ASSESSING DROUGHT PERCEPTION AND ITS IMPACTS ON RURAL COMMUNITIES' LIVELIHOOD: A CASE OF SEKHUKHUNE DISTRICT MUNICIPALITY

By

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Declaration

I, Karabo Motene the author of the research titled *Assessing Drought Perception and its Impacts on Rural Communities' Livelihood: A case of Sekhukhune District Municipality*, declare that this dissertation submitted in fulfilment of the requirements for awarding of a Master's Degree in Disaster Management from the Disaster Management Training and Education Centre for Africa (DiMTEC), is my own original work and has not been submitted by any other person to any other institution for any other qualification. The sources that I have used have been appropriately acknowledged.

Date: 30 November 2021

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Karabo Motene

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Signature

Karabo Motene

2018659017

Dedication

I dedicate this work to my husband Kabetso Mohlala and my daughter Kenya Mohlala. To my husband, for his never-ending support. Without your emotional and financial support, this dissertation would not have been possible and to my daughter for remaining resilient throughout my studies.

To my parents Kgaogelo and Thomas Motene for giving me the foundation and to my brother and sister Bokang and Tshwarelo Motene for the support you have given me and my family throughout my studies.

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Abstract

The last decade has seen an increase in drought events across South Africa that have wrought havoc on human and natural environments which has led to a significant increased the pressure on freshwater resources and food security and energy supply to millions of people in the country is in jeopardy. This study was conducted in a community that is 90% rural, depends on agriculture for their livelihoods, and is struggling with the recurring drought events. Therefore, the aim of the study was to understand smallholder famers' perceptions of drought and how drought affects their lives and livelihoods. The study examined three important aspects of drought, as they relate to community development, by examining the farmers' perceptions of drought, the impact of drought, and the coping and adaptation strategies and mechanisms of drought. The study employed a mixed-methods research approach to collect and analyse data. Quantitative data was collected using a survey questionnaire while qualitative data was collected through in-depth interviews with the smallholder farmers in Sekhukhune District Municipality, South Africa. The qualitative data was analysed using thematic analysis while quantitative data was analysed using descriptive statistics, namely frequencies and percentages.

The study revealed that there are different expectations of drought among smallholder farmers. Some smallholder farmers believed that drought was the result of both man-made and natural causes while others believed that drought was because of natural or human influences. In the end, the drought coping mechanisms often appeared to vary between farmers. The study concludes that drought has a variety of impacts, including changes in water supply, health, food security, and household income as well as other social factors. As far as coping methods are concerned, the study found that smallholder farmers seek other sources of income and depend on drought relief benefits from the Government. The results show that farmers lack the adaptive capacity to sufficiently deal with the effects of drought. This presents a great opportunity for the community to collaborate with the authorities to develop sustainable strategies to deal with the effects of drought. This study found that the majority of the farmers have no formal education or have at most a high school qualification. Educating and training these farmers will increase their chances of developing better coping capacities with drought, so the municipality should engage in education and training programmes for these farmers in order to increase their skills and knowledge and assist them to deal with the effects of drought better. The uptake of agricultural insurance as an adaption strategy is very slow in the study area. The municipality can collaborate with some insurance companies to offer group policies to farmers to cover their farming operations against natural disasters such as drought. This will greatly increase their adaptive capacity and help them bounce back faster and better.

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List of Acronyms

AIDS	Acquired Immunodeficiency Syndrome
CCF	Community Capitals Framework
DMA	Disaster Management Act
DRR	Disaster Risk Reduction
ENSO	El Niño Southern Oscillations
GDP	Gross Domestic Product
HIV	Human Immunodeficiency Virus
JDF	Joint Development Forum
KPA	Key Performance Area
KPI	Key Performance Indicator
NDMC	National Drought Management Centre
NDMF	National Disaster Management Framework
NGO	Non-Governmental Organisation
PAR	Pressure and Release
PDSI	Palmer Drought Severity Index
PGM	Platinum Group Metals
PoA	Plan of Action
SADC	Southern Africa Developing Countries
SDG	Sustainable Development Goals
SDM	Sekhukhune District Municipality
SFDRR	The Sendai Framework for Disaster Risk Reduction
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	The United Nations Framework Convention on Climate Change

Chapter 1 Introduction

1.1 Background of study

In the Southern African Development Community (SADC) region, for example in South Africa, many sectors and residents such as farmers and businesses suffer from frequent drought. The majority of people in South Africa are also affected by poverty, high unemployment, recurrent drought, and inequitable land distribution (Mpandeli *et al*., 2015). These factors are major problems that further constrain the livelihoods of ordinary South Africans, for example, the farming community and rural areas. Extreme climate conditions, such as periods of drought and floods, exert additional pressures on livelihoods and agricultural activities (Mpandeli *et al*., 2015).

Agriculture is an essential sector for the majority of rural communities in developing countries because it provides income, employment, and foreign exchange (Tizazu *et al*., 2018; Abera *et al.*, 2021). As the World Bank Report (2009) highlights, farming is the major activity for most rural households in Sub-Saharan Africa, including the study area, and it offers a powerful choice for boosting growth, overcoming poverty, and enhancing food security. However, due to shrinking farm sizes, low productivity due to drought hazards, and a high degree of subsistence farming, the industry has been repeatedly criticised for failing to provide a suitable income for smallholder farm households in the region (Oya, 2009).

Since the World Food Summits in 1996 and 2001, as Owusu *et al.* (2011) point out, eliminating hunger and food insecurity has been an important aspect of the worldwide development agenda. According to Godfray *et al*. (2010), guaranteeing food security is a major topic in academic and international debates as it is the task of feeding nine billion people (Tizazu *et al*., 2018; Abera *et al*., 2021). Food security exists when all people at all times have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for active and healthy life (Pérez-Escamilla, 2017).

The growing demand for food with a rising population has worsened the problem of food insecurity, which is found to be most prevalent in South African regions (Battersby & Haysom, 2018). Although increasing agricultural production is intended to improve and sustain rural people's livelihoods, agriculture alone is inadequate to offer sufficient means for the majority of poor rural households to overcome poverty (Sunam & McCarthy, 2016). As a result, studies undertaken by a variety of experts suggest that assessing the effects of drought on people's livelihoods and the rural economy is one of the ways out of poverty and to assure food security

for rural residents (Dagunga *et al*., 2018; Challa *et al*., 2019; Abera *et al*., 2021). Nevertheless, the contribution made by livelihood diversification to rural livelihoods has often been ignored by policymakers who have chosen to focus their activities on agriculture. Agricultural production and productivity is being challenged by recurrent drought occurrence compounded with poor usage of improved agricultural inputs, land degradation, and high population growth. Hence, most rural households in South Africa are exposed to food insecurity and chronic poverty as a result of drought events.

1.2 Description of study area

Sekhukhune District in Limpopo province of South Africa is predominantly rural, with rural areas accounting for 90% of the District's population. Agriculture is regarded as the primary source of employment and income. The Greater Sekhukhune District is rich in minerals, including huge platinum reserves. The District's southern areas have greater agricultural potential than other regions. Commercial agriculture accounts for 30% of the District's farming activity, while subsistence or smallholder agriculture accounts for 70% (Mpandeli *et al*., 2015). The Sekhukhune District is semi-arid, and water scarcity is common. The average annual rainfall in the District is around 560mm. However, irrigation systems are used by the majority of commercial farmers. One of the limitations preventing the District's agricultural production from growing and developing has been noted as water shortages and inadequate rainfall distribution (Figure 1.1)

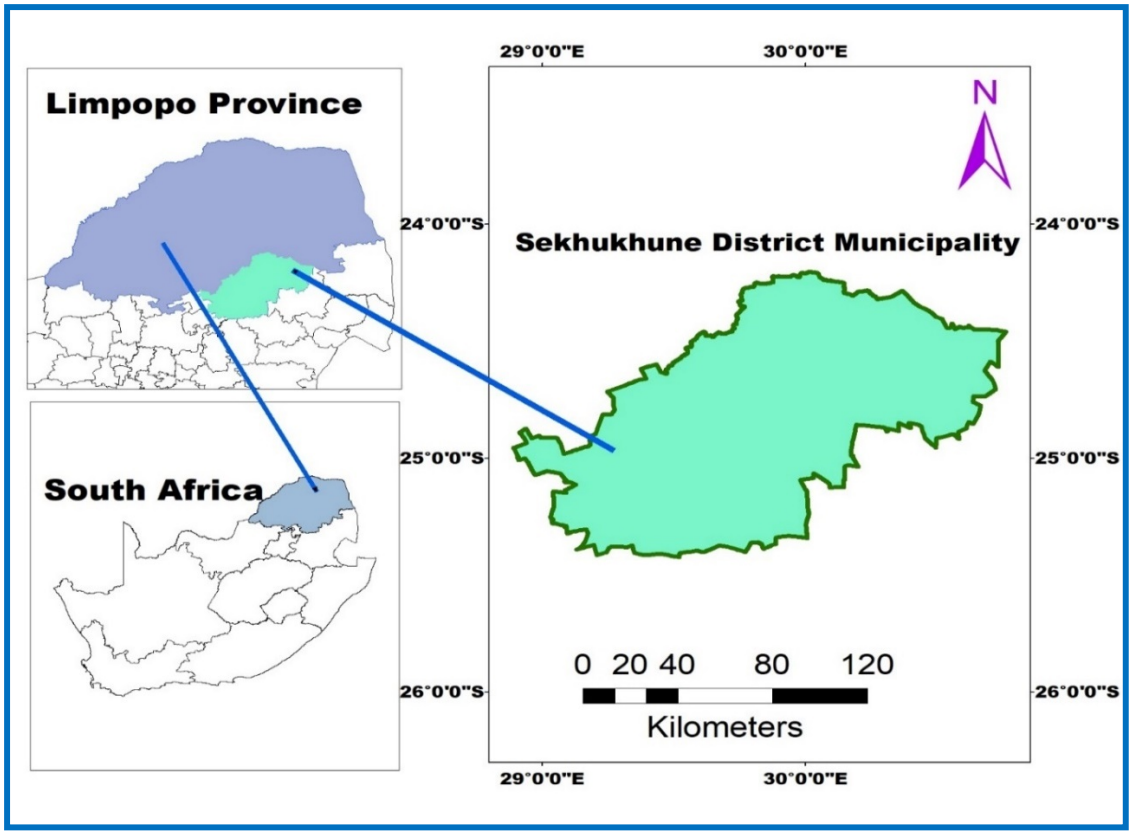

Figure 1.1: Map showing the study area

Source: Author, (2021)

1.2.1 **Topography, hydrology, and climate**

The study area falls within a summer rainfall region, with over 96% of the annual rainfall occurring during the October to April period. The area is associated with hot and dry weather conditions, leading to a decline in precipitation. The topography of Sekhukhune District Municipality is that of strongly undulating plains which cover the entire north-eastern and eastern regions of the Municipality. There are prominent dams, such as Flag Boshielo and De Hoop Dam, that are fed by rivers such as Spekboom and Steelpoort River through the Olifants River system (Kekana, 2013).

The study area is a semi-arid savannah environment that is part of the Bushveld ecoregion, which includes Mountain Bushveld and the Bushveld of the Sekhukhune Plain (Skowno *et al*., 2021). Precipitation is a major determining factor in the structure of savannah vegetation, which is made up of both woody and herbaceous vegetation (Nzuza *et al*., 2020). Acacia Rehmanniana, Acacia Karoo, Acacia Robusta, and Acacia Tortili are the most common trees and shrubs, whereas Eragrostis sp, Aristida sp, Digitaria sp, and Trichoneura sp are the most common grasses. Deserted cropland (3.19%), rangelands (71.32%), subsistence cultivation

(17.1%), and rural communities (7.5%) are the most common land cover categories. Land degradation has been exacerbated by livestock grazing, particularly on communal land, with soil erosion owing to a lack of herbaceous basal cover (Von Maltitz *et al*., 2019; Nzuza *et al*., 2020). The region is home to some of South Africa's most precious mineral deposits, including huge amounts of platinum group metals (Sefako *et al*., 2017; Safarzadeh *et al*., 2018). It is mineral-rich yet extremely arid, resulting in severe water shortages, drought, and reliance on irrigation facilities for agriculture. One of the largest clusters of commercial agricultural output in the country can be found in the District's southwest area. The serious water shortage impacts homes and is a huge stumbling block to the agriculture and mining sectors' expansion — roughly 65 000ha of prime land cannot be farmed owing to a lack of irrigation water.

1.2.2 **Population**

Statistics South Africa indicated during the 2016 (only available data on the community) Community Survey that the total population of Sekhukhune District is 1,169,762. In the 2011 Census, the population of Sekhukhune District Municipality stood at 1,076,830 persons. The total population of the District increased by 8.6% over five years. The youth population, which consists of mostly unemployed persons, increased by 30% over the same five years (Sekhukhune District Municipality Annual Report, 2020). However, Statistics South Africa indicated in the 2011 Census figures, that the annual population growth rate in the District was 1% per annum. Based on this statement, it can be seen that the population growth rate was projected to be slower as the District population was reached 1,130,670 in 2016. However, this projected number was exceeded in the 2016 community survey (Community Survey, 2016).

1.2.3 **Economic activity**

The economic activity within Sekhukhune District Municipality is dominated by agriculture, mining and quarrying, hunting, forestry, and fishing activities as well as manufacturing, with mining being the main contributor to the Gross Domestic Product (GDP) within the district municipality (Thobejane, 2019). The Sekhukhune economy is founded on the mining and agricultural industries and has a large public sector. Between 1995 and 2004, the Greater Sekhukhune District Municipality (GSDM) economy grew at an average annual rate of 4%, driven mainly by growth in the Tubatse-based mining industry.

The benefits of this growth have failed to lift the broader population out of poverty. Only 14% of the adult population is employed, and the high percentage of unemployed adults has a huge impact on the economy and people. Employment growth averaged 1,9% p.a. between 2000

and 2004. Furthermore, many emerging farmers have not yet been able to make a significant entry into commercial agriculture.

1.3 Selected economic sectors in Sekhukhune District Municipality

1.3.1 Agricultural production in Greater Sekhukhune

Commercial and subsistence farming coexist in the Sekhukhune District Municipality's agricultural sector. One of the largest clusters of commercial agricultural output in South Africa is found in the District's southwestern region (Ephraim Mogale and Elias Motsoaledi Local Municipalities). Despite the fact that agriculture is a significant source of employment in the District, it contributes about 9.7% of the District's total GDP (Drimie *et al*., 2012).

Unfortunately, water scarcity and the uncertainty produced by land claims are deterring the establishment of commercial agricultural businesses (Diale, 2011; Mayson *et al*., 2020). Essentially, commercial agriculture in the Sekhukhune District Municipality is centred in two areas: the Loskop Scheme in the southwestern part of the District (between Groblersdal and Marble Hall) and the Burgersfort and Ohrigstad Scheme in the east (the Ohrigstad Scheme). In the former homeland territories of the Sekhukhune District's north and west sides, subsistence farming predominates (Diale, 2011; Mayson *et al*., 2020). These areas are dependent on dry land farming. Agriculture in these former homelands, however, is less intense and mostly focused on subsistence farming. The Loskop Valley contains the settlements of Groblersdal and Marble Hall. The Loskop Dam services the commercial agricultural schemes in this valley.

It has been revealed that over 40% of households in Sekhukhune grew their own crops; this was largely for supplementary purposes and through a vegetable garden or maize plot (Masekoameng & Molotja, 2019). This has reinforced the importance of purchasing food for household requirements and the related necessity of having income sources for food security. This reflected a general picture in South Africa where many households are not in a position to address their food needs through household-level food production, as production levels are not sufficient.

Generally, food availability at the household level has been limited largely as a consequence of inadequate production and inadequate farm inputs (Mazibuko, 2018; Kom *et al*., 2020). Rainfall variation, in some cases rainfall failure, has led to food shortages in households whilst many farmers have underinvested to minimize risk, which has further exacerbated stagnation

in the sector. This food shortage is compounded by increases in the prices of farm inputs following the liberalisation of the sector for the past decades. Food accessibility has been undermined in some areas in South Africa, including the study area by declining formal and informal wage opportunities, a commensurate decline in remittances, and increasing poverty. As a result, where there is an inability to find work, there is difficulty in accessing cash to buy food. Food utilisation has increasingly become a critical concern in South Africa because of a lack of dietary diversity. This is largely a result of the preference for eating maize and the encouragement of mono cropping through agricultural policy that favours large-scale commercial production.

1.3.2 **Mining**

The District is abundantly endowed with a variety of lucrative minerals, including vanadium, chrome, and the world's largest deposits of platinum group metals (PGMs). Strong global demand for these minerals has ensured the Greater Sekhukhune District Municipality mining sector is booming despite volatility in prices, with 15 mines belonging to PGM mining companies currently operating in the District (Mkhari, 2018; Guidone, 2019). Sekhukhune District Municipality accounts for 58%, 50%, and 36% of global production of vanadium, platinum group metals, and chrome, respectively.

The sector accounts for about 8% of formal jobs in the area. The District and local municipalities have joined with several mining companies operating in the area to form a Joint Development Forum (JDF) to address service and infrastructural backlogs inhibiting mining development. To date, the JDF has funded a series of spatial development, water, skills building, and institutional capacity-building projects in Sekhukhune District Municipality (Mkhari, 2018; Guidone, 2019).

Eleven new mines and a R2 billion smelter have been proposed, which are expected to produce about 18,200 new jobs in the next few years (Mayson *et al*., 2020). The challenge for the District is to ensure that the greatest possible proportion of the local population shares in the spoils of this growth, which will require equipping people with the necessary skills to capture employment opportunities, as well as developing a supporting business around the mining industry, such as beneficiation, construction, catering, and so on (Lebaka, 2021). The outlook for resources mined in Sekhukhune is positive. Constraints to faster growth are the lack of water and electricity for the mines, lack of housing for mineworkers, shortage of local skilled workers, shortage of local support industries, and services for the mining sector as well as HIV and AIDS (Thobejane, 2019).

1.3.3 **Tourism**

Tourism currently plays a marginal role in Sekhukhune's economy, generating about R93 million in turnover (less than 1% of nodal GGP) and accounting for less than 1,000 jobs. Sekhukhune has several endowments that suggest that tourism could hold considerable potential for future growth (Ramaano, 2021a; Ramaano, 2021b). It is located within a two-and-a-half hour's drive from Gauteng, allowing for the targeting of the lucrative Gauteng business and weekend holiday markets.

The increase in business travel due to the mining boom in Tubatse and the large agri-business sector in Groblersdal and Marble Hall, as well as the presence of large dams (Loskop, Flag Boshielo, and in future De Hoop), hold opportunities for holiday properties and leisure estates. Sun Valley Tourism, mainly supported by the Marble Hall LM, is the main institution serving the tourism sector in Sekhukhune and receives varying degrees of support from provincial and national tourism bodies (Ramaano, 2021a; Ramaano, 2021b). There are 80 accommodation facilities offering a total of 2,627 beds, with more than half of them in Tubatse, which has strong business-traveller demand from the local mining sector. The average annual occupancy rate for the area is 62%. The vast majority of visitors to Sekhukhune are domestic business travellers and weekend holiday tourists (Seswai, 2013). Sekhukhune District Municipality attracts very few international tourists. The area as a whole has a marked lack of signage and information to guide tourists, with only Marble Hall having a tourism information bureau.

There is thus a strong perception that there is nothing to see or do in Sekhukhune. The District has several quality lodges but lacks a major attraction to firmly place Sekhukhune on established tourist routes such as Blyde River Canyon and the Kruger Park. The District recently established the Kamoka Open Africa Route, which has the potential to be linked with the existing African Ivory and Cultural Heartland routes and the planned Great Limpopo Route. The District's tourism development strategy has put forth an ambitious plan to ignite the sector through several large-scale anchor projects, although funding for these projects has yet to be mobilised. It suggests Sekhukhune District Municipality has the potential to generate R441 million per year in tourism revenues, nearly five times the current levels. In addition, the Sekhukhune District Municipality will have to increase tourist information and support services, address infrastructure deficiencies, and solicit greater marketing support from provincial and national tourism bodies in order to grow the number of visitors it receives.

Constraints to the growth of this sector include the low level of commitment to tourism development from local municipalities in Sekhukhune, limited financial or marketing support from the Limpopo Tourism and Parks Board, and the low prominence of Sekhukhune on national and provincial tourism routes.

1.3.4 **Marble Hall Cultural Centre**

The concept is of a cultural centre that will offer a mix of food, entertainment, shopping, and other activities along cultural themes inspired by all of South Africa's major cultural groups. It also houses a conference facility and the main tourist information centre for the region. The train station located across the street could be revitalised to facilitate the transport of tourists from Johannesburg and Pretoria, maybe even as day trips (Lebaka, 2021).

Ideally, the investment is a public-private partnership between the local municipality and a private investor. The centre is run by an experienced private operator, while the municipality would hold board positions. However, the construction of the centre is estimated to cost R18−20 million, with the proposed funding to be a third grant, a third loan, and a third private capital, all of which need to be sourced. If executed well, the centre could provide the major drawcard needed to kickstart tourism in the area. The centre could also be positioned to international tourists as a stop along the route to the Kruger Park.

1.4 Research problem

One of the most complex and the least understood of all-natural hazards, which affect more people than any other, is drought (Elkollaly *et al*., 2018). The world, including South Africa has been affected by climate-related hazards such as drought, flood, and water-related issues, which have severely affected the human and natural environments. The factors of these climate-related hazards are major problems further constraining the livelihoods of ordinary South Africans, including the study area. For example, the farming community, water-dependent sectors, businesses among others. This climate hazard (drought) exerts additional pressures on people's livelihoods (Mpandeli *et al*., 2015; Joseph *et al*., 2020).

