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Drought impacts on livestock and crop production along an urban-rural gradient: perceptions and response strategies in the Eastern Cape province, South Africa

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Thesis submitted in fulfilment of the requirements for the degree of Master of Science.

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DECLARATION

I, Avela Pamla, hereby declare that this thesis was written by myself and that the work contained herein is my original work that I carried out under the supervision of Prof. Gladman Thondhlana and Prof. Sheunesu Ruwanza. All the sources and contributions have been duly acknowledged within the text and the reference list. The thesis is submitted in fulfilment for the degree of Master of Science in Environmental Science in the Faculty of Science at Rhodes University, South Africa and has not been submitted for any other degree or professional qualification except as specified.

Signature:  Date: 27/06/2023

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ABSTRACT

Drought is a major challenge threatening agricultural productivity in urban and rural areas across southern Africa. Drought events are expected to be more frequent, severe, last longer, and, impact land-based livelihoods in the coming decades. Despite the growing literature on the impacts of drought on livelihoods, there is limited focus on the impacts of droughts across rural-urban gradients. The study examined small-scale farmers' perceptions of drought impacts and response strategies in the contexts of persistent droughts in the Eastern Cape province of South Africa. A total of 163 respondents, practicing livestock and/or crop farming across six towns, in urban and rural contexts were purposively identified. The study used snowball sampling approach to identify the relevant respondents. Data were collected through a semi-structured questionnaire survey, exploring the respondents' socio-demographic profiles, agricultural activities, perceptions of drought impacts, and drought response strategies. Qualitative data were coded and analyzed using descriptive statistics, thematic analysis, t-tests, and chi-square tests to identify patterns, themes, and relationships within the data. Nearly all (>95%) respondents owned livestock while substantially more rural farmers (81%) than urban farmers (35%) engaged in crop production. Drought was perceived by a sizeable proportion (>70%) of small-scale farmers as a very serious environmental challenge with adverse socio-economic repercussions on land-based activities. Livestock losses and crop failure were the key impacts reported by small-scale farmers in both rural and urban settings. About 86% of respondents across the sample reported declines in crop yields, with significantly more farmers in rural sites (45%) than urban sites (31%) reporting so. A substantial proportion of farmers across the sample (93%) reported drought response strategies relating to livestock and crop production, such as changing of farming practices, use of drought-resistant crops and government support, with slight differences in the proportion of farmers reporting so between urban (89 %) and rural (95 %) sites. Concerning government support, most respondents (>70%) stated that they were dissatisfied, with slightly more respondents in urban areas (77%) than in rural (70%) areas reporting so. Overall, the results of this study suggest a minimal response capacity of small-scale farmers to droughts in both rural and urban settings due to socio-economic and administrative factors, which calls for the need for drought-response strategies to build adaptive capacity for small-scale farmers. Turning to close cooperation between different stakeholders, such as local

farmers, government officials, practitioners, and scientists might allow co-production of knowledge needed to inform drought response strategies. In some instances, attention needs to be given to farmers who are more vulnerable than others.

CHAPTER 1: GENERAL INTRODUCTION

1.1 Introduction

Global warming due to climate change is expected to cause varied weather patterns, particularly increased temperatures and droughts (Udmale et al., 2014; Lottering et al., 2020). In the previous decades, approximately half of all countries (Wu et al., 2015) and more than half of the population globally have experienced severe droughts (Azadi et al., 2019; Quandt, 2021). The Intergovernmental Panel on Climate Change (IPCC) has predicted that drought occurrence is projected to increase in severity, duration, and impacts on land-based livelihoods (IPCC, 2021). Climate change has been projected to increase the frequency of droughts and severe weather globally, particularly in semi-arid regions with extreme water stress (Dai, 2013; Cook et al., 2018; IPCC, 2021). Droughts are among the world's largest natural disasters, with considerable losses to ecosystems (Allen and Breshears, 1998; Breshears et al., 2005; Cook et al., 2018), agriculture (Cooley et al., 2015; Cook et al., 2018), and rural livelihoods (Gautier et al., 2016). This represents a serious threat to food production for sustainable livelihoods (Bai et al., 2019), particularly in third-world countries that are agriculture dependent. Although drought is a naturally occurring climatic cycle (Lottering et al., 2020), other factors such as the increasing human population which results in an increased demand for water (Ruwanza et al., 2022), anthropogenic factors such as overgrazing, poor agricultural practices (Gomiero, 2016; Lottering et al., 2020), and poor water management (Ruwanza et al., 2022) can trigger drought events and the associated socio-economic vulnerability (Van Loon et al., 2016). Therefore, risk management of increasing drought intensity and frequency is a significant global task (IPCC, 2021).

The agricultural industry remains the most vulnerable to droughts affecting crop (Neisi et al., 2020) and livestock production (Wankar et al., 2021). Agricultural droughts occur when the amount of water in the soil has decreased to a threshold level, is deficient for crop growth and affecting crop yields (Vergni, 2004). The Food and Agriculture Organisation (FAO) states that the agricultural industry has experienced a significant economic impact as a result of climate change effects, with livestock experiencing much of the harm and crop production(FAO, 2017). For example, the US state of California experienced a severe drought

between 2012 to 2016, which impacted the agricultural sector. This drought event caused a significant reduction in crop yields because farmers had to reduce their water usage, and some were forced to fallow their land, resulting in economic losses for the industry (Lund et al., 2018). According to the Organisation for Economic Co-operation and Development (OECD), agricultural regions that are highly dependent on rain-fed water have been subjected to increasing water constraints, undermining the productivity of rainfed and irrigated crops and livestock activities (OECD, 2019). Similarly, in Ethiopia, an El Niño driven drought led to crop failures, livestock mortalities, and water shortages affecting livelihoods and food security (Menghistu et al., 2018).

Most people in Africa rely on subsistence farming for food and is therefore highly susceptible to drought conditions (FAO, 2017). The IPCC (2007) predicted that 250 million people in Africa would face a risk of water stress affecting mostly agriculture which is a primary socio-economic activity. Previous and recent reports indicate that droughts have become more severe and widespread in Africa, and the continent is getting hotter at a faster rate compared to other parts of the world (IPCC, 2007; Kotir, 2011; IPCC, 2021). Furthermore, the temperature increase is expected to reach 2°C warming which is above the anticipated global warning level (IPCC, 2021). Therefore, changing climate conditions are causing more unpredictable and extreme weather conditions such as droughts, and these changes have direct impacts on the continent (Lottering et al., 2020). Livestock and crop production in Africa are mainly rainfed, thus makes these production sectors more vulnerable to droughts because of changing rainfall patterns and increasing temperatures (Shiferaw et al., 2014). The livestock sector plays an important role in the lives of people living in rural areas and overall economies of most African countries, and approximately 100 million people sustain their livelihoods through livestock farming (Kristjanson et al., 2014; Nyberg et al., 2015; Zougmore et al., 2016).

However, livestock production in Africa is connected to the use of natural rangelands, which can lead to degradation under persistent future droughts (Roudier et al., 2011). Furthermore, livestock is often raised alongside crops in small-scale farming systems, where crop residues are used as animal feed to make the most of the available resources (Baudron et al., 2014). Drought is a major challenge to livestock production in Africa through declining in vegetation

production and water scarcity, leading to increased livestock mortalities (Hiernaux et al., 2009; Zougmore et al., 2016). The adverse drought impacts on crop yields depend primarily on the severity of the event and the stage of plant growth, and these extensive droughts have caused substantial yield losses in large field crops (FAO, 2017). Since drought negatively impacts agricultural practices (Kala, 2017), small-scale farming remains constrained due to the dependence on agricultural practices to survive (FAO, 2017).

South Africa, which is a drought-stricken country, is predicted to suffer from severe drought conditions by 2030 (Otieno and Ochieng, 2004; IPCC, 2021; UNCCD, 2022). Lately, the country has experienced some of the worst recent drought periods between 2015 and 2017 because of extreme El-Nino conditions (Baudoin et al., 2017). This El-Nino related drought was considered a long-term drought (lasting 12 months and more) and deemed by the authorities as the worst drought in history (Botai et al., 2016; DAFF, 2016; Vogel et al., 2019). Besides the above-mentioned 2015-17 drought event, South Africa has experienced other drought events in 1973–1974, 1983–1984, 1991–1992, 1994–1995, and 2014–2015 (Ruwanza et al., 2022). Droughts in South Africa have caused a significant strain on the economy, environment, local people, and rising pressures on the country's agroeconomic systems (Baudoin et al., 2017). Furthermore, challenges related to water scarcity have become apparent, though not an agricultural drought, the water crisis in Cape Town, South Africa, had a substantial effect on agricultural sector (Pili and Ncube, 2022). The drought resulted from limited rainfall, leading to the depletion of the city's water supply (Booysen et al., 2018; Brick et al., 2018). This, in turn, led to restrictions on water use for agriculture, resulting in reduced crop yields and economic losses for farmers. Furthermore, it is well acknowledged that the 2014-2016 drought turned the country from being able to export grains to becoming reliant on importing them instead (Baudoin et al., 2017). While, small-scale farmers were affected by reduced crop yields, livestock mortalities, and water shortages (Jordaan et al., 2019; Bahta, 2020; Vetter et al., 2020; Lottering et al., 2021). Correspondingly, small-scale farmers were forced to sell their livestock or migrate to urban settings in search for work to sustain their livelihoods. Other small-scale farmers struggled to access financial support, leaving them vulnerable to economic losses. For example, small-scale in the Free-State and Mpumalanga opted to sell their assets and took out loans (Adisa et al., 2018; Muthelo, 2018).

Since drought events are frequently rising, adaptation strategies have been formulated and implemented to improve adaptive capacity (Hou et al., 2017). Farmers implement a variety of agricultural and technical activities during drought events such as changing fertilizer inputs, adopting drought-tolerant crops and planting crops that need less water (Bahta, 2016; Lunduka et al., 2019; Lottering et al., 2020). Other coping methods farmers use are direct seedling and zero-tillage to preserve soil moisture loss (Patt and Gwata, 2002; Nembilwi et al., 2021; Renwick et al., 2021). These approaches require less water and seem ideal for early planting. Small-scale farmers in Zimbabwe, have opted to sell their livestock to make up for the shortfall in income due to inadequate harvest (Adger et al., 2002; Patt and Gwata, 2002), though this typically happens during extreme periods of stress. Therefore, small-scale farmers often use mixed farming methods, combining livestock and crop methods to ensure that the production is maintained for a prolonged duration (Scholtz et al., 2016). The responses to drought have mostly been post-drought interventions such as drought relief funding from the government, although these have been reported to be ineffective (Ruwanza et al., 2022). For example, Lottering et al. (2021) reported that small-scale in uMsinga were unhappy about government interventions in drought management. Most of the drought responses have been technical and educational, and information has not been readily available to small-scale farmers making it difficult to implement sustainable response strategies (Ruwanza et al., 2022).

1.2 The rationale of the study

Although South Africa has a Drought Management Plan (DMP) which aims to develop an effective, integrated risk, disaster management systems to minimize the drought impacts (DMP, 2005), preparing for and managing droughts remains a challenge (Vogel and Olivier, 2019). Policymakers are provided with early warnings of possible impacts on water supply and livelihoods, but this does not trigger an immediate response by implementing drought risk preparedness measures (Baudoin et al., 2017). Buurman et al. (2019) argue that many areas in the country cannot adapt and be resilient to drought events because policymakers often react to drought that is, by providing water and food aid to the impacted small-scale farmers than addressing the fundamental cause by implementing drought management strategies timeously. For example, areas in the Amathole district municipality in the Eastern

Cape province of South Africa have received community water tanks and food packages during extreme droughts. Still, a lack of awareness on how to adapt to drought at household level persists. This reactive response approach is tantamount to crisis management and has been deemed ineffective because it does not plan for drought conditions but deals with the impact when the event occurs (Mohammad et al., 2018; Lottering et al., 2021; Savari and Amghani, 2021). Therefore, an effective plan for improving adaptation strategies is necessary. To develop an effective plan, information on small-scale farmers' perceptions and responses to drought is needed, and remains limited in developing countries (Wilhite, 2002; Sivakumar et al., 2014; Lottering et al., 2021). This study is motivated by the need to gather such baseline information about small-scale farmers' drought perceptions, which can then be used to develop effective drought management strategies.

Since there is limited comprehensive information on the perceptions of the impacts of droughts (Habiba et al., 2012; Udmale et al., 2014; Bahta et al., 2016; Ofoegbu et al., 2016; Lottering et al., 2021; Talanow et al., 2021; Bahta, 2021), this calls for research aimed at understanding drought impacts and how they can be addressed to build resilience. Considering the expected increase in frequency and severity of droughts, it is important to document and inform the scientific community and policymakers on the impacts, response strategies perceived and experienced at local levels. Studies related to small-scale farming have mainly focused on rural areas but not urban settlements (Jordaan et al., 2019; Vetter et al., 2020; Lottering et al., 2021), making it difficult to appreciate the influence of biophysical, socio-economic, and institutional settings on drought impacts and the responses to droughts employed by local communities across a rural-urban gradient. Improving an understanding of drought impacts across a rural-urban gradient can inform and enhance the development of effective interventions to minimise drought impacts (Ruwanza et al., 2022).

Perceptions of drought can play an important role in understanding the impacts of drought. People perceive droughts based on experience, memory, definition, and expectation, and this influences the behaviour, decisions, and attitudes towards drought impacts (Elum et al., 2017). These factors influence how one responds to drought impacts. For example, people may perceive drought primarily as a temporary inconvenience, while others might see it as a

severe threat to their livelihoods and well-being (Elum et al., 2017). People who rely on agricultural practices as a means of subsistence experience drought considerably differently from those who do not (Lottering et., 2021). Small-scale farmers, for example, usually diversify their crop, implement water conservation and irrigation practices, and livestock management based on how they perceive drought conditions (Slayi et al., 2023). Therefore, this influences how small-scale farmers respond to the impacts of drought. Strengthening the perceptions of drought involves building an adaptive capacity. This is mostly done by providing financial incentives and support (technical support and capacity-building) that align with their perceptions and needs (Popoola et al., 2020; Lottering et al., 2021; Slayi et al., 2023). Furthermore, response capacity is improved by fostering collaborations among government institutions, non-governmental organizations, researchers, and local communities (Mare et al., 2018; Slayi et al., 2023). A multi-stakeholder approach can help bridge gaps between different perceptions and facilitate the development of comprehensive response strategies.

This study fills this gap by assessing drought perceptions on the impacts and adaptation measures in both rural and urban contexts. The perceptions and experiences need to be investigated because it is only then that current knowledge and understanding of drought impacts can be harnessed and implemented towards strengthening drought responses and mitigation. Improving drought preparedness and responding effectively is necessary to reduce small-scale farmers vulnerability on drought impacts in both urban and rural settings. The Eastern Cape province of South Africa was chosen as a case study area because it has been recently declared a drought disaster area and is considered one of the most vulnerable provinces to disasters due to high rates of poverty, excessive environmental degradation, poor household economies and limited access to resources (Bahta et al., 2016; Jordaan et al., 2019).

1.3 Research objective and key questions

The main objective of this proposed study is to examine small-scale farmers' perceptions of drought impacts and adaptation strategies in an urban-rural gradient in the contexts of persistent droughts in the Eastern Cape province of South Africa. The key questions of the study are:

1. What are the small-scale farmers' perceptions of the impacts of drought?
2. What are the drought response strategies of small-scale farmers?
3. What are the implications of the findings on drought impacts and response strategies?

1.4 Thesis outline

This thesis consists of six chapters that are organised as follows: Chapter one provides a general introduction and a brief overview of the study including the rationale, overall objective and key questions. Chapter two provides a critical and detailed review of the literature. Chapter three describes the study site and outlines the methodology used in the study. Chapter four explores the perceptions and experiences of the impacts of droughts on livestock and crop production across an urban-rural gradient in the Eastern Cape province of South Africa. Chapter five examines responses to drought, including drought management approaches employed by small-scale farmers in the Eastern Cape province of South Africa. Both chapters four and five are presented in journal article format. Chapter six provides the overall conclusions and including recommendations and implications of the study findings.

CHAPTER 2: LITERATURE REVIEW

2.1 Droughts and land-based livelihood activities

Climate change effects continuously affect human well-being, with negative repercussions on economic growth in developing countries (Dai, 2013; Cook et al., 2018; IPCC, 2021). The Sustainable Development Goal 13 calls for an immediate action to minimize the impact of climate change and strengthen resilience and build an adaptive capacity to natural hazards such as drought. Recently, warmer climatic conditions have become common due to extremely increasing temperatures causing severe drought conditions (IPCC, 2021). Drought definitions have been categorized as conceptual (generic in their description) and operational (designed to identify the detailed attributes and thresholds which define the onset, continuation, and termination of drought events, as well as their severity) (Wilhite, 2000). Wilhite (2005) argues that the conceptual definitions refer to drought (i) as a persistent and prolonged lack precipitation (see also World Meteorological Organization, 1986) or United Nations Convention to Combat Desertification (UNCCD) "the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems" (UNCCD,2007:4).

