam, M. (2020). Women farmers and agricultural innovation: Marital status and normative expectations in rural Ethiopia. Sustainability (Switzerland), 12(23), 1–22. https://doi.org/10.3390/su12239847

Bahta, Y. T. (2021). Perception of Agricultural Drought Resilience in South Africa: A Case of Small-scale Livestock Farmers. Jamba: Journal of Disaster Risk Studies, 13(1), 1–11. https://doi.org/10.4102/JAMBA.V13I1.984

Bahta, Y. T. (2022). Nexus between Coping Strategies and Households' Agricultural Drought Resilience to Food Insecurity in South Africa. Land, 11(6). https://doi.org/10.3390/land11060893

Bahta, Y. T. (2022). Social vulnerability to agricultural drought: Insights from Northern Cape, South Africa. Scientific African, 17. https://doi.org/10.1016/j.sciaf.2022.e01324

Bahta, Y. T., Jordaan, A., & Muyambo, F. (2016). Communal farmers' perception of drought in South Africa: Policy implication for drought risk reduction. International Journal of Disaster Risk Reduction, 20, 39–50. https://doi.org/10.1016/j.ijdrr.2016.10.007

Baker, D., Cadilhon, J., & Ochola, W. (2015). Identification and analysis of small-scale producers' constraints: applications to Tanzania and Uganda. Development in Practice, 25(2), 204–220. https://doi.org/10.1080/09614524.2015.1007924

Bandyopadhyay, N., Bhuiyan, C., & Saha, A. K. (2015). Temperature extremes, moisture deficiency and their impacts on dryland agriculture in Gujarat, India. Drought: Research and Science-Policy Interfacing - Proceedings of the International Conference on Drought: Research and Science-Policy Interfacing, 119–124. https://doi.org/10.1201/b18077-20

Bastian, R. M., Swanepoel, J. W., & van Niekerk, J. A. (2019). Effectiveness of the implementation of the mechanisation programme for emerging farmers in the Overberg and Eden districts

of the western cape. South African Journal of Agricultural Extension, 47(2), 58–71. https://doi.org/10.17159/2413-3221/2019/v47n2a503

Baudoin, M. A., Vogel, C., Nortje, K., & Naik, M. (2017). Living with drought in South Africa: lessons learnt from the recent El Niño drought period. International Journal of Disaster Risk Reduction, 23, 128–137. https://doi.org/10.1016/j.ijdrr.2017.05.005

Belle, J., Sithabile, M., & Ogundeji, A. A. (2017). Assessing communal farmers'preparedness to drought in the Umguza District, Zimbabwe. International Journal of Disaster Risk Reduction, 22, 194–203. https://doi.org/10.1016/j.ijdrr.2017.03.004

Bhatta, G. D., Pramod, Aggarwal, K., & Shrivastava, A. (2015). Livelihood diversification and climate change adaptationin indo-gangetic plains: implication of rainfall regimes. In The Journal of Agriculture and Environment (Vol. 16). http://dx.doi.org/10.3126/aej.v16i0.19841

Bhorat, H., Kanbur, R., & Stanwix, B. (2014). Estimating the impact of minimum wages on employment, wages, and non-wage benefits: The case of agriculture in South Africa. American Journal of Agricultural Economics, 96(5), 1402–1419. https://doi.org/10.1093/ajae/aau049

Blandford, D. (2018). The role of agriculture in global GHG mitigation Policies for climate change mitigation and adaptation in agriculture View project nontrade concerns View project. https://doi.org/10.1787/da017ae2-en

BM, H., & IM, M. (2015). Assessing Economic Impacts of Agricultural Drought: A Case of Thaba Nchu, South Africa. Journal of Earth Science & Climatic Change, 07(01). https://doi.org/10.4172/2157-7617.1000327

Bogale, G. A., & Erena, Z. B. (2022). Drought vulnerability and impacts of climate change on livestock production and productivity in different agro-Ecological zones of Ethiopia. In Journal of Applied Animal Research (Vol. 50, Issue 1, pp. 471–489). Taylor and Francis Ltd. https://doi.org/10.1080/09712119.2022.2103563

Botai, C. M., Botai, J. O., de Wit, J. P., Ncongwane, K. P., & Adeola, A. M. (2017). Drought characteristics over the Western Cape Province, South Africa. Water (Switzerland), 9(11).

https://doi.org/10.3390/w9110876 Wiseman Mbatha, M., Mnguni, H., & Mubecua, M. (2021). Subsistence Farming as a Sustainable Livelihood Approach for Rural Communities in South Africa. https://doi.org/10.31920/2634-3649/2021/v11n3a3

Botai, C. M., Botai, J. O., Dlamini, L. C., Zwane, N. S., & Phaduli, E. (2016). Characteristics of droughts in South Africa: A case study of free state and North West provinces. Water (Switzerland), 8(10). https://doi.org/10.3390/w8100439

Bukhosini, Z., & Moyo, I. (2023). An Analysis of the Challenges Faced by Small-Scale Farmers and their Response to the 2014-2016 Drought in Mfekayi, Mtubatuba, KZN, South Africa. African Journal of Development Studies (Formerly AFFRIKA Journal of Politics, Economics and Society), 13(1), 7–24. https://doi.org/10.31920/2634-3649/2023/v13n1a1

Buthelezi, M. N. M., maluling, R. T., Hlatshwayo, S. T., & Peerbhay, K. (2022). Comparing rotation forests and extreme gradient boosting for monitoring drought damage on KwaZulu-Natal commercial forests. Geocarto International, 37(11), 3223–3246. https://doi.org/10.1080/10106049.2020.1852612

Cai, W., Wang, G., Dewitte, B., Wu, L.,SAtoso, A., Takahashi, K., Yang, Y., Carréric, A., & McPhaden, M. J. (2018). Increased variability of eastern Pacific El Niño under greenhouse warming. Nature, 564(7735), 201–206. https://doi.org/10.1038/s41586-018-0776-9

Caleni, S., & Ncube, A. (2017). Assessing the Socio-Economic Impact of Drought in Goedgevonden Village, Ventersdorp Local Municipality in North West Province, South Africa.

Calzadilla, A., Zhu, T., Rehdanz, K., Tol, R. S. J., & Ringler, C. (2014). Climate change and agriculture: Impacts and adaptation options in South Africa. Water Resources and Economics, 5, 24–48. https://doi.org/10.1016/j.wre.2014.03.001

Caparas, C., Melati, K. (2023). Getting climate finance right for smallholder farmers: lessons from the Philippines, Vietnam, and India. Stockholm Environment Institute. https://www.sei.org/perspectives/climate-finance-equity-for-smallholder-farmers/ . Accessed 25 October 2023.

Carelsen, C. P. R., Ncube, B., & Fanadzo, M. (2023). Support Services to Small-scale Farmers

During the 2015-2018 Drought in the Overberg and West Coast Districts, South Africa. South African Journal of Agricultural Extension, 51(2), 128–149. https://doi.org/10.17159/2413-3221/2023/v51n2a13086

Cele, T. (2020). Effects of Collective Action on Market Participation and Food Security among Small-scale Farmers in Msinga Local Municipality. https://ukzn-dspace.ukzn.ac.za/bitstream/handle/10413/19476/Cele_Thobani_2020.pdf?sequence=1&isAllowed=y Accessed 16 July 2022

Cervantes-Godoy, D. (2015). Strategies for Addressing Small-scale Agriculture and Facilitating Structural Transformation. https://doi.org/10.1787/5jrs8sv4jt6k-en Accessed 14 May 2022
Chabalala, J. (2016). Drought: Farmer Commits Suicide a Day Before Rain Falls. www.news24.com/SouthAfrica/News/drought-farmer-commits-suicide-a-day-beforerain-falls-20160101. [Accessed June 9, 2023].

Chen, J., Shi, H., Sivakumar, B., & Peart, M. R. (2016). Population, water, food, energy and dams. In Renewable and Sustainable Energy Reviews (Vol. 56, pp. 18–28). Elsevier Ltd. https://doi.org/10.1016/j.rser.2015.11.043 Accessed 20 August 2022

Chersich, M. F., Wright, C. Y., Venter, F., Rees, H., Scorgie, F., & Erasmus, B. (2018). Impacts of climate change on health and wellbeing in South Africa. In International Journal of Environmental Research and Public Health (Vol. 15, Issue 9). MDPI. https://doi.org/10.3390/ijerph15091884

Christiaensen, L., & Martin, W. (2018). Agriculture, structural transformation, and poverty reduction: Eight new insights. In World Development (Vol. 109, pp. 413–416). Elsevier Ltd. https://doi.org/10.1016/j.worlddev.2018.05.027

Connolly-Boutin, L., & Smit, B. (2016). Climate change, food security, and livelihoods in subSaharan Africa. In Regional Environmental Change (Vol. 16, Issue 2, pp. 385–399). Springer Verlag. https://doi.org/10.1007/s10113-015-0761-x Accessed 24 August 2023.

Cresswell, J. W., & Vicki, P. C. (2018). 3rd edition designing and conducting mixed methods research. Accessed 8 May 2022. https://spada.uns.ac.id/pluginfile.php/510378/mod_resource/content/1/creswell.pdf

Creswell, J.W., (2014). Research design: Qualitative, Quantitative and Mixed Methods approaches, 4th ed. London: SAGE. http://www.ceil-conicet.gov.ar/wpcontent/uploads/2015/10/Creswell-Cap-10.pdf

Czekaj, M., Adamsone-Fiskovica, A., Tyran, E., & Kilis, E. (2020). Small farms' resilience strategies to face economic, social, and environmental disturbances in selected regions in Poland and Latvia. Global Food Security, 26. https://doi.org/10.1016/j.gfs.2020.100416 Accessed 15 October 2022

Dawit, D., & Balta, A. (2015). Review on Impact of Small-Scale Irrigations in Household Food Security in Ethiopia. In Journal of Economics and Sustainable Development www.iiste.org ISSN (Vol. 6, Issue 21). Online. www.iiste.org

de Kock, W. M., Blamey, R. C., & Reason, C. J. C. (2021). Large summer rainfall events and their importance in mitigating droughts over the South Western Cape, South Africa. Journal of Hydrometeorology, 22(3), 587–599. https://doi.org/10.1175/JHM-D-20-0123.1

Department Environmental Affairs, 2017. Walton, P. B. (2009). Integrated environmental management guideline on need and desirability. https://www.dffe.gov.za/sites/default/files/legislations/needanddesirabilityguideline2017_0.pdf Accessed 17 September 2022.

Department of Agriculture, Forestry and Fisheries (DAFF). Drought Status in the Agriculture Sector. Portfolio Committee on Water andSAitation; DAFF: Pretoria, South Africa, 2018.

Department of Water Affairs, 2013. Vision of the nwrs2. Sustainable, equitable and secure water for a better life and environment for all (2013). https://www.dws.gov.za/documents/Other/Strategic%20Plan/NWRS2-Final-emailversion.pdf

Du Plessis, J. A., & Burger, G. J. (2015). Investigation into increasing short-duration rainfall intensities in south Africa. Water SA, 41(3), 416–424. https://doi.org/10.4314/wsa.v41i3.14

Dumenu, W. K., & Obeng, E. A. (2016). Climate change and rural communities in Ghana: Social vulnerability, impacts, adaptations and policy implications. Environmental Science and

Policy, 55, 208–217. https://doi.org/10.1016/j.envsci.2015.10.010

Duru, M., & Therond, O. (2015). Livestock system sustainability and resilience in intensive production zones: which form of ecological modernization? Regional Environmental Change, 15(8), 1651–1665. https://doi.org/10.1007/s10113-014-0722-9

Dzama, K. (2016). South African Institute of International Affairs is the livestock sector in Southern Africa prepared for climate change? In South African Institute of International Affairs.

Edossa, D. C., Woyessa, Y. E., & Welderufael, W. A. (2014). Analysis of Droughts in the Central Region of South Africa and Their Association with SST Anomalies. International Journal of Atmospheric Sciences, 2014, 1–8. https://doi.org/10.1155/2014/508953

Edwards, B., Gray, M., & Hunter, B. (2019). The social and economic impacts of drought. Australian Journal of Social Issues, 54(1), 22–31. https://doi.org/10.1002/ajs4.52

Eischeid, J. K., Pegion, P., Quan, X., Allured, D., Dole, R. M., Bladé, I., Funk, C., Hoerling, M. P., & Liebmann, B. (2014). Understanding Recent Eastern Horn of Africa Rainfall Variability and Change. Journal of Climate, 27(23), 8630-8645. https://doi.org/10.1175/jcli-d-13-00714.1 Accessed 20 May 2022.schu

Elum, Z. A., Modise, D. M., & Marr, A. (2017). Farmer's perception of climate change and responsive strategies in three selected provinces of South Africa. Climate Risk Management, 16, 246–257. https://doi.org/10.1016/j.crm.2016.11.001

Erkossa, T., Wudneh, A., Desalegn, B., & Taye, G. (2015). Linking soil erosion to on-site financial cost: Lessons from watersheds in the Blue Nile basin. Solid Earth, 6(2), 765–774. https://doi.org/10.5194/se-6-765-2015

Etikan, I. (2016). Comparison of Convenience Sampling and Purposive Sampling. American Journal of Theoretical and Applied Statistics, 5(1), 1. https://doi.org/10.11648/j.ajtas.20160501.11

Everisto, Mapedza., Giriraj, Amarnath., Karthikeyan, Matheswaran., Luxon, Nhamo. (2019). Drought and the gendered livelihoods implications for smallholder farmers in the Southern Africa Development Community region. Available from: 10.1016/B978-0-12-814820-

4.00007-9

Fan, S., & Rue, C. (2020). The Role of Smallholder Farms in a Changing World. In The Role of Smallholder Farms in Food and Nutrition Security (pp. 13–28). Springer International Publishing. https://doi.org/10.1007/978-3-030-42148-9_2

FAO. (2014). The State of Food Insecurity in the World Strengthening the enabling environment for food security and nutrition. https://www.fao.org/3/i4030e/i4030e.pdf Accessed 17 April 2023

FAO. (2015). The impact of natural hazards and disasters on agriculture and food and nutrition security a call for action to build resilient livelihoods.