Most parts of South Africa have experienced recurrent droughts since 2013 (Botai *et al*., 2020; Mazibuko *et al*., 2021; Orimoloye *et al*., 2021). The severe drought particularly between 2014 and 2018 affected the country's economy causing severe physical and financial losses. The 2014–2018 drought catalysed a nationwide conversation vis-à-vis water security and enabled policy debate regarding water management and protection of the natural environment and vital ecosystems in South Africa (Donnenfeld *et al*., 2018). The drought equally exposed the vulnerabilities that exist in South Africa's water system, the dependence of vital

ecosystems on water resources, and properly frame the magnitude of the challenge of ensuring water security for the country (Otto *et al*., 2018; Steyn *et al*., 2019).

Sekhukhune District Municipality areas have been experiencing a high frequency of severe drought. Recently, it has been noted that the agricultural drought in Limpopo Province, including the study area, is creating problems not only for the smallholder farmers but also for the commercial farmers. During drought periods, farmers embark on several agricultural and technical activities, such as adjusting fertilizer input, adopting crop varieties that are tolerant to drought environments, and plant crops that require less water. With the persisting drought episodes in the area, farmers and other relevant sectors have been affected with varied impacts on an individual actor. This, however, always occurs under severe periods of stress. Studies have shown that the study area witnessed below-normal rainfall and the District has been affected by drought for a number of years (Mpandeli *et al*., 2015). Hence, there is a need to assess people's perspectives of drought hazards and their associated impacts on the community's livelihood in Sekhukhune District Municipality.

One of the best ways to combat drought impacts on communities is through scholarly research. Therefore, this study aimed to determine people's perception of drought hazards and how drought impact on the livelihood of rural communities in Sekhukhune District Municipality, Limpopo Province, South Africa. Outcomes from this study will help in determining strategies to increase community-coping capacity by focusing on drought hazards rather than distributing relief such as food aid and shelter as well as promoting a mistrust that puts people at risk if humanitarian entities when they leave the area.

1.5 Research questions

1.5.1 Main question

How does the rural community in Sekhukhune District perceive or look at drought hazards?

1.5.2 Sub-questions

i. How have drought hazards affected rural community livelihoods in Sekhukhune District Municipality in the last two years?
ii. What are the main livelihood activities in the area?
iii. What are the strategies that will increase community awareness and the coping capacity towards drought impacts?

1.6 Research objectives

1.6.1 Main objective

This research aims to determine the people's perspectives of drought hazards and evaluate the impact of drought on the livelihood of rural communities in Sekhukhune District Municipality, Limpopo Province, South Africa.

1.6.1.1 Sub-objectives

i. To assess how the rural community of Sekhukhune perceives drought hazards
ii. To assess the various livelihoods of the community affected by drought
iii. To assess the extent of damage caused by drought to people' livelihood in the study area
iv. To propose strategies that will increase community awareness and the coping capacity towards drought impacts in the Sekhukhune District of Limpopo Province

1.7 Significance of the study

Climate change is expected to continue to threaten environmental sustainability globally, especially in Africa where rainfall patterns have significantly shifted. Drought is one of the significant climate change impacts on the environment that poses significant threats to the natural environment, health, and livelihood of communities. Drought is a recurring phenomenon in South Africa and its impacts are felt throughout the country. However, the impact of climate change in general and drought in particular is felt the most in poor communities that lack the knowledge and capacity to deal with the effects. Given that these poor communities depend on agriculture and other environmental activities for their livelihoods, the effect of the drought is always profound on their household survival. Therefore, it is important to understand the perception of rural communities to drought and its related impact on their livelihoods in order to develop strategies to mitigate them. This study examines the implications of drought on the Sekhukhune District Municipality as it unpacks various explanations, narratives, and meanings of drought, the perception and the mitigation strategies chosen. For policymakers, this research informs and proposes to them of the impact of drought on the lives and livelihood of community members of Sekhukhune District Municipality and all the intervention strategies. The factors identified and intervention strategies proposed in this study will ensure that all stakeholders are alert to the effects of drought on the Municipality and actions and strategies to implement to mitigate the effects. This study is therefore relevant in the present context of recurring drought events across South Africa in general and the Sekhukhune District Municipality in particular.

1.8 Research design

The research design, according to Braimoh *et al.* (2018), is the method of collecting and analysing the results and providing guidelines for any study. According to the literature on research methods, there are generally three kinds of research designs recognised worldwide: qualitative, quantitative, and mixed methods. Selecting any of these research methods largely depends on the scope of the research, the respondents, the analysis, and the presentation of data and results. The qualitative research method (interpretive paradigm) is a methodology that makes little use of numerical, mathematical, and quantifying results, but rather uses advanced expertise to gather and evaluate data and report it to the general public (Tuffor, 2017; Ragab *et al*., 2018).

This research method used a naturalistic approach that aims to instil a deeper interpretation of the phenomenon under study (Cant *et al*., 2013). The researcher was involved and engaged with respondents in data collection, and this was achieved through interviews, focus groups, and direct findings as to the key methods for data collection (Basias & Pollalis, 2018). This method helped the researcher to collect sufficiently detailed information to explain ideas and to develop hypotheses (Basias & Pollalis, 2018).

Furthermore, Taherdoost (2016) describes the quantitative research method, a positivist paradigm, as an approach used to gather and interpret data using numeric, graphs, and other means of quantification of primary findings. This enables the research to interpret the findings and generalize them to the entire population. Using a quantitative analysis approach, the researcher is not heavily active in data gathering but uses survey methods such as questionnaires administration that can be self-managed by the respondents (Park & Park, 2016). Consequently, vast volumes of computational and mathematical evidence are obtained for every study in question. Mixed methods refers to an evolving research approach that advances the systemic combining or mixing of quantitative and qualitative evidence within a single inquiry or ongoing research (Apuke, 2017). Mixed methods also allow the integration of data during the compilation — usually during primary research, analysis and review, or in the discussion of findings.

The mixed-methods approach, which consists of both qualitative and quantitative research methods, was used for this study based on the scope and objectives of the study. For example, to understand the perception of community members on drought and the impact on their socio-

economic livelihoods, a mixed-method approach will help the researcher capture relevant information through asking open-ended and closed questions.

On the one hand, in using quantitative research methodology as part of mixed methods, the researcher will utilise surveys and approach the relevant community members to gather the data necessary for the study. No prior contact was made with community members. This will ensure that the data collected is free from bias as the researcher will not coerce or mislead the respondents in giving information.

The qualitative aspects of the mixed-methods approach, on the other hand, will enable the researcher to intensively understand this topic by engaging with the participants and be flexible in the execution of a research report (Cazeaux, 2017). In addition, Cazeaux (2017) holds that the mixed-methods approach helps the researcher to gain adequate and comprehensive information on the subject matter — and in this case, the main goal is to understand the various perceptions of community members to drought and how it impacts their socio-economic livelihoods in the Sekhukhune District Municipality.

1.8.1 **Target population and sampling**

Suitable community members with experience and knowledge of the area were identified and approached for collecting vital information for this study. According Hathaway *et al*. (2018), a target population represents the total number of relevant respondents with important information necessary to answer the important questions of the study and satisfy the objectives of the study. Members of the population should have a comparable set of attributes needed to complete a study.

The population of this study is the community members in the Sekhukhune District Municipality who are engaged in small-scale farming activities to sustain themselves and their families. According to the Sekhukhune District Municipality, the community of Sekhukhune depends mostly on subsistence farming, both crop and livestock, which is prone to erratic rainfall due to climate change conditions. The exact number of households engaged in farming is not available but information from the Department of Agriculture have it most of the households in the community are engaged in farming activities. An appropriate sample was chosen from this population using the non-probability sampling method. The population that was sampled for the purpose of this study is 125 participants from Sekhukhune District Municipality. Given the population distribution of the study area and other related constraints, such as COVID-19 and finances, the sample of 125 participants is considered representative of the population of the

study area. The size of the sample size of 125 equally gives much reliability and rigour to the results of this study.

1.8.2 **Data collection tools**

Data collection tools are instruments used in research to assess data from respondents (Yilmaz, 2013). These data collection tools include structured or semi-structured questionnaires, scientific simulations, and other types of testing, such as personality checks or skills evaluations (De Villiers *et al*., 2019). This study utilised questionnaires with both closed and open-ended questions. The use of questionnaires allowed for respondents to respond to questions with ease and clarity, making the process of data collection simple and easy to understand by all the participants (Creswell, 2013). The questionnaires were designed to be easy so that respondents with little or no formal education can understand them, and a pilot study was done to test the respondents' understanding of the questions and to train the enumerators on how to complete the questionnaires.

The questionnaires used in this study capture general information relevant to the research study, such as the gender of the participants, their age groups, population group membership, marital status, number of years of farming, and their size of land. Furthermore, some questions related to their knowledge of drought and the impact on their livelihoods were asked. Some open-ended questions about their perceptions of the prevailing drought were included. Other questions to understand the community members' perceptions of drought and the impact were included in a Likert Scale, ranging from 'strongly disagree' to 'strongly agree'. The questionnaires also include some open-ended questions to give the respondents the opportunity to express their view and opinions about drought and its related impact on the community.

1.8.3 **Data analysis**

Data analysis is the process of capturing and making sense of the data collected. This stage involves capturing, structuring, and organising the field data to answer important questions pertaining to the research (Patten & Newhart, 2017). Completed questionnaires obtained from the respondents were cleaned to remove outliers and coded and made ready for analysis (Queirós *et al.,* 2017; Van de Ven & Poole 2017). Statistical Package for Social Sciences (SPSS) version 27 was used to analyse the quantitative data of the study. The data was analysed and presented descriptively using tables and figures. Descriptive statistics is a research tool that investigates the distribution score for each variable and evaluates the relationship between the calculated variables (Cypress, 2018). The qualitative data was collected by writing the responses of the respondents and analysed using themes.

1.8.4 **Reliability and validity of data**

Validity in research is the extent to which an empirical measure accurately reflects the concept it is intended to measure (Etikan & Bala, 2017). Furthermore, validity measures the procedure of measuring the variables involved to be what they claim to be in the data collection process. Therefore, validity should measure the concept in question, and the concept should be measured accurately.

Reliability refers to the degree of similarity of information obtained when the measurement is repeated on the same subject or the same group of people (Patten & Newhart, 2017). Stated differently, the same value should be reached every time the measurement is taken. This means that the values should not vary a great deal on repeated tests. The reliability of a measurement instrument is the stability or consistency of the measurement. The data collection was submitted to the study leader such as a lecturer to ensure that data was collected in an accurate manner. The method of triangulation was also applied to the validity and reliability of the data by using questionnaires in the affected communities, with both open-ended and closed questions.

1.8.5 **Limitations and de-limitations**

The limitations of this research relate to insufficient resources. Therefore, the data collection has not included all the intended respondents. This means that the results were difficult to generalize to large populations, as they did not be fully represent the larger group. The results are therefore indicative of the general population. Another limitation related to this study was attributed to time management. This is largely due to the fact that Sekhukhune District Municipality is located within the borders of Limpopo province, but the researcher resides in Mpumalanga province. Similarly, there were language barriers when translating the questionnaires from English to other South African indigenous languages (Sepedi and Isindebele), considering the level of literacy within the District Municipality. The four enumerators hired as part of the data collection process were people with perfect understanding of the study area with knowledge of the indigenous languages.

1.8.6 **Ethical considerations**

This researcher is guided by the ethical considerations of the University of the Free State. The researcher applied for and obtained ethical clearance before collecting data from the identified

respondents. The research was done in strict accordance with the institution's academic ethics policies and guidelines. Concerning the collection of data, the researcher adhered strictly to the participants' voluntary participation by seeking their permission through the community leaders. The safety of data usage as well as the principles of anonymity were applied by using codes and not the participants' real names. Efforts were made to ensure that research engagement was based on the concept of informed consent and that the participants, during the data collection period, were not exposed to socio-political, psychological, or physical harm. The researcher remained neutral during the entire data collection process and all forms of bias were limited. Furthermore, participants were duly informed that the data they provide would only be used for academic purposes. All ideas used that are the property of other scholars were acknowledged as such through internal citation and a final list of references. Due to COVID-19, the researcher and the enumerators worked closely with the community leaders to ensure that all COVID-19 protocols were adhered to, from social distancing to wearing of masks, during the entire data collection process.

1.9 Chapter summary

This study examined the drought perception of community members of the Sekhukhune District Municipality and its impact on their livelihoods. The study examined the impact of drought on the farming activities of these community members. The chapter outlined the background of the study and provided a description of the study area (Sekhukhune District Municipality) and the statement of the problem under investigation. Furthermore, a brief literature review was presented to highlight the related studies done in this area. A descriptive research design and data collection tools were also presented, accompanied by details on the validity and reliability of the survey questionnaire. Then, the limitations of the study and ethical issues were presented and discussed.

Chapter 2 Theoretical and Legislative Frameworks for Drought Management

2.1 Introduction

Drought's driving mechanism is the theoretical foundation for understanding drought, both scientifically and in terms of developing efficient drought-resisting policies (Pei *et al*., 2013; Mo *et al*., 2018). The formation mechanisms of meteorological, hydrological, and agricultural droughts, as well as the relationships between them, are crucial in drought perception and its associated impacts on rural communities' livelihoods. The driving force-pressure-state-response model is used to create a theoretical framework for the driving mechanism for drought evolution. The principal factors of drought evolution, the driving mechanism of drought impacts, the methods of studying evolution rules, and drought response under changing environmental conditions are all-encompassing in the theoretical framework. In this study, the Pressure and Release (PAR) Model, Community Capital Framework, and Sustainable Livelihood Framework are discussed.

2.2 The Pressure And Release (PAR) Model

Some disasters are truly catastrophic in terms of their impact. For example, the recent drought events in South Africa, in which it is estimated that several people were affected. The PAR Model can be used to help understand this as presented in Figure 2.1 (De Silva & Kawasaki, 2018). The PAR Model depicts a drought disaster as a product of physical exposure on one side and socio-economic pressure on the other side. The disaster is a collision of the hazard and vulnerability. The model has three components, generating vulnerability in the social side: root causes, dynamic pressure, and unsafe conditions; meanwhile, the other side includes the hazards (Hamis, 2018; Tora *et al*., 2021). Economic, demographic, and political factors all have an impact on where and how resources are concentrated and dispersed among social groups. Drivers that translate root causes into a local context are referred to as dynamic pressures. Unsafe conditions are the unique scenarios in which individuals today live due to the fundamental causes, dynamic time, and space pressures.

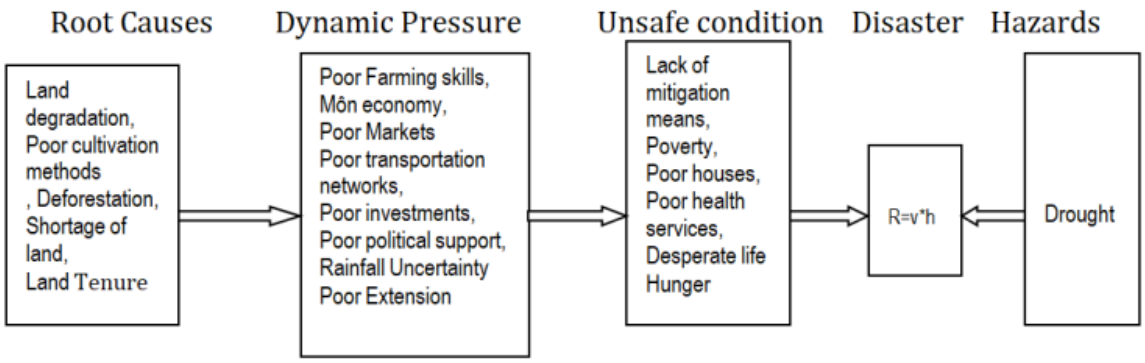

Figure 2.1: Modified pressure and release model-progression of vulnerability to drought

Source: Adapted from Hamis, (2018)

According to the PAR Model, the socioeconomic context of a hazard is critical. Poorly managed (root causes) regions with rapid change and insufficient capacity (dynamic pressures) and limited coping ability (unsafe conditions) are more prone to disasters (Kheirkhah *et al*., 2017; Pawar *et al*., 2019). In this study, the PAR Model depicts a drought disaster as a result of physical exposure on the one hand and socio-economic pressure on the other. Drought disaster is the result of a convergence of hazard and susceptibility caused by drought events.

2.3 The Community Capitals Framework

The Community Capitals Framework (CCF) can be an effective tool for assisting communities in their disaster recovery (Goreham *et al*., 2017; Peak, 2021). A community can examine its pre- and post-disaster capitals or use the CCF in the recovery process after a disaster. Although research literature includes many disaster-recovery cases studies, very few have been conducted using the CCF. It has been reported that communities with high capacity in the capitals may be better able to respond to and recover from disasters (Goreham *et al*., 2017; Peak, 2021). Rural and regional communities are being transformed by social and economic changes, necessitating a better knowledge of community change processes. Practitioners and academics in community development are interested in the study and design of policies and initiatives that could positively impact rural areas. The CCF has become one of the most widely used research methods in community development and analysis. It has been established that this framework is alternate strategic planning and measuring technique, and it has since been adopted by a number of scholars (Mattos, 2015; Flora *et al*., 2018; Paul *et al*., 2020). The CCF is a systemic way of analyzing communities and community development initiatives. During Jan and Cornelia Floras's research on entrepreneurial

communities, they discovered that those who were successful in fostering economic development focused on seven categories of capitals namely:

Natural capital: The environment, rivers, lakes, forests, wildlife, soil, weather, and natural beauty of a community are all included.

Cultural capital: Ethnic festivals, a multilingual population, traditions, heritage, or a strong work ethic are examples of this. What voices are heard and listened to, which voices have an impact in what sectors, and how creativity, invention, and influence arise and are nurtured are all influenced by cultural capital.

Human capital: Residents' skills and talents as well as their ability to access external resources and knowledge are all factors to consider in order to improve comprehension and discover promising methods (education, health, skills, and youth). Leadership's ability to lead across divides, focus on assets, be inclusive and participatory, and be proactive in molding the future of the community or group is also addressed by human capital.

Social capital: This reflects the connections among people and organizations or the social glue that makes things happen.

Political capital: This is the ability to influence standards, rules, regulations, and their enforcement. It reflects access to power and power brokers, including government officials and leverage with a regional company.

Financial capital: This includes the financial resources available to invest in community capacity building, underwrite businesses development, support civic and social entrepreneurship, and accumulate wealth for future community development.

Built capital: Telecommunications, industrial parks, main roadways, water and sewer systems, highways, and other infrastructure that sustains the community. The focus of community development activities is frequently on built capital.
CCF is more concerned with a community's assets than with its needs and deficits. These assets could either be unused or invested to generate more assets especially in drought perception and its associated impacts on rural communities' livelihood (Figure 2.2). When community resources are left underused, they deteriorate, resulting in the community's deterioration unless there is a catalyst to alter course.

Figure 2.2 Community Capitals Framework

Source: Adapted from : Mattos, (2015)

A community capitals method helps one to see how different elements, resources, and interactions within a community contribute to the community's overall functioning. After the community capitals have been identified, they can be used as a tool for future planning (Gordillo & Santana, 2019). This allows community resources to be assessed, needs to be identified, and partnerships to be formed to generate community capitals that are lacking. This approach not only identifies the capitals and the roles they play in community economic growth separately but focuses on the interactions between these seven capitals and the resulting effects of drought events. The intended outcomes of investing in the community's various forms of capital are to attain a vital local/regional economy, social well-being, and a healthy ecosystem as seen in Figure 2.2.

In order to attain community economic, social, and environmental sustainability, rural communities in South Africa and elsewhere invest their communal resources in a variety of ways. These expenditures have a wide range of effects and outcomes, especially in combating drought impacts. This term refers to the original capital (assets) of a community as well as investments in community change and the outputs and effects of those efforts (Duffy *et al*., 2017; Kline, 2017). The framework provides a mechanism for community researchers and practitioners to begin to understand the impact of community development policies and

initiatives on rural people and places by assessing investments in each of the capitals and the outcomes caused by those investments. Using the CCF to describe tactics and outcomes gives strong evidence of asset growth and illustrates the interplay among the capitals that can lead to an upward spiral of good community change (Stone & Nyaupane, 2018; Borron *et al*., 2019).

2.4 The Sustainable Livelihoods Framework

The Sustainable Livelihoods Framework (SLF) is an effort to conceptualise livelihoods in a holistic way, capturing the many complexities of livelihoods and the constraints and opportunities that they are subjected to (Amosah, 2021; Shrestha, 2019). These constraints and opportunities are shaped by numerous factors, ranging from global or national level trends and structures over which individuals have no control, and may not even be aware of, to more local norms and institutions and, finally, the assets to which the households or individual has direct access (Pandey *et al*., 2017). It also improves understanding of the livelihoods of the poor, especially in drought-prone areas (Elasha *et al*., 2005; Pandey *et al*., 2017; Yiridomoh *et al*., 2021). It organises the factors that constrain or enhance livelihood opportunities and shows how they relate. It can help plan development activities and assess the contribution that existing activities have made to sustaining livelihoods during and after disasters such as drought events.

2.4.1 The Sustainable Livelihoods Approach

The sustainable livelihoods approach (SLA) is a way of thinking about the objectives, scope, and priorities for development activities (Nasrnia & Ashktorab, 2021; Wadei *et al*., 2021). It is based on evolving thinking about the way the poor and vulnerable live their lives and the importance of policies and institutions. It helps formulate development activities that are: people-centred, responsive and participatory, multilevel, conducted in partnership with the public and private sectors, dynamic, and sustainable (Ibrahim *et al*., 2018; Nasrnia & Ashktorab, 2021). The sustainable livelihoods approach facilitates the identification of practical priorities for actions that are based on the views and interests of those concerned, but they are not a panacea. It does not replace other tools, such as participatory development, sector-wide approaches, or integrated rural development. However, it makes the connection between people and the overall enabling environment that influences the outcomes of livelihood strategies (Nasrnia & Ashktorab, 2021). It brings attention to bear on the inherent potential of people in terms of their skills, social networks, and access to physical and financial resources, and ability to influence core institutions (Figure 2.3).

2.4.2 **Livelihoods**

A livelihood comprises the capabilities, assets, and activities required for a means of living. It is deemed sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities, assets, and activities both now and in the future, while not undermining the natural resource (Massoud *et al*., 2016; Degarege & Lovelock, 2021).