The operational definitions of drought define drought according to classifications, that is, meteorological droughts, hydrological droughts, agricultural droughts, and socio-economic droughts (Wilhite and Glantz, 1985; Wilhite, 2000). Meteorological droughts are determined by how dry it is and the length of the dry period (Wilhite, 2005), and are specific to a region as climatic conditions differ from one place to another (Botai et al., 2016; Lottering et al., 2020). Hydrological droughts occur when there is an inefficient surface and groundwater supply (Wilhite, 2000; Mishra and Singh, 2010). According to Vergni (2004), agricultural droughts relate to when the amount of water in the soil has decreased to a threshold level, is deficient for crop growth affecting crop yields. On the other hand, socio-economic droughts acknowledge the interdependence between droughts and human activities (Wilhite, 2000; Mishra and Singh, 2010). Classifying droughts is necessary for predicting drought impacts on small-scale farmers based on the adequacy of rainfall, availability of water, and impacts on

livelihoods and resilience. Therefore, it makes it easy to understand droughts and develop relevant interventions to ensure that small-scale farmers respond effectively. Lottering et al. (2022) reported that small-scale farmers perceived drought through the socio-economic impacts experienced, whereas formal stakeholders viewed drought from scientific and environmental aspect. These different perspectives show that the concept of drought is not fixed and absolute but rather depends on the specific contexts (Lottering et al., 2022).

Vulnerability assessments have been used to understand the effects of drought on agricultural systems (Farhangfar et al., 2015). Adger (2006: 269) defines vulnerability as "the capacity of individuals to respond to, recover from or adapt to livelihood stress as a result of the impacts of environmental change". Therefore, vulnerability depends on how well the affected people can adapt or cope with drought which is characterized by socio-economic and environmental attributes (Kallis, 2008). For example, most small-scale farmers rely on rainfed agriculture to sustain their livelihoods. Depending on rainfed agriculture can increase drought vulnerability, hence, it is important to understand vulnerability based on the communities involved to formulate effective response strategies (Lottering et al., 2021). Lottering et al. (2021) reported that small-scale farmers' vulnerability is generally high and influenced by socio-economic, environmental, and institutional factors.

Smit and Wandel (2006) and Carrao et al. (2016) mention that drought risks are determined by hazard, exposure, and adaptive capacity. Buurman et al. (2017) define hazard based on the frequency, and the intensity of drought events, and exposure as elements such as vegetation, productivity, and humans that are affected by drought. Furthermore, in disaster preparedness, adaptive capacity refers to how well a system and its components can absorb or adjust to the impact (IPCC, 2021). Therefore, adaption improves the ability to cope, and this often requires human and financial resources (Sam et al., 2020).

There has been use of various indicators to measure the exposure and vulnerability to droughts (Bachmair et al., 2016; Buurman et al., 2017). Neset et al. (2019) reported that vulnerability indicators are difficult to apply practically, due to varying definitions and thresholds based on the geographical and temporal scales in the region being studied. A study in Malawi used the Standard Precipitation Index (SPI) to assess drought vulnerability of rain-fed maize and the results indicated that the drought event negatively impacted production

during ploughing seasons (Jayanthi et al., 2013). A focus on indicators to assess drought impacts is necessary and gives a more scientific analysis and monitoring over time and can provide vulnerability assessments (Neset et al., 2019). However, this often leads to a loss of contextual information on drought risks and vulnerabilities as it is more quantitative (Neset et al., 2019). Assessing the perceptions of the drought impacts is necessary as it poses direct effects on humans and has an influence on the response strategies. Perceptions can provide social contours to understanding the impact of droughts because the same impact may be perceived differently due to the socio-economic standing of individuals. A study in Ghana, on the vulnerability of crops to droughts used data on rainfall, crop yield, and socio-economic factors, and revealed that the vulnerability of crop production to drought varied across different locations and socio-economic conditions (Antwi-Agyei et al., 2012).

Small-scale farmers in rural settings sustain their livelihoods from rainfed-agriculture limited to a short-term rain period (Burney and Naylor, 2012). The crops grown are mostly staple foods, mostly cereals needed to sustain small-scale farmers' livelihoods (Burney and Naylor, 2012). However, these crops are subject to changes in climatic conditions causing a reduction in yields making small-scale farmers more vulnerable (Mango et al., 2018). Urban farming practices have been used as a strategy to change the social and environmental forms of the urban landscape (Diekmann et al., 2017). This form of agriculture includes home gardens, school gardens, and urban farms (McClintock, 2014). The FAO (2017) defines urban agriculture as the growing of food crops and non-food plants, livestock rearing within and on the outskirts of the city. Urban agriculture has been viewed as one of the significant ways to improve food security in urban areas and an opportunity to decrease malnutrition and poverty rates (FAO, 2017). This form of agriculture not only alleviates food security but creates employment opportunities for the urban poor (Phuong et al., 2016; Schmidt, 2011). Historically, urban dwellers have widely practised urban livestock rearing and crop production due to its contribution to sustaining livelihoods (Castillo, 2003; Butler, 2012; FAO, 2017; Thondhlana et al., 2022). Consequently, urban farming practices including livestock production have been realized as important by international organizations as an imperative coping strategy to alleviate poverty in urban settings, pressuring the local municipalities to abide by this new urban development agenda (Butler,2012; McClintock et al., 2014). Yet these

livelihood opportunities are threatened by recurrent droughts, which negatively impacts the well-being of small-scale farmers.

Furthermore, in South Africa, research on urban agriculture has mainly centered on large urban areas such as Cape Town, Gauteng and focusing on commercial farming rather than communal urban farmers. There is also minimal research on small urban and intermediate urban areas with emerging potential for the successful practice of urban agriculture (Martellozzo, 2014). Given this context, there is a need to assess the perceptions of the impacts of drought at local scales along an urban-rural gradient by assessing how have people who practice urban agriculture been affected by the current droughts as a basis of providing more contextual information and formulating drought interventions (Sam et al., 2020).

2.2 Small-scale farmers perceptions of drought

According to Slegers (2008) and Sam et al. (2020), drought perceptions are based on experience, memory, definition, and expectation, which shape how people view drought. An individual's memory is shaped by prior drought experiences, which affect how an individual defines and interprets drought (Elum et al., 2017). These factors ultimately influence how one responds to drought's effects. People who rely on agricultural practices as a means of subsistence experience drought considerably differently from those who do not (Lottering et al., 2021). Therefore, it is crucial to comprehend the perceptions of small-scale farmers directly impacted by drought based on their experiences to assess and formulate context-specific drought interventions (Lottering et al., 2021). Small-scale farmers' perceptions of drought can vary widely, influenced by factors such as cultural background, historical context, and personal experiences to previous drought events, socioeconomic status, and access to information (Sam et al., 2020).

Understanding how small-scale farmers perceive and respond to droughts, as well as the extent to which drought affects them can help guide the implementation of relevant response strategies (Debela et al., 2015; Aldunce et al., 2017). For example, Sam et al. (2020) allude that small-scale farmers who have experienced drought and understand the effects are more inclined to predict droughts and are more willing to act to minimize the negative impacts.

These small-scale farmers adopt varied strategies, including water conservation measures, crop diversification, drought-resistant crops, and alternative water sources compared to those with no experience who often have low adaptive capacity. Small-scale farmers' perceptions are influenced by access to weather information and extension support. For example, small-scale farmers that have access to weather information and extension support are likely to accurately estimate the rainfall patterns which can improve their preparedness (Kamruzzaman, 2015; Ogundeji and Okolie, 2022). Such small-scale farmers have experience in risk mitigation and therefore employ effective strategies to improve their adaptive capacity (Ogundeji and Okolie, 2022). Extension support such as training, good governance and policy, and multi-stakeholder collaborations can play a significant role in shaping the perceptions of the drought impacts and response strategies. For example, capacity-building that highlights the seriousness of drought can lead to increased awareness and encourage individuals and communities to adopt adaptive measures (Ogundeji and Okolie, 2022; Slayi et al., 2023). Moreover, if government policies and regulations aimed at drought management prioritize and support proactive measures, small-scale farmers are more likely to perceive drought as a significant concern and respond accordingly (Slayi et al., 2023). Furthermore, multi-stakeholder collaborations in communities can shape the adoption of communal strategies, such as water-sharing agreements or joint conservation efforts (Slayi et al., 2023).

Drought perceptions are also based on the economic and social effects it has on different individuals (Slegers, 2008) and are influenced by characteristics of the dry period and by whom is vulnerable (Higginbotham et al., 2014; Urquijo and De Stefano, 2016). Socio-demographic factors such as age, farming experience, education, and income play a role in shaping small-scale farmers' perceptions of the impacts of drought (Muthelo et al., 2019; Ogundeji and Okolie, 2022). Mudombi-Rusinamhodzi et al. (2012), Alemayehu and Bewket (2017), and Mwadzingeni et al. (2022) found that the perceptions of older people who have farming experience and have experienced several drought events are influenced by their resilience and ability to cope with drought based on historical experiences. However, Mwalukasa et al. (2018) reported that although older small-scale farmers have experience, age can hinder their ability to adopt technological and innovative strategies to respond to drought impacts. Concerning education levels, small-scale farmers with higher levels of

education generally respond to droughts effectively because they are equipped with knowledge and skills to respond to drought impacts and improve livelihoods (Lottering et al., 2021). For example, Pickson et al. (2021) indicate that low educational levels and skills undermine small-scale farmers' ability to manage their farming practices, affecting their adaptive capacity.

Therefore, higher education can improve small-scale farmers' response capacity (Thathsarani and Gunaratne, 2018; Choden et al., 2020). Similarly, in Mali, respondents with higher education levels were less impacted by natural disasters due to their diversified economic activities beyond agricultural practices (Muttarak and Lutz, 2014). Furthermore, Ogundeji and Okolie (2022) argue that small-scale farmers who have received specialized training or possess secondary education are likely to make accurate predictions regarding the expected rainfall during the onset of the farming period. A study by Rankoana (2016) in the Limpopo province, South Africa, found that negative drought impacts reduced due to the communities' indigenous knowledge, including the ability to predict rainfall patterns, crop diversification and mixed cropping. Such level of understanding is essential in preparing response strategies to tackle the influence of extreme temperatures and insufficient rainfall on sustainable livelihoods (Gandure, 2011).

Small-scale farmers with higher incomes have access to financial resources to employ sufficient drought response strategies and this improves their adaptive capacity and how they perceive the impacts of drought (Lottering et al., 2021; Savari and Amghani, 2022). For example, small-scale farmers who rely on agriculture for their livelihoods may have a more acute perception of drought due to its direct impact on their income and well-being, resulting to more determined efforts to implement response strategies. Legesse et al. (2013) found that small-scale farmers with access to financial resources are likely to make accurate rainfall predictions and thus influence their adaptation choice.

In South Africa, different social groups perceive drought impacts on how drought affects them, and their experiences may shape their perceptions of the severity of drought and the effectiveness of policy and responses.

Studies indicate that small-scale farmers are informed of natural hazards and their effect on livelihoods (Haque et al., 2012; Nhemachena et al., 2014; Rankoana, 2016). However, small-scale farmers' perceptions of droughts are based on fluctuations in temperature and rainfall patterns reflected in the decline in agricultural productivity (Gandure, 2011; Nhemachena et al., 2014). For example, Bahta and Jordaan (2019) reported that small-scale farmers in the Eastern Cape province perceived changes in temperature and rainfall, whereas the other half did not agree with this observation. Similarly, in Limpopo province, small-scale farmers perceived no changes in the climatic conditions, while the other half noticed less rainfall and higher temperatures (Rankoana, 2016). Since perceptions are influenced by an interplay of individual experiences and socio-economic factors (Dijksterhuis and Bargh 2001; Hou et al. 2017; Devkota et al. 2017), it is paramount that small-scale farmers' perceptions are assessed to understand and develop effective drought response strategies. As climate change exacerbates drought frequency and intensity, acknowledging the diversity of perceptions and tailoring response strategies to local contexts are essential for building resilience and minimizing drought impacts to improve small-scale farmers' well-being.

2.3 Drought impacts on livestock and crop production

South Africa is naturally prone to droughts because of its location and climatic conditions, and the country recorded its worst drought period between 2015-2018 (Baudoin et al., 2017; Sousa et al., 2018). However, droughts in South Africa have been occurring more frequently, particularly in the Eastern Cape and KwaZulu Natal provinces with noticeable water shortages in both urban and rural settings (Mahlalela et al., 2020). Furthermore, South African water sources have continually reduced in capacity (Botai et al., 2016), and cities and towns such as Cape Town, Makhanda, and Gqeberha have seen water shortages for daily consumption driven by recurrent droughts (Dos Santos et al., 2017; Pamla et al., 2021). Droughts have severely affected the national and local economies (Baudoin et al., 2017), with increased pressures on agro-economic systems, particularly on households that depend on small-scale farming to sustain their livelihoods (Shiferaw et al., 2014).

Small-scale farmers are subjected to declines in water availability, crop failure, forage availability and livestock mortalities with severe economic losses (Udmale et al., 2014; Mpandeli et al., 2015; Vetter et al., 2020). For example, small-scale farmers in Zimbabwe lost income generated from agricultural sales, affecting their livelihoods and leaving them with limited opportunities to generate income (Ndhlovu et al., 2020). Similarly, small-scale coffee farmers in Ethiopia experienced declines in yields, accompanied by loss of income and increased production costs as small-scale farmers had to employ response strategies such as irrigation schemes to reduce the impact on the coffee value-chain (Eshetu et al., 2021). Small-scale farmers remain most vulnerable to drought impacts due to limited resources undermining their potential to practice farming activities (Maltou and Bahta, 2019). For example, small-scale farmers in Burkina Faso had limited options of water sources, hindering their ability to maintain crop production during droughts. Small-scale farmers had no access to credit facilities, limiting their ability to purchase farm inputs and build irrigation schemes (Zoma-Traore et al., 2020). This trend is also evident in South Africa, where small-scale farmers in the Eastern Cape, Limpopo, and Free State provinces have no access to financial resources, limiting their capacity to respond to droughts effectively (Ngaka, 2012).

Drought impacts have been reported in several studies on both commercial and small-scale farmers (Bahta et al., 2016; Mare et al., 2018; Lottering et al., 2020; Bahta and Myeki, 2022). As noted, droughts result in substantial socio-economic impacts such as decreased crop yields, income losses, food insecurity, and inadequate resources (Lottering et al., 2021). These socio-economic drought impacts negatively affect the livelihoods of small-scale farmers, which mostly depend on agricultural practices to generate income. For example, in Kenya, small-scale farmers have experienced reductions in crop yields due to the unavailability of rainfall, resulting in income losses and food insecurity (Mburu et al., 2015). Furthermore, in the Eastern Cape and Kwa-Zulu Natal provinces of South Africa, small-scale farmers have experienced livestock mortalities due to reduced herbage, declining water availability to sustain livestock and crop irrigation (Ndlazilwana, 2020; Vetter et al., 2020). This resulted in reduced agricultural productivity leading to unemployment and economic stagnation, mostly in rural areas.

2.4 Socio-economic impacts of drought

Drought affects food security due to declines in agricultural productivity, during the 1991-1992 and 1994-1995 drought periods, South Africa experienced a decline in cereal yields (Austin, 2008). Furthermore, Masipa (2017) reported declines in crop yields, mainly maize and sorghum, resulting in reliance on cereal imports. This was accompanied by socio-economic losses such as jobs due to low productivity (Baudoin et al., 2017), subjecting more people to famine. In Mali, the unavailability of food due to continuous drought affected about300 000 people in 2015 (Giannini et al., 2017). Similarly, among other drivers in Ethiopia, severe drought conditions were reported as the cause for reduced sorghum productivity (Derese et al., 2018). In South Africa, livestock farming productivity declined by 15% with repercussions in the meat industry (Matlou et al., 2021).

The KwaZulu Natal province experienced livestock losses of more than R10 billion during the 2014-2016 drought period (Vetter et al., 2020). Lottering et al. (2021) also reported crop and livestock losses at household level, where small-scale farmers in uMsinga, in KwaZulu Natal lost approximately half of their cattle stock. Furthermore, Bahta (2020) and Rakgwale and Oguttu (2020) reported severe livestock losses by small-scale farmers in Northern Cape and Limpopo provinces, respectively. Other losses included loss of income obtained from selling the livestock (Baudoin et al., 2017; Lottering et al., 2021). However, the true rand value was not reflected as drought could be difficult to quantify financially. Income losses were also recorded during the 2014- 2015 drought in South Africa, but these were not quantified based on farming type and region (Ruwanza et al., 2022). Considering the aforementioned, it is evident that agricultural production declines are accompanied by socio-economic effects that directly affect people. Although there are studies that document socio-economic losses at household level (for example, Mpandeli et al., 2015; Bahta, 2020; Lottering et al., 2021; Matlou et al., 2021), most reported losses are based on experiences at a larger scale that is, commercial farming and these farmers are likely to respond effectively to droughts due to better access to resources, which in turn, improves their adaptive capacity. However, there is limited research on understanding the direct drought impacts on small-scale farmers. Thus, drought Impacts at household level need to be explored as a basis for informing and designing strategies to improve small-scale farmers' adaptive capacity.