Farah Delfiyan, Masoud Yazdanpanah, Masoumeh Forouzani & Jafar Yaghoubi (2021) Farmers' adaptation to drought risk through farm–level decisions: the case of farmers in Dehloran county, Southwest of Iran, Climate and Development, 13:2, 152-163, DOI: 10.1080/17565529.2020.1737797

Fatehi Marj, A., & Hosseini Hossein Abadi, F. (2020). A nine-step approach for developing and implementing an "agricultural drought risk management plan"; case study: Alamut River basin in Qazvin, Iran. Natural Hazards, 102(3), 1187–1205. https://doi.org/10.1007/s11069-020-03952-7

Fenta, A. A., Yasuda, H., Shimizu, K., Haregeweyn, N., Kawai, T., Sultan, D., Ebabu, K., & Belay, A. S. (2017). Spatial distribution and temporal trends of rainfall and erosivity in the Eastern Africa region. Hydrological Processes, 31(25), 4555–4567. https://doi.org/10.1002/hyp.11378

Final IDP 2015 16 Umtshezi Estcourt Municipality. (2015/2016.). https://studylib.net/doc/6961254/final-idp-2015-%E2%80%93-16---umtshezi-estcourtmunicipality Accessed 5 April 2022

Food and Agricultural Organisation of the United Nations (FAO). 2020. Committee on World Food Security (1996) Towards Universal Food Security. Draft Policy Statement and Plan of Action, 21st Session. https://www.tandfonline.com/doi/full/10.1080/03736245.2020.1795914. Accessed 23

Aug. 23. Holland, M. B., Shamer, S. Z., Imbach, P., Zamora, J. C., Medellin Moreno, C., Hidalgo, E. J. L., Donatti, C. I., Martínez-Rodríguez, M. R., & Harvey, C. A. (2017). Mapping adaptive capacity and smallholder agriculture: applying expert knowledge at the landscape scale. Climatic Change, 141(1), 139–153. https://doi.org/10.1007/s10584-016-1810-2

Food and Agriculture Organization of the United Nations (FAO). 2019. El Niño Available: http://www.fao.org/el-nino/en/ [2022, September 13].

Food and Agriculture Organization of the United Nations (FAO). 2019. El Niño Available: http://www.fao.org/el-nino/en/ [2022, September 13].

Fouotsa Manfouo, N. C., & von Fintel, D. (2022). Investigating the effects of drought and lockdowns on small-scale and commercial agricultural production in KwaZulu-Natal using remotely sensed data. Heliyon, 8(11). https://doi.org/10.1016/j.heliyon.2022.e11637

Fourie, P. J., Mahlako, S. R., & van der Westhuizen, C. (2018). Assessment of the management practices of emerging sheep production systems in the Eastern Free State: can the extensionist make a difference? South African Journal of Agricultural Extension (SAJAE), 46(2), 57–68. https://doi.org/10.17159/2413-3221/2018/v46n2a463

Frame, D. J., Rosier, S. M., Noy, I., Harrington, L. J., Carey-Smith, T., Sparrow, S. N., Stone, D. A., & Dean, S. M. (2020). Climate change attribution and the economic costs of extreme weather events: a study on damages from extreme rainfall and drought. Climatic Change, 162(2), 781–797. https://doi.org/10.1007/s10584-020-02729-y

Gashu, K., & Muchie, Y. (2018). Rethink the interlink between land degradation and livelihood of rural communities in Chilga district, Northwest Ethiopia. Journal of Ecology and Environment, 42(1). https://doi.org/10.1186/s41610-018-0077-0

Gautier, D., Denis, D., & Locatelli, B. (2016). Impacts of drought and responses of rural populations in West Africa: a systematic review. In Wiley Interdisciplinary Reviews: Climate Change (Vol. 7, Issue 5, pp. 666–681). Wiley-Blackwell. https://doi.org/10.1002/wcc.411

Gebremeskel, G., Tang, Q., Sun, S., Huang, Z., Zhang, X., & Liu, X. (2019). Droughts in East Africa: Causes, impacts and resilience. In Earth-Science Reviews (Vol. 193, pp. 146–161). Elsevier B.V. https://doi.org/10.1016/j.earscirev.2019.04.015

Gerring, J. (2017). Qualitative Methods. https://doi.org/10.1146/annurev-polisci-092415

Gibbons, M. J., Skrypzeck, H., Brodeur, R. D., Riascos, J. M., Dávila, J. A. Q., Grobler, C. A. F., Roux, J. P., Field, J. C., Daly, E. A., Miller, R. R., Ras, V., Schiariti, A., Chiaverano, L., Tjizoo, B. M., Prieto, L., Idrissi, H. F., & Palma, S. (2021). A comparative review of macromedusae in eastern boundary currents. In Oceanography and Marine Biology: An Annual Review, Volume 59 (pp. 371–482). CRC Press. https://doi.org/10.1201/9781003138846-5

Gizaw, M. S., & Gan, T. Y. (2017). Impact of climate change and El Niño episodes on droughts in sub-Saharan Africa. Climate Dynamics, 49(1–2), 665–682. https://doi.org/10.1007/s00382-016-3366-2

Godde, C. M., Mason-D'Croz, D., Mayberry, D. E., Thornton, P. K., & Herrero, M. (2021). Impacts of climate change on the livestock food supply chain; a review of the evidence. In Global Food Security (Vol. 28). Elsevier B.V. https://doi.org/10.1016/j.gfs.2020.100488

Golian, S., Mazdiyasni, O., & AghaKouchak, A. (2015). Trends in meteorological and agricultural droughts in Iran. Theoretical and Applied Climatology, 119(3–4), 679–688. https://doi.org/10.1007/s00704-014-1139-6

Gore, M., Abiodun, B. J., & Kucharski, F. (2020). Understanding the influence of ENSO patterns on drought over southern Africa using SPEEDY. Climate Dynamics, 54, 307–327. https://doi.org/10.1007/s00382-019-05002-w

Greyling, J. C. (2012). The Role of the Agricultural Sector in the South African Economy Unlocking the potential of emerging small-scale farmers in South Africa: an agent-based modelling approach View project. https://doi.org/10.13140/RG.2.2.33852.39049

Grillakis, M. G. (2019). Increase in severe and extreme soil moisture droughts for Europe under climate change. Science of the Total Environment, 660, 1245–1255. https://doi.org/10.1016/j.scitotenv.2019.01.001

Grobler, R., de Witt, F. H., Cason, E. D., Einkamerer, O. B., Josling, G. C., Adri O'Neill, H., Fair, M. D., Baloyi, J. J., MacNeil, M. D., & Neser, F. W. C. (2020). Training the next generation of animal scientists for South Africa. Animal Frontiers, 10(3), 10–17. https://doi.org/10.1093/af/vfaa017

Guo, Y., Huang, S., Huang, Q., Leng, G., Fang, W., Wang, L., & Wang, H. (2020). Propagation thresholds of meteorological drought for triggering hydrological drought at various levels. Science of the Total Environment, 712. https://doi.org/10.1016/j.scitotenv.2020.136502

Habtemariam, L. T., Gandorfer, M., Kassa, G. A., & Heissenhuber, A. (2016). Factors Influencing Small-scale Farmers' Climate Change Perceptions: A Study from Farmers in Ethiopia. Environmental Management, 58(2), 343–358. https://doi.org/10.1007/s00267-016-0708-0

Haghighi, A., Zaki, N., Rossi, P., Noori, R., Hekmatzadeh, A., Saremi, H., & Kløve, B. (2020). Unsustainability syndrome—from meteorological to agricultural drought in arid and semi-arid regions. Water, 12(3), 838. https://doi.org/10.3390/w12030838

Haile, G. G., Tang, Q., Hosseini-Moghari, S. M., Liu, X., Gebremicael, T. G., Leng, G., Kebede, A., Xu, X., & Yun, X. (2020). Projected Impacts of Climate Change on Drought Patterns Over East Africa. Earth's Future, 8(7). https://doi.org/10.1029/2020EF001502

Haile, G. G., Tang, Q., Li, W., Liu, X., & Zhang, X. (2020a). Drought: Progress in broadening its understanding.Wiley Inter-disciplinary Review RNA Water, 7, e1407. https://doi.org/10.1002/wat2.1407

Haile, G. G., Tang, Q., Hosseini-Moghari, S. M., Liu, X., Gebremicael, T. G., Leng, G., Kebede, A., Xu, X., & Yun, X. (2020b). Projected impacts of climate change on drought patterns over East Africa. Earth's Future, 8(7), e2020EF001502. https://doi.org/10.1029/2020EF001502

Hanel, M., Rakovec, O., Markonis, Y., Máca, P., Samaniego, L., Kyselý, J., & Kumar, R. (2018). Revisiting the recent European droughts from a long-term perspective. In Scientific Reports (Vol. 8, Issue 1). Nature Publishing Group. https://doi.org/10.1038/s41598-018-27464-4

Hao, Z., & Singh, V. P. (2015). Drought characterization from a multivariate perspective: A review. In Journal of Hydrology (Vol. 527, pp. 668–678). Elsevier. https://doi.org/10.1016/j.jhydrol.2015.05.031

Harvey, C. A., Saborio-Rodríguez, M., Martinez-Rodríguez, M. R., Viguera, B., ChainGuadarrama, A., Vignola, R., & Alpizar, F. (2018). Climate change impacts and adaptation among smallholder farmers in Central America. Agriculture and Food Security, 7(1). https://doi.org/10.1186/s40066-018-0209-x

Harvey, C. A., Saborio-Rodríguez, M., Martinez-Rodríguez, M. R., Viguera, B., ChainGuadarrama, A., Vignola, R., & Alpizar, F. (2018). Climate change impacts and adaptation among smallholder farmers in Central America. Agriculture and Food Security, 7(1). https://doi.org/10.1186/s40066-018-0209-x

Hermans, K., & Garbe, L. (2019). Droughts, livelihoods, and human migration in northern Ethiopia. Regional Environmental Change, 19(4), 1101–1111. https://doi.org/10.1007/s10113-019-01473-z

Hirakawa, R., Nurjanah, S., Furukawa, K., Murai, A., Kikusato, M., Nochi, T., & Toyomizu, M. (2020). Heat Stress Causes Immune Abnormalities via Massive Damage to Effect Proliferation and Differentiation of Lymphocytes in Broiler Chickens. Frontiers in Veterinary Science, 7. https://doi.org/10.3389/fvets.2020.00046

Hirons, M., Beauchamp, E., Whitfield, S., Conway, D., Asare, R., & Malhi, Y. (2020). Resilience to climate shocks in the tropics. In Environmental Research Letters (Vol. 15, Issue 10). IOP Publishing Ltd. https://doi.org/10.1088/1748-9326/abb156

Ho, M.T., Nguyen, Q.H., Le, N.T.B. and Tran, H.L.D., 2021. Preliminary findings on structural issues in the Vietnamese financial research landscape from 2008-2020. https://scholar.google.com/scholar_lookup?title=Preliminary%20Findings%20on%20Structural%20Issues%20in%20the%20Vietnamese%20Financial%20Research%20Landscape%20from%202008-2020&author=M.T.%20Ho&publication_year=2021

Holman, I. P., Hess, T. M., Rey, D., & Knox, J. W. (2021). A Multi-Level Framework for Adaptation to Drought Within Temperate Agriculture. Frontiers in Environmental Science,

8. https://doi.org/10.3389/fenvs.2020.589871

https://www.academicresearchjournals.org/ARJASR/PDF/2017/March/Abebe.pdf

Horn, L. N., & Shimelis, H. (2020). Production constraints and breeding approaches for cowpea improvement for drought prone agro-ecologies in Sub-Saharan Africa. Annals of Agricultural Science, 65, 83–91. https://doi.org/10.1016/j.aoas.2020.03.002

Hua, W., Zhou, L., Chen, H., Nicholson, S. E., Raghavendra, A., & Jiang, Y. (2016). Possible causes of the Central Equatorial African long-term drought. Environmental Research Letters, 11(12). https://doi.org/10.1088/1748-9326/11/12/124002

Huang, Z., Hejazi, M., Li, X., Tang, Q., Vernon, C., Leng, G., Liu, Y., Döll, P., Eisner, S., Gerten, D., Hanasaki, N., & Wada, Y. (2018). Reconstruction of global gridded monthly sectoral water withdrawals for 1971-2010 and analysis of their spatiotemporal patterns. Hydrology and Earth System Sciences, 22(4), 2117–2133. https://doi.org/10.5194/hess-22-2117-2018 Accessed 20 March 2022

Huq, M. E., Shoeb, A. Z. M., Hossain, M. A., Fahad, S., Kamruzzaman, M. M., Javed, A., Saleem, N., Adnan, K. M. M., Sarker, S. A., Ali, M. Y., & Sarven, M. S. (2020). Measuring Vulnerability to Environmental Hazards: Qualitative to Quantitative. In Environment, Climate, Plant and Vegetation Growth (pp. 421–452). Springer International Publishing. https://doi.org/10.1007/978-3-030-49732-3_17

IDP, 2015. 10, A. (2015.). Municipal Vision Mission Statement Key Performance Areas Municipal Goals Municipal Objectives Municipal Profiles MEC Comments Key Challenges Performance Measurement of Success Political Leadership on a Five-year IDP Planning and Development Principles Government Policies and Imperatives Sustainable Development Goals (SDGS) 14 National Outcomes NDP (National Development Plan) PGDP (Provincial Growth Development Plan) DGDP (District Growth Development Plan). https://studylib.net/doc/6961254/final-idp-2015-%E2%80%93-16---umtsheziestcourt-municipality

IDP. 2017.First IDP for the fourth IDP generation. uThukela District Municipality. (2017). http://www.uthukela.gov.za/media/content/documents/2020/6/o_1eds5eir11irrbkm1lj0mqmp5i5t.pdf?filename=ADOPTED%201%202017-18%20IDP.pdf

IDP. 2020/2021. Last review of the fourth IDP generation. uThukela District Municipality. https://www.cogta.gov.za/cgta_2016/wp-content/uploads/2021/02/APPROVED-2020-2021-IDP-REVIEW.pdf

International Fund for Agricultural Development, 2023. Investing in rural people: Report on the 2022 country visit of the IFAD Executive Board to the Republic of Sierra Leone. Rome. https://webapps.ifad.org/members/eb/138/docs/EB-2023-138-INF-3.pdf

IPCC, 2012: Glossary of terms. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 555-564. https://archive.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf