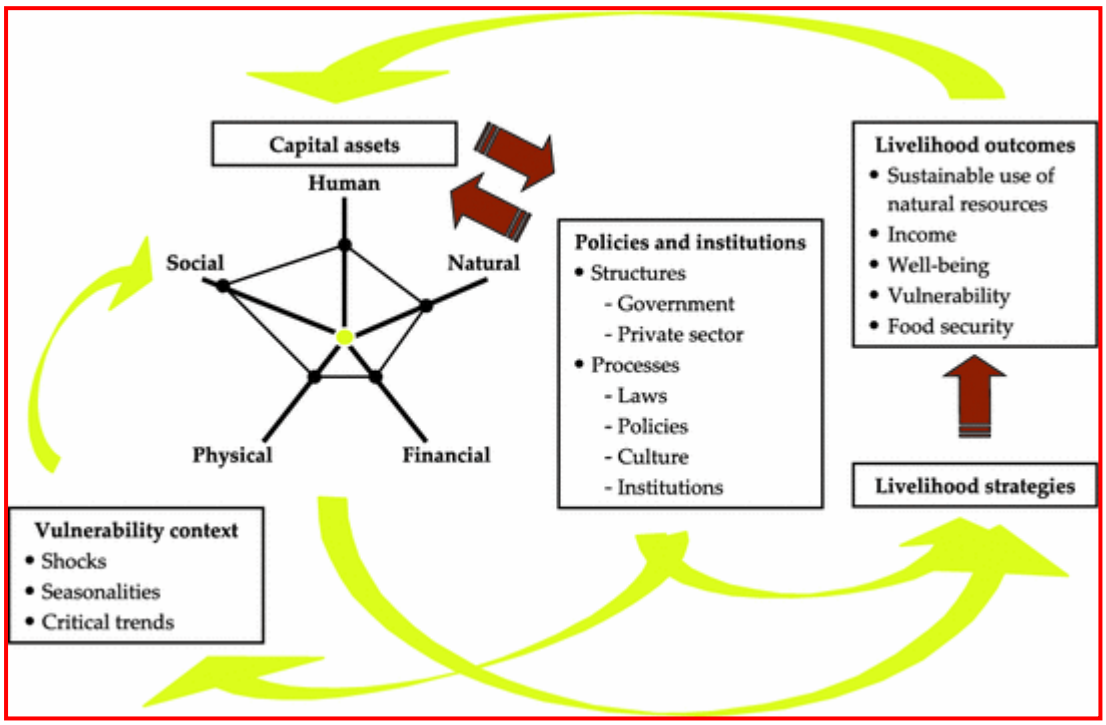

Figure 2.3 Sustainable livelihood framework.

Source: Serrat, (2017)

2.4.3 **Vulnerability context**

The vulnerability context in Figure 3 refers to the external environment in which people live. This includes trends (such as national or international economic trends, changes in available technology, political systems), shocks (such as impacts from drought, illness or death, conflict, weather), and seasonality (of prices, production cycles, and so on). The vulnerability context is important because the three factors have a direct impact on the possibilities that poor people have to earn a living now and in the future. Wider economic conditions can create more or fewer opportunities; an illness as a result of shock from drought disaster in a family can deprive a family of an important source of income and can force them to sell important assets that they have built up (Masud *et al*., 2016; Cannon & Müller-Mahn, 2010). Seasonal shifts in prices, production and employment opportunities are some of the most enduring sources of hardship for poor people all over the world. The transforming structures and processes box refer to the institutions and policies that affect poor people's lives, from public and private entities to

national policies and local culture. All of these can change both the vulnerability context and the assets to which poor people have access (Pandey *et al*., 2017).

The idea of assets is central to the sustainable livelihoods approach. Rather than understanding poverty as simply a lack of income, the sustainable livelihoods approach considers the assets that poor people need in order to sustain an adequate income to live (Figure 2.4). Based on those assets and shaped by the vulnerability context and the transforming structures and processes, poor people are able to undertake a range of livelihood strategies — activities and choices — that ultimately determine their livelihood outcomes. Poor people are usually obliged to combine a range of strategies in order simply to survive; individuals may engage in multiple activities, and the different members of a household may live and work in different places. The outcomes that they may achieve, all being well, could include more income, increased well-being, reduced vulnerability, and greater food security. Sometimes one outcome can negatively affect another; for example, when poor people engage in less risky, and hence lower, income activities in order to be less vulnerable to shocks (Twigg, 2001; Aznar-Crespo *et al*., 2020). The vulnerability has two facets — an external side of shocks, seasonality and critical trends — and an internal side of defencelessness caused by lack of ability and means to cope with these. The vulnerability context includes shocks (e.g. conflict, illnesses, floods, storms, droughts, pests, diseases), seasonality (e.g. prices and employment opportunities), critical trends (e.g. demographic, environmental, economic, governance, and technological trends).

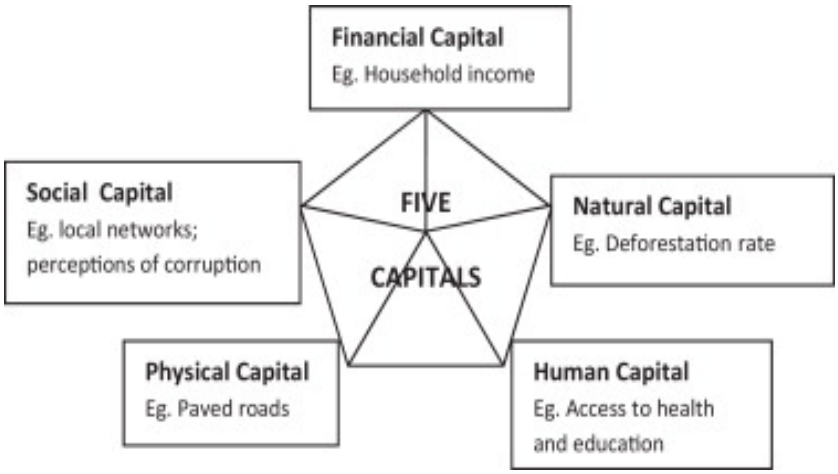

Figure 2.4 Livelihood capital

Source: Pandey *et al*., (2017)

2.4.3.1 ***Livelihood Capital Assets***

The sustainable livelihoods framework helps to organise the factors that constrain or enhance livelihood opportunities and shows how they relate to one another (Manlosa *et al*., 2019). A central notion is that different households have different access to livelihood assets, which the sustainable livelihood approach aims to expand. The livelihood assets, which the poor must often make trade-offs and choices about, comprise:

Human capital: Skills, knowledge, the ability to work and good health. Good health is not simply a means to earning a livelihood; it is of course an end in itself e.g. health, nutrition, education, knowledge and skills, capacity to work, capacity to adapt (Bhuiyan, 2013).

Social capital: The social resources that people draw on to make a living, such as relationships with either more powerful people (vertical connections), with others like themselves (horizontal connections), or memberships of groups or organizations. e.g. networks and connections (patronage, neighbourhoods, kinship), relations of trust and mutual understanding and support, formal and informal groups, shared values and behaviours, common rules and sanctions, collective representation, mechanisms for participation in decision-making, leadership.

Natural capital: The natural resource stocks that people can draw on for their livelihoods, including land, forests, water, air and so on. e.g. land and produce, water and aquatic resources, trees and forest products, wildlife, wild foods and fibres, biodiversity, environmental services (Pandey *et al*., 2017; Narula *et al*., 2017).

Physical capital: The basic infrastructure that people need to make a living as well as the tools and equipment that they use. e.g. infrastructure (transport, roads, vehicles, secure shelter and buildings, water supply and sanitation, energy, communications), tools, and technology (tools and equipment for production, seed, fertilizer, pesticides, traditional technology). Droughts often don’t destroy physical assets directly, which blurs their economic impact. Drought events can lower productivity through damaged physical infrastructure, destroyed harvests, or a temporary halt in production. Consequently, real GDP growth tends to be significantly lowered the year a region such as the study area is hit by a major drought disaster than the average real GDP growth witnessed in the years before the disaster.

Financial capital: Savings, in whichever form, access to financial services, and regular inflows of money during drought events. e.g. savings, credit, and debt (formal, informal), remittances,

pensions, wages. Primarily, financial and natural capital increase access to other resources and opportunities that enabled adaptation after drought disasters. Studies should highlight the complex pathways along which capital operates to support adaptation and further understanding of in-situ adaptation experiences during drought events.

2.4.4 **Policies, institutions, and processes**

Livelihood strategies and outcomes are not just dependent on access to capital assets or constrained by the vulnerability context; they are also transformed by the environment of structures and processes. Structures are the public and private sector organizations that set and implement policy and legislation; deliver services; and purchase, trade, and perform all manner of other functions that affect livelihoods (Molinas *et al*., 2004; Su *et al*., 2019). Processes embrace the laws, regulations, policies, operational arrangements, agreements, societal norms, and practices that, in turn, determine the way in which structures operate. Policy-determining structures cannot be effective in the absence of appropriate institutions and processes through which policies can be implemented. Processes are important to every aspect of livelihoods. They provide incentives that stimulate people to make better choices. They grant or deny access to assets. They enable people to transform one type of asset into another through markets. They have a strong influence on interpersonal relations.

2.4.5 **Livelihood strategies and outcomes**

Livelihood strategies aim to achieve livelihood outcomes. Decisions on livelihood strategies may invoke natural-resource-based activities, non-natural resource-based, and off-farm activities, migration and remittances, pensions and grants, intensification versus diversification, and short-term versus long-term outcomes, some of which may compete (Nielsen *et al*., 2013; Manlosa *et al*., 2019; Guo *et al*., 2019). One of the many problems of development is that projects and programmes, while favouring some, can disadvantage others. Potential livelihood outcomes can include more income, increased well-being, reduced vulnerability, improved food security, more sustainable use of the natural resource base, and recovered human dignity, between which there may again also be conflict during drought disasters.

In recent years, the prominence of the five capitals has been criticised by development practitioners for focusing too much on the micro-level and neglecting the higher levels of governance, the policy environment, national and global economic growth, and so on. This has led, for example, to a limited understanding of how markets work; how processes far from the lives of poor people nonetheless have an enormous impact on the possibilities that exist

for them to earn a secure income (Levine, 2014). These issues are of course captured in the wider sustainable livelihoods framework, within the transforming structures and processes and the vulnerability context but, in practice, many people have used the idea of the five capitals more than they have the linkages between those and the wider environment in which people live. It is very important to keep in mind that the wider environment affects not only the assets to which people have access, but also what can be achieved with those assets (Pandey *et al*., 2017; Narula *et al*., 2017).

The Sustainable Livelihoods Framework has also been criticised for failing to take power dynamics into consideration as it relates to gender, for example (Table 2.1). Again, while such dynamics are included in the framework, in practice, they have been neglected. In particular, social capital has often been seen as simply *a good thing* whereas, in reality, social networks can be both inclusive and exclusive, with often the weakest and most vulnerable excluded. They also often involve hierarchical and coercive relationships that limit options for those at the lower levels, and even when relationships are more horizontal than vertical, the obligations that reciprocal relationships involve can be onerous. The sustainable livelihoods approach is only one way of organizing the complex issues that surround poverty. It must also be made appropriate to local circumstances and local priorities.

Table 2.1 The Sustainable Livelihoods Framework—Strengths and Weaknesses

Strengths	Weaknesses
Seeks to understand changing combinations of modes of livelihood in a dynamic and historical context	Underplays elements of the vulnerability context, such as macroeconomic trends and conflict
Explicitly advocates a creative tension between different levels of analysis and emphasizes the importance of macro- and micro linkages	Assumes that capital assets can be expanded in generalized and incremental fashion
Acknowledges the need to move beyond narrow sectoral perspectives and emphasizes seeing the linkages between sectors	Does not pay enough attention to inequalities of power

Calls for investigation of the relationships between different activities that constitute livelihoods and draws attention to social relations	Underplays the fact that enhancing the livelihoods of one group can undermine those of another

(Source: Author, 2021)

2.5 Sustainable livelihoods approach to drought perception and its associated impact on rural communities' livelihoods

Various interpretations and elaborations of the sustainable livelihood concept have, in one way or another, inspired a number of development agencies to apply what is now becoming known as a sustainable approach to drought perception and its associated impact on rural communities' livelihoods. This has emerged in response to negative experiences with conventional approaches to drought reduction and its impact, but also as a result of recent findings regarding the nature and understanding of disaster reduction including droughts (Macfadyen & Corcoran, 2002). Three factors shed light on why the sustainable livelihood approach has been applied to drought perception and its impact reduction. The first is the realisation that while economic growth may be essential for drought-impact reduction, there is no automatic relationship between the two since it all depends on the capabilities of the poor or rural areas to take advantage of expanding economic opportunities (Levine, 2014; Serrat, 2017). Thus, it is important to find out what precisely it is that prevents or constrains the poor from improving their lot in a given situation so that support activities can be designed accordingly.

Secondly, there is the realisation that disaster — as conceived by the poor themselves — is not just a question of shock or implications but includes other dimensions such as lack of social services, environmental degradation, etc. as well as a state of vulnerability and feelings of powerlessness in general (Saikim *et al*., 2017; Jessup-Varnum, 2018). Moreover, it is now realized that there are important links between different dimensions of drought disaster reduction such that improvements in one aspect have positive effects on another. Raising people's educational levels may have positive effects on their health standards during or after a disaster, which in turn may improve their production capacity. Reducing poor people's vulnerability in terms of exposure to drought risk may increase their propensity to engage in previously untested but more productive economic activities, and so on. Finally, it is now recognized that the poor or rural areas often know their situation and needs best and must therefore be involved in the design of policies and projects intended to better their lot. Given

a say in the design, they are usually more committed to implementation. Thus, participation by the poor improves project performance (Pandey *et al*., 2017; Narula *et al*., 2017). The primary importance of the framework employed in this assessment is for assessing drought impact on the target community. To ensure coverage of the study area's circumstances and adequate representation of the affected people, a case study was used, focusing on a single community within a rural community in South Africa.

2.6 Legislative acts and frameworks related to drought management

Drought is a complex natural hazard that affects many elements of people's lives and sectors of society, including agriculture, energy, food security, health, water resources, migration, and resource-related conflicts. Drought is possibly the most dramatic natural phenomenon with the longest-lasting consequences (UNCCD, 2018). Drought impacts are significantly more complex today since they affect a wider range of economic sectors, resulting in greater disputes between water consumers whose societal vulnerability has shifted dramatically (Javadinejad *et al*., 2021). As such, the international communities and local governments are putting in place legislative frameworks to govern drought risk reduction measures. This section explores some important national and international legislative frameworks, acts, and laws in governing drought risk management and increasing drought resilience in the context of global environmental change and socio-economic development in developed countries and developing countries. The section will examine legislative frameworks for drought governance in South Africa.

2.6.1 International legislative frameworks for drought disaster risk reduction

International legislative systems that are integrated play a significant role in establishing laws and procedures for drought risk management in countries all over the world (Metz *et al*., 2020; Mashi *et al*., 2019). These legal frameworks and laws strive to govern drought management and develop strategies and duties in order to implement successful drought risk reduction measures (Wilhite *et al*., 2014). The international community implements international frameworks and laws to support the integration, coordination, and implementation of local and national disaster risk reduction measures as well as the coordination of stakeholders and the distribution of resources among various stakeholders, sectors, and institutions to ensure adequate drought risk preparedness, mitigation, and response at various scales (Sivakumar *et al*., 2014). International legal frameworks guarantee that disaster management specialists and other key stakeholders understand their roles and duties in preparing for and responding to drought risk at the local and national levels. International drought legislative frameworks

and laws, as a result, supplement national legislative frameworks and regulations and play a significant role in deciding drought risk mitigation measures (Howes *et al*., 2015; Baudoin *et al.*, 2017).

2.6.1.1 The United Nations Convention to Combat Desertification (UNCCD)

The United Nations Convention to Combat Desertification (UNCCD), which was founded in 1994, is the only legally enforceable international agreement that connects the environment and development to sustainable land management. The 197 parties to the Convention collaborate to enhance the living conditions of people living in drylands, to maintain and restore land and soil productivity, and to reduce the effects of drought (Zhongming *et al*., 2020). The Convention explicitly targets the arid, semi-arid, and dry sub-humid areas known as the drylands, which contain some of the most vulnerable ecosystems and peoples (United Nations (UN), 2021). The UNCCD 2018−2030 Strategic Framework is the new global commitment to achieve reduce land degradation and ensure land productivity in order to reduce the effects of drought and ensure food security and improve the livelihoods of more than 1.3 billion vulnerable people, especially in less developed countries (Laban *et al*., 2018). The 2018−2030 framework document states that:

> A future that avoids, minimises, and reverses desertification/land degradation and mitigates the effects of drought in affected areas at all levels … to achieve a land degradation-neutral world consistent with the 2030 Agenda for Sustainable Development (Nhamo and Muchuru, 2019).

Droughts wreak the most havoc on the most vulnerable populations, and when this occurs, everyone in the economy suffers in the medium- to long-term. Thus, prompting proactive policies and planning based on vulnerability and risk assessments can lower the risk of drought before the worst effects arise (King-Okumu *et al*., 2020). As such, concerted efforts are needed from all institutions at different scales locally and internationally. As a result, the UNCCD and its partner institutions have equally developed drought risk and vulnerability assessment tools to assist local and national governments and other relevant stakeholders in dealing with the devastating effects of drought especially in drought prone regions (Hagenlocher *et al*., 2019). This drought risk and vulnerability assessment tools are freely available to all stakeholders and can be accessed through an online Drought Toolbox: https://knowledge.unccd.int/drought-toolbox (King-Okumu *et al*., 2021). It is critical to emphasize that the difficulty is not just about the availability of tools but also about how they are used, by whom, and what use is made of the results to enable proactive management and avoid unnecessary adverse impacts on vulnerable people and ecosystems (Vitak *et al*., 2017).

*2.6.1.2 **Hyogo Framework for Action 2005−2015 and the Sendai Framework for DRR***

The United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations International Strategy for Disaster Reduction (UNISDR) are the most essential mechanism for tackling climate change on a global scale. The formulation of the Hyogo Framework for Action for 2005−2015 was critical to the UNFCCC's efforts (Bankoff, 2019; McDonald & Telesetsky, 2020). The Hyogo Framework for Action 2005−2015 was adopted in January 2005 at the World Conference on Disaster Reduction in Kobe, Hyogo, in response to the issues encountered by disaster manager (Aitsi-Selmi *et al*., 2015; Mal *et al*., 2018). During the meeting, the member countries agreed that changing demographic, technological, and socio-economic conditions, as well as modernization processes, have made people in general, and notably the poor, more vulnerable and sensitive to hydro-meteorological disasters such as drought (Phibbs *et al*., 2015; Briceño, 2015). One of the fundamental ideas of the Hyogo Framework was to guarantee that member countries build strong institutional bases that prioritize disaster risk reduction activities at various levels of the economy, ensuring that DRR initiatives are incorporated into plans, programmes, and policies for long-term development (Shaw *et al*., 2016). Drought is the most prevalent natural disaster in South Africa, as it is in most arid countries, and it poses a major threat to both the natural and human environments (Seddiky *et al*., 2020). As a result of the effects of drought, it is critical to coordinate plans and policies for community development and drought risk reduction as well as measures and initiatives to protect drought-affected areas (Al-Nammari & Alzaghal, 2015). The Hyogo Framework for Action that resulted is the worldwide disaster risk reduction plan, with the goal of significantly reducing catastrophic losses in human lives and socioeconomic assets (Pearson & Pelling, 2015). Hyogo Framework focused on DRR at national, and international levels and provided assistance to countries most vulnerable to disaster risks and lack the capacity for effective DRR efforts. The problem of drought in South Africa highlights the need and challenges of disaster risk reduction strategies. The mandate of the Hyogo Framework expired in 2015 and the Sendai Framework was adopted to build on the Hyogo Frame and provide more focused strategies for disaster risk reduction.

The Sendai Framework for Disaster Risk Reduction 2015–2030 was agreed upon and accepted by developed and developing countries globally (Clarke *et al*., 2018). According to the SFDRR, governments must drastically reduce disaster risk and losses by 2030 and provide a possible solution to improve disaster risk reduction across the globe by implementing policies that aim to reduce disaster risk on human and natural environmental. As a result, it marks a significant shift from disaster management to risk management, and it establishes resilience as a common denominator in the 2030 Agenda for Sustainable Development

(Goniewicz & Burkle, 2019). Six years after almost all African states signed the SFDRR, disasters continue to have a significant impact on African populations, livelihoods, and infrastructure (Van Niekerk, 2021; Vambe *et al*., 2021). As a result, in 2016, the African Union approved a Program of Action (PoA) for SFDRR Implementation in Africa (Van Niekerk, 2020; Walz *et al*., 2020). At the continental, regional, national, and subnational/local levels in Africa, the PoA provides advice and direction for efforts to prevent and reduce disaster risk, as well as to improve resilience for all (Lassa *et al*., 2019).

The South African Plan of Action (PoA) on SFDRR contributes significantly to a number of measures in South Africa aimed at developing effective strategies for disaster risk reduction efforts (Mothupi, 2020). The plan lays out a comprehensive approach for lowering risk, building society's resilience, and leveraging investments across a range of programmes, including development, humanitarian aid, drought risk management, and water and biodiversity conservation (Van Niekerk *et al*., 2020). Similarly, in 2015, governments all around the world agreed to and adopted a number of key international agreements, with the Sustainable Development Goals (SDGs) and the Paris Climate Agreement at the forefront. Continuous actions are implemented to ensure that these agreements are mutually binding and that disaster risk reduction, sustainable development and climate change adaptation are managed in an integrated manner (Khoza *et al*., 2021).