2.5 Environmental impacts of drought

Beyond socio-economic impacts, drought events can result in environmental impacts such as changes in the amount and frequency of rainfall and increased temperatures exacerbating the effects on small-scale farmers (Vetter et al., 2020; Lottering et al., 2020). Drought indicators such as declining temperatures and changing rainfall patterns trigger environmental impacts of drought and affect crop and livestock production. For example, suppose there are extended periods of minimal rainfall and high temperatures. In that case, this can prohibit the growth of natural vegetation and crops and water deficit in water sources such as dams, rivers, and wells (Baudoin et al., 2017). In such conditions, crop failure and livestock mortalities are experienced resulting in loss of forage due to the unavailability of soil moisture to allow plants to grow.

Lottering et al. (2021) reported that small-scale farmers in KwaZulu-Natal perceived loss of forage and water and degraded water quality as major environmental drought impacts, resulting in declines in crop productivity and water for livestock. Similarly, Vetter et al. (2020) revealed that loss of vegetation and drying of water sources resulted in severe livestock mortalities and displacements. Furthermore, Jordaan et al. (2019) reported a loss in grazing grass, leaving livestock with limited fodder. Overall, understanding the impacts of drought is necessary to formulate and implement sustainable strategies that will improve the response capacity of small-scale farmers. This can be done by conducting research in areas that will analyse the socio-economic contexts to provide comprehensive approaches that will enhance the understanding for the betterment of designing and implementing context-specific policy and management plans for drought impacts (Drysdale et al., 2021; Ruwanza et al., 2022).

2.6 Responses on the impacts of drought

As a result of drought impacts affecting agriculture, farmers respond by sing adaptation strategies (Muller and Shackleton, 2013) and how farmers perceive the impacts influences the implementation of these strategies. Literature reports various drought response strategies (Mpandeli et al., 2015; Matlou and Bahta, 2019; Kom et al., 2020; Nembilwi et al.,

2021). The widely used response strategies in small-scale farming include planting drought-resistant crops, crop diversification, changing planting dates, mixed cropping, storing water, culling, selling old stock and no-till farming among others (Mpandeli et al., 2015; Vilakazi et al., 2019; Kom et al., 2020; Lottering et al., 2020).

Habiba et al. (2012) reported that farmers stored their crops in replacement of unavailability of fodder, sold their livestock for alternative income, changed plant dates, planted crops that consume less water, and water harvesting. In Zimbabwe, small-scale farmers used accessible and alternative farm inputs such as composts and organic matter to improve soil nutrients (Muzari et al., 2016). On the contrary, some farmers stopped practising crop production due to insufficient soil properties required (Habiba et al., 2012). Small-scale farmers in uMsinga and Vhembe districts in South Africa preferred drought-resistant crops, crop rotation, mixed cropping, and early maturing crops as drought response strategies (Kom et al., 2020; Lottering et al., 2021). Using such strategies helps prevent crop losses or damage caused by drought-related factors such as reduced crop growth and increased crop diseases and pests (Ruwanza et al., 2022).

Regarding livestock farming, destocking is a typical coping mechanism for livestock farmers during droughts (Ngaka, 2012; Mpandeli et al., 2015; Bahta, 2020). These destocking strategies include selling old stock and moving cattle to areas that are not exposed to drought (Ngaka, 2012). During droughts, farmers also purchased maize and lucerne as supplemental fodder. To cope with animal diseases related to drought, some small-scale farmers purchased vaccines, which is likely to increase their input costs during drought years (Vetter et al., 2020). However, due to high financial costs, most small-scale farmers cannot afford such interventions. Storing water, silage, traditional medicine and harvesting grass are some cost-effective strategies used by small-scale farmers to cope with drought (Lottering et al., 2020). A Burkina Faso study revealed that combining water conservation methods and crop rotation improved crop productivity and income (Zoma-Traore et al., 2020).

Occasionally, relevant government departments provide small-scale livestock farmers with fodder such as lucerne and barley (Jordaan et al., 2013; Rakgwale and Oguttu, 2020).

However, studies have reported that these often come late, are insufficient, and corruption is involved during distribution resulting in households not receiving any aid (Jordaan, 2012; Ngaka, 2012; Bahta et al., 2016; Bahta, 2020). Poor extension support reduces the ability of small-scale farmers to adapt to drought, resulting to demotivation in applying alternative response strategies due to inadequate knowledge and financial resources. Agricultural extension support in the form of training and awareness programmes is minimal, and it was suggested that the use of awareness tools is necessary to improve the role of government institutions in drought management (Bahta et al., 2016). Jordaan (2012) mentions that across urban and rural areas, there are no established organizations which provide support during drought periods. Small-scale farmers tend to rely on municipalities with poor service delivery record (Jordaan, 2012).

In some cases, agricultural extension support is done through co-operatives, where small-scale farmers must collaborate to tackle problems faced with agricultural production (Bahta et al., 2016; Gwiriri and Benette, 2020). However, these co-operatives fail due to poor management and lack of resources. Therefore, Zantsi (2020) suggests improving co-operatives by involving more extension officers and specialists to cater for agricultural needs and improve productivity. Similarly, it is well documented that government institutions tend to apply reactive approaches when a drought event occurs (Bahta et al., 2016; Lottering et al., 2021). These are mostly relief programmes that have been reported to be insufficient and often delayed (Jordaan, 2012; Bahta et al., 2016). Bahta et al. (2016) stress the importance of consulting small-scale farmers for insights on their perceptions to apply relevant response strategies.

Drought is managed through the Integrated Drought Risk Management Framework, that is, monitoring early warning systems, vulnerability and impact assessment, and mitigation, preparedness, and response (DMP, 2005; Tadesse, 2016). To begin with, early warning encompasses monitoring specific indicators that help predict droughts, these indicators include rainfall, temperature, soil moisture, vegetation health, water flow in streams, and groundwater levels (Tadesse, 2016). Secondly, vulnerability and impact assessments aim to identify the factors that increase the susceptibility of a system to drought impacts and understand factors that contribute to vulnerability to build resilience (Tadesse, 2016). Lastly,

drought preparedness and response include structural (such as crops, and dams) and non-structural measures (such as policies, awareness, and information sharing) to minimize drought impacts (Tadesse, 2016). Responses to drought include aiding during or after the drought event has occurred in accordance with the long-term disaster plan (Tadesse, 2016). Though the Integrated Drought Risk Management Framework plans to provide structural early warning information, vulnerability assessments, and respond effectively to droughts, it is argued that government manages drought by responding to the impacts subsequent to the drought event (Mohammad et al., 2018; Buurman et al., 2019; Savari and Amghani, 2021).

In response to the issue of drought, governments have shown concern and initiated numerous interventions to aid affected populations (Karrou and Mourid, 2008; Bahta et al., 2016). However, most of these programs have primarily focused on crisis management and reactive measures, only partially addressing small-scale farmers' direct impacts (Bahta et al., 2016; FAO, 2017; Lottering et al., 2021). There has been a lack of substantial investment in long-term solutions that involve the development of strategies based on risk management, instead relief schemes such as subsidized fodder and welfare payments (Karrou and Mouris, 2008; Bahta et al., 2016; Herwehe and Scott, 2018). However, these relief efforts have faced delays and inadequate provisions (Bahta et al., 2016; Herwehe and Scott, 2018). For example, in Brazil, small-scale farmers have reported excessive bureaucracy in the distributing government aid, and some felt that it took long for the relief schemes to arrive (Herwehe and Scott, 2018). While government institutions in South Africa have initiated interventions to reduce drought impacts, there has been a limited emphasis on implementing comprehensive strategies for long-term risk management. The focus has been on meeting the immediate needs of small-scale farmers rather than enhancing their resilience to future droughts. Therefore, understanding how small-scale farmers perceive drought is crucial for developing relevant policies to reduce droughts' impact.

CHAPTER 3: STUDY AREA AND METHODS

3.1 Study area

The study was conducted in six small towns, namely, Peddie, Alice, Fort Beaufort, Whittlesea, Cacadu, and Bhisho in the Eastern Cape province of South Africa (Figure 1). The Eastern Cape covers an area of approximately 170 000 km^2, making it the second largest province in South Africa (Hamann and Tuinder, 2012). The province represents about 14% of the total population of South Africa (Community Survey, 2016), and it borders four South African provinces, namely, Western Cape, KwaZulu-Natal, Free State, Northern Cape as well as the neighbouring country of Lesotho. The weather patterns in the Eastern Cape range from mild warm temperatures to subtropical conditions, particularly along the coast (Climate Data, 2022). The average annual temperature across the study towns ranges from 15.4 – 18.3 ˚C (Climate Data, 2022) (Table 2.1). Drought conditions exist throughout the year, but the ploughing season is generally from October to March (Graw et al., 2017). The Eastern Cape has experienced recurrent droughts hence assessing perceptions of the impacts and responses to drought can provide insights into the effectiveness of strategies and interventions. The province's diverse agro-ecological zones, urban and rural landscapes are important for assessing the urban-rural gradient, providing a unique opportunity to examine how drought perceptions and response strategies differ between urban and rural contexts. Agricultural activities, particularly livestock and crop production in the province are significant for sustaining livelihoods and drought impacts have far-reaching socio-economic consequences.

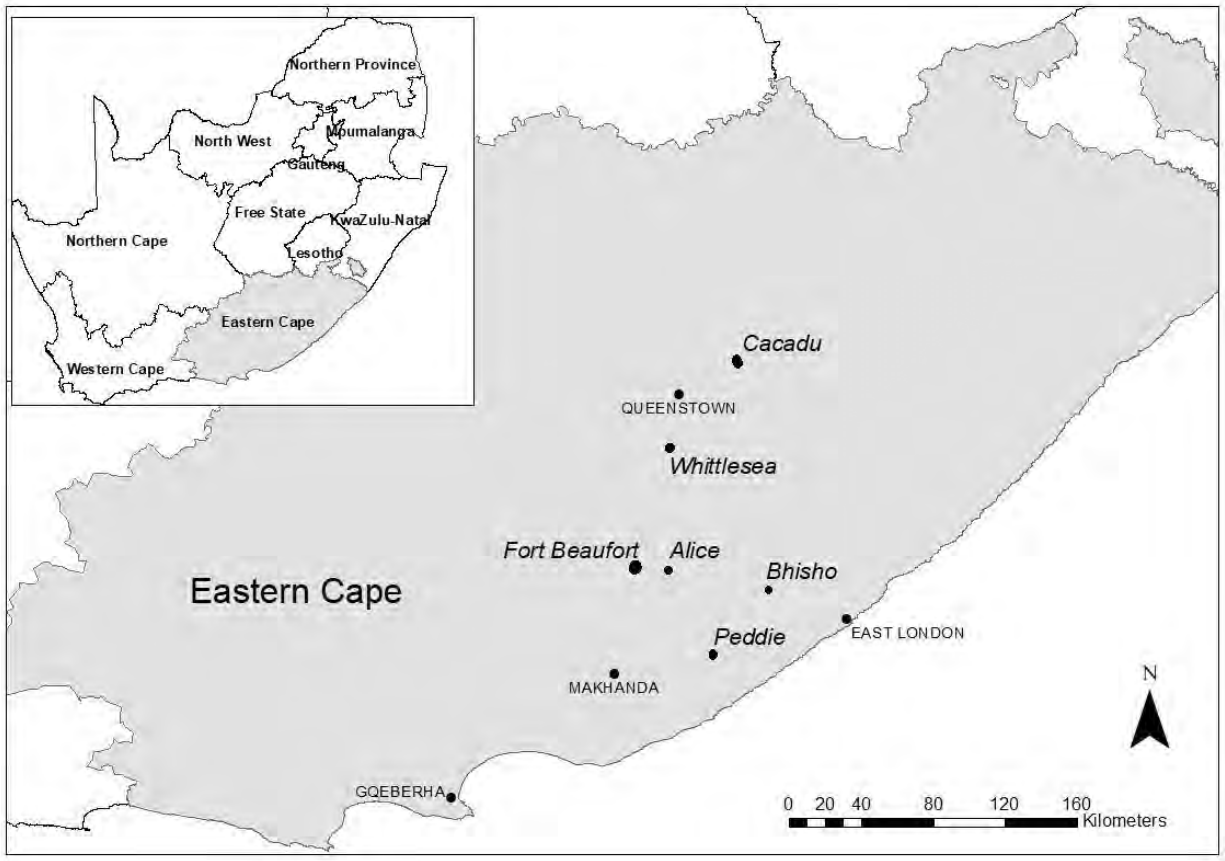

Figure 3.1. Map showing study towns.

There are variations in the amount of rainfall in the province depending on the seasons, but most rainfall is received during the austral summer months of November to April (Climate Data, 2023). The eastern part of the province receives approximately 700-1000 mm of rainfall annually, and the western part, the driest, receives approximately less than 400 mm of rainfall annually (Climate Data, 2022). The average annual rainfall in the study towns at the time of data collection ranged from 396 - 932 mm, with Cacadu receiving the lowest and Bhisho receiving the highest (Table 1). The province is mainly covered by the savanna biome, Nama karoo, thicket, and grassland biome which is largely distributed (Mucina and Rutherford, 2006). A significant portion of the land in the province is dedicated to agricultural practices, primarily involving livestock rearing and cultivating crops (AgriSA, 2016). Approximately 35 % of households in the Eastern Cape Province are actively involved in small-scale agricultural activities (Graw et al., 2017), and the majority are engaged in livestock farming (DAFF, 2016). Therefore, the grassland biome in the province is essential for pasture and ploughing.

Table 3.1. Town, location, average annual temperature, and average annual rainfall across six towns.

Town	Co-ordinates	Average annual temperature (°C)	Average annual rainfall (mm)
Peddie	33°11’42’’S, 27°06’95’’E	18,3	582
Alice	32°47’25’’S 26°49’59’’E	16,8	782
Fort Beaufort	32°46’44”S 26°38’07”E	17	782
Whittlesea	32°10’36”S 26°49’28”E	15,4	669
Cacadu	31°39’02’’S, 26°55’57’’E	15,5	396
Bhisho	32°50’58”S 27°26’17”E	16,7	932

Overstocking livestock is among the major problems in the province and is one of the primary drivers of the degraded landscapes (Graw et al., 2017). Communal-cultivated land primarily consists of small-scale agriculture that relies on rainfall and follows traditional management practices (DAFF, 2016). On the other hand, commercially cultivated land focuses on large-scale agriculture and often utilizes advanced techniques like irrigation systems (DAFF, 2016). While commercial land is spread throughout the province, communal land is primarily concentrated in the eastern region of the province which also has a higher population size (AgriSA, 2016; DAFF, 2016). Small-scale farms in communal areas predominantly have an average farm size of 18 hectares, indicating that they are relatively smaller in scale, while commercial farms are distributed over larger land with an average farm size of 1456 hectares (Ngaka, 2012; Graw et al., 2017). The small towns were selected based on population size, that is, towns with a population size of less than 20 000 people (Van Huyssteen et al., 2018).

3.2 Methods

3.2.1 Study design

Six small towns namely, Peddie (n=40), Alice (n=40), Fort Beaufort (n=21), Whittlesea (n=17), Cacadu (n=23), and Bhisho (n=22) were selected from the Eastern Cape province of South Africa for the study. The selection of towns was categorized based on population size as suggested by Van Huyysteen (2018). Van Huyysteen (2018) uses the Council of Scientific and Industrial Research (CSIR) Town Area Typology to categorise towns based on their population

size and have identified several categories namely, city regions/metropolitans, cities/large towns, regional centres, service towns, and small towns. The study focussed on six small towns with a population size of less than 20 000 people. Following identifying all the small towns in the province, all towns were assigned unique identifiers for random selection. A number of six small towns were targeted for representation and resource availability. Using the RANDBETWEEN function in Excel, six small towns were selected.

South Africa has a long history of defining urban and rural areas, which is an important aspect of the country's growth and development plans (Laldaparsad, 2011). Understanding the dynamics in such areas is significant for implementing successful policies (Laldaparsad, 2011). There is no common definition for urban and rural settings in the country, however, classifications are employed depending on the type of application, for example, access to water and sanitation services, well-developed infrastructure, population size, and socio-demographic factors such as level of education (Laldaparsad, 2011). A rural-urban gradient was identified following McDonnell and Pickett (1990) who define the urban-rural gradient based on by the concentration of buildings and infrastructure, along with a high density of human population in urban areas. In contrast, rural sites are characterized by sparse infrastructure and lower population density (McDonnell and Pickett, 1990). In addition, the differentiation between urban and rural areas can be further highlighted by considering biophysical factors, such as pollution, as well as social contrasts, such as the reliance on a consumption-driven economy, financial systems, and transportation in urban areas compared to the dependence on agriculture or the sustainable management of natural resources in rural areas (McDonnell and Pickett, 1990). Drawing the sample across an urban-rural gradient allowed capturing of respondents' perceptions located in specific socio-economic and physical backgrounds.

Households that practised livestock and or crop farming were purposively identified based on prior knowledge of the area in each town of the six towns and immediate surroundings. To increase the sample size, the snowball sampling approach was used to recruit more small-scale farmers across the study towns. A total of 163 respondents were interviewed across all six towns. Purposive sampling follows the non-probability method and selects a sample with

a particular purpose in mind (Bryman, 2016). This technique is also referred to as judgmental sampling, defined as “a process by which sample population is acquired through the discretion given to a particular group or individuals of the population by the researcher because they hold information of the target population that the researcher requires” (Marshall, 1996). Therefore, the first small-scale farmer was identified purposively based on prior knowledge, and other small-scale farmers were identified via referral.