Jepthas, G., & Swanepoel, J. W. (2019). Implications of the environmental impact assessment regulations on the agricultural sector in the Overberg district in the western cape for emerging farmers. South African Journal of Agricultural Extension, 47(2), 128–139. https://doi.org/10.17159/2413-3221/2019/v47n2a509

Jha, S., & Srivastava, R. (2018). Impact of drought on vegetation carbon storage in arid and semiarid regions. Remote Sensing Applications: Society and Environment, 11, 22–29. https://doi.org/10.1016/j.rsase.2018.04.013

Jordaan, A. J. Andries J., Sakulski, D. M., Muyambo, F., South Africa. Water Research Commission, & South Africa. Department of Agriculture, F. (n.d.). Vulnerability, adaptation to and coping with drought: the case of commercial and subsistence rain fed farming in the Eastern Cape. Volume I : report to the Water Research Commission and Department of Agriculture, Forestry and Fisheries. https://www.wrc.org.za/wpcontent/uploads/mdocs/TT%20716-17.pdf

Joseph, E., Mwesige, R., Kyarisiima, S., Aheisibwe, A., Gerald, K., Muhereze, R., Kutesa, R. A., Barekye, A., & Zonal, K. (2019). Seed Potato Production Business through a Gender Lens Gender and Women's Studies. http://dx.doi.org/10.31532/GendWomensStud.2.2.005

Kamruzzaman, M., Hwang, S., Cho, J., Jang, M., & Jeong, H. (2019). Evaluating the spatiotemporal characteristics of agricultural drought in bangladesh using effective drought index. Water, 11(12), 2437. https://doi.org/10.3390/w11122437

Karlie, M. (2020). Attribution of the 2015-2016 hydrological drought in KwaZulu-Natal to anthropogenic climate change. http://hdl.handle.net/11427/32512

Katiyatiya, C. L. F., Majaha, J., Chikwanha, O. C., Dzama, K., Kgasago, N., & Mapiye, C. (2022). Drought's implications on agricultural skills in South Africa. In Outlook on Agriculture (Vol. 51, Issue 3, pp. 293–302). SAGE Publications Inc. https://doi.org/10.1177/00307270221103289

Keesstra, S., Nunes, J., Novara, A., Finger, D., Avelar, D., Kalantari, Z., & Cerdà, A. (2018). The superior effect of nature based solutions in land management for enhancing ecosystem services. In Science of the Total Environment (Vols. 610–611, pp. 997–1009). Elsevier B.V. https://doi.org/10.1016/j.scitotenv.2017.08.077

Kelley, C. P., Mohtadi, S., Cane, M. A., Seager, R., & Kushnir, Y. (2015). Climate change in the Fertile Crescent and implications of the recent Syrian drought. Proceedings of the National Academy of Sciences of the United States of America, 112(11), 3241–3246. https://doi.org/10.1073/pnas.1421533112

Kemper, E.A., Stringfield, S. & Teddlie, C. (2003). Mixed methods sampling strategies in social science research. Handbook of mixed methods in social and behavioral research, pp.273-296.

Khapayi, M., & Celliers, P. R. (2016). Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape Province, South Africa. South African Journal of Agricultural Extension (SAJAE), 44(1). https://doi.org/10.17159/2413-3221/2016/v44n1a374

Khowa, A.A., 2021. The contribution of goats to household food security in selected communities of KwaZulu-Natal, South Africa (Doctoral dissertation). https://ukzndspace.ukzn.ac.za/bitstream/handle/10413/19964/Khowa_Anele_Aurelia_2021.pdf?sequence=1&isAllowed=y. Accessed 10 August 2023.

Khowa, T., & Mukasi, T. J. (2021). Agro-processing as a tool for poverty alleviation strategy: A case of Raymond Mhlaba municipality. Africa's Public Service Delivery and Performance Review, 9(1). https://doi.org/10.4102/apsdpr.v9i1.463

Khwidzhili, R. H., & Worth, S. H. (2017). Evaluation of policies promoting sustainable agriculture in South Africa. South African Journal of Agricultural Extension (SAJAE), 45(2). https://doi.org/10.17159/2413-3221/2017/v45n2a443

Kilimani, N., van Heerden, J., Bohlmann, H., & Roos, L. (2018). Economy-wide impact of drought induced productivity losses. Disaster Prevention and Management: An International Journal, 27(5), 636–648. https://doi.org/10.1108/DPM-05-2018-0155

Kim, W., Iizumi, T., & Nishimori, M. (2019). Global patterns of crop production losses associated with droughts from 1983 to 2009. Journal of Applied Meteorology and Climatology, 58(6), 1233–1244. https://doi.org/10.1175/JAMC-D-18-0174.1

Kom, Z., Nethengwe, N. S., Mpandeli, N. S., & Chikoore, H. (2020). Determinants of small-scale farmers' choice and adaptive strategies in response to climatic shocks in Vhembe District, South Africa. GeoJournal, 87(2), 677-700. https://doi.org/10.1007/s10708-020-10272-7

Kom, Z., Nethengwe, N. S., Mpandeli, N. S., & Chikoore, H. (2022). Determinants of small-scale farmers' choice and adaptive strategies in response to climatic shocks in Vhembe District, South Africa. GeoJournal, 87(2), 677–700. https://doi.org/10.1007/s10708-020-10272-7

Kuria, A. W., Barrios, E., Pagella, T., Muthuri, C. W., Mukuralinda, A., & Sinclair, F. L. (2019). Farmers' knowledge of soil quality indicators along a land degradation gradient in Rwanda. In Geoderma Regional (Vol. 16). Elsevier B.V. https://doi.org/10.1016/j.geodrs.2018.e00199

Kuria, A. W., Barrios, E., Pagella, T., Muthuri, C. W., Mukuralinda, A., & Sinclair, F. L. (2019). Farmers' knowledge of soil quality indicators along a land degradation gradient in Rwanda. In Geoderma Regional (Vol. 16). Elsevier B.V. https://doi.org/10.1016/j.geodrs.2018.e00199

Kusangaya, S., Warburton, M., & Archer van Garderen, E. (2017). Use of ACRU, a distributed hydrological model, to evaluate how errors from downscaled rainfall are propagated in simulated runoff in uMngeni catchment, South Africa. Hydrological Sciences Journal, 62(12), 1995–2011. https://doi.org/10.1080/02626667.2017.1349317

Łabędzki, L. (2016). Actions and measures for mitigation drought and water scarcity in agriculture. Journal of Water and Land Development, 29(1), 3–10. https://doi.org/10.1515/jwld-20160007 Accessed 20 August 2023.

Lakhraj-Govender, R., & Grab, S. W. (2019). Assessing the impact of El Niño–Southern Oscillation on South African temperatures during austral summer. International Journal of Climatology, 39(1), 143–156. https://doi.org/10.1002/joc.5791

Lansbury Hall, N., & Crosby, L. (2022). Climate Change Impacts on Health in Remote Indigenous Communities in Australia. International Journal of Environmental Health Research, 32(3), 487–502. https://doi.org/10.1080/09603123.2020.1777948

Lawal, S., Lennard, C., Jack, C., Wolski, P., Hewitson, B., & Abiodun, B. (2019). The observed and model-simulated response of southern African vegetation to drought. Agricultural and Forest Meteorology. https://doi.org/10.1016/j.agrformet.2019.107698

Leedy, P. D., Ormrod, J. E., & Johnson, L. R. (n.d.). Practical research : planning and design.

Lees, A. M., Sejian, V., Wallage, A. L., Steel, C. C., Mader, T. L., Lees, J. C., & Gaughan, J. B. (2019). The impact of heat load on cattle. In Animals (Vol. 9, Issue 6). MDPI AG. https://doi.org/10.3390/ani9060322

Leng, G. and Hall, J. (2020). Predicting spatial and temporal variability in crop yields: an inter-comparison of machine learning, regression and process-based models. Environmental Research Letters, 15(4), 044027. https://doi.org/10.1088/1748-9326/ab7b24

Leng, G., Tang, Q., & Rayburg, S. (2015). Climate change impacts on meteorological, agricultural and hydrological droughts in China. Global and Planetary Change, 126, 23–34. https://doi.org/10.1016/j.gloplacha.2015.01.003

Lester, L., Flatau, P., & Kyron, M. (2022). Understanding the Social Impacts of Drought. Prepared by the Centre for Social Impact The University of Western Australia. https://www.gsdc.wa.gov.au/app/uploads/2022/07/Understanding-the-Social-Impacts-of-Drought-UWA.pdf

Liebmann, B., Hoerling, M. P., Funk, C., Bladé, I., Dole, R. M., Allured, D., Quan, X., Pegion, P., & Eischeid, J. K. (2014). Understanding recent eastern Horn of Africa rainfall variability and change. Journal of Climate, 27(23), 8630–8645. https://doi.org/10.1175/JCLI-D-13-00714.1

Lindie, V., Maltitz., Yonas, T., Bahta. (2021). Empowerment of smallholder female livestock farmers and its potential impacts to their resilience to agricultural drought. doi: 10.3934/AGRFOOD.2021036.

Liu, X., Zhu, X., Pan, Y., Li, S., Liu, Y., & Ma, Y. (2016). Agricultural drought monitoring: Progress, challenges, and prospects. Journal of Geographical Sciences, 26(6), 750–767. https://doi.org/10.1007/s11442-016-1297-9

Liu, Y., & Chen, J. (2021). Future global socioeconomic risk to droughts based on estimates of hazard, exposure, and vulnerability in a changing climate. Science of the Total Environment, 751. https://doi.org/10.1016/j.scitotenv.2020.142159

Liu, Y., & Chen, J. (2021). Future global socioeconomic risk to droughts based on estimates of hazard, exposure, and vulnerability in a changing climate. Science of the Total Environment, 751. https://doi.org/10.1016/j.scitotenv.2020.142159

Liu, Y., Amin, A., Rasool, S. F., & Zaman, Q. U. (2020). The role of agriculture and foreign remittances in mitigating rural poverty: Empirical evidence from Pakistan. Risk Management and Healthcare Policy, 13, 13–26. https://doi.org/10.2147/RMHP.S235580

Loizou, E., Karelakis, C., Galanopoulos, K., & Mattas, K. (2019). The role of agriculture as a development tool for a regional economy. Agricultural Systems, 173, 482–490. https://doi.org/10.1016/j.agsy.2019.04.002

Losch, B. (2016). Structural transformation to boost youth labour demand in sub-Saharan Africa:

The role of agriculture, rural areas and territorial development Employment and Labour Market Policies Branch. http://www.ilo.org/global/about-the-ilo/mission-andobjectives/WCMS_099766/lang--en/indx.htm

Lottering, S. J., Mafongoya, P., & Lottering, R. T. (2021). Assessing the social vulnerability of small-scale farmer's to drought in uMsinga, KwaZulu-Natal. International Journal of Disaster Risk Reduction, 65. https://doi.org/10.1016/j.ijdrr.2021.102568

Lyon, B. (2014). Seasonal drought in the Greater Horn of Africa and its recent increase during the March-May long rains. Journal of Climate, 27(21), 7953–7975. https://doi.org/10.1175/JCLI-D-13-00459.1

Mahlalela, P. T., Blamey, R. C., Hart, N. C. G., & Reason, C. J. C. (2020). Drought in the Eastern Cape region of South Africa and trends in rainfall characteristics. Climate Dynamics, 55(9–10), 2743–2759. https://doi.org/10.1007/s00382-020-05413-0

Majaha, J. (2023). The impact of drought in the South African agricultural sector and the skills implications. https://scholar.sun.ac.za

Makaya, E., Rohse, M., Day, R., Vogel, C., Mehta, L., McEwen, L., Rangecroft, S., & van Loon, A. F. (2020). Water governance challenges in rural South Africa: Exploring institutional coordination in drought management. Water Policy, 22(4), 519–540. https://doi.org/10.2166/wp.2020.234

Makhado, R. A., Saidi, A. T., & Tshikhudo, P. P. (2014). Optimising drought adaptation by smallscale farmers in southern Africa through integration of indigenous and technologically driven practices. African Journal of Science, Technology, Innovation and Development,
6(4), 265–273. https://doi.org/10.1080/20421338.2014.945391

Malherbe, J., Dieppois, B., Maluleke, P., van Staden, M., & Pillay, D. L. (2016). South African droughts and decadal variability. Natural Hazards, 80(1), 657–681. https://doi.org/10.1007/s11069-015-1989-y

Malhi, G. S., Kaur, M., & Kaushik, P. (2021). Impact of climate change on agriculture and its mitigation strategies: A review. In Sustainability (Switzerland) (Vol. 13, Issue 3, pp. 1–

21). MDPI. https://doi.org/10.3390/su13031318

Maltou, R. and Bahta, Y. (2019). Factors influencing the resilience of smallholder livestock farmers to agricultural drought in south africa: implication for adaptive capabilities. Jàmbá Journal of Disaster Risk Studies, 11(1). https://doi.org/10.4102/jamba.v11i1.805

Maluleke, W., Mokwena, R. J., & Motsepa, L. L. (2016). Rural farmers' perspectives on stock theft: police crime statistics. South African Journal of Agricultural Extension, 44(2), 256–274. https://doi.org/10.17159/2413-3221/2016/v44n2a393

Maluleke, W., Tshabalala, N. P., & Barkhuizen, J. (2020). The effects of climate change on rural livestock farming: Evidence from Limpopo Province, South Africa. Asian Journal of Agriculture and Rural Development, 10(2), 645–658. https://doi.org/10.18488/journal.ajard.2020.102.645.658

Milovanovic, V., & Smutka, L. (2020). Populating Aging in Rural India: Implication for Agriculture and Smallholder Farmers. Journal of Population Ageing, 13(3), 305–323. https://doi.org/10.1007/s12062-019-09246-6

Mango, N., Makate, C., Tamene, L., Mponela, P., & Ndengu, G. (2018). Adoption of small-scale irrigation farming as a climate-smart agriculture practice and its influence on household income in the Chinyanja Triangle, Southern Africa. Land, 7(2). https://doi.org/10.3390/land7020049

Marandure, T., Mapiye, C., Makombe, G., & Dzama, K. (2017). Indicator-based sustainability assessment of the small-scale beef cattle production system in South Africa. Agroecology and Sustainable Food Systems, 41(1), 3–29. https://doi.org/10.1080/21683565.2016.1231152

Mare, F., Bahta, Y. T., & van Niekerk, W. (2018). The impact of drought on commercial livestock farmers in South Africa. Development in Practice, 28(7), 884–898. https://doi.org/10.1080/09614524.2018.1493091 Accessed 15 August 2022.