2.6.1.3 ***The Paris Climate Agreement***

The Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) has fostered the development of greater adaptation planning and action. This agreement pledges both industrialized and developing countries to adapt to climate change, as well as to keep global warming below 2 degrees Celsius in the twenty-first century and to pursue measures to keep it below 1.5 degrees Celsius (Tompkins *et al*., 2018). The Paris agreement has developed strategies to keep countries accountable. The purpose of developing systems for accountability is outlined in Article 7, paragraph 14 of the Paris Agreement, which includes identifying what adaptations have been made and assessing their effectiveness (UNFCCC, 2016). Each member country to the Paris Agreement progress and commitments will be tracked and documented against global objectives. According to Tompkins *et al*. (2018), member countries are accountable for their adaptation obligations, the effectiveness of adaptation could be assessed, better estimates of adaptation costs could be generated, and adaptation finance could be better targeted to those areas and people most in need and where insufficient adaptation is occurring with this evidence base in place. The Paris Agreement is a very important legislative framework for ensuring reduction in emissions and adaptation to climate-change-related events.

*2.6.1.4 **Sustainable Development Goals (SDGs)***

Drought disasters have becoming more common in urban areas around the world in the twenty-first century. Drought disasters have also wreaked havoc on developing countries. Meanwhile, climate change has increased the frequency and intensity of droughts, putting enormous strain on countries' water supplies (Zhang *et al*., 2019). As a result, addressing the issues of drought is a critical component of meeting the targets set out in at least five separate Sustainable Development Goals (SDGs) (Burford *et al*., 2016). As a result, tackling the drought problem is critical in attaining the 2030 Agenda for Sustainable Development of the United Nations. The five SDGs that can assist stakeholders taking drought mitigation actions and advancing sustainable livelihood include: SDG 6 Clean water and sanitation; SDG 11 Sustainable cities and communities; SDG 12 Responsible production and consumption; SDG 13 Climate actions; and SDG 15 Life on land. In contrast to traditional development objectives, which are focused on a collection of indicators, SDGs take a more holistic approach to development (Alaimo & Maggino, 2020). The SDGs have provided a framework for countries around the world to develop strategies for enhancing drought resilience and preparedness. Some of the strategies have been documented by Zhang *et al*. (2019) and include:

> raising public awareness on water right and water saving; fostering flexible reliable, and integrated urban water supply; improving efficiency of urban water management; investing in sustainability science research for urban drought; and strengthening resilience efforts via international cooperation.

2.6.2 **South Africa legislative frameworks for drought management**

Countries have developed policies and legislative frameworks to serve as a focal point for ensuring appropriate drought mitigation. These policies and legal frameworks outline how people should use their resources to deal with drought. As a result, it is critical for governments to be aware of their policies and strategies for mitigating the effects of drought. Although South Africa is not prone to severe drought events, their occurrence is more frequent and their impact is more pronounced among the most vulnerable in society who lack the capacity to deal with such events (Wentink & Van Niekerk, 2017).

The end of Apartheid in 1994 in South Africa saw a drastic shift in South African drought risk management, with the Disaster Management Act of 2002 advocating a modern proactive strategy (Ziervogel *et al*., 2016). Despite the fact that disaster management plans are included in the South African Constitution, the Disaster Management Act No. 57 of 2002 (DMA), and the National Disaster Risk Management Framework of 2005 (NDRMF), the effects of drought on the human and natural environment still persist (Manyama, 2020). Drought mitigation, emergency readiness, swift and effective drought response, and post-drought recovery are included in the DMA and NDRMF. The Act and Framework also call for the development of national, provincial, and local disaster management plans (Van Niekerk *et al*., 2020). The DMA

mandates and gives power to national, provincial, and municipal levels authorities, but the *"*most crucial sphere for efficient disaster management implementation is local government, where most operational actions connected to disaster management would occur*"* (Bruwer *et al*., 2017). Disaster management is defined in the DMA of 2002 as an integrated and coordinated process for preventing, reducing and mitigating the risk and severity of disasters, ensuring emergency preparedness, rapid and effective response to disasters and post-disaster recovery (Republic of South Africa, 2003).

2.6.2.1 ***The South African Disaster Management Act 57 of 2002 as amended Act 16 of 2015***

The Disaster Management Act of 2002 (Act No. 57 of 2002) establishes institutional capability at all levels of government (Takalani *et al*., 2020). South Africa was the first African country with a comprehensive disaster (risk) management law. As mandated by the Constitution of South Africa, the DMA and NDRMF were enacted in 2002 and 2005 respectively as legislative frameworks for managing disasters at national, local, and municipal levels (Van Niekerk, 2014). The DMA has encouraged policy makers and stakeholders to develop a new way of thinking about disaster response and disaster risk reduction efforts and move away from the conventional disaster response strategies thus placing disaster management at the forefront of policy making (Van Niekerk, 2015). The DMA aims to:

> Provide for an integrated and co-ordinated disaster management policy that focuses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post-disaster recovery; the establishment of national, provincial and municipal disaster management centres; disaster management volunteers; and matters incidental thereto (Republic of South Africa, 2002).

The DMA calls for the development and implementation of an integrated and coordinated disaster risk reduction policy focused on disaster risk reduction and specific areas of post-disaster recovery (Botha & Van Niekerk, 2013; Van Niekerk, 2014). Despite being boldly stated in the DMA, proper disaster management structures are yet to be established at various levels of government (Van Niekerk, 2015). Furthermore, at each level of government, the legislation provides particular information on the construction of disaster risk management centres and other intergovernmental organizations (Zuma *et al*., 2012). Though the DMA does not mention drought specifically, chapter two of it specifies the various institutional arrangements that must be in place for effective disaster risk management with drought events, drought, and wildfires at the centre of disasters most common in South Africa.

2.6.2.2 ***National Disaster Risk Management Framework of 2005 (NDMF)***

The Disaster Management Act calls for the construction of a National Disaster Management Framework (NDRMF) (Republic of South Africa, 2005). The development of the NDRMF is

mandated by Section 6 of the Act. The Framework's goal is to guide and inform all aspects of South African disaster management. The proposed NDRMF was published in April 2004 and the National Disaster Management Framework of 2005 was promulgated in May 2005, following public meetings and opinions (Kunguma, 2020). This Framework was developed as part of a strategy to bring South African disaster management legislation in line with international best practices (Botha & Van Niekerk, 2013). The Disaster Management Act 57 of 2002 established the NDRMF as a legal mechanism to guide disaster management implementation, and the Framework consists of four key performance indicators (KPIs) and three supporting enablers, all of which are guided and monitored by objectives in all three sectors of government (Republic of South Africa, 2005). While the DMA provides recommendations on disaster risk management in South Africa, the NDRMF strives to demonstrate how the Act's objectives can be met, which allows the NDRMF to be separated into two sections: key performance areas and enablers (Van Niekerk, 2014). The logic for this divide is that enablers are factors that must be present in each of the key performance areas for them to be properly implemented and sustained (Van der Merwe, 2016). For this research, Key Performance Area 3: Disaster risk reduction and Key Performance Area 4: Response and recovery are fundamental to addressing the questions and objectives outlined in the research study.

KEY PERFORMANCE AREA 3 (KPA): DISASTER RISK REDUCTION

Key Performance Area (KPA) 3 integrates disaster risk management planning and implementation to educate developmentally oriented disaster risk reduction techniques, plans, initiatives, and projects (Zembe, 2017). KPA 3 highlights the need for disaster management frameworks and planning to be aligned across all levels of government. It also pays special attention to the design and incorporation of the basic risk reduction principles of preventive and mitigation into ongoing programmes and initiatives (Republic of South Africa, 2005). Disaster risk management stakeholders must all establish and implement disaster risk management strategies according to KPA 3, and these plans must be prepared collaboratively by all parties involved (Van Niekerk, 2014). In addition to developing and implementing plans, KPA 3 comprises identifying and implementing disaster risk reduction programmes in accordance with approved frameworks (Kunguma, 2020). The Drought Management Plan proposed in South Africa is based on four key performance areas (KPAs), namely: institutional arrangements, integrated institutional capacity, disaster risk assessment and reduction planning, and response and recovery from disasters such drought and others. These enablers are seen to drive drought management: information and communication; education, training, public awareness and research; and funding.

KEY PERFORMANCE AREA 4: RESPONSE AND RECOVERY

Key performance area (KPA) 4 outlines the implementation priorities for disaster response, recovery, and rehabilitation and fulfils the Disaster Management Act's requirement for an integrated and coordinated policy that focuses on disaster response and recovery in a timely and effective manner (Republic of South Africa, 2005). When a large incident or crisis occurs or threatens to occur, it is critical that there is no confusion about roles, duties, and the eight protocols that must be followed (Bruwer *et al*., 2017). KPA 4 outlines steps to enable successful disaster response, recovery, and rehabilitation planning; it provides a methodical and coordinated response to major events and disasters, a response management system must be established and put into place. If the system is to be effective, it needs to clearly define who is responsible for what in terms of facility management as well as personnel management and equipment management; it also needs to provide clear communication procedures and procedures for operational command and on-scene operations, as well as technical task teams (Solik, 2017). One of the crucial steps in drought mitigation strategies is the development of information and its dissemination to political decision makers, administrative officials, and individuals and societies vulnerable to drought. The public should be informed of current and forecast conditions of drought events and the required response actions by the provision of accurate, timely information to the print and electronic media (research, seminar, workshop, TV, radio, newsletters, information centres, and the internet). An effective early warning and monitoring system should be in place to warn farming communities and other relevant sectors about risk and drought conditions well in advance.

2.7 Chapter summary

This chapter provides an overview of how the Pressure and Release (PAR) Model, Community Capitals Framework, and Sustainable Livelihood Framework may be used for drought disaster perception and its associated impact on communities. The factors that cause meteorological, hydrological, and agricultural droughts, as well as the interactions between them, are critical in understanding drought perception and the consequences for rural communities' livelihoods. To provide a theoretical foundation for the driving mechanism for drought evolution, the driving force-pressure-state-response framework is explored. In the framework, the main factors of drought evolution, the driving mechanism of drought impacts, techniques of investigating evolution rules, and drought response under changing environmental conditions are all covered. The framework used in this study is most useful for assessing drought impacts on the target community. A case study focusing on a specific community within a rural community area in South Africa was chosen to ensure coverage of study area situations and adequate representation of the affected people. For a more in-depth understanding of the process, Sustainable Livelihood Framework was used in this study.

Chapter 3 Literature Review

3.1 Introduction

This chapter examines drought-related literature from a global and an African perspective. The chapter is divided into four sections. The first section examines drought literature in the global context while the second section examines drought literature from an African perspective. The third section examines the impact of drought on the socio-economic and environmental perspectives, and the fourth section examines the vulnerabilities to drought and provides concluding remarks.

3.2 Drought episodes in the global context

The occurrence of widespread, severe drought in Africa, Asia, America, Australia, and Europe has been evident in various regions and societies' vulnerability to drought. The occurrence of severe drought recently across the world has emphasized the need for more research on the causes as well as the impact of drought and the need for additional planning to help mitigate the possible worst effects of future droughts (Otkin *et al*., 2018; Long, 2021).

Drought has been the subject of extensive systematic research, including rewriting of drought history, drought frequency assessments, and, to a lesser extent, analyses of first-, second-, and even third-order drought consequences on society. Droughts are all caused by a lack of precipitation, which results in water scarcity for an activity (e.g. plant development) or a group (e.g. farmers). Water availability in communities is influenced by a range of natural and human factors (Vargas & Paneque, 2017; Mera, 2018). During periods of extreme heat, low humidity, and/or high wind speed, this scarcity can arise.

Drought-related water constraints, however, must be seen as a relative condition rather than absolute (Otkin *et al*., 2018; Long, 2021). Because drought affects so many economic and social aspects, it has inspired a multiplicity of definitions from a variety of fields. Furthermore, because drought occurs with varied frequency in all parts of the world, in all types of economic systems— socialist and capitalist—, both developed, and developing countries, the methodologies used to define drought reflect regional distinctions as well as ideological viewpoints. The effects of drought vary from one region to the next, depending on the socio-economic environment in which it occurs. As a result, it appears that the search for a globally accepted definition of drought is futile (Vargas & Paneque, 2017; Mera, 2018).

The scientific body of research that looks into the processes that cause drought to develop and persist is growing rapidly. This research has highlighted several factors that may potentially impact drought occurrence, including large-scale atmospheric mechanisms that are associated with modes of climate variability and sea surface temperature (SST) anomalies (Parsons *et al*., 2018), and evidence that land-atmosphere feedbacks play a role in their persistence (Gore *et al*., 2020).

However, much of this research is based on coupled land-atmosphere-ocean models and may be model specific. Part of the reason that the research has favoured model-based approaches, and for our general lack of understanding of the mechanisms that control drought development and persistence, is the dearth of detailed observational data of the occurrence and variability of droughts over large time and space scales. Alternatively, land surface models forced by surface climate observations (which generally are more available than the relevant terrestrial hydrologic variables) can provide spatially and temporally consistent derived fields of variables that are not observed directly (Abiodun *et al*., 2019; Gore *et al*., 2020). They can also form the basis for seasonal hydrologic prediction (Wood & Lettenmaier, 2006) and thus drought forecasting.

The Palmer Drought Severity Index (PDSI) (Palmer, 1965) has generally been the tool of choice for observation-based indices of drought and has been used by several researchers (Abiodun *et al*., 2019; Gore *et al*., 2020; Orimoloye *et al*., 2021) for drought assessment. However, the PDSI has notable deficiencies, including its inability to represent the effects of snow and the absence of a sound probabilistic interpretation for the resulting index values. An alternative to the PDSI is the use of land surface models that simulate the detailed processes of water and energy transfer at the earth's surface (Andreadis *et al*., 2005).

3.3 Drought scenario in South Africa

Drought is caused by a variety of factors, including changing climatic conditions. According to Hao *et al*. (2018), air circulation interruptions create meteorological drought. This is similar to climate occurrences like anticyclones or high-pressure systems, which cause air and drought to subside for an extended period, blanketing an area (Saft *et al*., 2018). Furthermore, sea surface temperature variations consistent with El Niño Southern Oscillations in the Pacific are alleged to cause invasion of warm waters into so-called South American coastal waters, which typically correlate with drought in South Africa and other countries such as Australia and Brazil (Scholes *et al*., 2015). In South Africa, like any other country in the world, human actions also cause drought by encouraging desertification through land-use patterns such as deforestation, monoculture, overgrazing, over agriculture, and poorly maintained irrigation systems. This is

especially true in South Africa, where population pressure has forced people to abandon traditional practices such as nomadic pastoralism, which served as a drought-relieving mechanism (Mesene, 2017; Glantz, 2019).

Furthermore, significant fluctuation in rainfall is one of the main causes of drought in South Africa, and it is estimated that the El Nio phenomenon accounts for roughly 30% of the rainfall variability (Braimoh *et al*., 2018). Temperature, pressure, and airfields in Southern Africa are all affected by South Pacific Ocean occurrences (Tshimanga *et al*., 2016). Different conditions are formed during the high and low phases of the El Nio Southern Oscillation (ENSO). During the low phase or warm events of the Southern Oscillation, the convergence zone of cloud bands, which is normally the source of heavy precipitation, shifts offshore (Cooper *et al*., 2018). ENSO warm events have the largest impact on precipitation in the sub-continent's southeastern regions. As a result, as evidenced by the severe droughts of 1991/1992 and, to a lesser extent, 1997/1998, ENSO warm occurrences are frequently connected with drought across most of Southern Africa (Monyela, 2017). Global drought triggered by ENSO may dramatically alter the access of donor governments to food for a developing world. Studies show that while there is a link between ENSO events and drought, these associations do not explain all drought events in South Africa (Baudoin *et al*. 2017; Blamey *et al*., 2018). Therefore, nations need drought control that covers all facets of climate variability, not just fluctuations in rainfall correlated with ENSO. Drought is a widespread feature of the South African climate and its impacts, especially concerning the extra helpless community plus the farming subdivision and have therefore been straightforward.

South Africa has a highly volatile climate and highly restricted freshwater supplies as a semi-arid to arid region. Climate extremes imposed by climate instability and transition are affecting the scarce water supply. Drought, which has a catastrophic effect throughout the world, is a recurring characteristic of the extremely volatile climate and weather extremes of the world. It is one of the world's most alarming natural disasters, of which the socio-economic effects appear to be extreme in areas with less than 500mm of annual rainfall. The average annual rainfall in South Africa is around 450mm, and this makes this country primed for frequent drought (South African Weather Service, 2020).

Drought existed in South Africa with considerable regularity in the twentieth century. According to the South African Weather Service (SAWS) (2020), any volume of rain that is less than 75% of average annual rainfall constitutes a meteorological drought. Dry days have been witnessed in South Africa over the past 20 years, during which a major part of the country recorded below-normal rain (South African Weather Service, 2020). The key years of drought were

1991/1992, 1997/1998, 2001/2002, and late 2015/2016 (Botai *et al*., 2016; Botai *et al*., 2017). Due to the impact on food production and vulnerable populations, the drought in the early 1990s was one of the most severe droughts on record in South Africa (Muyambo *et al*., 2017).

3.4 Impact of drought

Drought is measured by the length of the occurrence, the intensity of the event, the affected region, economic loss, environmental and social costs, and long-term extreme repercussions. It is, in comparison to other disasters, an extremely significant and damaging event. The effects of natural calamities such as drought on a region's economy can be divided into direct and indirect effects. Drought effects can be split into three categories: economic, ecological, and social (Lunduka *et al*., 2021). The impacts of drought are characterised as a slow onset disaster and relate to direct physical harm to development factors and goods caused by natural disasters (Kokera & Ndoma, 2016), where the indirect effects are variations of the direct effects induced by natural disasters due to the effects of dislocation of demand and supply within economic sectors (Safdar *et al*., 2019).

Agriculture is vital for economic development and forms the economic base of the economy in most areas, the indirect effects of drought are always more serious than the direct impact (Hina & Saleem, 2019). The most severe consequences of drought directly influence the productivity of farmers, resulting in huge losses of income for agricultural farmers. Upstream and downstream entities' lost income are considered indirect supply chain impacts owing to the decline in production experienced by the producers. Drought repercussions are classified into three categories, as validated by the National Drought Management Center (NDMC), which shows that there are various diverse drought effects, including economic, environmental, and social impacts.

3.4.1 Economic impact

Drought consequences must be assessed economically in order to develop effective and long-term management and mitigation methods (Kuwayama *et al*., 2019). This is reinforced by the notion that, once the economic effects of drought are quantified, it is necessary to both advise ongoing efforts to mitigate the current drought's effects and to assist in the development of policies that will make these areas more informed and resilient to future drought cycles (Kiem *et al*., 2013; Spinoni *et al*., 2018). It should be noted that drought generally causes economic and financial difficulties for agricultural production and that if it lasts for a long time, it can cause enormous and crippling agro-economic problems as well as extreme economic difficulties for agricultural development and rural farming enterprises (Leichenko & Silva,

2014). Drought effects often extend to economic consequences that cost individuals (or enterprises) resources (NDMC, 2016).

Drought has a long history of causing direct and indirect financial, social, and environmental problems all across the world (Stakhiv *et al*., 2016). The effect of drought on macroeconomic trends, such as economic growth rates, investment, the current balance of payments, inflation and wages, all appear to have financial consequences for farmers and the economy (Yusuf & Sumner, 2015). According to Aryeetey and Fenny (2017), drought-related economic losses include those resulting from impaired dairy and beef production, vegetables, forestry, and fisheries; a lack of electricity for industrial use; a downturn in agriculture-dependent industries; increased unemployment in agriculture and other drought-affected industries; and the burden on financial institutions.

Drought has devastating consequences on the economic growth of a country. Even though most Southern African countries have agro-based economies, it is clear that agriculture contributes the most to the region's GDP, even if the region's countries do not rely completely on agriculture for income (Dube *et al*., 2016). Drought has a direct effect on agricultural productivity, lowering the expected yield and consequently lowering farmer income, which has a ripple effect on the taxes that farmers would infuse into the economy, both locally and internationally (Alemu & Mengistu, 2019). Fresh vegetables, herbs, cattle, and poultry meat, as well as hog and mutton, are exported throughout the region, the African continent, and internationally by farmers. Drought consequences are felt throughout the economy, with Zimbabwe suffering massive economic losses as a result of the 1982/83 drought, including US$360 million in direct agricultural losses and US$120 million in drought relief expenses (Lakitan, 2019).

3.4.2 **Impact of drought on the environment**

Drought has an impact on soil quality since soil moisture is required for the decomposition of organic matter. Drought degrades soil quality by reducing organic activity and increasing wind erosion, resulting in the death of soil insects and organisms. Drought wreaks havoc on water sources like streams, creeks, rivers, and lagoons, drying them out and causing the extinction of aquatic animals (Malinga, 2019). It all boils down to habitat loss, which disrupts entire food cycles and ecosystems as marine animals and other wildlife perish (Domeher & Abdulai, 2012). Drought can impact water sources, as it did in Botswana when Lake Ngami had water in the nineteenth century which has mostly dried up in recent times (McKittrick, 2018). In addition to a reduction in marine activity, drought often reduces water quality because

decreased water flow reduces pollutant dilution but increases pollution of remaining water supplies (Davis, 2016).

Drought leads to desertification, which happens when agricultural lands such as vegetation lands or forests — primarily due to overgrazing and overstocking, deforestation, and veld or runaway fires — become bare and infertile (Mujere & Moyce, 2018). Drought exacerbates the situation, hastening the development of desertification and reducing the chances of land reclamation or regeneration (Graves *et al*., 2021). Drought cycles endanger the health and quality of freshwater biomes such as lakes and wetlands, rivers, and streams. Wetlands are also impacted, putting the survival of living animals in specific habitats in jeopardy (Karaouzas *et al*., 2017).

The movement of species to new areas is referred to as drought. Wild creatures wander great distances in search of water. As a result, animals are exposed to possibly new interactions and threats in unknown environments as they grow up, leaving them vulnerable (Adams & Van Niekerk, 2020). Air quality deteriorates as a result of pollen, pollution, and reduced visibility due to drought. Drought in the United States' Great Plains from 1933 to 1940 resulted in huge dust storms that deposited dense dust in the skies for days (Nhamo *et al*., 2019).