3.2.2 Data collection

Data for this study were obtained via the administration of a semi-structured questionnaire survey consisting of open-ended and closed-ended questions to probe the perceptions of the impacts of and responses to droughts (Appendix 1). Bell and Bryman (2007) describe a questionnaire as a tool which provides the interviewer with a form or medium upon which answers are recorded. The questionnaire was administered between June 2021 and August 2021 and had questions relating to (i) the socio-demographic profile of the respondents, (ii) agricultural activities practised, (iii) farmers' perceptions of the impacts of drought on crop and livestock production, and (iv) small-scale farmers’ drought management strategies.

The first part of the questionnaire collected information on socio-demographics such as age, household size, gender, income status, education level and access to information. The second part of the questionnaire asked questions on agricultural activities and productivity exploring small-scale farmers’ farming practices, changes in crop yields and livestock mortalities and access to early warning information. The third part of the questionnaire collected information on small-scale farmers' perceptions of drought, exploring their understanding of drought impacts and their awareness of the ongoing or experienced droughts. The study drew on past extreme drought timelines and events in the different study areas to remind or give the respondents background information about droughts. This section of the interview also focused on how respondents became aware of the recurrent droughts in the Eastern Cape and how drought impacted crop and livestock production and affected their livelihoods.

The fourth section focused on drought response strategies by small-scale farmers and limitations to employing possible drought response mechanisms. This subsection asked about local response strategies practised, if any new techniques are implemented, and how farmers felt about these strategies. The section elicited information on the advantages of the response strategies employed, challenges encountered with locally adopted response strategies, and other strategies that help farmers implement them consistently, and whether they received any support from local government structures. The interviews were conducted in the local IsiXhosa language and lasted between 30 and 45 minutes each. The household head was targeted for the interviews, and if unavailable, the eldest member of the household was interviewed. Ethical clearance for the study was granted by the Rhodes University Human Research Ethics Committee (REC-241114-045).

3.2.3 Data analyses

Responses were recorded on the questionnaires and transferred to an MS Excel spreadsheet. Qualitative data were coded and sorted to allow numeric analysis on Statistica version 14. Descriptive statistics were presented in tables and bar graphs to summarise the socio-demographic profile of the respondents, agricultural activities undertaken and benefits and perceptions of the impacts of drought on crop and livestock production (Chapter 4). Descriptive statistics were also used to summarise drought response strategies, motivations for employing the strategies, farmers' perceptions of government support and challenges encountered by farmers in responding to drought impacts (Chapter 5). Further analysis was done via MS Excel including calculation of proportions and thematic analysis. Identifying patterns or themes from the data was done by looking at the data manually and identifying common themes that emerged. Similarities and differences between the themes were identified and grouped, and those that are connected were combined. A T-Test was done to identify any differences in age between rural and urban small-scale farmers. A chi-square test was done to establish if there was a relationship between the location (rural or urban) of small-scale farmers and perceptions of the impacts of drought, and there were significant differences in drought response strategies between small-scale farmers in urban and rural areas.

3.2.4 Limitations of the study

The limitations of this study relate to the sampling approach and are twofold. First, the snowball sampling approach employed in this study is prone to sample selection bias because it does not allow proper randomization of the population sample. With snowball approaches, respondents are likely to refer researchers to would-be respondents with similar socio-economic characteristics or who they have a relationship with. Second, the findings cannot be generalised due to a non-random sampling approach (Emerson, 2015). However, the objective of this study was not to generalize the findings but to provide transferrable insights for understanding a fairly complex subject of drought impacts and response strategies. With a sample size of 163 respondents, from six small towns through a snowball sampling approach, the representation of the broader small-scale farming population may be constrained. However, the sample size was sufficient to make comparisons on drought perceptions between urban and rural contexts. Furthermore, the cross-sectional data collection approach, conducted between June 2021 and August 2021, that is, winter season, might have captured the snapshot of the phenomena at a particular point in time, potentially overlooking significant changes over time. Drought impacts and small-scale farmers' responses may vary over different seasons or years, which this study's design may not fully capture. An extended data collection period could provide a more comprehensive understanding of these fluctuations and evolving trends. While efforts were made to ensure clarity and local language understanding, self-reported responses can be subject to recall bias or misinterpretation, potentially affecting the accuracy of the findings.

CHAPTER 4: PERCEPTIONS OF DROUGHT IMPACTS ON LIVESTOCK AND CROP PRODUCTION ACROSS AN URBAN-RURAL GRADIENT IN THE EASTERN CAPE PROVINCE OF SOUTH AFRICA

4.1 Introduction

Drought is a severe problem in both urban and rural areas, threatening agricultural productivity (Mahlalela, 2020). Drought is projected to become more severe in the coming decades, with severity and impacts likely to be more in less developed countries, particularly in Africa than in well-off countries (Lottering et al., 2020). The IPCC (2007) estimated an increase between 1.1-6.4°C in annual temperatures by 2025, and this temperature rise is accompanied by detrimental environmental shocks which are evident in different parts of the world. In Africa and some parts of the world, an estimated rise in temperature to above 2°C is expected, and this is likely to proliferate the drought problem (IPCC 2007). The adverse impacts of droughts on agricultural production are extensive (Kala, 2017; Lottering et al., 2020), with serious health, economic and livelihood implications. Over time, the impacts of drought have become diverse and complex which makes understanding the concept challenging (Lottering et al., 2020), but a key priority for investigation as basis for improving our understanding and harnessing that understanding towards strengthening adaptation to droughts.

Lottering et al. (2020) categorised the major impacts of droughts into two main classes namely, environmental and socio-economic impacts. Droughts have detrimental impacts on the environment, especially water supplies, vegetation, and biodiversity, and can affect ecosystem functioning ultimately resulting in the loss of ecosystem services (Kala, 2017; Mera, 2018; Lottering et al., 2020). In the southern Africa, droughts are usually not short and can last for more than one season or even the whole year (Rouault and Richard, 2005). These droughts affect large areas and have a larger impact on the people and livelihoods. Drought impacts can linger even after the event is over, making it difficult for the affected areas to recover before another drought hits (Rouault and Richard, 2005). For example, the 1982-1983 drought event lasted for over a year with adverse effects on food security, livestock, and income (Akpalu, 2005). The key impacts that droughts have on the agricultural sector and

livelihoods are mainly crop failure and pasture losses which result in livestock mortalities (Kotir, 2011; Ray et al., 2018; Lottering et al., 2020), and production in rain-fed and irrigated agriculture are the main affected economic sectors by drought due to unavailability of water (Lottering et al., 2020).

The socio-economic impacts of droughts are adversely experienced and accompanied by livestock and crop production declines, affecting food security (Lottering et al., 2020; Ngcamu and Chari, 2020). Indeed, there is no doubt that some socio-economic effects of drought are strongly liked to environmental effects. For example, the deterioration of rangeland grazing grass species due to drought is linked to the loss of livestock income (Lottering et al., 2020). Drought affects food availability, utilization, and stability (FAO, 2017) and results in serious economic losses. Swemmer et al. (2018) highlight commercial monetary losses of over R10 billion in KwaZulu Natal during the 2014-2016 drought due to extensive livestock production declines resulting in food shortages. Furthermore, drought events have also resulted in a massive decline in crop yields affecting the trade industry due to food insecurity, causing further declines in quantity and food quality, which in turn, causes malnutrition (AgriSA, 2016; Lottering et al., 2021).

The recurring extreme drought periods have caused a significant decline in crop harvest, particularly maize and wheat which are major sources of food and the largest produced field crops in South Africa and other African countries (AgriSA, 2016). Agricultural production decreased by 8.4 % during the 2015 drought in South Africa, and there was a 15% decrease throughout the local livestock herd. In the KwaZulu-Natal province alone, cattle mortality reached 40 000 in 2015 (Mare et al., 2018). Furthermore, Limpopo province recorded livestock mortalities between 2016 and 2019 due to extreme droughts, and many cattle ranchers lost at least 50 % of their herds (Maponya and Mpandeli, 2016; Farmers Weekly, 2018). The above losses have mainly been reported from a large-scale commercial farming perspective, with a limited focus on small-scale farmers.

Some studies reported that maize production among small-scale farmers in South Africa had declined drastically during the 2014-2016 drought period (AgriSA, 2016; Baudoin et al., 2017), causing considerable losses in income and livestock feed, and food insecurities (Ruwanza et

al., 2022). Similarly, there have been declines in wheat production resulting in the country relying more on imports which can result in a trade deficit in the agricultural sector (AgriSA, 2016). Small-scale farmers depend on livestock production for sustaining livelihoods, the economic losses experienced can be attributed to various factors such as, degradation of grazing fields, drinking water scarcity, and heat stress (Vetter et al., 2020). Given these income losses, small-scale farmers in rural areas remain impoverished (Rajesh et al., 2018) as they struggle to maintain their livelihoods during a drought period. Lottering et al. (2021) found that respondents in uMsinga in KwaZulu-Natal experienced decline in food security and increased levels of poverty due to drought.

In South Africa, small-scale farming is primarily located in former homeland areas (Zantsi et al., 2020; Ruwanza et al., 2022) and municipal commonages (Davenport and Gambiza, 2009; Thondhlana et al., 2022). Complex challenges such as land tenure insecurity, scarce arable land and limited access to water resources and markets limit agricultural productivity (Von Loeper et al., 2016). In South Africa, research on the effects of droughts on small-scale farmers exists, however, it is primarily from a rural perspective. Furthermore, small-scale farming is common in urban areas, particularly livestock farming (Thondhlana et al., 2022), but there has been no consideration of the effects of drought on small-scale farmers across a rural-urban gradient (Ruwanza et al., 2022). Monitoring the impact and risks of drought is significant because this can provide baseline information needed to develop effective response strategies, policies, and management plans (Buurman et al., 2019). Without appropriate responses, droughts can negatively impact the agricultural sector. This chapter aims to assess perceptions of the impacts of droughts on livestock and crop production among small-scale farmers across an urban-rural gradient in the Eastern Cape province of South Africa.

4.2 Methods

The study area description, experimental design, data collection and analysis methods and limitations are presented in Chapter 3.

4.3 Results

4.3.1 Socio-demographic profile of the respondents

A total of 163 respondents across the six study towns participated in the study, with slightly more respondents in rural areas (53 %) than in urban areas (47 %). The mean age across urban and rural areas was 55±1 years, ranging from 20 to 88 years in urban areas and 19 to 86 years in rural areas. There were no significant differences in age between urban and rural areas (t = 0.309; p = 0.76). The average household size was about 5 in both urban and rural areas and at least 70 % of all the respondents were household heads. There were marked differences in education levels between rural and urban respondents, with urban areas showing more respondents with secondary (38 %) and tertiary (25 %) level education than the rural areas (33 % and 17 %) respectively (Table 4.1). About 5 % of the respondents in both rural and urban areas did not have formal education. Most respondents in both urban and rural areas were male (66 % and 62 % respectively). Table 4.1 shows that nearly half of the respondents in both urban and rural areas were married (48 % and 49 % respectively). Dependence on social grants was common across the sample, though more respondents (55 %) in rural areas than in urban areas (36 %) reported so. Other sources of income included wages (27 % in urban and 13 % in rural), private pensions (6 % and 9 %), and remittances (1 % and 3 %).

Table 4.1. The socio-demographic information of respondents

Aspect	Urban (n=77)	Rural (n=86)	Total sample (n =163)
Mean age (years)	55±17	54±16	55±1
Household size	5±0.58	5±2.85	5± 0.14
Head of house (%)	70	77	74
Education level (%)			
Primary	32	43	38
Secondary	38	33	36
Tertiary	25	17	21
No formal education	5	5	5
Gender (%)			
Female	34	38	36
Male	66	62	64
Marital status (%)			
Married	48	49	73
Widow/Widower	17	17	17
Divorced	6	7	7
Single	29	0	15
Household income (%)			
Wages	27	13	20
Social grant	36	55	46
Private pension	6	9	8
Own business	1	7	4
Other: Remittances and Piece jobs	1	3	2

4.3.2 Agricultural activities and benefits

Nearly all respondents in both urban (97 %) and rural areas (99 %) owned livestock. Slightly below half (47 %) of the respondents in urban areas practised crop farming compared to about 57 % in rural areas (Table 4.2). There were no significant differences in livestock ownership ($\chi^2 = 3$; $p > 0.05$) and crop production ($X^2 = 8$; $p > 0.05$) between urban and rural areas. Most respondents (31 %) in urban areas reared goats and cattle (24 %) and only 7 % had sheep, while in rural areas 23 % reared cattle with goat and sheep ownership at 22 % and 14 %, respectively. Other livestock mentioned were chickens, pigs, goose, horses, and donkeys. The benefits obtained from livestock production include cash income from sales in both urban (44 %) and rural (40 %), while the use of livestock for rituals, ceremonies or parties was common in both urban (24 %) and rural (30 %) areas. About 20 % across urban and rural areas obtained meat from livestock production. Other benefits included milk, skins, and dung for manure mentioned by about 12 % of the respondents. A majority (77 %) of the respondents in urban areas grazed their livestock in commonage land while 90 % of the

respondents in rural areas grazed their livestock in communal land. A small proportion of small-scale farmers in urban (14 %) and rural areas (8 %) grazed their livestock in local forests while about 12 % grazed their livestock in streets and gardens. All the respondents in urban areas and nearly all (99 %) in rural areas had no protection insurance against droughts.

Table 4.2. Respondents' responses on livestock and crop production and drought protection insurance

Questions	**Urban**	**Rural**	**Sample mean**	X^2; ***p*-value**
Does your household own any livestock? (% Yes)	97	99	98	3.3; 0.19
Does your household practice crop farming? (% Yes)	47	57	52	10.7; 0.83
Do you have protection insurance against droughts? (% No)	100	99	100	22; 0.00001

The findings show that more small-scale farmers in rural areas than in urban areas practised crop production. For example, more rural farmers (81 %) than urban farmers (35 %) cultivated vegetables (Table 4.3). Common vegetables reported include potatoes, spinach, cabbage, beetroot, pumpkin, and carrots. Similarly, more rural farmers (76 %) than urban farmers (69 %) cultivated maize, with a few farmers planting barley and sorghum. A sizeable number of respondents indicated that they used their gardens for cultivation with more respondents in rural areas (47 %) than in urban areas (34 %) reporting so. Other respondents said they could not use home gardens for crop cultivation because of lack of land “due to buildings and further development encroaching communal farming fields”. The respondents in urban areas used tap water (42 %) as their main water source, while only 15 % in rural areas relied on tap water. Some respondents in both urban (15 %) and rural (19 %) areas indicated that they used local dams as a source of water. About a third of respondents in urban areas (33 %) and rural areas (35 %) used water from the river for livestock husbandry and crop production. Other respondents indicated that their crop production was rainfed and some used water tanks to store water.

Table 4.3. Livestock ownership, crop production and benefits

Question	Urban	Rural
Livestock ownership		
Cattle	24	23
Goat	31	22
Chicken	21	23
Pig	16	15
Sheep	7	14
Uses of livestock		
Cash from sales	44	40
Ceremonies (rituals and parties)	24	30
Meat	20	20
Where do you graze your livestock? (%)		
Communal land/Commonage	77	90
Forest	14	8
Along streets	10	1
Which crops do you cultivate? (%)		
Maize	35	81
Vegetables	69	76
Where do you farm your crops? (%)		
Garden	92	96
Communal land	3	4
What is your main water source for crop and livestock farming? (%)		
Taps	42	15
Dam	15	19
River	33	35
Tanks	2	9
Rainfed	3	10

4.3.3 Respondents' perceptions of drought impacts

Respondents were asked to indicate their perceptions of drought awareness and its impacts on crop production and livestock husbandry. Just about 70 % of the respondents in both urban and rural areas stated that they are aware of the recurrent drought conditions in their areas (Table 4. 4), primarily through self-observation (89 % urban and 93 % rural) by looking at the landscapes, weather, crop yields and cattle. Most respondents said they could tell the impacts of droughts based on the deteriorating health of their livestock, drying grazing fields, changing weather and landscapes and water scarcity. Across the sample, 89 % of the respondents said they experienced problems with livestock production in their areas, with marginal differences in the proportion of urban (90 %) and rural (88 %) respondents (Table 4. 4). Respondents were asked if they experienced livestock losses and over 80 % of the respondents in both rural and

urban areas reported losses (Table 4.4). At least 80% of respondents across the sample attributed the livestock losses to persistent droughts, with a few others mentioning degraded grazing field, unavailability of dipping chemicals, disease outbreaks, and theft as other causes (Figure 4). A substantial proportion of the respondents (86 %) also reported declines in crop yields in the past 5 – 10 years, with significantly more respondents in the rural areas (45 %) than in urban (31 %) reporting so ($\chi^2 = 15.4$; $p < 0.05$) (Table 4.4). A chi-square test on small-scale farmers' perceptions and socio-demographic variables showed no significant differences (Table 4.5).