Marengo, J. A., Galdos, M. v., Challinor, A., Cunha, A. P., Marin, F. R., Vianna, M. dos S., Alvala, R. C. S., Alves, L. M., Moraes, O. L., & Bender, F. (2022). Drought in Northeast Brazil: A

review of agricultural and policy adaptation options for food security. Climate Resilience and Sustainability, 1(1). https://doi.org/10.1002/cli2.17

Masemola, M. J., & Agrometeorology, I. (2021). Assessment of vulnerability of cattle farming to climate variability and change in South Africa.

Masih, I., Maskey, S., Mussá, F. E. F., & Trambauer, P. (2014). A review of droughts on the African continent: A geospatial and long-term perspective. In Hydrology and Earth System Sciences (Vol. 18, Issue 9, pp. 3635–3649). Copernicus GmbH. https://doi.org/10.5194/hess-18-3635-2014

Masih, I., Maskey, S., Mussá, F. E. F., & Trambauer, P. (2014). A review of droughts on the African continent: A geospatial and long-term perspective. In Hydrology and Earth System Sciences (Vol. 18, Issue 9, pp. 3635–3649). Copernicus GmbH. https://doi.org/10.5194/hess-18-3635-2014

Masinde, M. (2015). An innovative drought early warning system for sub-saharan Africa: Integrating modern and indigenous approaches. African Journal of Science, Technology, Innovation and Development, 7(1), 8–25. https://doi.org/10.1080/20421338.2014.971558

Masipa, T. S., & Masipa, T. (2017). Jàmbá-Journal of Disaster Risk Studies Affiliation. https://doi.org/10.4102/jamba

Masoga, M. A., & Shokane, A. L. (2019). Viewpoint: Indigenous knowledge systems and environmental social work education: Towards environmental sustainability. Southern African Journal of Environmental Education, 35(1). https://doi.org/10.4314/sajee.v35i1.14

Mastrorillo, M., Licker, R., Bohra-Mishra, P., Fagiolo, G., D. Estes, L., & Oppenheimer, M. (2016). The influence of climate variability on internal migration flows in South Africa. Global Environmental Change, 39, 155–169. https://doi.org/10.1016/j.gloenvcha.2016.04.014

Mathinya, V. N., Franke, A. C., van de Ven, G. W. J., & Giller, K. E. (2022). Productivity and constraints of small-scale crop farming in the summer rainfall region of South Africa. In Outlook on Agriculture (Vol. 51, Issue 2, pp. 139–154). SAGE Publications Inc. https://doi.org/10.1177/00307270221091839

Matimelo, A. M. (2016). Mobilizing community assets to alleviate poverty among women: a case study of Zimele developing community self-reliance in rural KwaZulu-Natal. www.spss.com

Matlakala, F. K., Nyahunda, L., & Makhubele, J. C. (2021). Challenges Faced by Small-scale Farmers in the Face of Natural Disasters in Rural Areas: An Afrocentric Perspective African Journal of Development Studies (AJDS) Challenges Faced by Small-scale Farmers …. 11(4), 177–194. https://doi.org/10.31920/2634-3649/2021/v11n4a9

Matlou, R., Bahta, Y. T., Owusu-Sekyere, E., & Jordaan, H. (2021). Impact of agricultural drought resilience on the welfare of small-scale livestock farming households in the northern cape province of south africa. Land, 10(6). https://doi.org/10.3390/land10060562

Mbatha, C. N. (2021). Livestock production and marketing for small emerging farmers in South Africa and Kenya: comparative lessons. South African Journal of Agricultural Extension, 49(1), 141–161. https://doi.org/10.17159/2413-3221/2021/v49n1a10783 Accessed 15 August 2022.

Mbatha, C. (2021) "Livestock production and marketing for small emerging farmers in South Africa and Kenya: comparative lessons", South African Journal of Agricultural Extension (SAJAE), 49(1), pp. 141–161. https://doi.org/10.17159/2413-3221/2021/v49n1a10783

McCarthy, J. (2021) How Funding for Farmers Can Help End Hunger and Poverty. Global Citizen. https://www.globalcitizen.org/en/content/why-smallholder-farmers-need-funding/

Mdungela, N.M., Bahta, Y.T. and Jordaan, A.J., 2017. Farmer's choice of drought coping strategies to sustain productivity in the Eastern Cape Province of South Africa. Book Series Frontiers in Sustainability, 1(1), pp.73-89. https://doi.org/10.3390/books978-3-03842331-7-5. Accessed 9 June 9, 2023.

Mehran, A., Mazdiyasni, O., & AghaKouchak, A. (2015). A hybrid framework for assessing socioeconomic drought: Linking climate variability, local resilience, and demand. Journal of Geophysical Research, 120(15), 7520–7533. https://doi.org/10.1002/2015JD023147 8 October 2022.

Meza, I., Eyshi Rezaei, E., Siebert, S., Ghazaryan, G., Nouri, H., Dubovyk, O., Gerdener, H., Herbert, C., Kusche, J., Popat, E., Rhyner, J., Jordaan, A., Walz, Y., & Hagenlocher, M. (2021). Drought risk for agricultural systems in South Africa: Drivers, spatial patterns, and implications for drought risk management. Sci Total Environ, 799, 149505. https://doi.org/10.1016/j.scitotenv.2021.149505 Accessed 23 November 2022.

Mishra, A., Bruno, E., & Zilberman, D. (2021). Compound natural and human disasters: Managing drought and COVID-19 to sustain global agriculture and food sectors. In Science of the Total Environment (Vol. 754). Elsevier B.V. https://doi.org/10.1016/j.scitotenv.2020.142210 10 February 2023.

Mkuhlani, S., Crespo, O., Rusere, F., Zhou, L., & Francis, J. (2019). Classification of small-scale farmers for improved rainfall variability management in South Africa. Agroecology and Sustainable Food Systems, 44(1), 7-29. https://doi.org/10.1080/21683565.2018.1537325 Accessed 26 July 2022.

Mnyaka, S., 2018. Assessment of the contributions of water allocation reforms to achieving equitable access to water by small-scale emerging farmers in the Breede-Gouritz catchment management agency. Assessment of the contributions of water allocation reforms to achieving equitable access to water by small-scale emerging farmers in the Breede-Gouritz catchment … Accessed 24 July 2023.

Mogomotsi, P. K., Sekelemani, A., & Mogomotsi, G. E. J. (2020). Climate change adaptation strategies of small-scale farmers in Ngamiland East, Botswana. Climatic Change, 159(3), 441–460. https://doi.org/10.1007/s10584-019-02645-w

Mosley, L. M. (2015). Drought impacts on the water quality of freshwater systems; review and integration. In Earth-Science Reviews (Vol. 140, pp. 203–214). Elsevier. https://doi.org/10.1016/j.earscirev.2014.11.010 14 June 2022.

Moswetsi, G., Fanadzo, M., & Ncube, B. (2017). Cropping systems and agronomic management practices in small-scale farms in South Africa: Constraints, challenges and opportunities. In Journal of Agronomy (Vol. 16, Issue 2, pp. 51–64). Asian Network for Scientific Information. https://doi.org/10.3923/ja.2017.51.64

Mpandeli, S., Nesamvuni, E., & Maponya, P. (2015). Adapting to the Impacts of Drought by Small-scale Farmers in Sekhukhune District in Limpopo Province, South Africa. Journal of Agricultural Science, 7(2). https://doi.org/10.5539/jas.v7n2p115

Mthi, S & Nyangiwe, N. (2018). Farmers perception on sheep production constraints in the communal grazing areas of the Eastern Cape Province, South Africa. International Journal of Livestock Production, 9(12), 334–339. https://doi.org/10.5897/ijlp2018.0500

Müller, A., Mora, V., Rojas, E., Díaz, J., Fuentes, O., Giron, E., Gaytan, A., & van Etten, J. (2019). Emergency drills for agricultural drought response: a case study in Guatemala. Disasters, 43(2), 410–430. https://doi.org/10.1111/disa.12316

Muller, J. C. Y. (2014). Adapting to climate change and addressing drought - learning from the Red Cross Red Crescent experiences in the Horn of Africa. Weather and Climate Extremes, 3, 31–36. https://doi.org/10.1016/j.wace.2014.03.009

Mulualem, T., Mekbib, F., Hussein, S., & Gebre, E. (n.d.). Yam Production Constraints, Farming Systems and Farmer Preferred Traits in Ethiopia: Implication for Breeding and Conservation. In Ethiop. J. Crop Sci (Vol. 9, Issue 2).

Munien, S. (2016). A comparative assessment of the socio-economic and spatial factors impacting the implementation of renewable energy in marginalised communities: the case of Inanda and Bergville. http://hdl.handle.net/10413/15162

Muremela, G., Kutame, A., Kapueja, I., & Adigun, O. T. (2021). Retaining scarce skills teachers in a South African rural community: an exploration of associated issues. African Identities. https://doi.org/10.1080/14725843.2021.1965864

Musvoto, C., Nortje, K., de Wet, B., Mahumani, B. K., & Nahman, A. (2015). Imperatives for an agricultural green economy in South Africa. In South African Journal of Science (Vol. 111, Issues 1–2). Academy of Science of South Africa. https://doi.org/10.17159/sajs.2015/20140026

Muthelo, D., & Ogundeji, A. A. (n.d.). Perception and adaptation strategies of small-scale farmers to drought in the free state province, South Africa.

Muthelo, D., Owusu-Sekyere, E., & Ogundeji, A. A. (2019). Small-scale farmers' adaptation to drought: Identifying effective adaptive strategies and measures. Water (Switzerland), 11(10). https://doi.org/10.3390/w11102069

Myeki, V. A., & Bahta, Y. T. (2021). Determinants of small-scale livestock farmers' household resilience to food insecurity in South Africa. Climate, 9(7). https://doi.org/10.3390/cli9070117

Myeni, L., Moeletsi, M., Thavhana, M., Randela, M., & Mokoena, L. (2019). Barriers affecting sustainable agricultural productivity of small-scale farmers in the eastern free state of South Africa. Sustainability (Switzerland), 11(11). https://doi.org/10.3390/su11113003

Myers, K. K., & Powers, S. R. (2017). Mixed Methods. In The International Encyclopedia of Organizational Communication (pp. 1–11). Wiley. https://doi.org/10.1002/9781118955567.wbieoc143

Nairizi, S. (n.d.). Irrigated Agriculture Development under Drought and Water Scarcity.

National Drought Mitigation Center (NDMC). 2006. Understanding and defining drought. National Drought Mitigation Center, University of Nebraska-Lincoln. https://drought.unl.edu/Education/DroughtBasics.aspx Accessed 15 February 2023.

Ncoyini-Manciya, Z., & Savage, M. J. (2022). The Assessment of Future Air Temperature and Rainfall Changes Based on the Statistical Downscaling Model (SDSM): The Case of the Wartburg Community in KZN Midlands, South Africa. Sustainability (Switzerland), 14(17). https://doi.org/10.3390/su141710682

Ncube, B. (2018). WRC Project 2084: Insights into Indigenous Coping Strategies to Drought for Drought Adaptation in Agriculture: The Southern Cape Scenario. https://www.greenagri.org.za/assets/documents-/Drought-dialogue-2016-/Dr.-Bongani-Ncube-Presentation.pdf

Ndlovu, M. S., & Demlie, M. (2020). Assessment of meteorological drought and wet conditions using two drought indices across Kwazulu-Natal province, South Africa. Atmosphere, 11(6). https://doi.org/10.3390/atmos11060623

Ndoro, J. T., Mudhara, M., & Chimonyo, M. (2015). Farmers' choice of cattle marketing channels under transaction cost in rural South Africa: a multinomial logit model. African Journal of Range and Forage Science, 32(4), 243–252. https://doi.org/10.2989/10220119.2014.959056

Neisi, M., Bijani, M., Abbasi, E., Mahmoudi, H., & Azadi, H. (2020). Analyzing farmers' drought risk management behavior: Evidence from Iran. Journal of Hydrology, 590. https://doi.org/10.1016/j.jhydrol.2020.125243

Ngcamu, B. S., & Chari, F. (2020). Drought influences on food insecurity in africa: A systematic literature review. International Journal of Environmental Research and Public Health, 17(16), 1–17. https://doi.org/10.3390/ijerph17165897

Ngeywo, J., Basweti, E., & Shitandi, A. (2015). Influence of Gender, Age, Marital Status and Farm Size on Coffee Production: A Case of Kisii County, Kenya. Asian Journal of Agricultural Extension, Economics & Sociology, 5(3), 117–125. https://doi.org/10.9734/ajaees/2015/15702

Nhemachena, C., Nhamo, L., Matchaya, G., Nhemachena, C. R., Muchara, B., Karuaihe, S. T., & Mpandeli, S. (2020). Climate change impacts on water and agriculture sectors in southern africa: Threats and opportunities for sustainable development. In Water (Switzerland) (Vol. 12, Issue 10, pp. 1–17). MDPI AG. https://doi.org/10.3390/w12102673

Nieuwoudt, T., 2019. Grazing management in drought-prone regions. https://repository.up.ac.za/bitstream/handle/2263/76335/Nieuwoudt_Grazing_2019.pdf?sequence=1. Accessed 29 Aug. 23.

Nkadimeng, M., van Marle-Köster, E., Nengovhela, N. B., & Linah, M. M. (2022). Understanding beef cattle production practices and associated factors constraining performance: a survey of small-scale farmers in South Africa. Journal of Agriculture and Rural Development in the Tropics and Subtropics, 123(1), 131–145. https://doi.org/10.17170/kobra202204216054 23 April 2023.