3.4.3 **Social implications of drought**

Drought's social implications are more likely to be severe because they directly affect individuals. Most people in rich countries have never experienced what it is like to go without enough water, yet this is a common nightmare in less developed countries (Hoekman *et al.*, 2018). In the event of a drought, the drop in the rural population, limited access to education, and extreme health and well-being indicators in rural areas are all well-known patterns. (Day *et al*., 2019). The water supply of any settlement has a direct impact on health. Drought has a significant impact on the water quality that people consume.

Communities can avoid and control diseases by consuming clean water, cleaning it, and treating it. Drought has an indirect impact on poverty, hunger, anaemia, and death. Drought reduces food production (crops and cattle), leaving people hungry, especially in poorer areas (Qin *et al*., 2020). Insecurity, disease/illness, and mortality are all consequences of poor food nutrition. People migrate, in search of improved living environments, to other places with better opportunities during drought, leaving the elderly and children in the hands that are unable to enhance growth in the region.

The most affected are subsistence farm groups; other members migrate. This stresses the life of farming families in rural areas around the globe (Graves *et al*., 2021). It is argued that as many as 50 million could become environmental refugees if the world does not act to support sustainable development (Kokera & Ndoma, 2016). Stress, anxiety, and the generally low and drained feeling of not knowing when things will improve can hurt individuals (Mujere & Moyce, 2018). Furthermore, community networks are broken, and social contact is jeopardised, resulting in poor morale and social alienation for individuals.

3.5 Mitigation measures to cope with drought (evidence from previous empirical studies)

Drought mitigation measures encompass a wide range of activities that can be divided into three categories: supply expansion, demand reduction, and drought impact reduction (Table 3.1). Each category has a varied impact on the physical, economic, and sociological effects of drought. Severe drought events that have occurred around the world in recent decades have raised awareness of the severity of the impact of this hydro-meteorological hazard, prompting many researchers and decision-makers to create drought mitigation strategies. In arid and semi-arid places like South Africa, where the risk of catastrophic water shortages is developing due to the strain of increasing demands on restricted water resources with significant natural variability, the need for an immediate response to drought crises is particularly acute (Rossi, 2000; Mohammad *et al*., 2018; Haile *et al*., 2020). According to the scientific field of the participating researchers and the institutional responsibility of the organization tasked to reduce detrimental effects of drought, perceptions of the priority activities essential to cope effectively with drought might be extremely different. However, there is broad agreement on the importance of a comprehensive strategy (Choudhury & Sindhi, 2017; Schulze, 2019; Guo *et al*., 2018). This strategy includes a better knowledge of the drought phenomenon (in terms of general meteorological causes as well as of continuous monitoring of drought conditions); an accurate assessment of drought impacts on environmental, economic and social systems; and the definition of a set of actions aimed to mitigate drought impacts and to reduce the vulnerability of water systems to droughts.

Table 3.1 Drought mitigation measures classification

SN	Mitigation measures	Short-term measures	Long-term *measures*
1	Supply increase	• Additional resources usage in form of low-quality water and high exploitation cost • Over-exploitation of aquifers • Increase diverted waters by not mandating ecological and recreational water use constraints; for example, minimum instream flow, minimum lake or stream level • Existing water system efficiency improvement through leak detection platforms and modification operation rules	Augmentation of available resources through: • New and innovative surface reservoirs. • Inter-basin and within-basin water transfers • Conveyance network for dua-directional exchanges • Treated wastewater reuse • Brackish or saline waters desalination • Evaporation losses control • Use of aquifer as groundwater reserves • Rainfall augmentation
2	Demand reduction	• Municipal water usage restrictions, for instance, car washing, gardening among others • Irrigation water usage restriction on some crops; for example, annual crops • Pricing • Public awareness campaign • Voluntary water saving • Compulsory water rationing	• Dual distribution network for municipal use. • Industrial water recycles. • Use of less water consumptive crops • Water consumption reduction using the agronomic technique • Irrigation using sprinkle or drip to safe water usage • Shifting from irrigated crops to dry crops • Economic incentive for private investment in water conservation
3	Impact minimisation	• Reallocation of water resources temporarily on the basis of assigned use priority • Compensation for loss of revenue through public aid • Tax relief • Reduction in the delay of payment deadline • Rehabilitation programmes	• Early warning system development • Water resources reallocation based on water quality requirements • Drought resilient plants usage • Drought contingency plan development • Economic and social impact mitigation through voluntary insurance, pricing, and economic incentives

			• Education activities from drought preparedness improvement

(Source: Haile *et al*., 2020)

There are numerous ways to categorize the steps that will be implemented to minimize the effects of the drought. Three main categories are mentioned in an initial classification (Rossi, 2000): water supply-oriented measures, water-demand-oriented measures, and drought-impact reduction measures. Simplified information of the complex process, which flows from meteorological drought to its economic and intangible consequences via the filtration of water bodies, the water delivery system, and the socioeconomic structure is presented in Figure 3.1. The importance of the three types of drought mitigation techniques suggested is highlighted in detail; it is clear that the first two categories of actions try to lower the likelihood of a water shortage due to a drought event by changing supply or demand, whereas the third category is geared toward minimizing the environmental, economic, and social repercussions of drought (Rossi, 2000; Ahmadalipour *et al*., 2019; Byers *et al*., 2020).

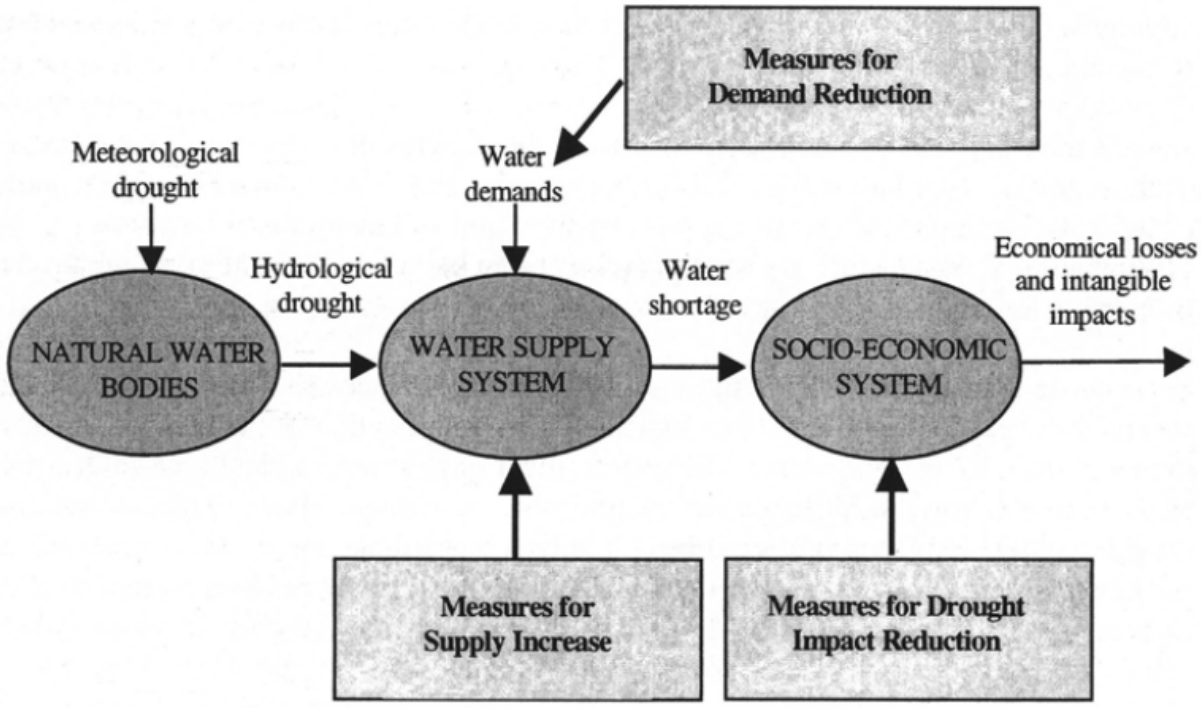

Figure 3.1 Drought Impacts reduction and the role of mitigation measures

Source: Adapted from: Rossi, (2000)

Another classification is based on the type of response to drought issues, with the reactive and proactive approaches being distinguished. The reactive method entails taking action after

a drought has occurred and its consequences have been identified (Baudoin *et al*., 2017; Bandyopadhyay *et al*., 2020). It includes steps that are performed during and after the drought to mitigate the effects of the drought. Because it is not based on pre-planned strategies, it is referred to as the crisis management method (Baudoin *et al*., 2017). Although the reactive strategy is still the most prevalent reaction to drought occurrences, there is growing recognition that it entails last-minute decisions and expensive interventions, many of which have unsustainable environmental and social consequences (Mera, 2018; Farooq *et al*., 2009; Oladosu *et al*., 2019). Before a drought event happens, the proactive approach comprises of measures designed and prepared according to a planning strategy rather than improvised actions (Baudoin *et al*., 2017). Before, during, and after the drought, preventative interventions are created and executed. In particular, measures taken prior to the initiation of a drought event and prior to the forecasting of a drought aim to reduce the vulnerability of the system to droughts and/or to improve preparedness to face drought effectively (Ward *et al*., 2020).

Water supply planning, according to research, includes two sorts of drought responses: tactical and strategic (Rad *et al*., 2017; Rubio-Martin *et al*., 2020). Tactical measures are steps taken after a drought has begun and it is too late to create new facilities to address water shortages. Strategic measures are acts that are prepared ahead of time and include changes to infrastructure, existing legislation, and institutional frameworks. Researchers prefer to distinguish between an unplanned reactive strategy and a proactive approach, which contains two primary types of measures, both of which are prepared ahead of time (Bandyopadhyay *et al*., 2020; Engler *et al*., 2021):

- Long-term efforts aimed at reducing the susceptibility of water supply systems to droughts, i.e. improving the reliability of each system's ability to fulfil future needs in drought conditions through a set of appropriate structural and institutional mechanisms; and
- Short-term actions, which try to face an incoming drought event within the existing framework of infrastructures and management policies.

For a more specific analysis of the various measures, besides the category-based and approach-based classification above indicated, the identification of the affected societal sector results to be necessary. Measures regarding urban, agricultural, industrial, recreational, energy, wildlife sectors should also be distinguished. Thus, a specific drought mitigation measure can be classified according to a three-dimensional positioning. Table 3.1 above shows a list of short- and long-term actions, grouped into three categories: water supply expansion, water demand reduction, and drought impact mitigation, with the affected industries highlighted.

The implementation of the drought mitigation measures is difficult for several reasons, such as:

- inadequate understanding of drought problems and in particular of natural and man-induced aspects of water shortages;
- difficulty in forecasting drought characteristics (duration, severity) and time and space variability over a region;
- lack of an appropriate network for monitoring hydro-meteorological variables and water resources conditions;
- difficulty in quantifying the impacts of drought on different sectors of economy and on society;
- presence of strong conflicts among different user groups (farmers, municipalities, ecologists, etc.) pushing political decisionmakers;
- low priority assigned to the problems of preparedness to natural hazard with respect to other investment sectors;
- legal and institutional constraints to the application of several measures (e.g. changes in water allocation, reuse of treated wastewater, etc.);
- inadequate development of decision support systems aimed to help the managers of water resources systems and/or the government officials to analyze in advance the consequences of the selected measures;
- lack of appreciation of a proactive approach to face drought, which requires an attitude to plan in advance measures for an event of uncertain occurrence; and
- inadequate capability and authority to manage drought problems in particular to assure horizontal coordination among water supply organizations and vertical coordination among local, regional, national and international levels.

Several types of action are required to properly confront these challenges. The first aim is to move from a reactive to a proactive approach, which should include strategic water resource planning that considers drought risk explicitly, as well as a drought contingency plan. An early warning of impending water shortages in various usage sectors would greatly benefit the latter, including the short-term steps to be taken after the commencement of a drought event (Rossi *et al*., 2005; Yang & Liu, 2020).

3.6 Drought and drought mitigation in South Africa

Getting governments and other relevant stakeholders to consider a proactive approach to prepare for future drought events is almost always an uphill battle. As South Africa continues to experience the effects of drought, which has devastated most parts of the country, there is

a need for immediate and long-term measures to mitigate the resultant risks (South Africa Government, 2019). Previously, South African drought management strategies depended on more reactive short-term response approaches, such as giving post-drought assistance and imposing water supply limits during low-flow periods. Recent attempts have recognized the significance of taking a more proactive approach to drought mitigation as a regular aspect of climate variability as well as agricultural production planning and management decision-making (Botai *et al*., 2016; Orimoloye *et al*., 2021). However, the new drought management plans that have been produced and are currently being implemented make limited use of economic policy instruments to promote self-reliance in drought risk management.

3.6.1 **Immediate measures to mitigate drought**

Recently, there was an announcement by the Department of Human Settlements, Water, and Sanitation that, in the short-term (South Africa Government, 2019), the Department will implement measures to mitigate drought. These include:

- implementing drought-operating rules;
- undertaking borehole drilling and/or rehabilitation;
- delivery of water using tankers from available sources;
- rainwater and fog harvesting;
- protection and use of springs; and
- cloud seeding, evaporation suppression, desalination of brackish groundwater or sea water, and effluent treatment and re-use.

3.6.2 **Long-term measures**

In the long-term, the Department also aims to implement measures to enhance water security against drought. These include:

- water storage and transfer developments;
- developing water infrastructure such as dams and conveyance pipelines to redistribute water over time and space;
- reviewing and promulgating restrictions within the legislation to restore and protect ecological infrastructure; and
- developing and integrating other sources like groundwater, desalination and re-use, etc., with surface systems to enhance water security.

Drought-mitigation plans include activities such as water-use planning, rainwater harvesting, run-off collection utilizing surface and subterranean structures, enhanced channel and well management, and the investigation of additional water resources through drilling and dam

construction (Rossi, 2000; Eludoyin *et al*., 2017; Kuswanto *et al*., 2019). In the year 2021, the South African Treasury provided an investment of R220 million towards the Drought Relief Intervention Project. For example, in the Free State Province, the Department of Human Settlements, Water, and Sanitation engaged with Sedibeng Water as an implementation agency to provide sustainable access to water to the Maluti-a-Phofung community (South Africa Government, 2021). In order to deal with the immediate crisis of water shortage and other drought-related issues, the priority for Sedibeng Water was to focus on providing a water emergency solution to supply potable water for the distressed community, especially in the eastern parts of the Free State where water crisis identified as new-order (Botai *et al*., 2017; Manyama, 2020; Mocwagae, 2020). As a result of this development, 2,000 water tanks were procured in February 2020. From March 2020, and in view of the looming threat of the COVID-19 pandemic, an accelerated distribution of water tanks were commissioned and successfully implemented by Sedibeng Water to ensure that residents had access to water (South Africa Government, 2021). The 816-litre and 486-litre communal water tanks were distributed and equipped with taps during the period of 1 March to 30 June 2020, constituting 82% (for 816-litre tanks) and 42% (for 486-litre tanks) success rate respectively for mitigating water crisis impacts in the area.

3.7 Factors influencing smallholder farmers' choice of adaptation to drought

Agriculture is a major social and economic sector in the Southern African Development Community (SADC) region, contributing between 4% and 27% of the region's GDP. The majority of the population in the region depends largely on agriculture as their primary source of livelihood, employment, and income (Mdungela *et al*., 2017; Muthelo *et al*., 2019; Bahta, 2020). Smallholder farming is the most widely used method of agricultural farming in Sub-Saharan Africa, with the majority of the rural poor depending on it for survival. Drought is a common occurrence in South Africa, with varying degrees of severity (Botai *et al*., 2017; Orimoloye *et al*., 2021). The driest year in South Africa since 1904 was officially declared in 2015 (Botai *et al*., 2017). Farmers with limited resources, whose output is endangered by periodic droughts (Mare *et al*., 2018; Pili, 2020), are the hardest hit. The great inconsistency in inter-annual and intra-seasonal rainfall over most of South Africa is to blame for these droughts. Drought is the climate hazard that has the greatest impact on farmers in semi-arid regions like South Africa's Limpopo province in general and the Sekhukhune District Municipality in particular. Drought hazards are determined by how drought interacts with the vulnerability of both human and ecological systems (Hagenlocher *et al*., 2019; Wang *et al*., 2020).

Putting those who are susceptible at the centre of communication for adaptation is a crucial aspect of the answer to the drought problem. This necessitates considering end consumers of information as collaborators in co-learning through procedures and products that reflect their own contributions, rather than as a target audience (Mdungela *et al*., 2017; Muthelo *et al.*, 2019; Bahta, 2020). There are a few adaption success stories among the most vulnerable, but they primarily come from developed countries and have been turned into initiatives. Accelerating the replication and dissemination of best practices has now become a necessity. Drought adaptation and coping measures must be widely disseminated among vulnerable farmers, which necessitates new approaches to knowledge exchange. Smallholder farmers frequently lose their livelihood and investment in agriculture during droughts and beyond (Schmidt, 2019; Fanadzo *et al*., 2021). During droughts, smallholder farmers are unable to manage or cope without aid from governmental and non-governmental groups in the form of relief packages. Drought can cause food shortages, social turmoil, and land redistribution can be slowed. Drought has caused farmers in several areas to sell some of their animals in order to buy fodder for the rest (Muthelo *et al*., 2019; Wens *et al*., 2021). During sensitive situations such as drought and other climate hazards, farmers' coping and adaptation options are limited due to a lack of knowledge and a lack of resources or livelihood assets (Fahad & Wang, 2018). Furthermore, strengthening smallholder farmers' adaptive capability and drought resilience requires minimizing vulnerability (Mashizha, 2019; Quandt, 2020). However, it is unclear to what extent farmers' levels of susceptibility influence their choice of coping or adaptive tactics. Studies nearly solely focus on the impact of the environment on agricultural productivity, focusing on the socio-economic implications of global climatic variability.

Drought can affect different locations and people within the same area differently, according to studies (Eckstein *et al*., 2018; Tung *et al*., 2019). According to Tung *et al*. (2019), there is a link between climate risk components such as hazard, exposure, and susceptibility. According to Eckstein *et al*. (2018), emerging economies are more sensitive to climate risk than industrialized ones. Some believe that climatic changes would progressively affect the poor, necessitating the development of adaption measures (Eckstein *et al*., 2018; Tung *et al*., 2019; Muthelo *et al*., 2019). The following consequences experienced by households or people, as well as their coping techniques or processes, may be heavily influenced by their prior standing in terms of access to various resources or assets, such as wealth, information, financial aid, and loans (Eckstein *et al*., 2018; Tung *et al*., 2019). The issue is that vulnerability is not taken into account, and smallholder farmers are the ones who suffer the most as they are the most vulnerable during droughts because they rely on agriculture for a living (Apata *et al*., 2009; Ogunpaimo *et al*., 2020). Perception and adaption research, according to Apata *et al*. (2009), aid in better understanding communities' perceptions of climate change and existing

adaptation measures. The majority of prior research has concentrated solely on identifying farmers' adaptation techniques, rather than attempting to determine which of those strategies are helpful in dealing with drought (Apata *et al*., 2009; Ogunpaimo *et al*., 2020; Halloran *et al*., 2021). As a result, identifying effective and economical adaptation solutions for minimizing or adjusting to the effects of drought is critical.

Farmers' perceptions of soil fertility management strategies are significantly tied to their experiences and knowledge of the activities, according to research (Meijer *et al*., 2015). For example, Meijer *et al.* (2015) propose that farmers' knowledge of a new technique is linked to their perceptions of the practice, which, combined, shape their decisions about whether or not to adopt the practice. Farmers' personal qualities, such as age and education, have been observed to play a significant effect in structuring their perspectives about adoption (Muthelo *et al.*, 2019; Ogunpaimo *et al*., 2020). Farmers' attitudes toward and perceptions of adoption behaviour are influenced by risk. Farmers who are at risk are quick to adopt new conservation techniques that they believe will minimize risk (Mamba, 2016; Muthelo *et al*., 2019) and are consistent with their economic motivations and objectives. Furthermore, personal qualities of farmers, such as wealth (livestock, land, cash), previous farming experience, and age, have a significant impact on their risk attitudes and perceptions (Lucas & Pabuayon, 2011; Asravor, 2019).

Olaleye (2010) found that farmers in the Free State area of South Africa use coping techniques during droughts. Gardening, selling vegetables, casual labour, selling cattle and livestock products such as milk, and limited use of credit are some of these farmers' coping techniques. Unlike in other parts of the world, personal effects (such as jewellery or watches), household effects (such as furniture), or agricultural equipment are only sold in exceptional circumstances to collect cash during drought difficulties (Muthelo *et al*., 2019; Abubakar *et al*., 2020). The three most important adjustment mechanisms are the sale of livestock, the use of financial assets, and additional employment (Olaleye, 2010; Muthelo *et al*., 2019).

Farmers in South Africa's Eastern Cape and Free State regions are willing to pay for livestock feed in order to maintain a nucleus herd of cattle, according to Ngaka (2012). The majority of farmers say they've had to sell their animals as a result of the terrible drought. For new small- and medium-scale farmers, selling cattle is a harsh approach to mitigate the effects of a drought crisis. Other coping tactics include moving animals to better grazing sites, buying treatments (especially vitamin A supplements), fetching water for livestock, and weaning calves earlier than usual (Wilk *et al*., 2017; Walz *et al*., 2020). Farmers in South Africa have developed a range of adaptation techniques to manage the changes in climatic circumstances

according to Benhin (2006). Adjusting farming operations, such as changing planting dates for some crops, planting crops with a shorter growing period, such as cabbage, and planting short-season maize, are the most common alterations in farming activities. Crop rotation is being used more frequently, and some crops are being harvested earlier. Not all adaptation mechanisms are effective in all places of the world (Masupha, 2020; Carelsen, 2020). However, none of the prior research in the subject area looked at effective adaption strategies.

3.8 Chapter summary

The chapter presented literature on the perception of smallholder farmers to drought and the mitigation and coping strategies used to adapt and reduce the effects of drought. The chapter presented a discussion of drought from a global perspective and the analysis of drought in South Africa and its social, economic, and environmental impacts were discussed. This was followed by an outline and discussion of various mechanism and strategies used to cope with drought. In drought mitigation planning, it is essential to have an adequate understanding of where the water supply sources are. Information from previous drought events, in terms of timing, location, and duration, are crucial in drought mitigation at every stage. This information can also help to understand the linkage between a drought event and the impacts on supply.