Table 4.4. Small-scale farmers' perceptions of drought impacts

Question	**Site**		**Sample Mean**	***X²*; *p*-value**
	Urban	**Rural**		
Are you aware of the recurrent droughts (% Yes)	70	71	71	7.0; 0.73
Have you noticed changes in the environment relating to drought? (% Yes)	99	95	97	3.0; 0.56
Are there any problems regarding livestock production? (% Yes)	90	88	89	6.5; 0.77
Have you experienced livestock losses in the past 5-10 years? (% Yes)	87	85	86	19.7; 0.48
Have you experienced low crop yields in the past 5-10 years? (% Yes)	84	98	91	15.4; 0.02

Table 4.5. Small-scale farmers' perceptions and socio-demographic variables

Perceptions	**Socio-demographics**	
	Gender ***X²*; *p*-value**	**Education** ***X²*; *p*-value**
Problems regarding livestock production	0.5; 0.48	4.5; 0.34
Experience of livestock losses	0.20; 0.65	2.06; 0.72
Experience of crop losses	0.00; 0.97	2.46; 0.65
Access to weather information	1.15; 0.28	1.2; 0.87
Aware of the recurrent droughts	5.61; 0.018	4.22; 0.38
Changes in the environment relating to drought	1.18; 0.28	1.5; 0.83

About 57 % and 63 % of the respondents in urban and rural areas respectively rated livestock losses as ‘very severe’, while about 22 % and 29 % respectively felt it was ‘moderately severe’ (Figure 4.1). Only 10 % in urban and 7 % in rural areas rated the losses as ‘not severe’ (Figure 4.1). Concerning causes of livestock losses, a larger proportion in both rural (84 %) and urban areas (89 %) indicated that droughts were the main drivers of livestock losses Some of the respondents stated that their worst livestock losses were between 2017 to 2020.

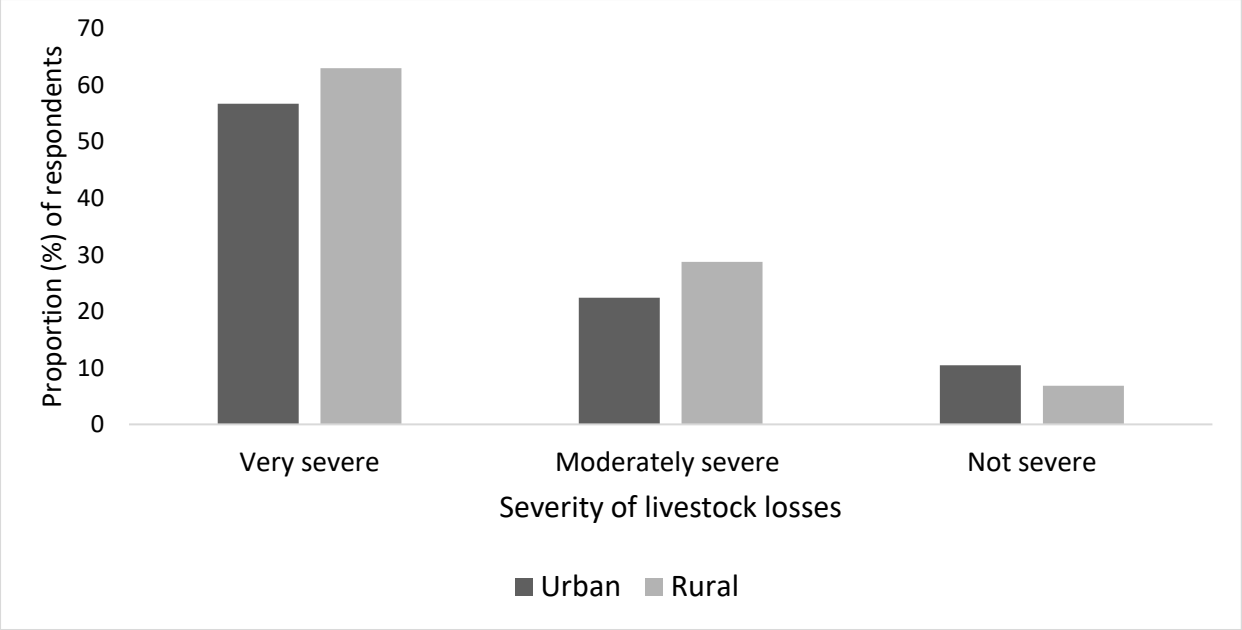

Figure 4.1. Respondents' views on the severity of livestock losses.

The problems experienced with livestock production included lack of water, increasing diseases and lack of dipping chemicals and theft. Many of the respondents (80 %) across the sample perceived lack of water as a major problem but more respondents in rural (88 %) areas than in both urban areas (72 %) perceived so (Figure 4.2).

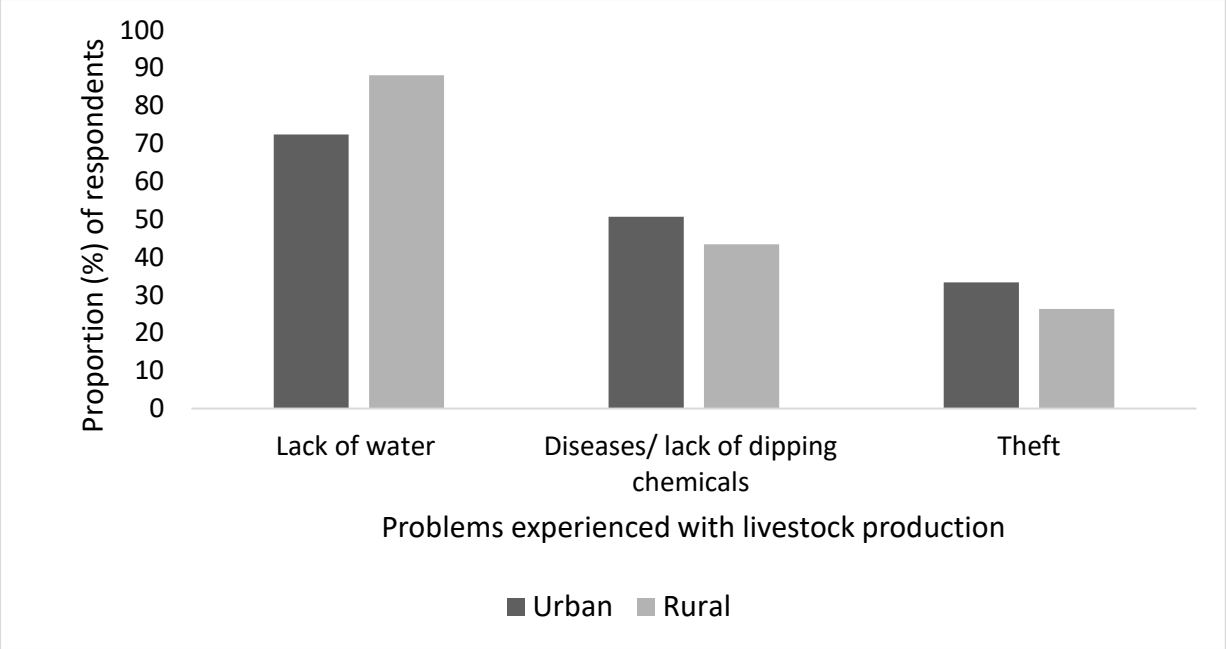

Figure 4.2. Problems experienced with livestock production.

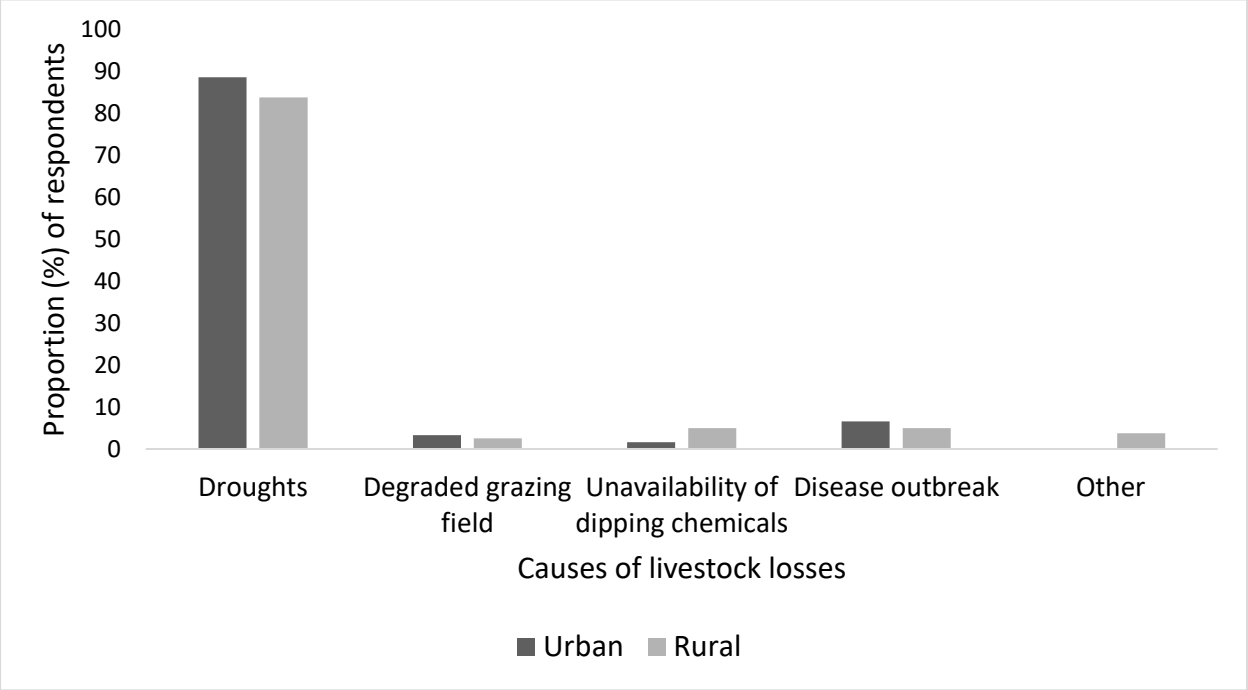

Figure 4.3. Causes of livestock losses.

Just above half of the respondents in rural areas (53 %) and urban areas (57 %) rated crop yield declines as 'moderately severe' while those who rated it as very severe and not severe were less than one-fifth in both rural and urban contexts (Figure 4.4). Concerning crop yield

declines, a larger proportion (82 %) in rural areas than in urban areas (60 %) indicated that drought was the main driver of the decline in crop yields, and a few respondents perceived causes such as unavailability of farm inputs and water for irrigation, disease outbreaks, and disease outbreak (Figure 4.5). Most respondents explained that the low crop yields were due to the unavailability of rainfall and no water from taps which hampered irrigation efforts.

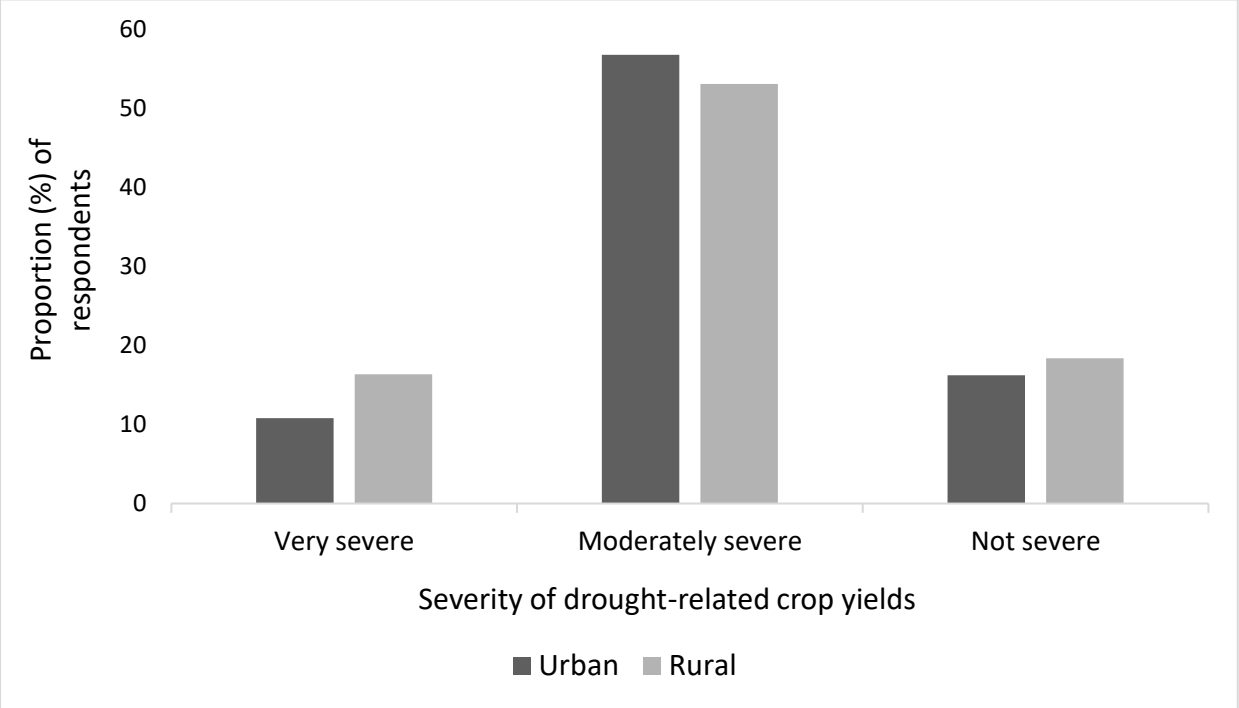

Figure 4.4. Respondents' perceptions of the severity of drought-related crop yield declines.

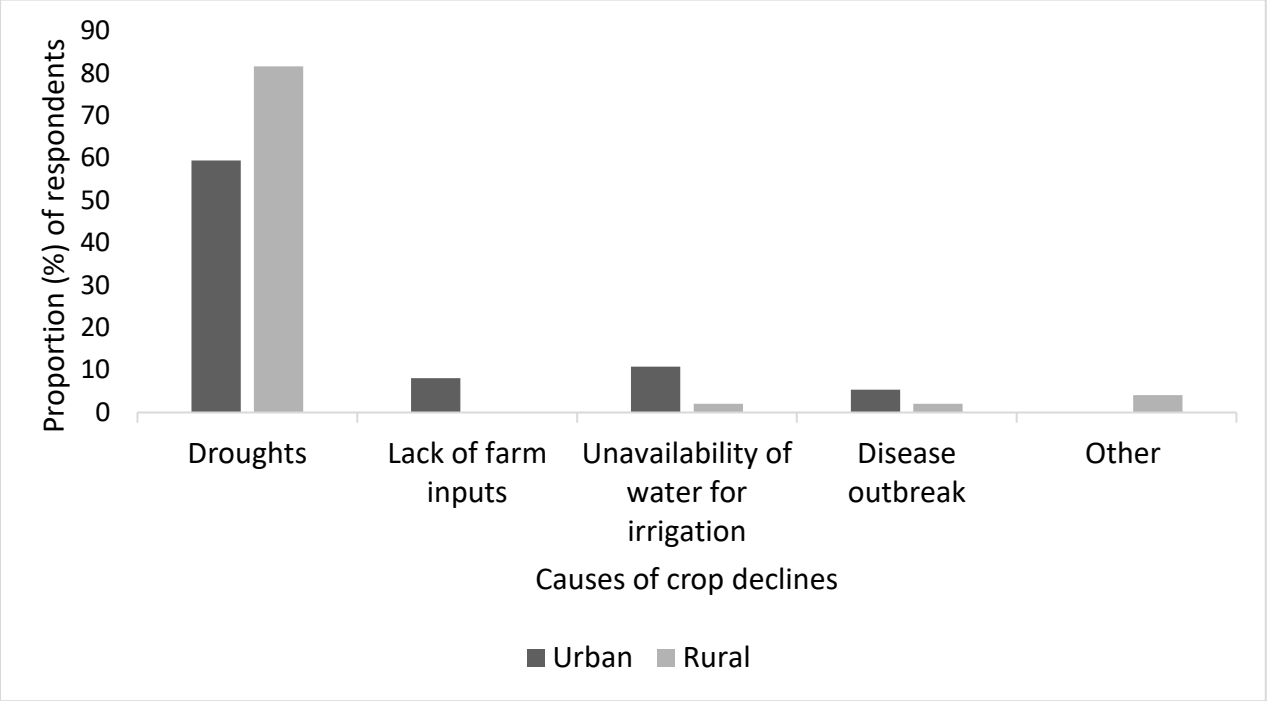

Figure 4.5. Causes of crop yield decline.

Table 4.6. Indicators of change, impacts, and other drought-related losses.

Aspect	Urban	Rural
Indicators of change		
Rainfall patterns	48	41
Amount of rainfall	35	33
An increase in temperatures	5	6
Other, specify	1	21
The main impact of changes		
Crop failure	28	35
Livestock mortalities	69	63
Food insecurity	1	2
Disease Outbreaks	1	0
Other losses besides livestock and crop yields		
No other losses	78	86
Income	18	9
Water for daily use activities	1	3
Lives and livelihoods	3	3

Respondents were asked if they noticed any environmental changes due to droughts, and nearly all respondents in both urban (99%) and rural areas (95 %) reported noticeable changes

in the environment. The indicators of change mentioned include changes in rainfall patterns, changes in the amount of rainfall and increase in temperatures (Table 4.6). Other changes such as prevalent winds, water scarcity, unavailability of grass and dry vegetation were also mentioned.