Nkonya, E., Mirzabaev, A., & von Braun Editors, J. (2016). Economics of Land Degradation and

Improvement a Global Assessment for Sustainable Development. https://doi.org/10.1007/978-3-319-19168-3

Nosipho Hlophe-Ginindza, S., & Mpandeli, N. S. (2021). The Role of Small-Scale Farmers in Ensuring Food Security in Africa. www.intechopen.com

Nyangiwe, N., Goni, S., Skenjana, A., & Nyangiwe, & N. (2018). Applied Animal Husbandry & Rural Development. In Appl. Anim. Husb. Rural Develop (Vol. 11). https://www.researchgate.net/publication/330359426_The_status_of_livestock_production_in_communal_farming_areas_of_the_Eastern_Cape_A_case_of_Majali_Community

Ochieng, J., Kirimi, L., & Mathenge, M. (2016). Effects of climate variability and change on agricultural production: The case of small-scale farmers in Kenya. NJAS - Wageningen Journal of Life Sciences, 77, 71–78. https://doi.org/10.1016/j.njas.2016.03.005 29 July 2023.

Odubote, I. K., & Ajayi, O. C. (2019). Scaling Up Climate-Smart Agricultural (CSA) Solutions for Smallholder Cereals and Livestock Farmers in Zambia. In Handbook of Climate Change Resilience (pp. 1–23). Springer International Publishing. https://doi.org/10.1007/978-3-319-71025-9_109-1v

Oduniyi, O. S., Rubhara, T. T., & Antwi, M. A. (2020). Sustainability of livestock farming in south africa. outlook on production constraints, climate-related events, and upshot on adaptive capacity. Sustainability (Switzerland), 12(7). https://doi.org/10.3390/su12072582 20 May 2023.

Ojo, O. S., Oyedeji, O., & Megbowon, E. T. (2022). Local Farmers' Perceptions about Covid-19 Impact on Agriculture: Case of Selected Rural Areas in Ekiti State, Nigeria. Journal La Sociale, 3(3), 117–127. https://doi.org/10.37899/journal-la-sociale.v3i3.646

Ojo, T. O., Adetoro, A. A., Ogundeji, A. A., & Belle, J. A. (2021). Quantifying the determinants of climate change adaptation strategies and farmers' access to credit in South Africa. Science of the Total Environment, 792. https://doi.org/10.1016/j.scitotenv.2021.148499

Olwethu, P., & Bongani, N. (2022). Small-scale farmer coping and adaptation strategies for agricultural water use during drought periods in the Overberg and West Coast Districts,

Western Cape, South Africa. Water SA, 48(1 January). https://doi.org/10.17159/wsa/2022.v48.i1.3846 Accessed 19 March 2023.

Omotayo, O. A., & Zikhali, P. T. (2019). Multi-stakeholder platforms and drought mitigation in South Africa. Journal of Human Ecology, 66(1–3), 19–24. https://doi.org/10.31901/24566608.2019/66.1-3.3146

Opiyo, F., Wasonga, O., Nyangito, M., Schilling, J., & Munang, R. (2015). Drought Adaptation and Coping Strategies Among the Turkana Pastoralists of Northern Kenya. International Journal of Disaster Risk Science, 6(3), 295–309. https://doi.org/10.1007/s13753-015-0063-4

Ordway, E. M., Asner, G. P., & Lambin, E. F. (2017). Deforestation risk due to commodity crop expansion in sub-Saharan Africa. Environmental Research Letters, 12(4). https://doi.org/10.1088/1748-9326/aa6509

Orimoloye, I. R., Olusola, A. O., Belle, J. A., Pande, C. B., & Ololade, O. O. (2022). Drought disaster monitoring and land use dynamics: identification of drought drivers using regression-based algorithms. Natural Hazards, 112(2), 1085–1106. https://doi.org/10.1007/s11069-022-05219-9

Otkin, J. A., Svoboda, M., Hunt, E. D., Ford, T. W., Anderson, M. C., Hain, C., & Basara, J. B. (2018). Flash droughts: A review and assessment of the challenges imposed by rapid-onset droughts in the United States. In Bulletin of the American Meteorological Society (Vol. 99, Issue 5, pp. 911–919). American Meteorological Society. https://doi.org/10.1175/BAMS-D-17-0149.1

Otto, F. E. L., Wolski, P., Lehner, F., Tebaldi, C., van Oldenborgh, G. J., Hogesteeger, S., Singh, R., Holden, P., Fučkar, N. S., Odoulami, R. C., & New, M. (2018). Anthropogenic influence on the drivers of the Western Cape drought 2015-2017. Environmental Research Letters, 13(12). https://doi.org/10.1088/1748-9326/aae9f9

Owino, G., 2020. Institutional factors influencing drought mitigation process in drought management programme in Kenya, a case of Makueni County, Kenya (Doctoral dissertation, UoN). http://erepository.uonbi.ac.ke/handle/11295/154257

Pachauri, R. K., Reisinger, A., Bernstein, L., Intergovernmental Panel on Climate Change. Core Writing Team, & Intergovernmental Panel on Climate Change. (n.d.). Climate change 2007: synthesis report.

Pamla, A., Thondhlana, G., & Ruwanza, S. (2021). Persistent droughts and water scarcity: Households' perceptions and practices in Makhanda, South Africa. Land, 10(6). https://doi.org/10.3390/land10060593

Pawlak, K., & Kołodziejczak, M. (2020). The role of agriculture in ensuring food security in developing countries: Considerations in the context of the problem of sustainable food production. Sustainability (Switzerland), 12(13). https://doi.org/10.3390/su12135488

Peñuelas, J., Ciais, P., Canadell, J. G., Janssens, I. A., Fernández-Martínez, M., Carnicer, J., Obersteiner, M., Piao, S., Vautard, R., & Sardans, J. (2017). Shifting from a fertilizationdominated to a warming-dominated period. In Nature Ecology and Evolution (Vol. 1, Issue
10, pp. 1438–1445). Nature Publishing Group. https://doi.org/10.1038/s41559-017-0274-8

Phillipson, J., Proctor, A., Emery, S. B., & Lowe, P. (2016). Performing inter-professional expertise in rural advisory networks. Land Use Policy, 54, 321–330. https://doi.org/10.1016/j.landusepol.2016.02.018

Pienaar, L., & Traub, L. N. (n.d.). Give to AgEcon Search Understanding the small-scale farmer in South Africa: Towards a sustainable livelihoods classification. http://ageconsearch.umn.edu

Pili, O., & Ncube, B. (2022). Small-scale farmer coping and adaptation strategies for agricultural water use during drought periods in the Overberg and West Coast Districts, Western Cape,

South Africa. Water SA, 48(1), 97–109. https://doi.org/10.17159/wsa/2022.v48.i1.3846b Accessed 15 June 2023.

Pili, O., & Ncube, B. (2022). Small-scale farmer coping and adaptation strategies for agricultural water use during drought periods in the Overberg and West Coast Districts, Western Cape, South Africa. Water SA, 48(1), 97–109. https://doi.org/10.17159/wsa/2022.v48.i1.3846

Pinar, Dinc., Lina, Eklund. (2023). Syrian farmers in the midst of drought and conflict: the causes, patterns, and aftermath of land abandonment and migration. Climate and Development, Available from: 10.1080/17565529.2023.2223600

Platt, J. (2022). Regenz. Next Generation Agriculture: What is crop diversity, and why is it important? https://regenz.co.za/blog/crop-diversity/ Accessed 20 February 2024

Polsky, L., & von Keyserlingk, M. A. G. (2017). Invited review: Effects of heat stress on dairy cattle welfare. Journal of Dairy Science, 100(11), 8645–8657. https://doi.org/10.3168/jds.2017-12651

Pomposi, C., Funk, C., Shukla, S., Harrison, L., & Magadzire, T. (2018). Distinguishing southern Africa precipitation response by strength of El Niño events and implications for decisionmaking. Environmental Research Letters, 13(7). https://doi.org/10.1088/1748-9326/aacc4c

Powers, S. R., & Myers, K. K. (2017). Vocational Anticipatory Socialization: College Students' Reports of Encouraging/Discouraging Sources and Messages. Journal of Career Development, 44(5), 409–424. https://doi.org/10.1177/0894845316660627 Accessed 16 April 2022.

Proag, V. (2014). The Concept of Vulnerability and Resilience. Procedia Economics and Finance, 18, 369–376. https://doi.org/10.1016/s2212-5671(14)00952-6

Raghuvanshi, R. (2017). A Study of Farmers' Awareness About Climate Change and Adaptation Practices in India. International Journal of Applied Agricultural Sciences, 3(6), 154. https://doi.org/10.11648/j.ijaas.20170306.13

Rakgwale, T. J., & Oguttu, J. W. (2020). The impact of the 2014–2016 drought in Greater Letaba Local Municipality: How the farmers coped and factors that were significantly associated with loss of animals. International Journal of Disaster Risk Reduction, 50. https://doi.org/10.1016/j.ijdrr.2020.101869

Ramosolo, T. (2018). The Role of Agriculture in Reducing Poverty Evidence from South Africa.

Ray, D. K., Gerber, J. S., Macdonald, G. K., & West, P. C. (2015). Climate variation explains a third of global crop yield variability. Nature Communications, 6. https://doi.org/10.1038/ncomms6989

Ringetani, Matlou., Yonas, T., Bahta., Enoch, Owusu-Sekyere., Henry, Jordaan. (2021). Impact of Agricultural Drought Resilience on the Welfare of Smallholder Livestock Farming Households in the Northern Cape Province of South Africa. Land, Available from: 10.3390/LAND10060562.

Roco, L., Engler, A., Bravo-Ureta, B. E., & Jara-Rojas, R. (2015). Farmers' perception of climate change in mediterranean Chile. Regional Environmental Change, 15(5), 867–879. https://doi.org/10.1007/s10113-014-0669-x

Rojas-Downing, M. M., Nejadhashemi, A. P., Harrigan, T., & Woznicki, S. A. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. In Climate Risk Management (Vol. 16, pp. 145–163). Elsevier B.V. https://doi.org/10.1016/j.crm.2017.02.001

Roux, J. 2016. What is El Niño, the event contributing to South Africa's current drought African Climate Reality Project? Available: http://climatereality.co.za/what-is-el-nino/ Accessed 13 September, 2022.

Rukema, J. R., & Umubyeyi, B. S. (2019). Indigenous knowledge approach in maintaining a livelihood in the face of disastrous climate change: Case of drought in Msinga villages, KwaZulu-Natal. Jamba: Journal of Disaster Risk Studies, 11(1). https://doi.org/10.4102/JAMBA.V11I1.758

Ruwanza, S., Thondhlana, G., & Falayi, M. (2022). Research Progress and Conceptual Insights on Drought Impacts and Responses among Small-scale Farmers in South Africa: A Review. Land, 11(2). https://doi.org/10.3390/land11020159. Accessed September 5, 2023

Sankar, S., Ahmed Co-supervisor, F., & Muswema, A. P. (2015). An Investigation into the Waste Management Practices of Emerging Livestock Farmers: The case of the KwaZulu-Natal Midlands. https://ukzn-dspace.ukzn.ac.za/bitstream/handle/10413/13349/Sankar_Sasha_2015.pdf?sequence=1&isAllowed=y

Savari, K., Naseri, M., & Savari, Y. (2023). Evaluating the Role of Perceived Stress, Social Support, and Resilience in Predicting the Quality of Life among the Parents of Disabled Children. International Journal of Disability, Development and Education, 70(5), 644–658. https://doi.org/10.1080/1034912X.2021.1901862

Savari, M., & Shokati Amghani, M. (2022). SWOT-FAHP-TOWS analysis for adaptation strategies development among small-scale farmers in drought conditions. International Journal of Disaster Risk Reduction, 67. https://doi.org/10.1016/j.ijdrr.2021.102695

Savari, M., & Shokati Amghani, M. (2022). SWOT-FAHP-TOWS analysis for adaptation strategies development among small-scale farmers in drought conditions. International Journal of Disaster Risk Reduction, 67. https://doi.org/10.1016/j.ijdrr.2021.102695

Savari, M., & Shokati Amghani, M. (2022). SWOT-FAHP-TOWS analysis for adaptation strategies development among small-scale farmers in drought conditions. International Journal of Disaster Risk Reduction, 67. https://doi.org/10.1016/j.ijdrr.2021.102695

Savari, M., Abdeshahi, A., Gharechaee, H., & Nasrollahian, O. (2021). Explaining farmers' response to water crisis through theory of the norm activation model: Evidence from Iran. International Journal of Disaster Risk Reduction, 60. https://doi.org/10.1016/j.ijdrr.2021.102284

Scasta, J. D., Lalman, D. L., & Henderson, L. (2016). Drought Mitigation for Grazing Operations: Matching the Animal to the Environment. Rangelands, 38(4), 204–210. https://doi.org/10.1016/j.rala.2016.06.006

Schaub, S., & Finger, R. (2020). Effects of drought on hay and feed grain prices. Environmental Research Letters, 15(3). https://doi.org/10.1088/1748-9326/ab68ab

Scholes, R. and Engelbrecht, F., 2021. Climate impacts in southern Africa during the 21st Century. Report for Earthjustice and the Centre for Envrionmental Rights. Global Change Instiute, University of Witwatersrand. https://cer.org.za/wpcontent/uploads/2021/09/Climate-impacts-in-South-Africa_Final_September_2021.FINAL_.pdf Accessed 20 November 2022.

Scholtz, M., Maiwashe, A., Tjelele, T., Nkosi, B., & Matabane, M. (2016). The reality of drought, consequences and mitigation strategies for livestock production in South Africa. In Citation of this paper: Appl. Anim. Husb. Rural Develop (Vol. 9). https://www.researchgate.net/publication/316620452_The_reality_of_drought_consequences_and_mitigation_strategies_for_livestock_production_in_South_Africa/link/59083ed7aca272116d3cc2fb/download

Schoonenboom, J., & Johnson, R. B. (2017). Wie man ein Mixed Methods-Forschungs-Design konstruiert. Kolner Zeitschrift Fur Soziologie Und Sozialpsychologie, 69, 107–131. https://doi.org/10.1007/s11577-017-0454-1

Schreiner, B. G., Mungatana, E. D., & Baleta, H. (2018). Impacts of Drought Induced Water Shortages in South Africa: Sector Policy Briefs Report to the Water Research Commission. www.wrc.org.za

Schubert, S. D., Stewart, R. E., Wang, H., Barlow, M., Berbery, E. H., Cai, W., Hoerling, M. P., Kanikicharla, K. K., Koster, R. D., Lyon, B., Mariotti, A., Mechoso, C. R., Müller, O. v., Rodriguez-Fonseca, B., Seager, R., Senevirante, S. I., Zhang, L., & Zhou, T. (2016). Global meteorological drought: A synthesis of current understanding with a focus on sst drivers of precipitation deficits. Journal of Climate, 29(11), 3989–4019. https://doi.org/10.1175/JCLI-D-15-0452.1

Senyolo, M. P., Long, T. B., Blok, V., & Omta, O. (2018). How the characteristics of innovations impact their adoption: An exploration of climate-smart agricultural innovations in South Africa. Journal of Cleaner Production, 172, 3825–3840. https://doi.org/10.1016/j.jclepro.2017.06.019

Serdeczny, O., Adams, S., Baarsch, F., Coumou, D., Robinson, A., Hare, W., Schaeffer, M., Perrette, M., & Reinhardt, J. (2017). Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions. Regional Environmental Change, 17(6), 1585–1600. https://doi.org/10.1007/s10113-015-0910-2

Serdeczny, O., Adams, S., Baarsch, F., Coumou, D., Robinson, A., Hare, W., Schaeffer, M., Perrette, M., & Reinhardt, J. (2016). Climate change impacts in Sub-Saharan Africa: from

physical changes to their social repercussions. Regional Environmental Change, 17(6), 1585-1600. https://doi.org/10.1007/s10113-015-0910-2 4 June 2022.