Chapter 4 RESEARCH METHODOLOGY

4.1 Introduction

The primary goal of this chapter is to detail and explain the complete methodological approach utilized in this dissertation to answer research questions and meet research objectives. The research technique is a template that is employed in an analysis to accomplish the test purpose. A research methodology is a plan for collecting and evaluating primary and secondary data that is relevant for analysis in order to meet research objectives and answer research questions. This chapter presents a discussion on the different components of the methodological approach used in this study, such as research design, data collection tools, data analysis, the reliability and quality of the findings collected. Ethical issues are also discussed in this chapter.

4.2 Research design

The research design, according to Braimoh *et al.* (2018), is the method of collecting and analyzing the results and provides guidelines for any study. According to the literature on research methods, there are generally three kinds of research designs recognized: qualitative, quantitative, and mixed methods. Selecting any of these research methods largely depends on the scope of the research, the respondents, the analysis, and the presentation of data and results. The qualitative research method (interpretive paradigm) is a methodology that makes little use of numerical, mathematical, and quantifying results, but rather uses advanced expertise to gather and evaluate data and report it to the general public (Tuffor, 2017; Ragab *et al*., 2018).

This research method used a naturalistic approach that aimed to instil a deeper interpretation of the phenomenon under study (Cant *et al*., 2013). The researcher can be involved and engage with respondents in data collection, and this can be achieved through interviews, focus groups, and direct findings as to the key methods for data collection (Basias & Pollalis, 2018). This method helps the researcher to collect sufficiently detailed information to explain ideas and to develop hypotheses (Basias & Pollalis, 2018).

Furthermore, Taherdoost (2016) describes the quantitative research method as a positivist paradigm, as approaches used to gather and interpret data using numeric, graphs, and other means of quantification of primary findings. This enables the research to interpret the findings

and generalising them to the entire population. Using a quantitative analysis approach, the researcher is not heavily active in data gathering but uses survey methods such as questionnaires administration that can be self-managed by the respondents (Park & Park, 2016). Consequently, vast volumes of computational and mathematical evidence are obtained for every study in question. Mixed methods refers to an evolving research approach that advances the systemic combination or mixing of quantitative and qualitative evidence within a single inquiry or ongoing research (Apuke, 2017). Mixed methods also allow the integration of data during the compilation — usually during primary research, analysis, and review, or in the discussion of findings.

The mixed-methods approach, which consists of both qualitative and quantitative research methods, was used for this study based on the scope and objectives of the study. For example, to understand the perception of community members on drought and the impact on their socio-economic livelihoods, a mixed-method approach helped the researcher capture relevant information through asking open-ended and closed questions.

In using quantitative research methodology as part of mixed methods, the researcher utilized surveys and approach the relevant community members to gather the data necessary for the study. No prior contact was made with community members. This ensured that the data collected was free from bias as the researcher did not coerce or mislead the respondents in giving information.

The qualitative aspects of the mixed-methods approach, however, enabled the researcher to intensively understand this topic by engaging with the participants and be flexible in the execution of a research report (Cazeaux, 2017). In addition, Cazeaux (2017) holds that the mixed-methods approach helps the researcher to gain adequate and comprehensive information on the subject matter — and in this case, the main goal is to understand the various perceptions of community members to drought and how it impacts their socio-economic livelihoods in the Sekhukhune District Municipality.

4.3 Research philosophy

Philosophy is a set of beliefs about how information about a phenomenon should be gathered, understood, and applied. There are several research philosophies in literature, but the two major research philosophies that are popular among researchers is the positivist and interpretivist. Given that the objective of this study relies on perception and deduction of data that requires certain aspects of the respondents thought process be examined, the positivism theory necessitates the analysis and interpretation of such cases (Yilmaz, 2013; Queirós *et*

al., 2017). As such, positivism philosophy can be viewed as an experimental research method. Quantitative data is used to validate the theory and idea using these experiments. This is based on the assumption that reality occurs regardless of the subject under investigation. The interpretivists then argue that reality can only be truly comprehended through subjective interpretation and interference with it (Gillani, 2021). Interpretive theory is based on the observation of phenomena in their natural setting as well as the recognition that scientists cannot avoid the effects of the phenomena they study (Ormston *et al*., 2014). They acknowledge that the facts can be interpreted in a variety of ways, but they insist that these interpretations are part of the scientific explanation they seek (Mohajan, 2018). Given that this study sought to examine the farmers' perception of drought, a mixed-methods approach was found to be appropriate for this study, as such calling for the positivism and interpretivism research philosophies to be used. The positivism philosophy allows the researcher to examine the perspective of the research participants to a certain topic (Rahi, 2017). Issues such as smallholder farmers' perceptions of drought's effects are more objectively examined in order to produce reliable and accurate results. The interpretivism research philosophy was equally used because the qualitative aspect of the research examined the respondents' lived experiences and the socio-economic drivers influencing their daily choices rather than depend only on the quantitative aspect (Næss, 2015). Critically examining the perception and opinions of the respondents provided a deeper understanding of their lived experiences and offered insight to their social and economic situations. In this case, different interpretations were gathered, and an analysis was conducted to arrive at a single explanation for the smallholder farmers' perception of drought and mitigation strategies.

4.4 Research instruments

There exist several types of research instruments, each suited to different researches depending on the audience, participants, and objectives of the research. In literature, research instruments such as experiments, surveys, case studies, action research, grounded theory, ethnography, and archival research have been utilized in different research settings successfully (Clarke *et al*., 2016). Given that the nature of this research involved interviewing smallholder farmers, surveys were considered most appropriate to collect data to achieve the objectives of this study. The process of conducting a survey begins with the selection of a survey group from the entire population and the distribution of questionnaires for the primary data set. To avoid bias during the analysis, this method was used without the involvement of the researcher or the research team. More information was only given to the participants during the qualitative section of the questionnaire so that they could understand how to answer the questions. This approach enabled the researcher and the enumerators to have no

influence on the responses provided by the respondents and the data collection process. This ensured that all forms of data manipulations were avoided and free from bias.

4.5 Data collection tools

Data collection tools are instruments used in research to assess data from respondents (Yilmaz, 2013). These data collection tools include structured or semi-structured questionnaires, scientific simulations, and other types of testing such as personality checks or skills evaluations (De Villiers *et al*., 2019). This study utilized questionnaires with both closed and open-ended questions. The use of questionnaires allowed for respondents to respond to questions with ease and clarity, thus making the process of data collection simple and easy to understand by all the participants (Creswell, 2013). The questionnaires were designed to be easy so that respondents with little or no formal education could understand, and a pilot study was done to test the respondents' understanding of the questions and to train the enumerators on how to complete the questionnaires. The questionnaires used in this study captured general information relevant to the research study, such as the gender of the participants, their age groups, population group membership, marital status, number of years of farming and their size of land. Furthermore, some open-ended questions related to their knowledge of drought and its impact on their livelihoods were asked. Some open-ended questions about their perceptions of the prevailing drought were included. Other questions to understand the perception of the community members to drought and the impact were included in a Likert Scale, ranging from 'strongly disagree' to 'strongly agree'.

4.5.1 Target population and sampling

To provide answers to the research questions posed, a relevant population must be identified. The target population refers to the total number of cases that meet the study's stated criteria. To complete a study, both members of the population should have a similar set of characteristics. The participants in this study were smallholder farmers in the Sekhukhune District in Limpopo province, South Africa. A sampling method had to be used to select an appropriate sample from the population. Probability and non-probability sampling are two sampling methods that both require statistical and functional considerations (Buelens *et al*., 2018). As a process, probability sampling gives each member of the population a chance to be selected to represent the sample for analysis. This method assigns an equal chance of being chosen to each member of the population, and the selection is based on a reasonable chance. Simple random sampling, stratified random sampling, and systematic sampling are among the methods used to select respondents. Simple random sampling necessitates the selection of participants at random and random numbers are assigned to the sample elements,

and a random list of these elements is created while stratified random sampling divides the population into distinct homogeneous strata based on age, gender, and/or occupation. The respondents for the research sample are then chosen at random from these strata (Etikan & Babtope, 2019).

For the quantitative and qualitative data collection in this study, survey questionnaires were used. Respondents were able to complete questionnaires on their own time, ensuring greater consistency in data collection. Furthermore, because the pilot study (discussed in the following section) was completed and the answers were already predetermined, the questionnaires were simple to understand, and the respondents were guided from start to finish. The open-ended questions, which required the respondents to provide more detail, were not included in the pre-determined questions.

4.6 Data analysis

Data analysis is the process of capturing and making sense of the data collected. This the stage capturing, structuring, and organizing the field data to answer important questions pertaining to the research (Patten & Newhart, 2017). Completed questionnaires obtained from the respondents were cleaned to remove outliers and coded and made ready for analysis (Queirós *et al*. 2017; Van de Ven & Poole, 2017). Statistical Package for Social Sciences version 27 was used to analyse the quantitative data of the study. The data was analysed and presented descriptively using tables and figures. Descriptive statistics is a research tool that investigates the distribution score for each variable and evaluates the relationship between the calculated variables (Cypress, 2018). The qualitative data were collected by writing the responses of the respondents and analysing them using themes. Due to financial constraints, tape recorders were not used.

4.7 Reliability and validity of data

Validity in research is the extent to which an empirical measure accurately reflects the concept it is intended to measure (Etikan & Bala, 2017). Furthermore, validity measures the procedure of measuring the variables involved to be what they claim to be in the data collection process. Therefore, validity should measure the concept in question, and the concept should be measured accurately.

Reliability refers to the degree of similarity of information obtained when the measurement is repeated on the same subject or the same group of people (Patten & Newhart, 2017). Stated differently, the same value should arrive at every time the measurement is taken. This means

that the values should not vary a great deal on repeated tests. The reliability of a measurement instrument is the stability or consistency of the measurement. The data collection was submitted to the study leader such as a lecturer to ensure that data was collected in an accurate manner. The method of triangulation as also be applied to the validity and reliability of data by using questionnaires to the affected communities with both open-ended and closed questions.

4.8 Limitations and de-limitations

The anticipated limitations of this research relate to insufficient resources. Therefore, the data collection might not include all the intended respondents. This would mean that the results would be difficult to generalize to large populations as they may not be fully representative. The results will therefore be indicative of the general population. A larger sample would have been used if there had been sufficient funds. Another anticipated limitation related to this study was time management. This is largely due to the fact that Sekhukhune District Municipality is located within the borders of Limpopo province, but the researcher resides in Mpumalanga province. Language barriers when translating the questionnaires from English to other South African indigenous languages, considering the level of literacy within the District Municipality, were another limitation. Five enumerators were hired as part of the data collected process; all five had perfect understanding of the study area with knowledge of the indigenous language.

4.9 Ethical considerations

This researcher was guided by the ethical considerations of the University of the Free State. The researcher applied for and obtained ethical clearance before collecting data from the identified respondents. The research was done in strict accordance with the institution's academic ethics policies and guidelines. Concerning the collection of data, the researcher adhered strictly to the participants' voluntary participation by seeking the permission of the participants through the community leaders. The safety of data usage as well as the principles of anonymity were applied by using codes and not participants’ real names. Efforts were made to ensure that research engagement was based on the concept of informed consent and that the participants, during the data collection period, was not exposed to socio-political, psychological, or physical harm. The researched remained neutral during the entire data collection process and all forms of bias were limited. Furthermore, participants were duly informed that the data they provided would only be used for academic purposes. All ideas that used that are the property of other scholars have been duly acknowledged as such through internal citation and a final list of references. Due to COVID-19, the researcher and the enumerators worked closely with the community leaders to ensure that all COVID-19 protocols

were adhered to, from social distancing to wearing of masks, throughout the data collection process.

4.10 Chapter summary

This chapter provided the methodological approach used in this study. It provided an overview of the research strategies used in conducting the research as well the technique for sampling the population included in the study. This chapter further provided a summary of the research philosophy used in this study, namely mixed methods. This section was accompanied by an outline of the research instrument used, and it explained how the questionnaire for this review was built. A description of the data collection and analysis was then presented, accompanied by details on the validity and reliability of the survey questionnaire. The chapter discussed the ethical issues consideration followed in the study. The following chapter discusses the results of the research, discussion of the study.

Chapter 5 DATA ANALYSIS, INTERPRETATION AND DISCUSSION OF RESULTS

5.1 Introduction

This chapter presents the analysis and discussion of the results obtained to achieve the objectives of this study. This aim of this study was to determine the perception of farmers in Sekhukhune District Municipality, Limpopo province, to drought hazards and to evaluate the impact of drought on their livelihood. The chapter is divided into four sections. The first section discusses the socio-economic characteristics of the farmers and the farmers' perceptions of drought. The second section presents a discussion on the farmers' level of vulnerability and the impact of drought on their livelihoods. The third section presents a discussion on coping and adaptation strategies used by the farmers to mitigate the effects of drought on their environment. The last summarizes the chapter and provide concluding remarks.

5.2 Socio-economic characteristics of respondents

This section presents a discussion of the socio-economic characteristics of the respondents, such as gender, educational level, age, household size and farming experience, and household income. Table and figures are used to present the results.

5.2.1 Gender of respondents

The gender distribution of the respondents in the study area is shown in Figure 5.1. The data collected shows an almost even distribution between male and female respondents. Figure 5.1 shows data of the 125 households that were sampled, in which 50.40% (63) were male farmers while 49.60% (62) were female farmers. While some studies have argued that female farmers make up the vast majority of the smallholder farming community, several studies have found men dominate in some sectors such as livestock (Muthelo *et al*., 2019; Nyam *et al*., 2020) and rice farming (Donkor *et al*., 2018). However, this study reveals that women make up almost half of the farming population in the Sekhukhune District Municipality, thus showing the involvement of women in agriculture in the Municipality.

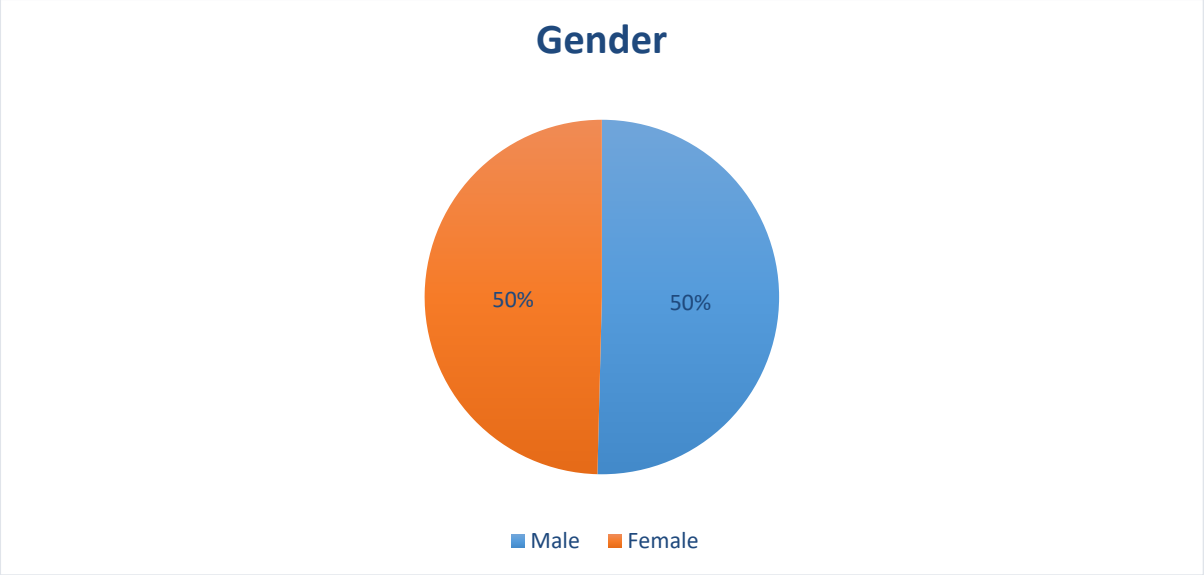

Figure 5.1 Gender distribution of the respondents

Source: Field Survey, (2021)

5.2.2 Educational level of respondents

Respondents were asked to indicate their highest levels of education. Figure 5.2 shows the education levels of the respondents. The education level of the household heads was categorized into no formal education, high school, diploma, and postgraduate degree. For this study, a diploma is a college or professional certificate lower than a university degree, and a postgraduate degree is the highest academic qualification. The survey results in Figure 5.2 show that 43% of the household heads in (the study area) had no formal education, 44% had completed high school, 12% had obtained a diploma, while just 1% of the household heads had completed a postgraduate degree. Education influences the decisions of household heads to adopt and apply smart farming techniques (Obi & Maya, 2021). Education is important as it enables farmers choose the best mitigation and adaptation strategies to drought (Jiri *et al*., 2017). The results of this study show that a majority of the farmers in the Sekhukhune District Municipality have no formal education or have a high school qualification. The implication of this result is that due to their low levels of education, these farmers may not be able to develop the adaptive capacity to deal with the effects of drought. This might negatively affect their farming operation and their livelihoods

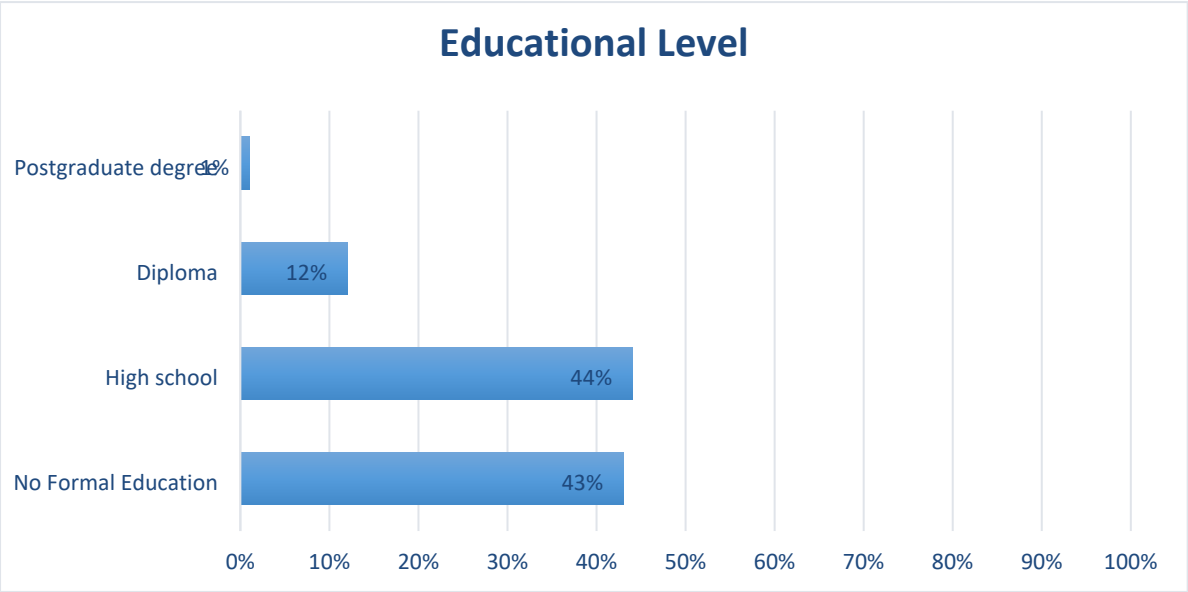

Figure 5.2 Educational level of respondents

Source: Field Survey, (2021)

5.2.3 Farming skills of the respondents

Figure 5.3 shows data on the farming skills of household heads. This study reveals that 89% (111) of the total sample size had some level of farming skills while 11% (14) had zero farming skills. The population of the target community is made up farmers especially smallholder farmers who often lack the capacity to deal with the effects of drought. Most studies in Africa confirm that most Africans especially in rural communities, informal settlements, and disadvantaged communities depend on agricultural production for their livelihood and hence depend on land and water availability (Mfitumukiza *et al*., 2017; Hannaford, 2018; Nash *et al*., 2019; Nyam *et al*., 2021). The results of this study confirm what previous studies found in terms of the majority of community's members depending on farming for their livelihood.

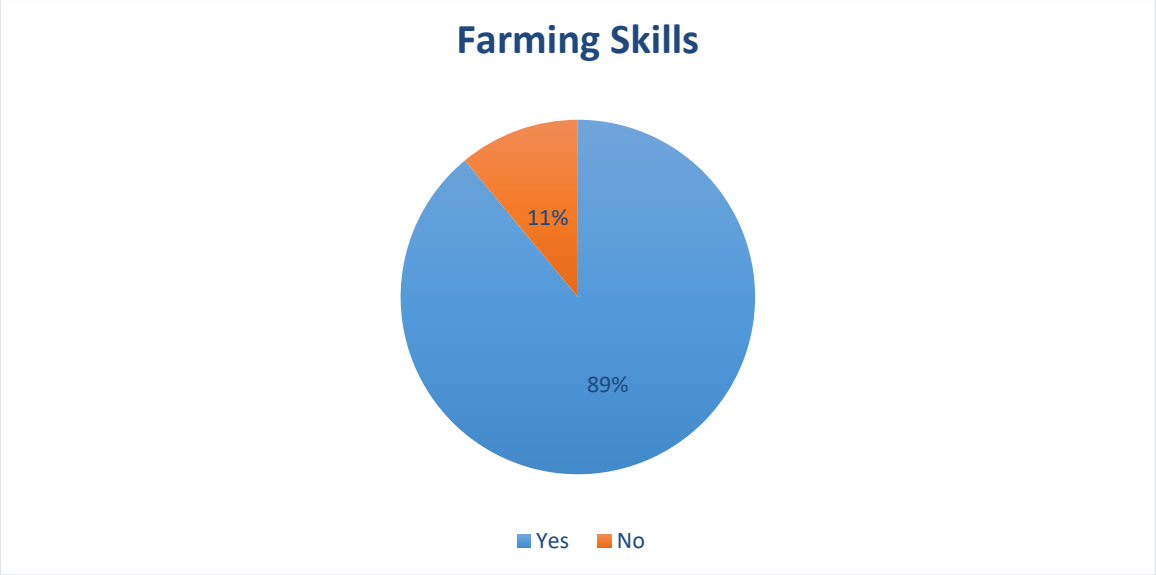

Figure 5.3 Farming skills of respondents

Source: Field survey, (2021)

5.2.4 Marital status of respondents

Figure 5.4 presents the marital status of the sampled population (respondents). The marital status of the household heads is categorized as single, married, widowed, divorced, and separated. Figure 5.4 below shows that 62% (numbers) of household heads were single, 26% were married, 6% were widowed, 4% were divorced, and 2% were separated. This study shows that most smallholder farmers in the study area are single, and some are married. Muthelo *et al*. (2018) found no significant correlation between marital status and the adoption of adaption and coping mechanism to drought among smallholder livestock farmers in the Free State.