4.4 Discussion

4.4.1 Agricultural activities and benefits

The study assessed the perceptions of small-scale farmers on the socio-economic impacts of drought. The findings suggest that many of the respondents in both urban and rural areas owned livestock and practised farming and used water from rivers, local dams, and tap water to support these activities. Livestock ownership has historically been a common livelihood strategy in rural areas (Shackleton et al., 2005; Turner et al., 2014), and urban areas (Thondhlana et al., 2022). The commonly reared livestock are cattle, sheep, goats, chickens and pigs. In terms of small stock, there are more goat owners, and small scale-farmers perceived goats as more resilient to droughts. This coincides with Nair et al. (2021), who allude that goats are resilient animals that can cope with droughts, unavailability of feed, and other environmental stressors compared to cattle and sheep (Nair et al., 2021).

The benefits obtained from livestock production include cash from sales (livestock and wool), meat and traditional practices. However, some small-scale farmers in the study stated that they rarely consumed meat daily to sustain their livelihoods but used livestock as an investment strategy. Cash from sales and the use of livestock in ceremonies or rituals were the most important benefits. These common benefits of livestock production have been reported in South Africa (Chaminuka et al., 2014; Du-Pont et al., 2020; Herd-Hoare and Shackleton, 2020). A study by Herd-Hoare and Shackleton (2020) points out monetary and non-monetary benefits of livestock and poultry for rural and urban households. These include meat, milk, eggs, skins, dung, and draught power, which enhance crop productivity and income (Herd-Hoare and Shackleton, 2020). Small-scale farmers use the cash from sales and savings as income reserves during droughts to buy fodder and medication. A study conducted in the Sand River catchment illustrated that livestock held a significant value for households, serving as a means for generating income through cash sales and as a form of savings

(Shackleton et al., 2005). Furthermore, Herd-Hoare and Shackleton (2020) allude that livestock are essential assets that play a vital role in protecting livelihoods during times of food insecurity or unexpected hazards like droughts, and serve as a valuable resource for communities, providing a buffer against economic shocks and ensuring resilience (Herd-Hoare and Shackleton, 2020). Yet, livestock productivity amongst small-scale farmers remains constrained by droughts, undermining livelihoods.

The results showed that small-scale farmers graze their livestock on communal rangelands in rural areas and commonage land in urban areas. Further, small-scale farmers perceived rangelands as deteriorated and offering low nutritional value. For example, in Peddie, small-scale farmers stated that during apartheid, communal land was previously pineapple farms that collapsed in the late 1990s. Following land redistribution, the grazing fields remained degraded and unproductive. Similarly, landscapes in Cacadu are covered by the invasive *Euryops floribundus* and *Opuntia,* which thrive in dry conditions causing further degradation of the rangelands, reduction in species diversity, restrictions in the growth of the grassland area, and increased competition among livestock. In urban settings, commonage areas are being used for the reconstruction and development of low-cost houses, whereas in principle, commonage land is meant for poor residents to build and enhance their livelihoods.

Concerning crop production, the findings show that most farmers grow their crops in gardens, these include vegetables such as potatoes, spinach, cabbage, beetroot, pumpkin, carrots, and maize. These are early maturing and easy to manage crops. Maize is predominantly grown in rural settings due to its importance for livestock feed and is used as a staple in most households, whereas, in urban households' crops are grown mainly for human consumption. The results indicate that small-scale farmers who practised crop farming used their gardens instead of communal land, a scenario attributed to limited access to resources such as fences, farm inputs, irrigation schemes, machinery and many more (Blair et al., 2018).

4.4.2 Perceptions of drought impacts

Drought was recognized as a highly significant environmental problem with adverse socio-economic repercussions. Perceptions of droughts are likely to be influenced by the social and

economic factors that affect small-scale farmers' livelihoods. Most small-scale farmers were aware of the recurrent droughts in their areas through self-observation, that is, assessing changes in landscape conditions, cattle, and weather as indicators of droughts. It has been reported that the use of indigenous predictions for forecast information is common in small-scale farmers to assist them with planning farming activities (Zuma-Netshiukhwi et al., 2013; Lottering et al., 2021). However, contrary to small-scale farmers in uMsinga who still use indigenous weather prediction (Lottering et al., 2021), most farmers in the study indicated that they mostly rely on television as a source of weather information due to the development of modern and scientific weather forecasting.

The respondents indicated there were significant changes in the environment related to drought. The major indicators include uneven rainfall patterns and a decrease in the amount of rainfall - a common phenomenon in the Eastern Cape with socio-economic effects in rural areas and urban areas where the water supply is declining excessively. This is supported by literature on rainfall statistics, indeed, there is a noticeable decline in the quantity of rainfall and rainfall patterns (Mahlalela et al., 2020). Small-scale farmers also stated that it had become harder to predict rainfall seasons than before, which affected planting dates and drought preparation. Further, it was stated that reliance on indigenous weather prediction was increasingly uncertain. Hence, there was reliance on scientific forecasting methods, although these were also perceived as unreliable.

The results indicate that lack of water is the major problem associated with livestock production in urban and rural settings, though it was more prevalent in rural settings. This could be explained by the fact that urban households have access to tap water and alternatively use it during drought periods. The lack of water results in poor rangelands due to inadequate rainfall to enrich the soil and promote plant growth. Small-scale farmers in rural settings relied on rainfall to sustain their agricultural activities. Although unavailability of adequate rainfall has been mentioned as a constraint to farming activities, water supply has consistently been attributed as the significant problem, particularly in urban areas where small-scale farmers stated that there is “barely water coming out of their taps” and “there are no streams or dams nearby”. While, in rural settings, there was access to local dams and

streams most of these water sources had reportedly run dry due to rainfall scarcity. In response, small-scale farmers opted for harvesting rainwater in water tanks and drums as supplements during scarcity. Therefore, farming activities rely on stored water in both urban and rural settings, where livestock would return from the field to drink water stored in barrels. The reliance on stored water is not sustainable during periods of water scarcity, with reported increases in livestock mortalities and displacement due to the unavailability of water reserves.

In the past 10 years, droughts in the study area have been reported as the main causes of livestock mortalities. For example, Muyambo et al. (2017) reported severe livestock deaths in the OR Tambo district of the Eastern Cape province. This is also substantiated by small-scale farmers in uMsinga, who indicated that they were severely affected by droughts. Elsewhere in South Africa, Rakgwale and Oguttu (2020) reported that small-scale farmers in the Greater Letaba Local Municipality in Limpopo province experienced livestock losses during the 2014-2016 droughts, with each farmer losing an average of five animals. Other studies also reported major livestock mortalities related to droughts between 2014-2016 in KwaZulu-Natal, Northern Cape and Limpopo provinces (Swemmer et al., 2018; Bahta, 2020). Some small-scale farmers, in particular, of urban settings alluded that livestock mortalities were not severe. This may be explained by access to financial resources, allowing them to buy fodder and medication during droughts.

Crop losses are a major drought impact in the study although they were rated as moderately severe in urban areas. This can be explained by the dependence on tap water to support their irrigation, which they also store for future use. Respondents perceived droughts as the major cause of the decline in crop yields due to rainfall scarcity. Similarly, some studies mentioned that the crop yield declines were caused by the unavailability of rainfall and soil moisture (Mpandeli et al., 2015; Bahta et al., 2016; Bahta, 2020; Kom et al., 2020; Lottering et al., 2021). For example, maize production in small-scale farming declined excessively between 2014-2016 due to drought (Baudoin et al., 2017). The results indicate loss of income as an impact of drought because of direct reliance on livestock to sustain their livelihoods. This is consistent with findings by Lottering et al. (2021) and Ngaka (2012) who found that declines in livestock and crop yields caused economic losses to farmers. Drought-related economic costs in communal areas are primarily caused by crop failures and livestock mortality, given the lack

of soil moisture and grazing pastures (Lottering et al., 2021). Since small-scale farmers rely on natural rain, particularly in rural areas, losses can become substantial due to rainfall scarcity.

4.5 Conclusions

With predicted climate change and extreme events, droughts are likely to be a frequent occurrence with severe consequences on lives and livelihoods. For small-scale farmers, prolonged dry periods (droughts) will unfortunately result in loss of and low crop yields, loss of livestock and capital and related psychological costs. These impacts have implications for drought response strategies in future. The main objective of this chapter was to gain insight into small-scale farmers' perceptions of drought impacts across a rural-urban gradient in the Eastern Cape province of South Africa as a basis for developing relevant response strategies. The findings show that droughts have detrimental impacts on small-scale farmers in both urban and rural settings, resulting in declining crop yields, livestock losses, and loss of income, increasing vulnerability and affecting small-scale farmers' livelihoods. With reduced harvests, small-scale farmers remain subjected to income losses affecting their livelihoods. Insufficient rainfall also compromises pastures and drinking water, causing malnourishment of livestock. This results in livestock mortalities and is accompanied by income losses and disruptions in small-scale farmers' long-term investment in breeding and building their herds.

There is limited access to resources and necessary support systems to build an adaptive capacity during drought. For example, there is no access to irrigation schemes, that is, different technologies that can potentially improve the productivity of small-scale farmers, and hence they remain heavily impacted. To minimize the impacts of drought on small-scale farmers, interventions should factor in the perceptions of small-scale farmers and tailor the drought response strategies to suit different contexts, for example, urban or rural. Among other interventions, improved water management strategies, drought-resistant crops, and financial and institutional support should be provided to minimize the vulnerability of small-scale farmers. Since drought events are expected to worsen, addressing drought impacts on small-scale farmers requires innovative solutions to improve their livelihoods.

CHAPTER 5: DROUGHT RESPONSE STRATEGIES BY SMALL-SCALE FARMERS ACROSS A RURAL-URBAN GRADIENT IN THE EASTERN CAPE PROVINCE OF SOUTH AFRICA

5.1 Introduction

In South Africa, droughts have caused a significant strain on the economy, environment and local people, and are behind rising pressures on the country's agro-economic systems (Baudoin et al., 2017). Drought management consists of adaptation (a proactive adjustment or response to an environmental condition) and mitigation (initiatives taken to reduce the impacts) strategies (Lottering et al., 2020). There are significant relationships between adaptive and mitigative strategies, and studies have indicated that combining these strategies can address the impacts of droughts (Seymour and Desmet, 2009; Lottering et al., 2020). Drought adaptation is essential to minimise the vulnerability of small-scale farmers by building resilience to drought impacts and enhance farmers' ability to cope (Muller and Shackleton, 2013). Adaptation is often described as planning, adopting, monitoring, and evaluating strategies, policies, and measures to mitigate the impacts of natural hazards (IPCC, 2007). The IPCC (2007: 118) defines adaptation as an ''adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts''. Furthermore, the IPCC (2007) report adds that adaptation requires action to minimise vulnerability and improve resilience and recognizes that adaptation is an ongoing process.

Adaptation includes learning about risks, assessing and implementation of alternative responses, mobilization of resources, and re-evaluation of choices based on newfound insights (Leary et al., 2007). Muller and Shackleton (2013) argue that adaptation depends on the farmers' awareness of environmental problems. Therefore, the risks accompanied by environmental problems can be recognised and addressed based on how farmers view changes in the local environment and how these changes affect their farming practices (Muller and Shackleton, 2013). This has a crucial effect on the decision-making process of implementing and adopting various adaptive strategies (Muller and Shackleton, 2013). Kurukulasuriya and Rosenthal (2003) and Dinar et al. (2012) categorise adaptation methods into four groups. The first group of adaptation methods is micro-level adaptation

methods which are mainly adjustments in farming practices, that is, diversifying livestock and crops, change in land use and timing activities (Kurukulasuriya and Rosenthal, 2003; Dinar et al., 2012). The second group is an income-related adaptation which includes income diversification and insurance benefits such as crop insurance schemes (Kurukulasuriya and Rosenthal, 2003; Dinar et al., 2012). The third group of adaption measures is institutional adaptation which consists of adjusting and implementing new policies and agricultural support initiatives (Kurukulasuriya and Rosenthal, 2003; Dinar et al., 2012). Lastly, the fourth group is technical adaptation methods that include the development of drought-resistant crops and livestock feeds and adjusting soil and water management practices (Kurukulasuriya and Rosenthal, 2003; Dinar et al., 2012).

Small-scale farmers employ a combination of adaptation measures during droughts. For example, Benin farmers adopted at least an activity in each of the categories mentioned above, ranging from micro-level and technical adaptation strategies such as crop and livestock diversification, mulching, and use of organic fertilisers (Fadina and Barjolle, 2018). Some small-scale farmers in Zimbabwe resorting to selling their livestock to offset income losses (Adger et al., 2002; Patt and Gwata, 2002), though this typically happens during drought periods. In South Africa, small-scale farmers adopt various response strategies. For example, small-scale farmers in the Eastern Cape province practice sustainable land management practices such as mulching, crop rotation, organic fertilizers, crop diversification, and rainwater harvesting. In Limpopo province, farmers adopted water harvesting, contour ploughing, companion planting, and crop diversification focusing on crops suitable for their climatic conditions**.** Other strategies, such as implementing policies and local government interventions to droughts, have been criticised as ineffective due to poor communication and management among government institutions, inadequate financial resources, and relief programmes (Keshavarz et al., 2010).

Since there is an urge for adaptive action due to changing environmental conditions, factors that limit adaptation are continuously being discussed (Adger et al., 2009; Muller and Shackleton, 2013; Trbic et al., 2018; Talanow et al., 2021). Gray and Mueller (2012) identify factors influencing adaptation such as (i)lack of readiness and inadequate response measures, (ii) reliance on natural resources to sustain livelihoods which causes land degradation, and

(iii) limited technological and economic capacity to have an influence in hindering adaptation in developing countries. Some issues faced by small-scale farmers that limit their adaptive capacity to droughts include insufficient knowledge, skills and access to adequate resources and a lack of financial and extension support from government institutions (Bahta et al., 2016). An observation of the response strategies used by the small-scale farmers suggests that these measures are relatively inexpensive measures, for example, changing planting dates and diversifying crops are often preferred and used. In contrast, the expensive strategies require financial resources, and are adopted by fewer small-scale farmers (Below et al., 2012). Indeed, small-scale farmers' financial capabilities influence the choice of adaptation option.

Adaptation strategies are often complex, long-term, and cost-dependent (Lottering et al., 2020), making it challenging for communal farmers to adopt hence they tend to employ reactive strategies which are formulated after the drought event has occurred rather than using anticipatory strategies that provide early warning signs to improve the adaptive capacity (Malik et al., 2010; Biagini et al., 2014; Lottering et al., 2020). Most drought responses have been technical, yet information and knowledge about these technical strategies have not been made available to small-scale farmers. Hence, many small-scale farmers use indigenous and local knowledge to implement drought response strategies. While there have been multiple efforts aimed at addressing drought responses for small-scale farmers in rural settings, drought response strategies in an urban-rural gradient remain understudied, although small-scale farming has become common in urban settings (Thondhlana et al., 2022). This chapter aims to assess the drought responses of small-scale farmers across an urban-rural gradient in the Eastern Cape province of South Africa. Without appropriate responses, droughts can negatively impact the agricultural sector, therefore the need to document small-scale farmers' drought response strategies.

5.2 Methods

The study area description, experimental design, data collection and analysis methods and limitations are presented in Chapter 3.

5.3 Results

5.3.1 Drought response strategies employed

A substantial proportion of farmers across the sample (93%) reported drought response strategies relating to livestock and crop production, with slight differences in the proportion of farmers reporting so between urban (89 %) and rural (95 %) sites (Figure 5.1). There were no significant differences in adaptation and mitigation strategies between urban and rural areas (X^2 = 10.8; p > 0.5).

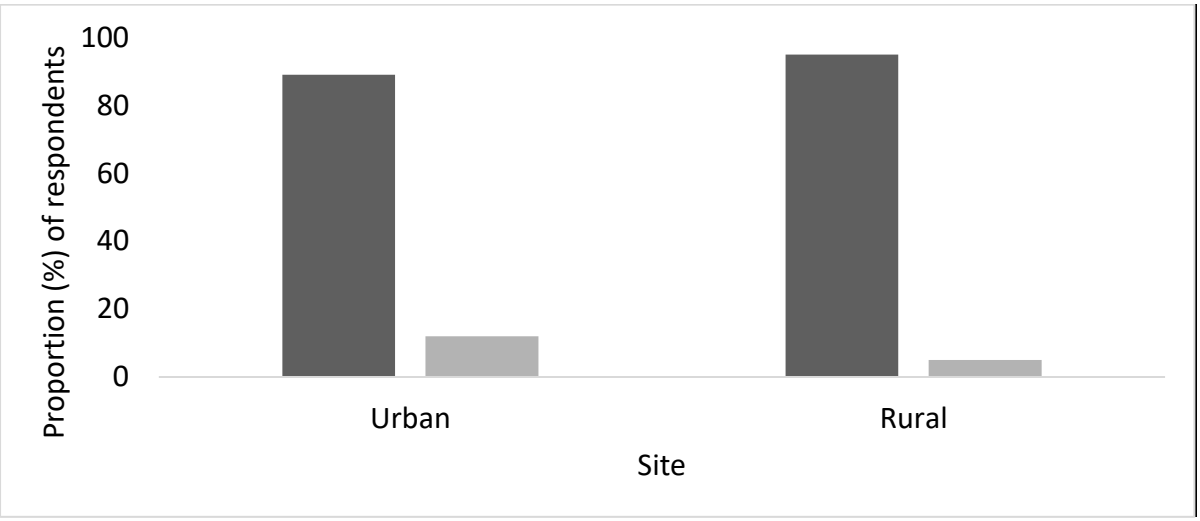

Figure 5.1. Proportion of respondents employing response strategies.