Sharafi, L., Zarafshani, K., Keshavarz, M., Azadi, H., & van Passel, S. (2021). Farmers' decision to use drought early warning system in developing countries. Science of the Total Environment, 758. https://doi.org/10.1016/j.scitotenv.2020.142761

Sharafi, L., Zarafshani, K., Keshavarz, M., Azadi, H., & van Passel, S. (2020). Drought risk assessment: Towards drought early warning system and sustainable environment in western Iran. Ecological Indicators, 114. https://doi.org/10.1016/j.ecolind.2020.106276

Shi, H., Chen, J., Wang, K., & Niu, J. (2018). A new method and a new index for identifying socioeconomic drought events under climate change: A case study of the East River basin in China. Science of the Total Environment, 616–617, 363–375. https://doi.org/10.1016/j.scitotenv.2017.10.321

Shiferaw, B., Tesfaye, K., Kassie, M., Abate, T., Prasanna, B. M., & Menkir, A. (2014). Managing vulnerability to drought and enhancing livelihood resilience in sub-Saharan Africa: Technological, institutional and policy options. Weather and Climate Extremes, 3, 67–79. https://doi.org/10.1016/j.wace.2014.04.004

Shikwambana, S., & Malaza, N. (2022). Enhancing the Resilience and Adaptive Capacity of Smallholder Farmers to Drought in the Limpopo Province, South Africa. Conservation, 2(3), 435–449. https://doi.org/10.3390/conservation2030029

Sihlobo, W. (2018). Brief Reflections on SA's agricultural labour market in the context of changing farm structures. https://agbiz.co.za/uploads/AgbizNews18/Agbiz%20Info%20Day_Wandile%20Sihlobo_01%20November%20%202018.pdf 17 April 2023.

Singh, N. P., Bantilan, C., & Byjesh, K. (2014). Vulnerability and policy relevance to drought in the semi-arid tropics of Asia - A retrospective analysis. Weather and Climate Extremes, 3, 54–61. https://doi.org/10.1016/j.wace.2014.02.002

Singh, S., & Bangarwa, K. (2015). Commercial Agriculture Thesis Work View Project Weather based Farm Advisory Services View project Bimlendra Kumari. https://doi.org/10.13140/RG.2.2.14214.57921

Sivakumar, M. V. K., Stefanski, R., Bazza, M., Zelaya, S., Wilhite, D., & Magalhaes, A. R. (2014). High Level meeting on national drought policy: Summary and major outcomes. Weather and Climate Extremes, 3, 126–132. https://doi.org/10.1016/j.wace.2014.03.007

Slayi, M., Zhou, L., & Jaja, I. F. (2023). Exploring Farmers' Perceptions and Willingness to Tackle Drought-Related Issues in Small-Holder Cattle Production Systems: A Case of Rural Communities in the Eastern Cape, South Africa. Applied Sciences (Switzerland), 13(13). https://doi.org/10.3390/app13137524

South Africa. Department of Agriculture, F. (2010). Strategic plan for the Department of Agriculture Forestry and Fisheries, 2010/11. Department of Agriculture, Forestry and Fisheries.https://www.gov.za/sites/default/files/gcis_document/201409/daffstratplan2010.pdf Accessed 15 May 2022.

South Africa. Department of Agriculture, F. (2013). Strategic plan for the Department of Agriculture, Forestry and Fisheries, 2013/14 to 2017/18. https://www.gov.za/sites/default/files/gcis_document/201501/daff-strategic-plan-20132014-2017-2018.pdf Accessed 12 February 2022.

STATS SA, 2012. Department of Statistics South Africa. Statistics South Africa, Private Bag X44, Pretoria 0001. https://www.statssa.gov.za/?page_id=1859. Accessed November 25, 2022

Stephen, Adaawen., Christina, Rademacher-Schulz., Benjamin, Schraven., Nadine, Segadlo. (2019). Drought, Migration and Conflict in Sub-Saharan Africa: What are the Links and Policy Options? Available from: 10.1016/B978-0-12-814820-4.00002-X

Svoboda, M. D., Fuchs, B. A., Poulsen, C. C., & Nothwehr, J. R. (2015). The drought risk atlas: Enhancing decision support for drought risk management in the United States. Journal of Hydrology, 526, 274–286. https://doi.org/10.1016/j.jhydrol.2015.01.006 27 April 2022.

Swart, M. C., & Cape, A. W. (2016). Challenges facing commercial producers: 2015 | 2016 Drought. https://www.greenagri.org.za/assets/documents-/Drought-dialogue-2016-

/Cornie-Swart-Agri-Western-Cape-Presentation.pdf Accessed 12 July 2022

Swarts, M. B., & Aliber, M. (2013). The "youth and agriculture" problem: implications for rangeland development. African Journal of Range and Forage Science, 30(1–2), 23–27. https://doi.org/10.2989/10220119.2013.778902 31 May 2022.

Tadesse, G. (2018). Impact of Climate Change on Smallholder Dairy Production and Coping Mechanism in Sub-Saharan Africa-Review. Advances in Life Science and Technology,

Talanow, K., Topp, E. N., Loos, J., & Martín-López, B. (2021). Farmers' perceptions of climate change and adaptation strategies in South Africa's Western Cape. Journal of Rural Studies, 81, 203–219. https://doi.org/10.1016/j.jrurstud.2020.10.026 13 May 2022.

Tan, G., Ayugi, B., Ngoma, H. N., & Ongoma, V. (2020). Projections of Future Meteorological Drought Events under representative concentrations pathways (RCPs) of CMIP5 over Kenya, East Africa. Atmosphere Research. https://doi.org/10.1016/j.atmosres.2020.105112

Tan, X., Fujiu, K., Manabe, I., Nishida, J., Yamagishi, R., Nagai, R., & Yanagi, Y. (2015). Choroidal neovascularization is inhibited via an intraocular decrease of inflammatory cells in mice lacking complement component C3. Sci Rep, 5, 15702. https://doi.org/10.1038/srep15702 Accessed 15 August 2023.

Thabang, J., Rakgwale., James, Wabwire, Oguttu. (2020). The impact of the 2014–2016 drought in Greater Letaba Local Municipality: How the farmers coped and factors that were significantly associated with loss of animals. International journal of disaster risk reduction, Available from: 10.1016/J.IJDRR.2020.101869

Thabo, Ndlovu., Vuyo, Mjimba. (2021). Drought risk-reduction and gender dynamics in communal cattle farming in southern Zimbabwe. International journal of disaster risk reduction, Available from: 10.1016/J.IJDRR.2021.102203

The State of Food Security and Nutrition in the World 2022. (2022). In The State of Food Security and Nutrition in the World 2022. FAO. https://doi.org/10.4060/cc0639en Accessed 21 January 2023

Thoai, T. Q., Rañola, R. F., Camacho, L. D., & Simelton, E. (2018). Determinants of farmers' adaptation to climate change in agricultural production in the central region of Vietnam. Land Use Policy, 70, 224–231. https://doi.org/10.1016/j.landusepol.2017.10.023

Trnka, M., Hlavinka, P., Možný, M., Semerádová, D., Štěpánek, P., Balek, J., Bartošová, L., Zahradníček, P., Bláhová, M., Skalák, P., Farda, A., Hayes, M., Svoboda, M., Wagner, W., Eitzinger, J., Fischer, M., & Žalud, Z. (2020). Czech Drought Monitor System for monitoring and forecasting agricultural drought and drought impacts. International Journal of Climatology, 40(14), 5941–5958. https://doi.org/10.1002/joc.6557 25 July 2022.

Tr, M., M, G., & B, G. (2023). Challenges and perception of communal farmers on cattle production in Ga- Matlala, Limpopo Province, South Africa. Heliyon, 9(3), e14190. https://doi.org/10.1016/j.heliyon.2023.e14190

Tully, K., Sullivan, C., Weil, R., & Sanchez, P. (2015). The State of soil degradation in subSaharan Africa: Baselines, trajectories, and solutions. In Sustainability (Switzerland) (Vol. 7, Issue 6, pp. 6523–6552). MDPI. https://doi.org/10.3390/su7066523

Uamusse, M. M., Tussupova, K., & Persson, K. M. (2020). Climate change effects on hydropower in Mozambique. Applied Sciences (Switzerland), 10(14). https://doi.org/10.3390/app10144842 Accessed 7 September 2023.

Uhe, P., Philip, S., Kew, S., Shah, K., Kimutai, J., Mwangi, E., van Oldenborgh, G. J., Singh, R., Arrighi, J., Jjemba, E., & Cullen, H. (2017). Attributing drivers of the 2016 Kenyan drought. International Journal of Climatology, 38, 554–568. https://doi.org/10.1002/joc.5389

Uhe, P., Philip, S., Kew, S., Shah, K., Kimutai, J., Mwangi, E., van Oldenborgh, G. J., Singh, R., Arrighi, J., Jjemba, E., Cullen, H., & Otto, F. (2018). Attributing drivers of the 2016 Kenyan drought. International Journal of Climatology, 38, e554–e568. https://doi.org/10.1002/joc.5389

Umtshezi Municipality Integrated Development Plan. (2008/2009.). https://www.kzntopbusiness.co.za/site/user_data/files/umtshezipdf.pdf Accessed 4 February 2022

Valizadeh, N., Bijani, M., Abbasi, E., & Ganguly, S. (2018). The role of time perspective in predicting Iranian farmers' participatory-based water conservation attitude and behavior: The role of time perspective in water conservation behavior. Journal of Human Behavior in the Social Environment, 28(8), 992–1010. https://doi.org/10.1080/10911359.2018.1485602

van Ginkel, M., & Biradar, C. (2021). Drought early warning in agri-food systems. In Climate (Vol. 9, Issue 9). MDPI. https://doi.org/10.3390/cli9090134

van Loon, A. F. (2015). Hydrological drought explained. Wiley Interdisciplinary Reviews: Water, 2(4), 359–392. https://doi.org/10.1002/WAT2.1085

Vetter, S., Goodall, V. L., & Alcock, R. (2020). Effect of drought on communal livestock farmers in KwaZulu-Natal, South Africa. African Journal of Range and Forage Science, 37(1), 93–106. https://doi.org/10.2989/10220119.2020.1738552

Vilakazi, B. S. (2017). Indigenous knowledge systems available to conserve soil and water and their effects on physio-chemical properties on selected small-scale farms of KwaZulu-Natal. http://hdl.handle.net/10413/14854

Vilakazi, B. S., Zengeni, R., & Mafongoya, P. (2019). Indigenous strategies used by selected farming communities in KwaZulu Natal, South Africa, to manage soil, water, and climate extremes and to make weather predictions. Land Degradation and Development, 30(16), 1999–2008. https://doi.org/10.1002/ldr.3395

Vilakazi, B. S., Zengeni, R., & Mafongoya, P. (2019). Indigenous strategies used by selected farming communities in KwaZulu Natal, South Africa, to manage soil, water, and climate extremes and to make weather predictions. Land Degradation and Development, 30(16), 1999–2008. https://doi.org/10.1002/ldr.3395

von Fintel, D., & Pienaar, L. (2016). Small-Scale Farming and Food Security: The Enabling Role of Cash Transfers in South Africa's Former Homelands. https://docs.iza.org/dp10377.pdf

Vu, M. T., Raghavan, V. S., & Liong, S. Y. (2015). Ensemble Climate Projection for HydroMeteorological Drought over a river basin in Central Highland, Vietnam. KSCE Journal of Civil Engineering, 19(2), 427–433. https://doi.org/10.1007/s12205-015-0506-x

W, M., & R. J., M. (2017). The effect of climate change on rural livestock farming: case study of Giyani Policing Area, Republic of South Africa. South African Journal of Agricultural Extension (SAJAE), 45(1). https://doi.org/10.17159/2413-3221/2017/v45n1a404

Walz, Y., Min, A., Dall, K., Duguru, M., Villagran de Leon, J. C., Graw, V., Dubovyk, O., Sebesvari, Z., Jordaan, A., & Post, J. (2020). Monitoring progress of the Sendai Framework using a geospatial model: The example of people affected by agricultural droughts in Eastern Cape, South Africa. Progress in Disaster Science, 5. https://doi.org/10.1016/j.pdisas.2019.100062

Wang, W., Ertsen, M. W., Svoboda, M. D., & Hafeez, M. (2016). Propagation of drought: From meteorological drought to agricultural and hydrological drought. In Advances in Meteorology (Vol. 2016). Hindawi Publishing Corporation. https://doi.org/10.1155/2016/6547209

Ware, L. J., Kim, A. W., Prioreschi, A., Nyati, L. H., Taljaard, W., Draper, C. E., Lye, S. J., & Norris, S. A. (2021). Social vulnerability, parity and food insecurity in urban South African young women: the healthy life trajectories initiative (HeLTI) study. Journal of Public Health Policy, 42(3), 373–389. https://doi.org/10.1057/s41271-021-00289-8

Warner, B. P., Schattman, R. E., & Hatch, C. E. (2017.). Farming the Floodplain: Ecological and Agricultural Tradeoffs and Opportunities in River and Stream Governance in New England's Changing Climate. www.nnvl.