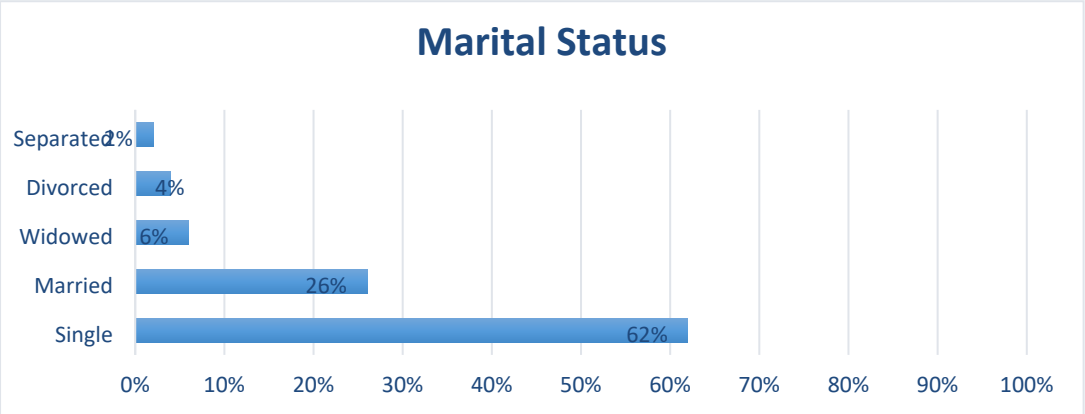

Figure 5.4 Marital status of respondents

Source: Field Survey (2021)

5.2.5 Income level of respondents

The monthly income of the respondents was categorized into less than R1,000, R1,000 to R5,000, R6,000 to R10,000, and above R10,000. Data on the monthly income level of the respondents is shown in Figure 5.5. Figure 5.5 shows that 27% of the household heads earned less than R1,000 a month on average, while 43% of household heads earned between R1,000 and R5,000. Furthermore, 20% of household heads earned between R6,000 and R10,000 a month, while 10% of household heads earned above R10,000. The 10% who earn above R10,000 monthly, however, represents a small proportion of the sampled population and make the most of these income from non-farm activities. This shows that the main source of livelihood for farmers in (study area) is agriculture as the majority of household heads make the most of their income from agriculture. This makes coping difficult during droughts.

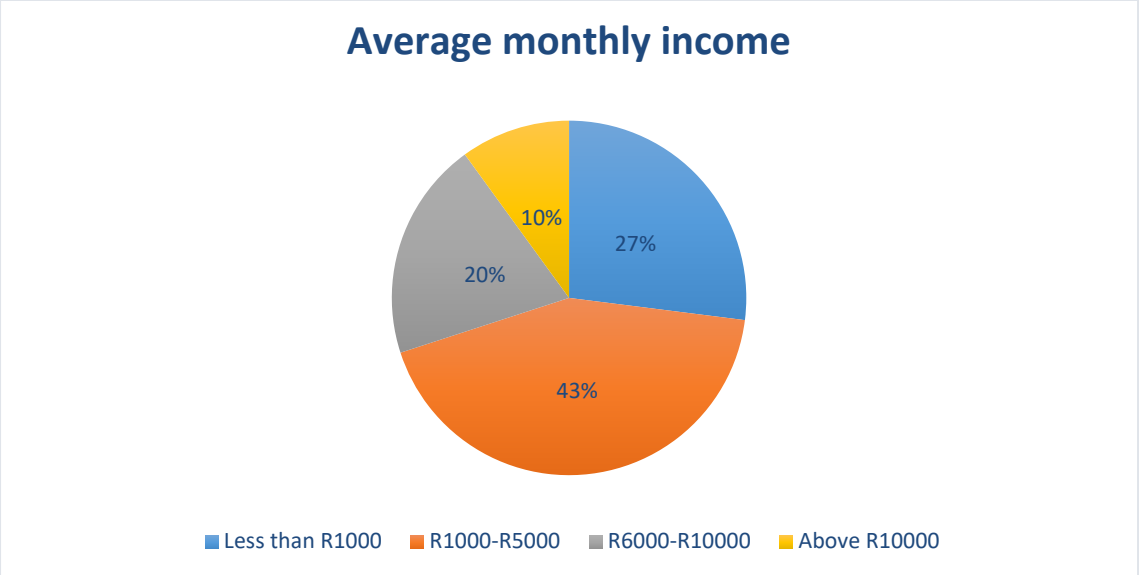

Figure 5.5 Average monthly income of respondents

Source: Field Survey, (2021)

5.2.6 Age, farming experience, and household size of respondents

Table 5.1 shows the descriptive statistics of the socio-economic characteristics of smallholder farmers for age, household size, and years of farming experience in terms of the mean and standard deviation. Descriptive statistics of age, farming experience, and household size of respondents is presented in Table 5.1.

Table 5.1 Descriptive statistics of age, farming experience, and household size of respondents

Descriptive Statistics	Minimum	Maximum	Mean	Std. Deviation
Age	19	60	45	12
Farming experience	1	20	11	10
Household Size	1	8	3	2

(Source: Field Survey, 2021)

Table 5.1 shows that the youngest household head was 19 years old, while the oldest was 60 years old, and the mean age was 45 years. Also, with a mean of 11 years of agricultural experience, the lowest farming experience was one year and the highest was 20 years. The statistics also show that the average household size was three (3), with the smallest and largest household sizes being one (1) and eight (8), respectively. This means that, on average, smallholder farmers in (the study area) are relatively middle aged, with many years of farm experience and small household sizes. This means that the farmers are of middle age with many years of farming experience. Studies have shown that experienced farmers can easily detect drought and develop adaptive capacity to counter the effects of drought or mitigation measures to reduce the effect of the drought (Lemos *et al*., 2016; Patnaik & Das, 2017; Delfiyan *et al*., 2021).

5.3 Drought perception and awareness

Farmers' views of drought are essential because they give perspective into their knowledge and experiences of drought, their awareness to drought events and its causes, and the impact on the environment and their livelihood. This also allows for the assessment of the sources of information relating to drought (Bryan *et al*., 2020).

5.3.1 Have you experienced drought?

Respondents were asked to indicate their past experiences with drought in the study area. Their responses were analysed and presented in Figure 5.6. The results in Figure 5.6 show that a vast majority (97% (number) of the respondents have experienced drought while only 3% indicated that they have not experienced drought. The results demonstrate the frequent occurrence of drought in the Sekhukhune District Municipality as a high rate of smallholder farmers are experiencing drought. This equally shows that the farmers are perceptive of the occurrence of drought and have been impacted by it in some capacity. These results are consistent with the findings of Bahta and Myeki (2021) who noted that smallholder farmers are knowledgeable about the occurrence of drought but often lack the capacity to deal with the

effects of drought. However, Mpandeli *et al.* (2015) argue that smallholder farmers are often not aware of the occurrence of drought due to lack of knowledge and experience.

Figure 5 1: Drought experience of farmers

Source: Field Survey (2021)

Farmers were asked if they had experienced drought in the last five years; their perceptions of the frequency of drought are presented in Table 5.2. Table 5.2 shows that 73.6% of the farmers perceived that drought occurrence has been more frequent in the last five years, 2.4% of the farmers perceived that drought occurred less frequently, 13.6% of the farmers were indifferent about the frequency of drought in the last five years, and 10.4% said they did not know. These results are consistent with the findings of Mpandeli *et al*. (2015), who found that rate of drought occurrence has increased or increasing in the Sekhukhune District Municipality, Limpopo province. This result is crucial, especially for smallholder farmers who are vulnerable to the effects of drought and often lack the capacity to cope with the effects of drought. Asked to explain if they feel drought will continue to increase in future, respondents noted that the climate is changing rapidly and we cannot say for sure if drought events will increase or reduce but at this current, we must prepare ourselves for more drought events in the nearest future (Respondent 25). Another respondent reckoned that we don't receive adequate rains in the Sekhukhune District Municipality, but there are times we get lots of rain and we some areas are flooded. So, it is difficult to say for sure these trends will continue in future but I suggest we continue to prepare ourselves for the worst (Respondent 78).

Table 5.2: Farmers' perceptions of the frequency of drought over the last 5 years

Drought frequency	Number of respondents	Percent
More	92	73.6
Less	3	2.4
No difference	17	13.6
Do not know	13	10.4
Total	125	100

(Source: Field Survey, 2021)

5.3.2 Farmers' perception to drought

Whether or not the current trends continue in future, the farmers and authorities must continue to prepare to respond to the effects of drought. As such, knowledge and experience will play a major role. Thus, farmers were asked whether they perceived drought as a natural or man-made disaster. The information is presented in Figure 5.7.

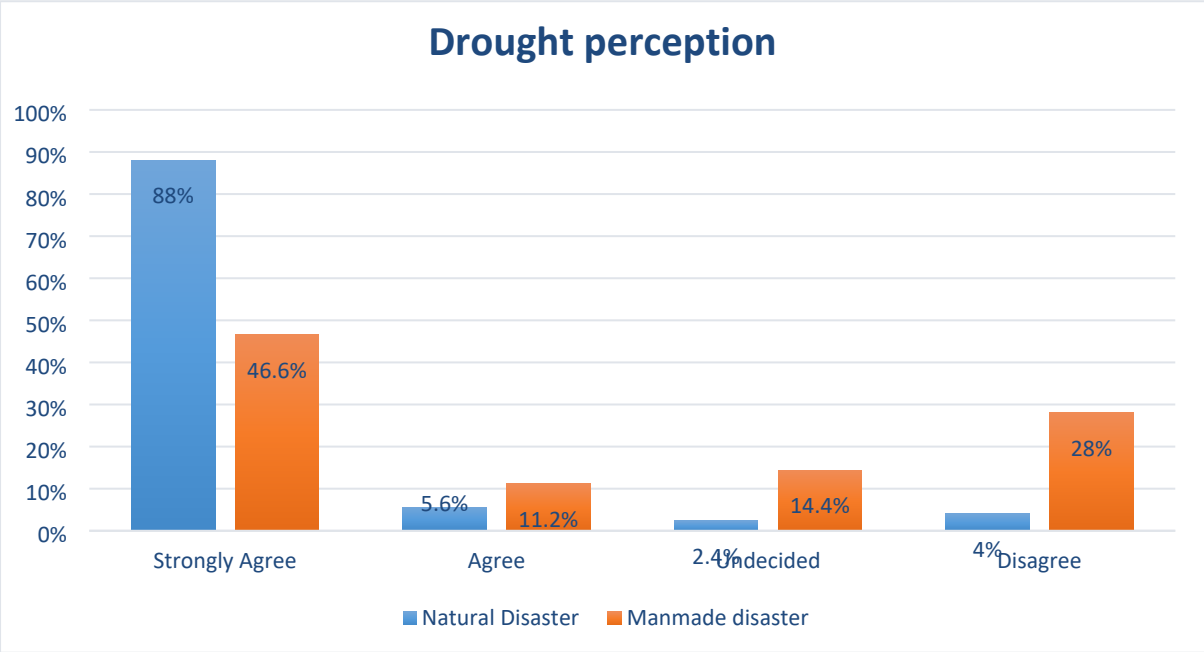

Figure 5.2: Farmers' perceptions of the causes of drought

Source: Field survey, (2021)

Figure 5.7 shows that 88% (number) of the respondents perceived drought as a natural disaster and only 4% did not perceive it as a natural disaster; therefore, the majority perceived drought as a natural disaster. Also, when the same farmers were asked if they thought drought was a man-made disaster, 46.6% strongly agreed that drought is a man-made disaster, while 28% of the farmers strongly disagreed that drought was a man-made disaster. Drought means different things to different people based on their environmental and socio-economic

conditions (Fusco *et al*., 2018). Since 89% of farmers strongly believe that drought is a natural disaster, it is reasonable to conclude that farmers consider drought as a natural disaster. Respondents were asked to indicate in their opinion whether drought is man-made or natural. Respondent 20 explained: I think drought is a natural phenomenon because we can hardly predict drought and occurs as result of climate change. However, Respondent 1 reckoned that drought is man-made because we are mismanaging the environment and it is causing changes in climate and temperature and when the climate changes, it causes drought. We must take care of our environment to reduce the effects of climate change and drought. Explaining that drought is a natural event, Respondent 15 explained that drought occurs when we have insufficient rain and rainfall is linked to the climate, as such it cannot be man-made because we cannot directly affect the climate. It is evident from the results that farmers are of the opinion that drought is a natural event.

5.3.3 **Effects of drought**

Farmers were asked to indicate the effects of drought on the human and natural environment. The results are presented in Table 5.3. The identified drought effects are drying of water resources, surroundings dryer, crop failures, livestock loss, affect health of people, food price increase, increases anxiety, and loss of vegetation. These effects were ranked from not severe to very severe according to each respondent.

Table 5.3 Farmers' perception of the effects of drought

Drought effects perception	Not severe		Not so severe		Moderate		Severe		Very severe	
	%	Number of respondents	%	Number of respondents	%	Number of respondents	%	Freq	%	Freq
Drying of water resources	12	15	2.4	4	14.4	18	27.2	34	44	55
Surroundings are drier	15.2	19	0.8	1	13.6	17	45.6	57	24.8	31
Crop failures	17.6	22	3.2	4	21.6	27	31.2	39	26.4	33
Livestock loss	8	10	3.2	4	15.2	19	40	50	33.6	42
Affect health of people	10.4	13	3.2	4	15.2	19	46.4	58	24.8	31

Food price increase	14.4	18	3.2	4	19.2	24	44	55	19.2	24
Increases anxiety	20	25	10.4	13	35.2	44	23.2	29	11.2	14
Loss of vegetation	11.2	14	8.8	11	21.6	27	40.8	51	17.6	22

(Source: Field Survey, 2021)

About 44% of the smallholder farmers in the Sekhukhune District Municipality perceived drying of water resources as a very severe effect of drought, 27.2% perceived it as severe, 2.4% perceived it as not so severe, 14.4% perceived it as moderate, and 12% did not perceived it as severe. Furthermore, 33.6% of the respondents perceived livestock loss as one of the most severe drought effects, while 3.2% perceived it as not so severe, 15.2% perceived it as moderate, and 40% perceived it as severe. However, 46.4% of respondents perceived drought effects on health as severe, with 10.4% perceiving it as not severe, 3.2% perceiving it as not so severe, 15.2% perceiving it as moderate, and 24.8% perceiving it as very severe. More so, 26.4% perceived crop failures as very severe, 31.2% perceived it as moderate, 21.6% perceived it as moderate, while 17.6% perceived it as not severe. Only about 3.2% of respondents perceived crop failures, livestock loss, and food price increase as least severe. Furthermore, the respondents perceived increases in anxiety (35.2%) and loss of vegetation (21.6%) as moderate effects of drought. Hence, the respondents perceive drying of water resources, crop failures, livestock loss, and loss of vegetation as very severe. The severity of the drought effects differs because the majority of farmers in Sekhukhune District Municipality are both crop and livestock farmers and experience drought slightly differently.

5.3.4 **Estimated economic loss**

The impact of drought is often not just felt socially or environmentally. There is always an element of economic cost during drought. The respondents were required to indicate the monthly economic loss incurred by them as result of drought in their community. Table 5.4 presents data on the monthly economic loss experienced by farmers in the study area.

Table 5.4 Estimated drought economic loss

Estimated economic loss	Percent	Frequency
Not affected	18.4	23
R0–R2,000	49.6	62
R5,001–R10,000	19.2	24

R10001–R20,000	4.8	6
Above R20,000	8	10
Total	100	125

(Source: Field Survey, 2021)

The results show that over 19.2% of farmers experience a R5,001–R10,000 loss in their monthly income as a result of drought while 8% of the farmers have lost more than R20,000. 4.8% lost between R10,001 and R20,000, while 49.6% experienced an economic loss between R0 and R2,000. Asked to explain the economic cost of the drought on their households, Respondent 12 lamented, my livestock did not have water to drink and we had to buy water from others and even at that, I still lost a considerable number of my sheep and goats, thereby losing money because I sell my livestock to support my family. Furthermore, I lost a lot of money because I had to auction my livestock for very cheap and stopped farming because I did not have any alternative source of water (Respondent 112).

5.3.5 **Impact of drought**

Respondents were asked to identify the impacts of drought on their households. The results of the impact of drought on their households are presented in Table 5.5. The identified drought impact increases food insecurity, food scarcity, affects food choices, increases malnutrition, and increases health problems among others (Table 5.4). The impact was ranked from very little to very high according to the perception of each respondent. The results show that 50.4% (63) of the respondents indicated that the impact of drought of household food security is very high while 40% (50) indicated that the impact is high, and only 1.6% (2) indicated the impact of drought on food security was minimal. Furthermore, 52.8% of the respondents indicated that the impact of drought on food scarcity was high while 32% indicated that the impact of food scarcity was very high. However, 40.8% (51), 44% (55), 42.4% (53), and 44% (55) indicated that the impact of drought on food choices, malnutrition, health problems, and household income was high, respectively. More so, 46.4% (58), 52.8% (66), and 50.4% (63) indicated that the impact of drought on festival spending, population migration, and farmers' suicide was minimal. According to the results, drought significantly impacts house food security, food scarcity, food choices, and malnutrition and health problems. These results are consistent with the findings of Muthelo *et al.* (2018) and Ogalleh *et al*. (2012).

Table 5.5: Drought impact on households

Drought impact on households	Very little		Less		Medium		High		Very high	
	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq
Increases household food insecurity	-	-	1.6	2	8	10	40	50	50.4	63
Increases food scarcity	1.6	2	1.6	2	12	15	52.8	66	32	40
Affects food choices	3.2	4	4.8	6	19.2	24	40.8	51	32	40
Increases malnutrition	4	5	10.4	13	24	30	44	55	17.6	22
Increases health problems	4	5	7.2	9	23.2	29	42.4	53	23.2	29
Reduces household income	2.4	3	5.6	7	16.8	21	44	55	31.2	39
Increases festival spending	8	10	46.4	58	16.8	21	18.4	23	10.4	13
Increases population migration	11.2	14	52.8	66	15.2	19	11.2	14	9.6	12
Schools are affected	8.8	11	24	30	34.4	43	24	30	8.8	11
Increases hopelessness	5.6	7	16.8	21	38.4	48	26.4	33	12.8	16
Increases water conflict	8	10	18.4	23	42.4	53	23.2	29	8	10
Increases farmers' suicide	46.4	58	50.4	63	0.8	1	2.4	3	-	-

(Source: Field Survey, 2021)

5.3.6 **Effect of drought on your farming operations**

Farmers were asked if they think drought is affecting their farming operations and would continue to do so in future. Figure 5.8 shows farmers' perceptions of the effect of drought on their farming operations. The results show that 64% of the respondents were of the opinion that climate change will drastically affect their farming operations due to changes in seasonality as well as drought effects while 3.2% perceive it will affect their farm operation, and 32.8% were not sure if climate change would affect their farming operations.

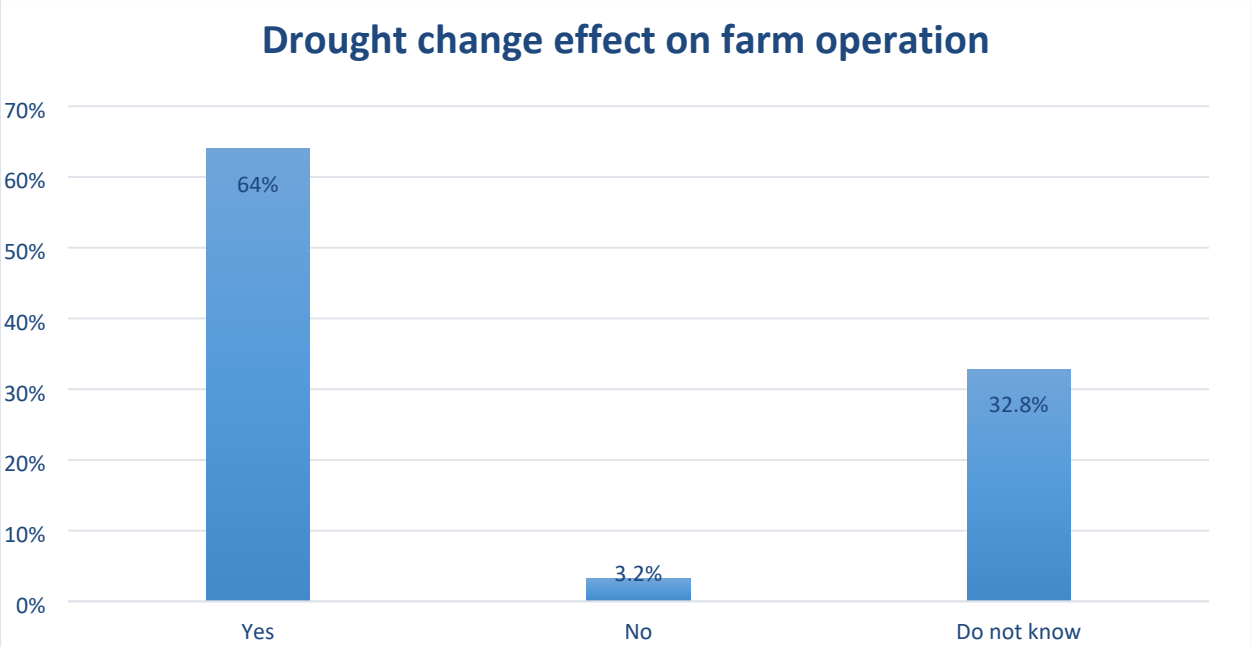

Figure 5.3: Drought change effects on farm operations

Source: Field Survey, (2021)

5.4 Vulnerability to drought risk

5.4.1 Level of risk to drought

This section explains how vulnerable farmers are to drought. Farmers were asked to rate their farming operations' level of risk to drought. The results in Figure 5.9 show that 54% of the farmers perceived their vulnerability to drought to be very high while 14% of the farmers perceived their vulnerability to drought as high, 26% perceived their level of risk as moderate, and only 2% perceived their risk level as low. Hence, it can be concluded that the majority of farmers in this study area are highly vulnerable to drought effects. Given that these farmers are smallholder farmers who often lack the adaptive capacity and resources to deal with the effects of drought, the results of this study are reliable and consistent with the findings of Matlou *et al.* (2021), who found that smallholder livestock farmers in the Northern Cape province are highly vulnerable to the effects of drought. Bahta (2021) equally found that smallholder farmers are highly vulnerable to the effect of drought in the Free State province.