Various response strategies were practiced in both urban and rural areas with insignificant differences between urban and rural farmers. The common strategies used in both urban and rural areas were water harvesting schemes (54 % and 45 %, respectively), fodder (42 % and 36 %, respectively) and supplements (29% and 31 %, respectively). Small-scale crop farmers also mentioned strategies such as planting fodder, crop diversification, changing planting dates and mixed cropping (Figure 5.2). Other strategies included crop rotation, and the use of farm inputs (such as kraal manure), selling old stock, saving money, storing grass, and fencing fields (Figure 5.2).

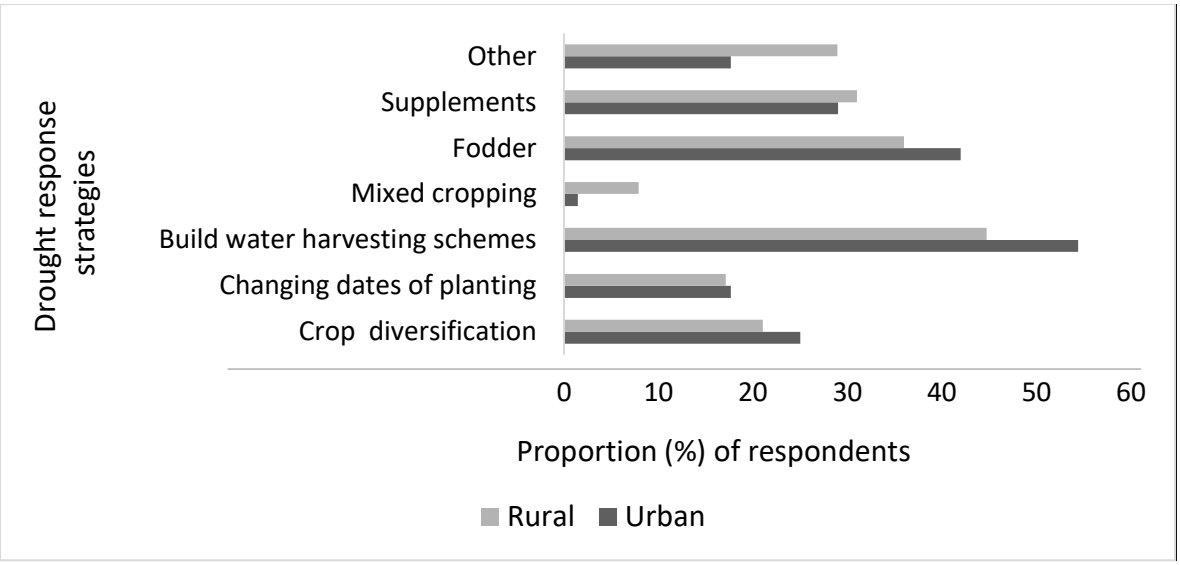

Figure 5.2. Drought response strategies reported by small-scale farmers.

5.3.2 Motivations for employing drought impact responses

Small-scale farmers that reported adaptation and mitigation were asked about their motivations for implementing these strategies (Table 5.1). A substantial proportion of respondents mentioned that small-scale farming was essential for their livelihoods but more farmers in urban (92 %) than rural areas (71 %) reported so. Just about over one-third (30%) of the respondents in rural areas and 21 % in urban areas stated that livestock and crop production were a way of life. Other reasons mentioned included minimising mortalities and income losses, avoiding displacements due to water shortages, lack of sufficient water sources, and past experiences. Only a few respondents did not implement or adopt any drought response strategies and attributed this to a lack of knowledge, insufficient resources and water to support their farming practices (Table 5.1).

Table 5.1. Motivations for adopting drought response strategies

	Urban	**Rural**
Motivations for adopting response strategies (%)		
Enhance livelihoods	92	71
Way of life	21	38
Barriers to adopting response strategies (%)		
Lack of knowledge and information	9	-
Water shortages	3	3
Lack of resources	-	2

5.3.4 Perceptions of support from government institutions during droughts

Farmers were asked if any institutions or organisations were working with them to provide support during droughts. The findings show no marked differences in responses between urban and rural farmers. Just over half in both urban (55%) and rural areas (51%) said they received support. The respondents mentioned that most support came from local government institutions such as the Department of Rural Development and Agrarian Reform (DRDAR), local agricultural co-operatives, and local universities. However, out of these, a sizeable proportion of the respondents (>70%) stated that they were not satisfied with the support they received, with slightly more respondents in urban areas (77%) than rural (70%) areas reporting so (Figure 5.3). The reasons for the dissatisfaction included perceived bias in selecting the recipients of support programmes, lack of tangible benefits, and lack of awareness programmes to empower them. Very few respondents in urban (4 %) and rural (8 %) areas indicated satisfaction, while the remaining proportion was less or moderately satisfied with the support.

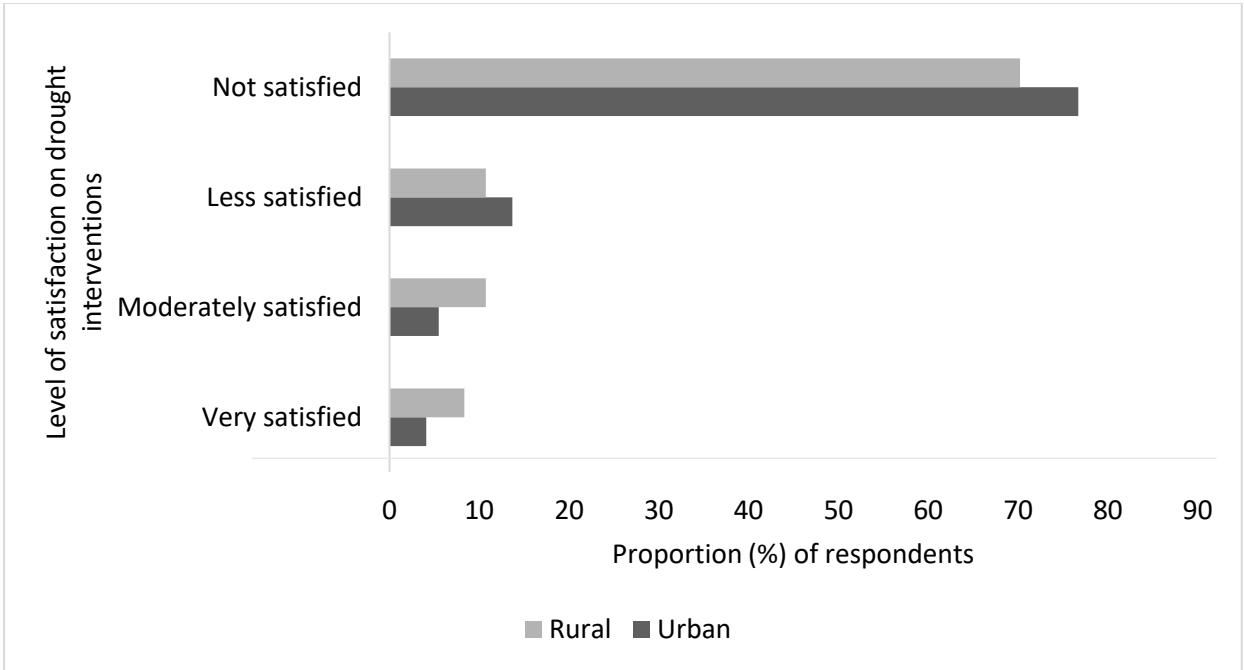

Figure 5.3. Level of satisfaction with drought support interventions.

Respondents stated that the agricultural extension officers were knowledgeable about drought support interventions in both urban (75 %) and rural (86 %) areas. Respondents were asked if agricultural extension officers are resourceful with the support interventions, and 55 % in urban and 49 % in rural areas 'strongly disagreed', and 23 % in urban and 28 % in rural areas 'disagreed'. Just 9 % of the respondents in urban areas 'agreed' while double the proportion in rural (18 %) areas agreed (Figure 5.4). Other respondents were 'neutral', and only a handful of respondents in urban areas 'strongly agreed'.

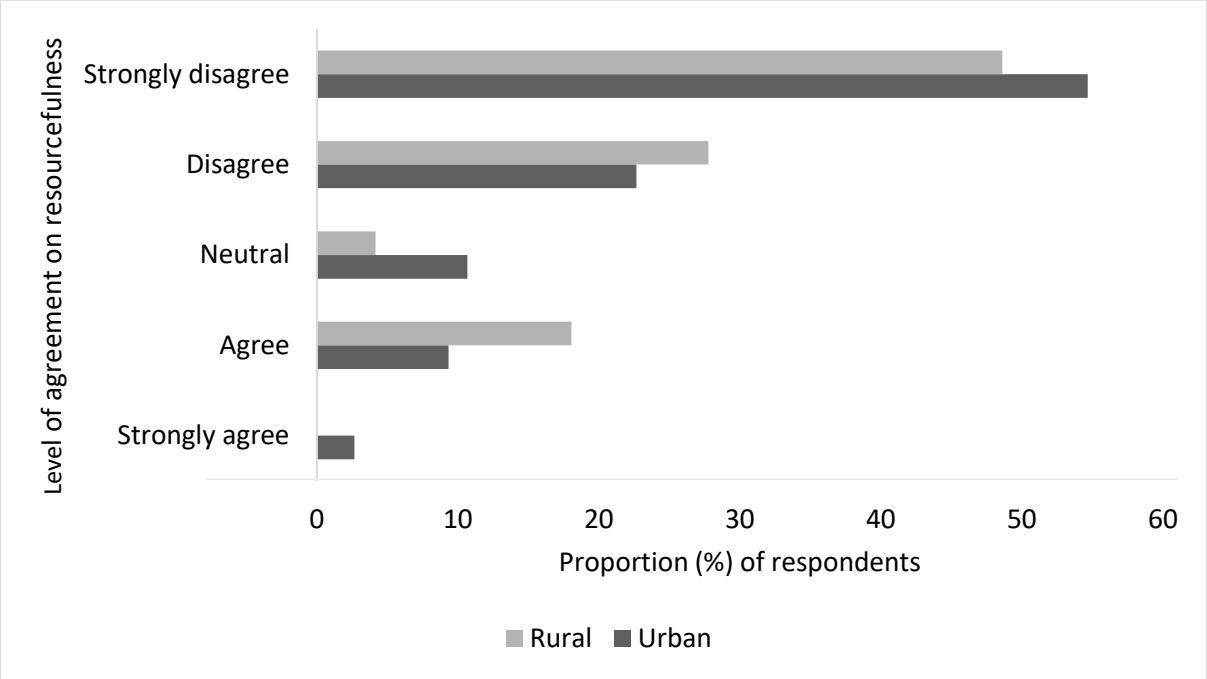

Figure 5.4. Resourcefulness of drought support interventions.

A chi-square test on small-scale farmers' perceptions on the responses to drought showed no significant differences except for knowledge of drought support interventions by extension officers ($\chi^2 = 19.26$; $p < 0.05$) (Table 5.2).

Table 5.2. Small-scale farmers' responses and socio-demographic variables.

Perception	**Gender** X^2; p-value	**Education** X^2; p-value
Training on drought interventions	0.75; 0.38	5.6; 0.23
Drought response measures	0.36; 0.83	11.36; 0.18
Institutional support during droughts	0.086; 0.77	10.02; 0.040
Extension officers knowledgeable about drought support interventions	2.15; 0.34	19.26; 0.013

5.3.3 Challenges encountered by the respondents

The respondents were asked about the challenges they experienced in implementing drought adaptation strategies. Most of the respondents across the sample mentioned lack of support and information provision as the main challenges to implementing adaptation strategies, with a slightly higher proportion in urban (93 %) than in rural areas (80 %) (Table 5.3). Two times more respondents in rural areas (41 %) than in urban areas (19 %) cited lack of resources as a challenge to adaptation. Other challenges mentioned are corruption in the distribution of incentives to farmers in distress, lack of direct communication between extension officers and small-scale farmers, lack of monitoring in the distribution of incentives such as fodder, lack of reliable water sources, and a focus on rural small-scale farmers. A substantial and nearly similar proportion of the respondents in both urban (74 %) and rural (70 %) areas said they provided own support to cope with the challenges. About 26% of the respondents in urban areas mentioned that they received support from Department of Rural Development and Agrarian Reform (DRDAR). Only 17 % in rural areas mentioned that they received support from DRDAR. Other respondents in rural areas said they receive support from co-operatives.

Table 5.3. Challenges to implementing drought adaptation strategies.

Challenges to implementing drought adaptation strategies (%)	**Urban**	**Rural**
Lack of support and information	93	80
Lack of resources	19	41
Corruption	4	1
Lack of communication	5	5

5.3.4 Potential interventions

Respondents were asked to suggest ways in which challenges related to drought adaptation can be addressed. There were no marked differences in responses between rural and urban farmers. Roughly a third of the respondents in both urban (30 %) and rural (31 %) areas stated the need for a direct farmer-to-government institutions interaction. Respondents in both urban (18 %) and rural (26 %) stated that government institutions should provide them with incentives in the form of farm inputs, fodder, and supplements for livestock. Approximately a fifth of the respondents (21%) in urban areas said information sharing and early warning information are essential to improving their adaptive capacity, and only 10 % in rural areas

felt the same. About 14% of the respondents in urban areas and 4% in rural areas said that developing sustainable community organisations can improve drought management. Other solutions mentioned were restoration of water sources, dissemination of early warning information, and monitoring of small-scale farmers' co-operatives and distribution of incentives. Meanwhile, other respondents stated that they did not know how these challenges could be improved in both urban (18 %) and rural areas (26 %).

Respondents were asked about their future projections of droughts on small-scale agricultural production. A substantial proportion of the respondents in both urban (75 %) and rural (76 %) perceived droughts to be a recurrent phenomenon in the future, with severe negative impacts on livestock and crop production. Only 12 % of the respondents in urban areas and 7 % in rural areas mentioned that the drought events would get better. A few respondents in urban and rural areas acknowledged the uncertainty or unpredictability of droughts and continued water scarcity issues; others said they did not know.

5.4 Discussions

The small-scale farmers in this study use different adaptation response strategies, and most of these strategies have been documented in the literature (Muller and Shackleton, 2013; Mavhura et al., 2015; Maltou and Bahta, 2019; Bahta et al., 2020; Lottering et al., 2021; Quandt, 2021). Therefore, understanding response strategies is essential to provide insights into the range, forms, and types of strategies used in both urban and rural settings. Water harvesting schemes have been a commonly used approach by small-scale farmers to respond to droughts (Rakgwale and Oguttu, 2020; Lottering et al., 2021). There is a dependence on stored water in both urban and rural settings to support small-scale farming. The harvesting of water cushions small-scale farmers from relying on tap water as the primary water source to sustain their farming, which is mostly unavailable as dams, rivers, and wells nearby get dry during drought seasons. Therefore, the storage of water in tanks and water drums was reported as a reliable adaptation strategy that helped farmers provide drinking water for their livestock during drought periods. Ngingi (2009) showed that water harvesting strategies in Ethiopia were an effective coping strategy during droughts and resulted in improved yields. Although rain harvesting and storage is a good drought adaptation strategy, several factors affect the strategy, namely environmental factors such as less rainfall during drought means

less water is harvested, economic constraints such as the cost of buying storage tanks, and social factors such as lack of technical knowledge regarding rain harvesting systems consistent with findings in Ghana (Bessah et al., 2022). Similarly, in a study in Kenya, rainwater harvesting did not relieve small-scale farmers due to low rainfall, preventing adequate water storage (Mburu et al., 2015). It is evident that the adopted strategies are mainly reactive and may not be sustainable because of low levels of preparedness.

The findings revealed slight differences between urban and rural settings on reliance on fodder to sustain livestock. Small-scale farmers in urban areas bought fodder, and supplements while farmers in rural areas relied on fodder that the government freely provides, or they planted maize and fodder to feed livestock. Previous studies have shown that socio-economic status and factors such as household income and affordability could explain this trend as small-scale farmers in urban areas are generally more economically well-off than those in rural areas (Ezra and Kiros, 2001). Furthermore, Muller and Shackleton (2013) state that the reliance on purchasing fodder by small-scale farmers, particularly those in urban areas as shown in this study, is a means to subsist than a sustainable response strategy. Therefore, this adaptation strategy can potentially weaken small-scale farmers' adaptive capacity. Although small-scale farmers, mostly in rural areas, mentioned that they plant fodder, this approach is often not sustainable due to no irrigation systems, access to land, and fences.