Williams, P. A., Crespo, O., Abu, M., & Simpson, N. P. (2018). A systematic review of how vulnerability of small-scale agricultural systems to changing climate is assessed in Africa. In Environmental Research Letters (Vol. 13, Issue 10). Institute of Physics Publishing. https://doi.org/10.1088/1748-9326/aae026

Wiseman Mbatha, M. (2020). The agricultural sector in improving the country's economy: a critical comparison of South Africa and India The Agricultural Sector in Improving the

Country's Economy: A Critical Comparison of South Africa and India. 7(2), 77–93. https://doi.org/10.31920/2056-5658/2020/v7n2a5

Wong, L.P., (2008). Focus group discussion: a tool for health and medical research. Singapore Med Journal, 49(3), pp. 256-259.

Wu, H., Su, X., Singh, V., Feng, K., & Niu, J. (2021). Agricultural drought prediction based on conditional distributions of vine copulas. Water Resources Research, 57(8). https://doi.org/10.1029/2021wr029562

Wu, J., Chen, X., Yao, H., Gao, L., Chen, Y., & Liu, M. (2017). Non-linear relationship of hydrological drought responding to meteorological drought and impact of a large reservoir. Journal of Hydrology, 551, 495–507. https://doi.org/10.1016/j.jhydrol.2017.06.029

Yadav, S. S., Hegde, V. S., Habibi, A. B., Dia, M., & Verma, S. (2018). Climate Change, Agriculture and Food Security. In Food Security and Climate Change (pp. 1–24). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119180661.ch1

Yadeta, Teshome, Negasa. (2018). Social Perception Towards Impact of Soil Erosion and Drought on Livelihood of Smallholder Farmers in Shashemene Wereda, West Arsi Zone, Oromia, Ethiopia. Journal of Natural Sciences Research.

Yonas, T., Bahta., Vuyiseka, A., Myeki. (2022). The Impact of Agricultural Drought on Smallholder Livestock Farmers: Empirical Evidence Insights from Northern Cape, South Africa. Agriculture, Available from: 10.3390/agriculture12040442

Yuan, X., Wang, L., & Wood, E. F. (2018). 17. Anthropogenic intensification of southern African flash droughts as exemplified by the 2015/16 season. Bulletin of the American Meteorological Society, 99(1), S86–S90. https://doi.org/10.1175/BAMS-D-17-0077.1

Zebiak, S. E., Orlove, B., Muñoz, Á. G., Vaughan, C., Hansen, J., Troy, T., Thomson, M. C., Lustig, A., & Garvin, S. (2015). Investigating El Niño-Southern Oscillation and society relationships. Wiley Interdisciplinary Reviews: Climate Change, 6(1), 17–34. https://doi.org/10.1002/wcc.294

Zhu, Y., Wang, W., Singh, V. P., & Liu, Y. (2016). Combined use of meteorological drought indices at multi-time scales for improving hydrological drought detection. Science of the

Total Environment, 571, 1058–1068. https://doi.org/10.1016/j.scitotenv.2016.07.096

Zhu, Y., Wang, Y., Fu, B., Liu, Q., Li, M., & Yan, K. (2021). How are rural youths' agricultural skills? Empirical results and implications in southwest china. Agriculture (Switzerland), 11(9). https://doi.org/10.3390/agriculture11090874

Zou, B., Mishra, A. K., & Luo, B. (2018). Aging population, farm succession, and farmland usage: Evidence from rural China. Land Use Policy, 77, 437–445. https://doi.org/10.1016/j.landusepol.2018.06.001

Zungu, N. S., Egbewale, S. O., Olaniran, A. O., Pérez-Fernández, M., & Magadlela, A. (2020). Soil nutrition, microbial composition and associated soil enzyme activities in KwaZulu-Natal grasslands and savannah ecosystems soils. Applied Soil Ecology, 155. https://doi.org/10.1016/j.apsoil.2020.103663

Zwane, E. M., Igodan, C., Agunga, R., & van Niekerk, J. A. (2015). Changing demands of clients of extension: What kind of competency is needed to meet the new demand? South African Journal of Agricultural Extension, 43(2). https://doi.org/10.17159/24133221/2015/v43n2a356

APPENDICES

APPENDIX A: TABLE RESEARCH PROCEDURE

Objectives	Data collected	Data collection techniques & tools	Analysis
To find out the impacts of droughts on small-scale livestock farmers	• Small-scale farmers environmental, social, economic and livestock impacts of droughts	**Surveys**: • Questionnaires **PRA:** focus groups discussions • Key informant interviews	• Descriptive statistical analysis and frequencies • Quantitative analysis • Content analysis to identify themes, concepts, patterns, and trends.
To identify the skills that smallscale livestock farmers possess and used to cope with droughts.	• Skills used to cope with droughts	Questionnaire • Focus group discussion • Key informant interviews	• Descriptive statistical analysis and frequencies Content • and theme analysis
To identify the training needs that farmers require to prepare for droughts.	• Training needs that farmers require to prepare for and cope with droughts	• Questionnaire • Focus group discussion • Key informant interviews	• Descriptive statistical analysis • Content and theme analysis

APPENDIX B: Questionnaire/Imibuzo

My name is Othaniel Shabalala, and I am a student from the School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal. The aim of this survey is to inform my masters research entitled:

Igama lami uOthaniel Shabalala, ngiwumfundi osuka eSchool of Agricultural, Earth and Environmental Sciences, eNyuvesi yaKwaZulu-Natal. Inqubo yalembuzo ukuphendula isihloko eophenyo lwami oluthi:

"THE IMPACTS OF DROUGHTS AND THE SKILLS GAP ON SMALL-SCALE LIVESTOCK FARMERS IN KWA-ZULU NATAL, SA: A CASE STUDY OF SELECTED AREA IN THE UKHAHLAMBA AND LANGALIBALELE MUNICIPALITIES"

Name of interviewer ……..... Date: …… Area: …… Contact details of Interviewee: …… Questionnaire number: ……

SECTION A: DEMOGRAPHIC DETAILS OF THE PARTICIPANTS

---

1. **Igama neSibongo**

2. **UBULILI**

1	2
MALE/UMLISA	FEMALE/OWESIFAZANE

3. **IMINYAKA**

1	2	3	4	5
18-29	30-39	40-49	50-59	60+

4. MARITAL STATUS

1	2	3	4	5
MARRIED/USHADILE	WIDOW/UMFELOKAZI	DIVORCED/SIDIVOSILE	SEPERATED/SIHLUK ENE	NEVER MARRIED/AKAZE NGISHADE

5. EDUCATION LEVEL OF PARTICIPANT

1	2	3	4
NO FORMAL SCHOOLING	PRIMARY	SECONDARY	TERTIARY

6 **EMPLOYMENT**

1	2	3	4	5
EMPLOYED/NGIYASEBENZA	UNEMPLOYED/ANGISEBENZI	FARMER/NGIWUMLIMI	PENSION/NGIHOLA IMPESHENI	PREFER NOT TO SAY/ANGFUNIUKUSHO

7.

7 LOCATION OF FARM

1	2	3
BERGVILLE	ESTCOURT	WINTERTON

SECTION B: To describe the drought phenomenon and the impacts it has on livestock farmers.

1. What is a drought? Isomiso siyini

---

2. Ulitholephi ulwazi ngesomiso

1	2	3	4	5	6
NEWS	TRAINING	INTERNET	EXTENSION OFFICER	CONFERENCES	OTHERS (SPECIFY)

3.

a nesomiso gaph

1	2
YES	NO

4.

esomiso owabhe
naso?

1	2
SEASONAL/Isizini	YEARLY/ Unyaka nonyaka

5. How often do you experience drought conditions on your farm? Ubhekana nesomiso kangaki

1	2	3	4
NEVER/ awubhekani nhlobo nesomiso	RARELY/imvela kancane	SOMETIMES/kwenzeka lapho nalapho	VERY OFTEN/Kwenzeka kaningi

6. When facing water shortage is it due to/ mayengekho amanzi kusuke kubangwa:

1	2	3	4	5
LACK OF RAIN/ukushoda kwemvula	NO IRRIGATION SYSTEM/indlela yokunisela engekho	A LOT OF RAIN BUT dry SOIL/imvula iningi koda umhlabathi womile	DRY DAMS AND RIVERS/amadamu nemifula eshile	OTHER (SPECIFY)

7. How long do these drought conditions typically last? Isomiso sivame ukululeka iskhathi esingakanani

1	2	3	4	5
1-6 MONTHS/weziny anga	1-5 YEARS/iminyaka	5-10 YEARS/ iminyaka	10-20 YEARS/ iminyaka	MORE THAN 20 YEARS/ iminyaka

8.

***W*HAT TYPE OF LIVESTOCK DID YOU HAVE DURING THE D**
ni?

1	2	3	4	5	6	7
BEEF/izink mo zenyama	PIGS/Izingu lube	POULTRY/iz inkukhu	SHEEP/izikl abhu	DAIRY/ezob si	GOATS/izi mbuzi	OTHER

9. HOW DID THE DROUGHT AFFECT YOUR LIVESTOCK PRODUCTIVY? Isomiso siyilimaze kanjani imfuyo yakho

1	2	3	4	5	6
REDUCE PRODUCTION /kwancipha ukuzala	DECREASED FERTILITY/kw ancipha ukuvunda kwemfuyo	POOR ANIMAL HEALTH/eze mpilo zancipha	RISE IN MORTALITY/k wanyuka ukufa	DISEASE ATTACK/kwah lasela izifo	OTHER (SPECIFY)

10. How does the drought affect the availability of water for your livestock? Isomiso sikuphazamise kanjani ukuba khona kwamanzi?

1	**2**	**3**	**4**
Reduced water availability/kwehla inani lamanzi	Reduce water quality/kwehla izinga lokuhlanzeka	Increased irrigation costs/kwanyuka amanani okunisela	Other (specify)

11. How has the drought impacted the quality and quantity of feed for your livestock? Isomiso siyithinte kanjani izinga nenani lokudla kwemfuyo?

1	2	3	4
Reduced feed availability/kwehla ukutholakala	Reduce feed quality and quantity/kwehla izinga nenani	Increased feed costs/kwanyuka ukubiza	Other (specify)

12. Whenever there is a drought do majority of the farmers experience high death rate in livestock. Makunesomiso abafuyi babhekana nezinga eliphezulu lokufa kwemfuyo.

STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1	2	3	4	5

13. Whenever there is a drought farmers move their livestock to less distressed land for grazing? Makunesomiso abafuyi bayayixaxamisa imfuyo yabo beyise endaweni enamadlelo angcono?

STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1	2	3	4	5

14.

ɛr it occurs? Isomiso

STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1	2	3	4	5

15. Have you experienced any financial losses because of the drought? Wake walehlekelwa imali

1	2
YES	NO

farms wher

ɀini ngenxa yesomis

1	2	3	4	5
STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE

ıoods due t

ezintweni zethu ezi

1	2	3	4	5
STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE

ngenxa yesomiso?

16.

17.

18. **Shortage of rainfall from 2015 has had negative impacts on stocking rate with more area being over grazed. IsomisoSAgo 2015 sehlise izinga lokwandisa imfuyo ngenxa yamadlelo amoshekile?**

STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1	2	3	4	5

19. **It is important for farmer to have grazing management plan with good infrastructure or good rotational grazing. Kubalulekile ukuba nendlela yokuphakela imfuyo, izinsiza zokuphakela imfuyo.**

STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1	2	3	4	5

20. **Shortage of rainfall facilitate increased conflict over natural resources. Ukushoda kwemvula kudala udlame emphakathini ngenxa yokushoda kwezinsiza kufakela zemvelo?**

STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1	2	3	4	5

SECTION C: To identify skills gap and training needs of livestock farmers and key professionals in the livestock sector with respect to the drought preparedness and mitigation in SA

1. **What is your current role in the livestock sector? (Please select all that apply) Yini umsebenzi wakho**

1	2	3	4
FARMER/Ungumfuyi	VETERINIAN/udokodetal wezilwane	EXTENSION OFFICER	OTHER (SPECIFY)

working in the livestock

ɛulomkhakha

1	2	3	4
1-5 years	5-10 years	10-20 years	More than 20 years

emfuyweni?

2.

3. **How important do you think it is for livestock farmers and professionals in the sector to have the necessary skills and knowledge to prepare for and mitigate the impacts of drought? Kubaluleke kangakanani ukuba nabafundile abnolwazi mayelana nokuzilungiselelela isomiso?**

1	2	3	4	5
Not important	Somewhat important	Neutral	Very important	Extremely important

4. **Do you feel confident in your ability to prepare for and mitigate the impacts of drought on your farm or in your professional capacity? Uyazithemmba ngamakhona akho okuzilungiselela isomiso?**

1	2	3	4	5
NOT AT ALL CONFIDENT	CONFIDENT	NEUTRAL	MODERATELY CONFIDENT	VERY CONFIDENT

5. **WHAT ACTION HAVE YOU TAKEN TO PREPARE FOR DROUGHT? Yini osuyenzile ukuzilungiselela isomiso?**

1	2	3	4	5
NO ACTION	STORED WATER	DUG A BOREHOLE	APPLIED FOR FUNDING	OTHER (SPECIFY)

6. **HAVE YOU RECEIVED TRAINING ON DROUGHT MANAGEMENT RELATED TO DROUGHT PREPAREDNESS AND MITIGIATION? IF YES PLEASE SELECT ALL THAT YOU HAVE RECEIVED BELOW. Wake waqeqeshelwa ukuzilungiselelela isomiso. Khetha ukuthi ulthole kanjani ikhono?**

YES	NO

1	2	3	4	5	6
FORMAL EDUCATION PROGRAMME	ON-THE-JOB TRAINING	WORKSHOP OR SEMINARS	ONLINE COURSES	DEPARTMENT OF AGRICUTURE	OTHER (SPECIFY)

7. **How satisfied are you with the training or resources you have received in the past related to drought preparedness and mitigation? Ugculisekile ngokuqeqeshwa noma ngezinsiza onazo mayelana nokuqeqesheka kokubhekana nesomiso esizayo?**

1	2	3	4
NOT SATISFIED AT ALL	SOMEWHAT SATISFIED	SATISFIED	VERY SATISFIED

8. **HAVE YOU BEEN INVOLVED IN ANY MANAGEMENT ACTIVITIES RELATED TO DROUGHT PREPAREDNESS AND MITIGIATION? Wake wazibandakanya nemisebenzi emayelana nokuzilungiselelela isomiso?**

YES	NO

9. **DO YOU HAVE A DROUGHT PREPAREDNESS AND MANAGEMENT PLAN? Unalo uhlelo lokubhekana nesomiso?**

YES	NO

10. **Did you have any savings during the 2015 drought to cope with the disaster? Ikhona imali owawuyibekele isomisoSAgo 2015?**

1	2
YES	NO

11. **Do you have savings to prepare and recover from drought? Ikhona imali oyibekele**

1	2
YES	NO

12. **Do you have access to credit? Uyakwazi ukufinyelela ekutholeni imali ebhange wenze isikweleti**

1	2
YES	NO

13. **What specific skills or knowledge do you feel you currently lack related to drought preparedness and mitigation? (Please select all that apply) Imaphi amakhono ozizwa ushodelwa iwona mayelana nokubhekana nesomiso**

1	2	3	4	5
Understanding the causes and impacts of droughts/ Ukuqondisisa imbangela nemiphumela yesomiso	Developing a drought preparedness plan/ukusungula uhlelo lokbhekana nesomiso	Implementing drought mitigation strategies/ukuse benzisa uhlelo nezinsiza zokubhekana nesomiso	Accessing resources to prepare for droughts/ukutho la izinsiza zokubhekana nesomiso	Other (please specify)

14. What measures do you currently have in place to prepare for and mitigate the impacts of drought. Iziphi izinhlelo onazo zokubhekana nesomiso?