Similar to other studies (Muthelo et al., 2019; Shinbrot et al., 2019; Lottering et al., 2021), small-scale crop farmers in both urban and rural settings relied on crop diversification, changing planting dates, and mixed cropping. These strategies are important for improving soil nutrients, suppressing weeds, and overall productivity (Rudel et al., 2016). Somboonsuke et al. (2018) and Menghistu et al. (2018) reported that small-scale farmers in Sub-Saharan Africa predominantly employ crop and livestock diversification, along with changing planting dates, as their main response strategies based on practicality and affordability, as small-scale farmers face constraints in accessing necessary resources. Small-scale farmers in Cacadu (formerly Lady Frere) in the Eastern Cape province of South Africa mentioned that they mainly focus on planting sorghum and barely because these are drought tolerant plants that require

less water. Agesa et al. (2019) and Quandt (2021) revealed that the introduction of drought-tolerant crops in Kenya was an effective response strategy. Selling old stock, fencing fields, saving money, and storing grass are short-term strategies that help small-scale farmers overcome adverse drought impacts. The response strategies practised in the study are mainly changes in local practices and technical strategies (Ruwanza et al., 2022).

Although several studies (for example, Udmale et al., 2014; Yousefpour et al., 2017; Quandt, 2021) classify the strategies mentioned above as significant reactive approaches, these strategies do not necessarily prepare small-scale farmers to build resilience. Instead, they are short-term survival strategies that fit within existing socio-economic contexts (Udmale et al., 2014; Yousefpour et al., 2017; Quandt, 2021). Small-scale farmers consistently adopt drought response strategies due to their passion for crop farming and livestock rearing. Livestock rearing in rural areas has historically been a common practice compared to rural areas. However, formal employment opportunities in urban areas in small towns are scarce. Hence, small-scale farmers in urban areas have rare livestock to sell compared to rural small-scale farmers carrying out a historical tradition from forefathers. The findings suggest that home gardens supply staple foods and are essential for sustaining livelihoods by improving food security in urban and rural settings. This is consistent with Galhena et al. (2013) who found that gardens positively impact food security, malnutrition, and income. The results also indicate that barriers such as lack of knowledge, insufficient resources and water to support small-scale farming practices hinder the adaptive capacity of small-scale farmers to droughts. This concurs with Muller and Shackleton (2013), who reported that small-scale farmers in the Eastern Cape Karoo perceive unavailability of funds, government support, and information as major constraining factors to build an adaptive capacity.

Muller and Shackleton (2013) suggested that access to information, funds, and government support would be essential adaptation strategies. However, in the present study, support from government institutions was acknowledged, although it was regarded as minimal and unsatisfactory in both urban and rural settings. This is supported by Jordaan (2012), Mdungela et al. (2017), Ncube (2020), and Bahta (2020), who concluded that support interventions during droughts are insufficient and the support is usually delayed. In a study by Muller and

Shackleton (2013), inadequate institutional support was mentioned to be a constraint in building resilience. Political structures influence government institutions in these areas and face institutional challenges such as a lack of transparency, corruption, and fragmentation (Bahta, 2020; Ncube, 2020). This is consistent with Lottering et al. (2021), who found that small-scale farmers in uMsinga, KwaZulu Natal, South Africa were not content with institutional support during drought events. Furthermore, government institutions in uMsinga tended to favour community members involved in politics and failed to uphold or carry out the management decisions as intended. (Lottering et al., 2021). Similarly, small-scale farmers in the study alluded to community political leaders taking ownership of government incentives such as fodder, farm inputs, broilers, and seedlings as service delivery.

Although government institutions face administrative factors affecting the adaptive capacity of small-scale farmers, Jiri et al. (2017) state that institutions have a positive impact on improving drought response capacity through the provision of vouchers used to buy fodder, farm inputs, and medicine for livestock. The results illustrate that agricultural extension officers are aware of the interventions needed to improve drought adaptation. Small-scale farmers have opted to provide own support interventions during droughts, while others formed co-operatives to assist each other. Keil et al. (2008) and Maltou and Bahta (2019) found that small-scale farmers that are part of co-operatives and community organisations are likely to be resilient to drought impacts. However, joining such organisations requires money. Most small-scale farmers in the study cannot afford to join co-operatives as they solely depend on social grants, which are already insufficient to meet daily basic needs.

A direct farmer-to-government institutions interaction is essential to ensure that agricultural extension officers are aware of the challenges experienced by small-scale farmers as a basis for improving the capacity of small-scale farmers to employ drought response strategies and to improve their welfare. Small-scale farmers in the study suggested developing stable community organisations as an effective solution to improve drought responses. The findings of the study highlight the importance of strengthening drought response strategies such as the provision of early warning information and awareness, dam scooping, provision of water storing systems, fencing of land to create reserves for livestock feed, and creating a market

to sell old livestock. Mburu et al. (2015) show that developing stable community organisations is a good platform for information sharing and skills among small-scale farmers, and as a result, small-scale farmers who were part of the organisation were aware of and opted for drought-tolerant crops. Providing adequate financial and institutional support to small-scale farmers would allow them to consider and employ better-informed drought response strategies to adapt to droughts. This may arguably reduce the burden on government institutions to provide social services to farmers during droughts.

5.6 Conclusions

This study examined drought response strategies employed by small-scale farmers across a rural-urban gradient in the Eastern Cape province, South Africa. Mostly, there were slight differences in the strategies employed and the number of respondents reporting the strategies between urban and rural farmers, suggesting broad-scale measures are needed to support farmers across economic and geographic gradients. Small-scale farmers adopted various response strategies during drought periods including crop rotation, crop diversification, use of farm inputs, and drought-tolerant crops. From the farmers' perspective, these strategies improved soil properties and promoted the growth of crops. Small-scale farmers also practised water harvesting techniques which helped reduce reliance on limited rainfall. This involved storing water in tanks and drums for use during rainfall scarcity to minimize losses. Concerning livestock production, small-scale farmers predominantly relied on storing water, buying fodder, planting drought-tolerant plants, and vaccinations. These strategies have cost implications for small-scale farmers who are already struggling financially. Small-scale farmers did not have the expertise and adequate information on drought response strategies. Institutional support is mainly in the form of incentives such as providing feed to small-scale farmers that are impacted by droughts. Overall, drought in the study is perceived as an ongoing disaster that will continue to impact small-scale farmers. Therefore, it is important to capacitate small-scale farmers by providing adequate support, access to information and resources, and tailoring response strategies based on their specific requirements.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Drought has far-reaching and devastating effects on small-scale farmers who lack sufficient resources, leaving them vulnerable and at risk (Ruwanza et al., 2021). This is accompanied by socio-economic repercussions such as livestock and crop losses. This thesis reports on the perceptions of small-scale farmers on drought impacts and response strategies in rural and urban settings in the Eastern Cape province of South Africa. Drought impacts are significant and affect small-scale farmers negatively, hence it is important to develop response strategies that will prepare for and enable small-scale farmers to build adaptive capacity during droughts. An inadequate understanding of small-scale farmers' perceptions of droughts and local response strategies can make it difficult to design drought management strategies that are in line with local conditions and views. Furthermore, this can assist decision-makers in formulating more effective plans despite facing institutional limitations and financial constraints. Studies on drought impacts and adaptation strategies have been reported, focusing on commercial farmers and communal farmers in rural areas in South Africa. Focusing on urban and rural contexts is necessary to understand the differences and similarities in the drought impacts experienced by small-scale farmers. This study attempted to fill this gap.

6.2 Summary of findings

The findings of this study showed that small-scale farmers in both urban and rural practised agricultural activities such as raring livestock and planting crops (Chapter 4). Generally, agricultural activities are practiced in rural areas in South Africa, but due to insufficient economic opportunities in urban settings, there is a growing trend for farming activities to improve their livelihoods (Thondhlana et al., 2022). Small-scale farmers in urban and rural settings are aware of the recurrent droughts through self-observation using indigenous weather prediction methods. This includes observing the state of grazing fields, livestock health, plant growth, and changing temperatures and rainfall patterns. Televisions and radio are also used for weather updates based on scientific forecasting. Small-scale farmers in the study are affected by recurrent droughts with severe livestock and crop losses. Several studies

have reported that the key impact of drought in agriculture is crop failure and livestock mortalities, which directly affect the marginalised small-scale farmers.

The findings also show that small-scale farmers employ drought response strategies (Chapter 5), including water harvesting practices, purchasing fodder, changing planting dates, crop diversification, mixed cropping, and planting drought-tolerant plants. Small-scale livestock farmers often have to deal with the negative effects of drought such as less fodder available in grazing fields. Some common response strategies reported are reducing the number of livestock by selling old stock, moving them to different places, or purchasing fodder. Old livestock is sold for income generation needed to buy supplements and fodder during drought periods. Purchasing fodder has been used as a response strategy during periods of degradation in grazing fields, though this option is often expensive, considering that small-scale farmers struggle to make a living. Some small-scale farmers in the study applied cost-effective strategies such as planting barley, and maize, and using silage as feed. The small-scale farmers reported receiving government support, typically fodder and vouchers to purchase farm inputs though there was a high degree of dissatisfaction. Other strategies small-scale farmers use include getting rid of low-producing animals, improving the birth rate by selling certain calves, borrowing money from banks (if they have something valuable to use as collateral), giving up farming, renting parts of their land to others, and working together with other farmers to deal with the effects of drought. Some of the response strategies require financial capital, which was beyond the reach of many small-scale farmers, given that most farmers depend on government welfare grants to sustain their livelihoods.

6.3 Implications of the study

Small-scale farmers in the Eastern Cape province of South Africa can enhance their resilience by adopting drought-resistant crops (such as sorghum, maize, wheat), implementing rainwater harvesting, practicing conservation agriculture, and integrating agroforestry to improve the soil properties to allow crop growth. Small-scale farmers can also adopt livestock management practices such as fence-line contrasts, supplementary feeding, and use of indigenous knowledge to minimize drought impacts. Small-scale farmers can form cooperatives and collaborate with local extension officers to engender capacity development

in their farming practices. This can also improve market access through local markets and digital platforms and strengthen their income. Although the above strategies exist, they need improvement. Hence, this study's findings has implications for policy-making related to ensuring improved drought management plans in South Africa and beyond.

Drought-related socio-economic losses, such as loss of income from crops and livestock, means investing in drought management interventions is required to ameliorate the negative impacts of droughts on lives and livelihoods. Small-scale farmers indicated a disconnect between farmers and government extension officers. This can be addressed by ensuring effective communication and engagement between extension officers, nongovernmental organisations, and small-scale farmers to identify the constraints and pathways towards sustainable drought response interventions. Programmes aimed at raising awareness about droughts impacts and effective strategies for responding to droughts can provide an opportunity for all small-scale farmers to consider available options based on their respective situations. A key aspect dimension to consider in this study is there were no significant differences in experiences between rural and urban farmers. Most farmers were recipients of government social grants, indicating that they are generally poor. Therefore, the underlying vulnerability and limited capacity for small-scale farmers can make a recovery after droughts much more difficult, which calls for investment in drought response strategies aimed at improving the capacity of poor farmers to adapt to droughts.

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APPENDIX 1: QUESTIONNAIRE

Makhanda ● 6139 ● South Africa

Questionnaire no: ____Date: _____Field worker name: _____

Town: _____ Neighborhood: Urban [ ] Rural [ ]

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SECTION A: AGRICULTURAL ACTIVITIES AND PRODUCTIVITY

Livestock farming

1. Does your household own any livestock? YES/NO

   If Yes, fill out table

Animal	Number	Animal	Number
Cattle		Horses	
Sheep		Chickens	
Goats		Pigs	
Donkeys		Other; specify	

2. How long have you been practising livestock production? ……
3. Where do you graze your livestock? ……..
4. Who looks after your livestock during the day? Self [ ] Family member [ ] Friend [ ] No-one [ ] Hired help [ ] Join with other friends [ ]
5. What benefits (uses) does your household get from the livestock?

Resource/Activity	Get/use	Resource/Activity	Get/use
Meat		Transport	
Milk		Ceremonies/rituals/parties	
Skins		Other:	
Cash (from sales)		Other:	
Lobola payments		Other:	
Savings			
Dung for manure			

6. Are there any problems regarding livestock production? YES/NO

   If Yes, fill out table

Problems	Tick
Lack of water	
Diseases/Lack of dipping chemicals	
Theft	
Lack of a reliable market	
Other specify:	

7. Have you experienced livestock loss in the past 5 to 10 years YES/ NO

If YES, how severe has been the loss

1= Very severe (i.e. lost almost everything)	2= Moderately severe (lost about 50% of expected yields)	3= Not severe (lost very little)

8. What do you think are the causes of the livestock loss?

1= Natural disasters such as droughts	2= Degraded grazing land	3= Unavailability of dipping chemicals	4= Disease outbreak	5= Other, specify?

9. Can you tell me about your major livestock losses/impacts and how you responded to these?

……

……

……

10. What is your main source of water for crop and livestock farming?

1=Rain-fed	2=Tanks	3=River	4=Dam	5=Taps	6=Other

CROP FARMING

Does your household practice crop farming? Y/N

11. If YES, which crops do you cultivate?

……

……

12. Where do you farm your crops?

    A. Garden
    B. Communal fields
    C. Both
    D. Others ……

13. How do you select which crops to grow?

    A. Early maturity

B. Resistance to disease

C. Resistance to drought

D. High yield potential

E. Easy management of crop

F. Other, specify…….

14. What benefits (uses) does your household get from crop farming?

Benefit	**Tick**
Food	
Cash income (from sales)	
Animal feed	
Other (explain)	

15. How long have you been practicing crop farming? ……

16. Have you experienced low crop yields of the past 5- 10 years? YES/NO

If yes, how severe has the loss been

1= Very severe (i.e. lost almost everything)	2= Moderately severe (lost about 50% of expected yields)	3= Not severe (lost very little)

17. What do you think are the causes of the crop yield decline?

1= Natural disasters such as droughts	2= Lack of farm inputs	3= unavailability of water for irrigation	4= Disease outbreak	5= Other, specify?

Please, explain your answer in detail

……

……

……

18. Do you have protection insurance against droughts? YES/ NO

19. Do you have access to weather information? YES/ NO

If Yes, what is your most reliable source of information?

1 = Radio	2 = TV	3= Agricultural extension officers	4 = Farmer to farmer	5 = Internet	6 = Other

Section 3: Farmers' experiences and perceptions of drought impacts

20. Are you aware of the recurrent droughts in your area? YES/NO

If Yes, where did you hear about such information?

……

……

21. Have you noticed any changes in the environment relating to drought? YES/NO

    If Yes, what indicators of change have you observed relating to the above-mentioned

    A. Changes in rainfall patterns
    B. Changes in the amount of rainfall
    C. An increase in temperatures
    D. Other,

       specify……..

22. What is the main impact of these changes on the local community?

1 = Crop failure	2 = Livestock mortalities	3 = Food insecurity	4 = Disease outbreaks

23. Have you been trained or informed on drought interventions? YES/ NO
24. Are there any drought adaptation measures practiced during drought periods? YES/NO

    If yes, what measures are these (Please explain your answer in detail)?

    A. Crop and variety diversification
    B. Changing dates of planting
    C. Build water harvesting schemes
    D. Mixed cropping
    E. All the above
    F. Others,specify……

       ……

25. Are there any mitigation strategies applied during dry seasons for sufficient livestock and crop production? YES/NO

    If yes, what are these strategies?

    ……..

    ……

    ……

26. What was the motivation to adopting the abovementioned adaptation strategies?

    ……

    ……

    ……

27. If you did not adopt any adaptation measures, what demotivated you?

1 = Lack of knowledge	2 = insufficient information	3 = Extreme water shortages	4 = Do not see the need	5 = Other

28. Are there institutions/ organizations that are working with you to provide support during droughts? YES/NO
    If yes, please list them

    ……

    ……

    ……

    How satisfied are you with the support received?

1 = Very satisfied	2 = Moderately satisfied	3 = Less satisfied	4= Not satisfied

Please explain your choice……..

……

……

29. Do you think agricultural extension officers are knowledgeable about drought support interventions? YES/NO
30. Agricultural extension officers are resourceful with these support interventions

1= Strongly agree	2= Agree	3 = Neutral	4 = Disagree	5 = Strongly disagree

31. What are the challenges to implementing drought adaptation strategies (e.g. lack of support and information, unavailability of resources, etc.)

    ……

    ……

32. What support systems have you used to cope with these challenges and who provides them?

    ……

    ……

    ……

33. How do you think these challenges can be addressed?

    ……

    ……

    ……

34. When you think about droughts in this area, what comes to your mind?

.....

.....

.....

35. Can you explain your worst experience associated with droughts?

.....

.....

.....

36. Other than losing your livestock or crops, what else have you lost due to droughts?

.....

.....

.....

37. How do you see environmental hazards such as drought affecting agricultural production in the future?

.....

.....

.....

38. What can be done to ensure that small-scale farmers are prepared and respond effectively to such events?

.....

.....

.....

SECTION B: RESPONDENT PROFILE

1. How long have you lived in this area? .....
2. What year were you born?.....
3. What is your highest level of education? .....
4. Gender: Female [ ] Male [ ] Non-binary [ ] [ ]
5. What is the total number of people living in your household, including you?.....

6. Are you the head of this household? Yes/No

7. What is your marital status
   Married [ ] Widow/widower [ ] Divorced [ ] Single [ ]
8. What is the biggest source of your household income?

   Wages [ ] Social grants [ ] Private pensions [ ] Own business [ ]

9. Pls indicate the broad range of the household monthly income (Rands)

<2,000 [ ] 2,001 – 6,000 [ ] 6,001 – 15,000 [ ] 15,0001 – 30,000 [ ] > 30,000 [ ]