1	2	3	4	5
Irrigation systems/ Unezinsiza zokunisela	**Water storage/reservoirs/ unendawo yokugcina amanzi**	**Droughtresistant crops/ unezitshalo ezikhula noma kunesomiso**	**Stored fodder/unefolishi ozliphakela imfuyo**	**Other/okunye (specify)**

15. HOW DO YOU REDUCE YOUR RISK TO DROUGHT? Ulehlisa kanjani izinga lengozi lesomiso

1	2	3	4	5
DESTOCKING/unciphisa imfuyo	IRRIGATION System/ Unezinsiza zokunisela	COLLECT WATER FROM RIVER/DAM/Amanzi uwalanda emfuleni	UNDERGROUND WATER/ Amanzi anagaphansi komhlaba	Other

16. Did you have access to municipal piped water during the 2015-2019 drought? Wawunawo amanzi avela ezimpompini ngo 2015-2019

1	2
NO	**YES**

17. Do you currently have access to municipal pipe
empompi namhlanje?

1	2
NO	**YES**

18. Did you receive any water or aid from the Department of Water and Sanitation? Waluthola usizo from DWS?

1	2
Yes	No

19. How do you find out that you need to prepare for drought? wathola kanjani ukuthi mele uzilungiselele isomiso?

1	2	3	4	5	6
Government	Local Elders	Radio/TV	NGO	Newspaper	Other

20. In your opinion, what are the most pressing needs or challenges facing livestock farmers in SA with respect to drought preparedness and mitigation? (Please select all that apply) Iziphi izimo ezinzima kakhulu ezihlasele abafuyi eMzansi Africa mayelana nokubhekana nesomiso?

1	2	3	4	5	6
Lack of access to water	High feed costs	Lack of knowledge	Limited access to finance	Lack of infrastructure	Other (specify)

21. Do you think there are sufficient resources or support available for farmers to improve their drought preparedness and mitigation skills in SA? Mawucabanga zanele izinsiza zokusekela

1	2
NO	YES

ents whene

le ukuba noxhaso nc

1	2	3	4	5
STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE

abafuyi mayelana nokubhekana nesomiso eMzansi Africa namhlanje

22.

23. **Drought relief play an important role during drought period to keep farmers in farming business. Uxhaso ludlala indima ebaluleke kakhulu makunesomiso ukuze abafuyi beqhubeke nebhizinisi lakufuya?**

1	2	3	4	5
STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE

24. **In your opinion, what can be done to better manage and mitigate the impacts of drought on livestock farming? Ngokubona kwakho yini engenziwa ukuze abafuyi bekwazi ukubhekana nesomisop kangcono?**

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25. **Is there anything else you would like to share about the skills gap and training needs related to drought preparedness and mitigation in theSA livestock sector? Kukhona yini ofisa ukukusho mayelana nokushoda kwamakhono kubafuyi okuthintana nokubhekana nokuzilungiselelela isomiso?**

APPENDIX B: FOCUS GROUP DISCUSSION QUESTION GUIDE

Exploring the Impacts of Droughts and the Skills Gap inSA Small-Scale Livestock Farming

Introduction:

1. Welcome participants and introduce the purpose of the Interview.
2. Explain the confidentiality and voluntary nature of participation.
3. Encourage participants to share their experiences, perspectives, and suggestions openly.

Section 1: Understanding the Impacts of Droughts

1. What are droughts?
2. How did droughts affect your livestock?
3. How did the drought affect your environment/land?
4. How did droughts affect you financially?
5. Did the droughts cause any conflict within livestock farmers and the community at large?
6. Did the droughts cause an increase in crime? Why?

Section 2: Identifying the Skills Gap

1. In your opinion, what are the key skills and knowledge required to effectively manage livestock farming that farmers find in demand during drought conditions?
2. What support, if any, have you received from government or agricultural organisations during drought periods?
3. WHY do you think people have not received training or support related to drought management?
4. What resources or information do you rely on to enhance your understanding and skills in drought management?
5. How did you manage your soil during drought?
6. How did you manage your livestock during drought?
7. How did you manage your water resources during drought?
8. How did you manage your finances during drought?
9. How do you predict droughts?

Section 3: Bridging the Skills Gap

1. What do you think could be done to address the skills gap in small-scale livestock farming related to drought management?

Conclusion:

1. Summarise the key points discussed during the interview.
2. Invite participants to share any additional thoughts or concerns related to the impacts of droughts and the skills gap.
3. Express gratitude for their participation and valuable contributions.

APPENDIX C: KEY INFORMANT INTERVIEW GUIDE

Focus Group Discussion Question Guide: Exploring the Impacts of Droughts and the Skills Gap inSA Small-Scale Livestock Farming

Introduction:

Name of interviewer:.....

Date: ……..

Contact details of key informant…….....

Role in the community: …….....

4. Welcome participants and introduce the purpose of the Interview.
5. Explain the confidentiality and voluntary nature of participation.
6. Encourage participants to share their experiences, perspectives, and suggestions openly.

Section 1: Understanding the Impacts of Droughts

7. What are droughts?
8. How did droughts affect farmers livestock?
9. How did the drought affect farmers environment/land?
10. How did droughts affect you/farmers financially?
11. Did the droughts cause any conflict within livestock farmers and the community at large?
12. Did the droughts cause an increase in crime? Why?

Section 2: Identifying the Skills Gap

10. In your opinion, what are the key skills and knowledge required to effectively manage livestock farming that farmers find in demand during drought conditions?
11. What support, if any, have you received from government or agricultural organisations during drought periods?
12. WHY do you think farmers have not received training or support related to drought management?
13. What resources or information do you/farmers rely on to <u>enhance your understanding</u> and skills in drought management?
14. How did you/farmers manage your soil during drought?
15. How did you/farmers manage your livestock during drought?
16. How did you/farmers manage your water resources during drought?
17. How did you/farmers manage your finances during drought?

18. How do you/farmers predict droughts?

Section 3: Bridging the Skills Gap

2. What do you think could be done to address the skills gap in small-scale livestock farming related to drought management?

Conclusion:

1. Summarise the key points discussed during the interview.
2. Invite participants to share any additional thoughts or concerns related to the impacts of droughts and the skills gap.
3. Express gratitude for their participation and valuable contributions.

APPENDIX D: GATEKEEPRS LETTER

Chief
Kwa-Smahla D277
3340
13 April 2023

Dear Sir/Madam

This letter serves to confirm that I chief ...N. TSHABALALA..... know Othaniel Shabalala who lives in Pietermaritzburg and a Masters student at the University of KwaZulu Natal in Agriculture in the Food Security programme and here-by give him permission to conduct research about the impacts of droughts and skills gap implications on livestock farmers in the area of Winterton, Estcourt and Bergville. Your co-operation will be highly appreciated.

Yours sincere

Othaniel

[redacted]...

Chief signature

..... Student signature

..... Supervisor Signature

AMASWAZI TRADITIONAL COUNCIL
KWASMAHLA
13 APR 2023
INKOSI: N. TSHABALALA
P.O. BOX 269 WINTERTON 3340

APPENDIX E: INFORMED CONSENT FORM

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

06 July 2023

Othaniel Shabalala (217044612)
School Of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear O Shabalala,

Protocol reference number: HSSREC/00005710/2023
Project title: Investigating the impacts of droughts and the skills gap on the South African small-scale livestock farmers in KwaZulu-Natal
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 06 June 2023 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

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

This approval is valid until 06 July 2024.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

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

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

IFOMU YOLWAZI NEMVUME

Othandekayo: Lunga LoMphakathi wase Bergville

Igama lami ngingu Othaniel Shabalala ngisuka Unyuvesi ya KwaZulu-Natali, Esikhungweni Soku Londeka kokudla, Ucingo: +27 (0) 33 260 6171

Uyamenywa ukuba ube yingxenye yocwanigo olumayelana : Nemiphumela yesomiso kubafuyi, amakhono abanawo mayelana nokumelana nesomiso, nokuthi bazilungiselele kangakanani ukubhekana mesomiso esizayo eBergville eKwaZulu-Natal. Inhloso nenjongo yalolu cwaningo ukuphenya izinga lekhono abafuyi abanalo ekubhekaneni nesomiso nemiphumela yeomiso kubayi nemfuyo yabo ngonyaka ka 2015 kuya ku 2019 nasekunciphiseni imithelela emibi yokushintsha kwezulu kubafuyi abasafufusa.

Kulolu cwaningo kulindeleke ukuba kubhaliswe abafuyi abasafufusa abawu 40 basendaweni eyodwa. Ucwaningo lubandakanya ukuqoqwa kwedatha kusebentshenzisa inhlolovo /surveyi kanye nengxoxo namaqembu amancane. Isikhathi okulindeleke ukuthi usihlale uma uvuma ukuba ingxenye yocwaningo silinganiselwe emizuzwini ewu 30 kuya ku 45. Ukugcwalisa inhlolovo/survey kuthatha imizuzu ewu 30 masekuthi ingxoxo yamaqembu amancane ithatha imizuzu ewu 45. Lolu cwaningo luxhaswe yi Nyuvesi yaKwaZulu-Natali, ekolishi lweZolimo, Ubunjiniyela ne Sayensi. kulolu cwaningo ungase uhlangabezane nobungozi noma ukungakhululeki okulandelayo : ukwabelana noma ukushicila ulwazi lwendabuko, izinkolelo namasiko zomdabu. Sithemba ukuthi isifundo sizoletha izinzuzo ezilandelayo:

Lolu cwaningo lubuyekezwe, lamukelwa ubulungiswa i University of KwaZulu-Natal (UKZN) Humanities and Social Sciences Research Ethics Committee (inombolo yokwamukela _ **HSSREC/00005710/2023____).**

Esimweni sokubhekana ne zinkinga noma ukukhathazeka / imibuzo engase ithinte umcwaningi nginga xhumana nomgcwaningi ku:063 060 3777 noma UKZN Humanities & Social Sciences Research Ethics Committee, kulemininingwane elandelayo:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SA
Tel: 27 31 2604557- Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

Akuyikuba khona inkokhelo ekubeni ingxenye kulolu cwaningo. Lonke ulwazi luzogcinwa luyimfihlo futhi ngeke lusentshenziswe ngenjongo okungasiyo eyalolu cwaningo. Awuphoqelekile ukuthi ube ingxenye yalolu cwaningo, abahlanganyeli bangahoxisa ukuba yingxenye nganoma yingasiphi iskhathi.Esimweni zokwenqaba / sokuhoxisa ekubeni ingxenye ngeke uhlawuliswe noma ulahlekelwe ukwelashwa noma enye inzuzo ethile. Uma ungathanda ukuhoxa ekubeni ingxenye uzizwe ukhululekile ukubuza lomsakazi ukuba akudedele. Kungaba intokozo umu uhoxa umazise umsakazi ukuthi uyabuyayini noma ngeke usayiqedela imibuzo

IMVUME

Mina u_____ ngathola ukwaziswa mayelana nesifundo esithi: Ukuphenywa kwemiphumela yesomiso kubafuyi kanye namakhono abanawo ekubhekaneni nesomisoSAgonyaka ka 2015-2019 eKwaZulu-Natal. uOthaniel Shabalala.

Ngiyaqonda inhloso kanye nenqubo yesifundo.Nginikeziwe ithuba lokuphendula imibuzo mayelana nesifundo futhi nethuba lokunika izimpendulo ngokwaneliseka kwami.Ngiyaqinisa ukuthi ngibeyingxenye kulolu cwaningo ngokuzithandela ngokuphelele nokuthi ngingahoxisa noma nini ngaphandle kokulahlekelwa inoma yiziphi izinzuzo engingaba nelungelo lokuyithola.Ngazisiwe mayelana nesinxephezelo esitholakalayo noma indlela yokwelashwa uma kubakhona ukulimala kimi ngenxa yezinqubo ezihlobene cwaningo.Uma noma yimiphi imibuzo enginayo eminye / ukukhathazeka noma imibuzo ezihlobene cwaningo, ngiyaqonda ukuthi ngingaxhumana nomcwaningi kulenombolo (0630603777)

Uma kukhona imibuzo enginayo noma ukukhathazeka mayelana namalungelo ami njengoba ngiyengxenye yesifundo, noma uma ngiyakhathazeka nganoma yini evala kucwaningo ngiyazi ukuthi ngingaxhumana:

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KwaZulu-Natal, SA
Tel: 27 31 2604557 - Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

imvume engeziwe, lapho ifanele khona

Ngiyaqinisekisa ukunikezela ngemvume ukuze :

Ukusetshenziswa kwezithombe zami ngenjongo yocwaningo YEBO / CHA

Isignesha eyo ingxenye kuncwaningo usuku :