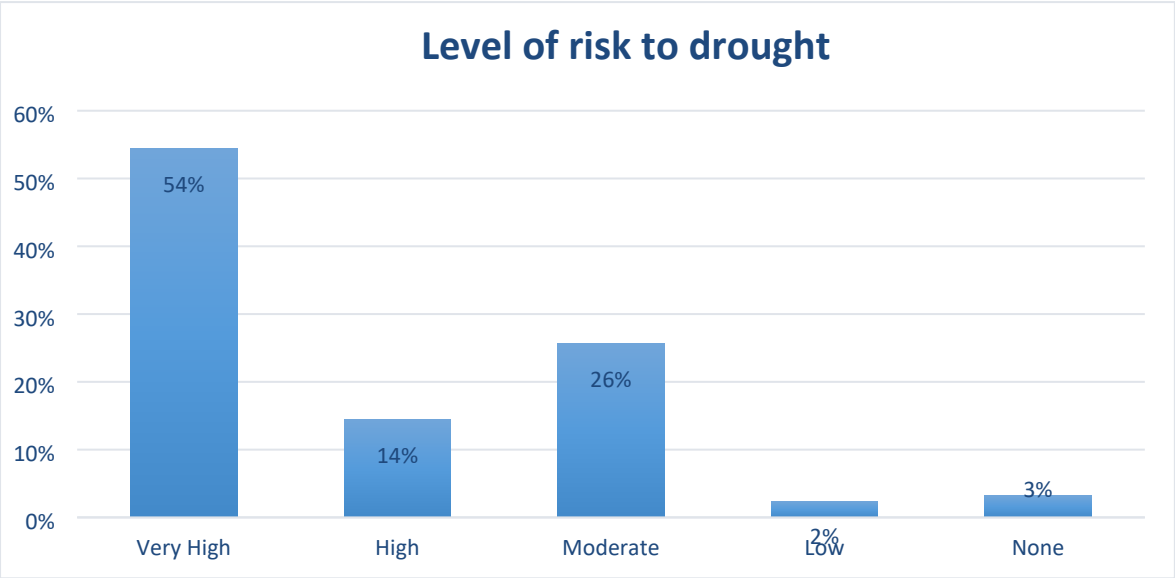

Figure 5.4: Level of risk to drought

Source: Field Survey, (2021)

5.4.2 **Drought early warning system information and climatic advisory**

Smallholder farmers depend on resources from the authorities to help them adapt and mitigate the effects of drought on their farm operations. The availability of support from authorities increases their resilience while the lack of support increases their vulnerability. Smallholder farmers depend on early warning and climatic advisory services to prepare and mitigate the effects of drought (Andersson *et al*., 2020). Smallholder farmers' ability to deal with drought in a proactive manner is limited due to a lack of application and use of forecast information and advisory services (Wilk *et al*., 2017; Nhamo *et al*., 2019). The results presented in Figure 5.10 show that a majority of the farmers (60%) did not receive any early warning to drought and climatic advisory services while 40% indicated that they receive early warning and climatic advisory services. This shows that the farmers are highly vulnerable to the effects of drought as a result of a lack of these services.

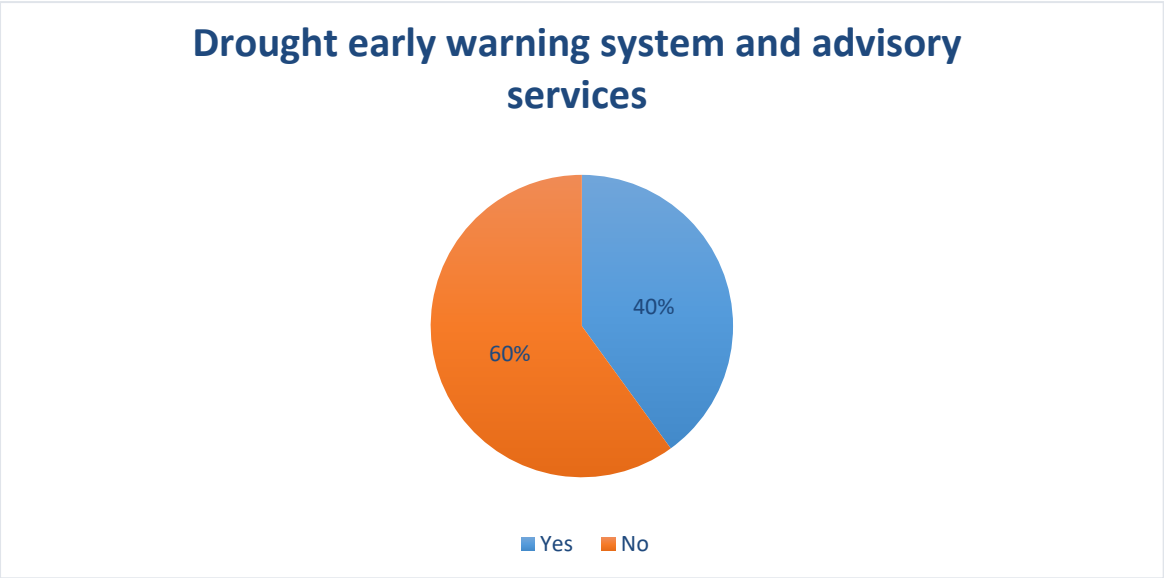

Figure 5.5: Drought early warning system information and climatic advisory

Source: Field Survey, (2021)

5.4.3 **Agricultural insurance**

Agricultural insurance is a very important financial and risk mitigation tool for farmers to deal with the effects of disasters, especially drought, that often have devastating consequences on lives and livelihoods (Fusco *et al*., 2018). Agricultural insurance is a powerful tool that farmers can use as an adaptation measure and even to mitigate the effects of hazards such as drought (Nnadi *et al*., 2013). The respondents were asked to indicate whether or not they use agricultural insurance as a preparedness and mitigation tool against drought. The results show that 98% (???) of the respondents do not use agricultural insurance while only 2% indicated that they use agricultural insurance (Figure 5.11). The uptake of agricultural insurance has been slow in Africa, especially among smallholder farmers who are either not aware of it or cannot afford it (Mohmmed *et al.*, 2018). This further increases the vulnerability of the farmers to the effects of drought.

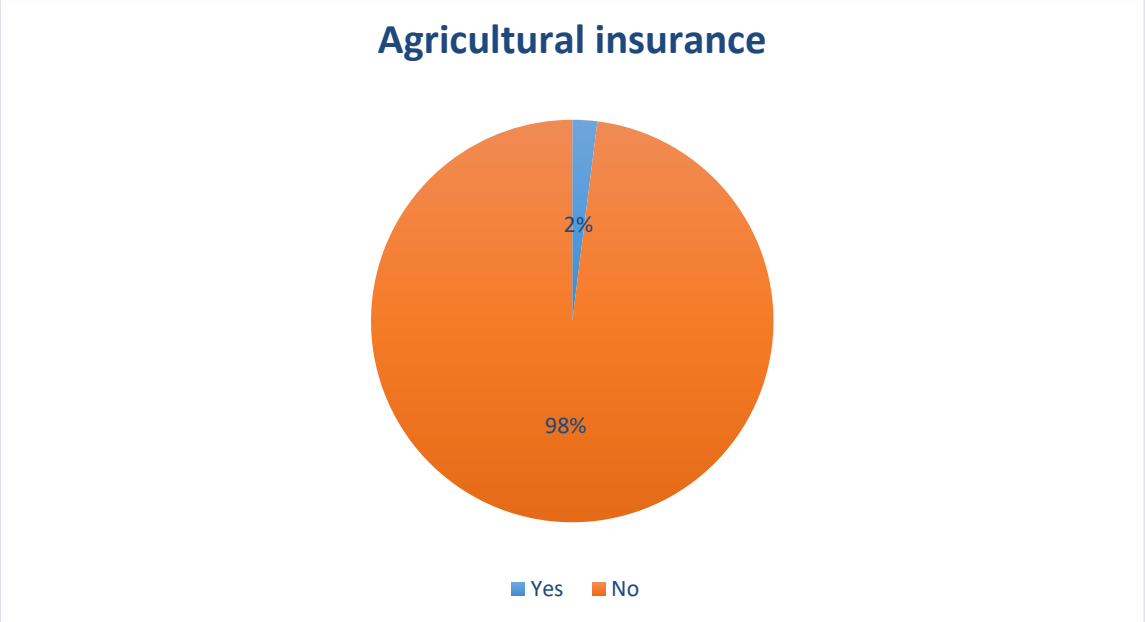

Figure 5.6: Use of agricultural insurance among smallholder farmers

Source: Field Survey, (2021)

5.5 Drought and coping and adaptation strategies

The ability of people, organizations, and systems to face and manage unfavourable conditions and disasters using skills and resources is referred to as coping capacity (Shah *et al.*, 2019). This section examines the different coping strategies adopted by the farmers based on available resources, benefits, and relief services.

5.5.1 Drought relief benefits

Drought relief benefits are one of the strategies used by officials to help farmers cope with the effects of drought. The farmers were asked to indicate if their farms have registered for drought relief benefits. The results show that only 19% of the farmers have registered their farmers for drought relief benefits while 81% of the farmers indicated that they are yet to register their farms the drought relief benefits (Figure 5.12). Furthermore, 60% indicated they have used drought relief benefits about one to five times while 2.4% indicated they have used it more than 20 times; 37.6% indicated that they did not use the benefits (Table 5.6). These results show that only some farmers use drought relief benefit as a coping mechanism.

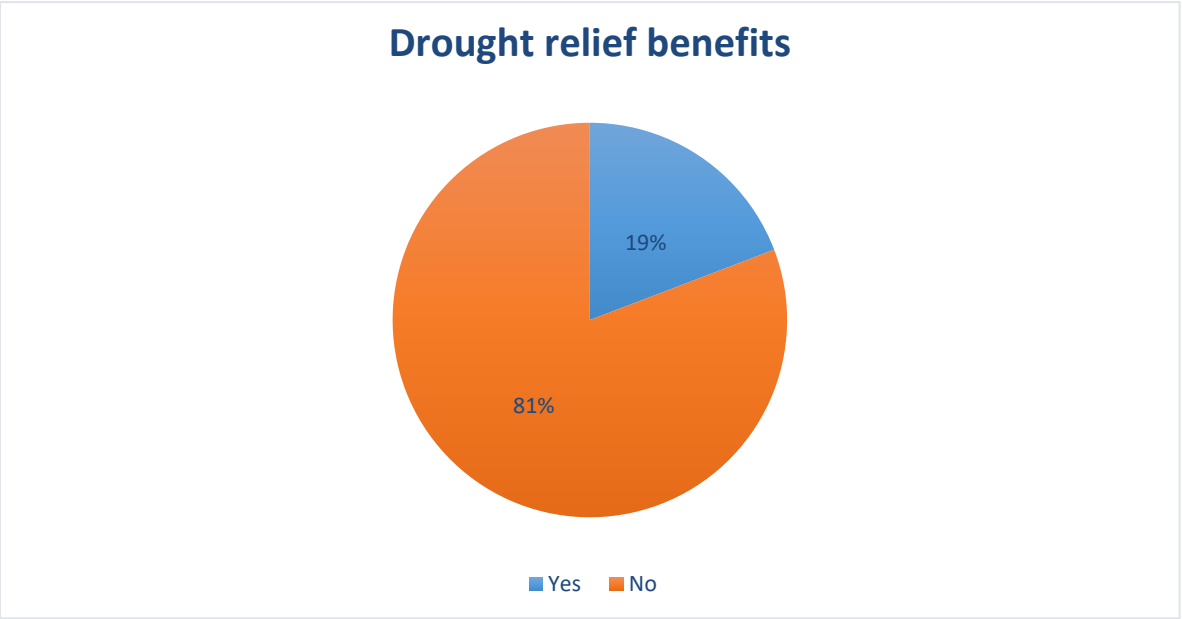

Figure 5.7: Drought relief benefits

Source: Field Survey, (2021)

Table 5.6 How often have you used drought relief benefit?

Drought relief use	Number of respondents	Per cent
1 to 5 times	75	60
More than 20 times	3	2.4
Not applicable	47	37.6
Total	125	100

(Source: Field Survey, 2021)

Furthermore, the results presented in Table 5.7 show that the most frequently used coping strategy in Sekhukhune District Municipality was rainwater harvesting, which was indicated by 63.2% of the farmers, followed by seeking employment elsewhere, indicated by 50.4% of the farmers. Furthermore, 40% indicated NGO interventions in the community as a means of adapting to drought while 27.2% of the farmers kept water reserves as a drought coping capacity, and 10.20% looked for other sources of food. Smallholder farmers in Sekhukhune District Municipality are not flexibility as 95.2% of the respondents did not use maintaining flexibility as a coping strategy (Table 5.7). The results show that the most used coping strategy was rainwater harvesting, which is a common practice in most developing countries and especially smallholder farmers who often lack the capacity to invest in irrigation infrastructure (Nhamo *et al*., 2019).

Table 5.7 Coping strategies

Coping strategies	Yes		No	
	%	Freq	%	Freq
NGO intervention in the community	40	50	60	75
Seek new sources of food	20	25	80	100
Seek employment elsewhere	50.4	63	49.6	62
Keep reserves	27.2	34	72.8	91
Rainwater harvesting	63.2	79	36.8	46
Maintaining flexibility	4.8	6	95.2	99
Get assistance from government	80	100	20	25

(Source: Field Survey, 2021)

The government often develop schemes and strategies to assist smallholder cope with the effects of drought. Some of these measures often produce effective while some don't. Respondents were asked to indicate the government programs that they use as coping mechanisms. The results are presented in Figure 5.8.

Table 5.8 Government developed schemes to assist farmers

	Number of respondents	Percent
The drought relief assistance scheme	68	54.4
Farm household allowance	9	7.2
Rural financial counselling service	4	3.2
Drought communities programme	15	12
Managing Farm risk programme	1	0.8
Enhanced social support	3	2.4
None	25	20
Total	125	100

(Source: Field Survey, 2021)

The results show that 54.4% (68) of the respondent used drought assistance schemes as drought coping mechanisms while 20% did not use any government programme as a coping mechanism. Furthermore, 12% (15) indicated that they used drought community programmes while 7.2% (9) used farm household allowance as a drought coping mechanism (Figure 5.8). However, only 0.8% (1) used managing farm risk programmes as coping mechanisms. The

implication of this result is that there are many coping and adaptation strategies available at government level to deal with the effects of drought.

5.6 Chapter summary

In conclusion, the study found that smallholder maize farmers in the Sekhukhune District Municipality had different perceptions of the prevailing drought. Importantly, the study found that the smallholder farmers were aware that drought is a result of natural and human causes and can either be predicted or not anticipated from its onset. The farmers' perceptions of drought were found to be important in understanding drought awareness. The survey data revealed that the majority of the farmers perceived drought as a natural disaster. Furthermore, the smallholder farmers perceived water pans drying as the most severe effect of drought, with crop failure and livestock loss being the next most severe effect. The analysis shows that the important coping strategies include rainwater harvesting, seeking employment elsewhere, and NGO intervention in the community. The study established that drought has severe implications on the smallholder farmers' income. The following chapter provides conclusions and recommendations of the study.

Chapter 6 : SUMMARY, CONCLUSION, AND RECOMMENDATIONS

6.1 Introduction

The previous chapter presented and analysed data. It also focused on discussion and interpretation of the findings of the study. The data was collected through the questionnaire survey and in-depth interviews. Chapter five provided the basis on which the current chapter proceeds. This chapter provides conclusions of the study and articulates recommendations on drought among smallholder farmers. First, the chapter provides the conclusion based on the findings the research. This is then followed by an outline of the recommendations. Lastly, the chapter gives suggestions for further studies.

6.2 Conclusions

The first objective of this study was to assess the perception of the community of Sekhukhune District Municipality to drought hazards. Farmers' views of drought are essential because they give insight into their knowledge and experiences drought, their awareness to drought events, and its causes and impact on the environment and their livelihood. This also allows for the assessment of the sources of information relating to drought. The results show that a vast majority (97%) of the respondents have experienced drought while only 3% indicated that they have not experienced drought. This imply that drought is a serious issue in the community; given that the community is most rural, their adaptive capacity is low as such increasing their vulnerability to drought. Furthermore, the results show that 73.6% of the farmers perceived that drought occurrence has been more frequent in the last five years, 2.4% of the farmers perceived that drought occurred less frequently, 13.6% of the farmers were indifferent about the frequency of drought in the last five years, and 10.4% said they did not know. This shows that the farmers understand drought and are aware of drought occurrence in their community. In order the assess the farmers' understanding of drought, farmers were asked to indicate if drought is a natural or man-made event. The results show that 88% of the respondents' perceived drought to be a natural disaster and only 4% did not perceive it as a natural disaster; therefore, the majority perceived drought to be a natural disaster. When the same farmers were asked if they thought drought was a manmade disaster, 46.6% strongly agreed that drought is a man-made disaster, while 28% of the farmers strongly disagreed that drought is a man-made disaster. This result shows a good understanding of what drought is and how it manifests itself in the community. An estimated 44% of the smallholder farmers in the Sekhukhune District Municipality perceived drying of water resources as a very severe effect of drought while 33.6% and 26.4 perceive crop failure and livestock loss to be severe effects of drought. Drought has heavily impacted on the household food security in the area.

The second objective was to assess the various livelihoods of the community affected by drought. The results show that 50.4% (63) of the respondents indicated that the impact of drought on household food security is very high while 40% (50) indicated that the impact is high, and only 1.6% (2) indicated the impact of drought on food security was less. Furthermore, 52.8% of the respondents indicated that the impact of drought on food scarcity was high while 32% indicated that the impact of food scarcity was very high. However, 40.8% (51), 44% (55), 42.4% (53), and 44% (55) indicated that the impact of drought on food choices, malnutrition, health problems, and household income, respectively, was high. Moreover, 46.4% (58), 52.8% (66), and 50.4% (63) indicated that the impact of drought on festival spending, population migration, and farmers' suicide was less. This implies that drought has a serious impact on farmers' household food security and increases food scarcity while also affecting food choices of household and increasing malnutrition and health problems in the community.

The third objective was to assess the extent of damage drought caused to people's livelihoods in the Sekhukhune District Municipality. The respondents were required to indicate the monthly economic loss incurred by them as result of drought in their community. The results show that over 19.2% of farmers experience a R5,001–R10,000 losses in their monthly income as a result of drought while 8% of the farmers have lost more than R20,000, 4.8% lost between R10,001 and R20,000, and 49.6% experienced an economic loss between R0 and R2,000. The results equally show that 64% of the respondents were of the opinion that climate change will drastically affect their farming operations due to changes in seasonality as will drought effects while 3.2% perceive it will affect their farm operation and 32.8% were not sure if climate change would affect their farming operations. Furthermore, the results show that 54% of the farmers perceived their vulnerability to drought to be very high while 14% of the farmers perceived their vulnerability to drought as high, 26% perceived their level of risk as moderate, and only 2% perceived their risk level as low. Hence, it can be concluded that the majority of farmers in this study area are highly vulnerable to drought effects.

The fourth objective was to assess coping and adaptation strategies that will increase community awareness towards drought impacts in the Sekhukhune District of Limpopo province. The study examined drought relief benefits as a coping and adaption strategy to drought and assessed if the farmers are making them an adaptation strategy. The results show that only 19% of the farmers have registered their farmers for drought relief benefits while 81% of the farmers indicated that they are yet to register their farms the drought relief benefits. Furthermore, 60% indicated they had used drought relief benefits about 1 to 5 times, while 2.4% had used it more than 20 times, and 37.6% indicated that they did not use the benefits. This implies that only a certain percentage of farmers are using the drought relief

benefits as adaptation and coping mechanisms. The results further show that the most frequently used coping strategy in Sekhukhune District Municipality is rainwater harvesting, which was indicated by 63.2% of the farmers, followed by seeking employment elsewhere (50.4%). Furthermore, 40% indicated NGO interventions in the community as a means of adapting to drought while 27.2% of the farmers kept water reserves as a drought coping strategy, and 10.20% looked for other sources of food. However, the results show that 54.4% (68) of the respondent used drought assistance schemes as drought coping mechanisms while 20% did not use any government programme as a coping mechanism. Furthermore, 12% (15) indicated that they used drought community programmes while 7.2% (9) used farm household allowance. It can be concluded from the results that drought is a recurring event in the Sekhukhune District Municipality and has a serious socio-economic and environmental impact on the community. However, the results show that farmers lack the adaptive capacity to sufficiently deal with the effects of drought. This presents a great opportunity to the community to collaborate with the authorities to develop sustainable strategies to deal with the effects of drought.

6.3 Recommendations

Policy recommendation can be proposed based on the findings of this study. This section proposes a number of policy recommendations for reducing the effects of drought and enhancing the livelihoods of smallholder farmers in the Sekhukhune District Municipality of Limpopo province. The policy recommendations proposed for this study include:

Farmers in the Sekhukhune District Municipality are not taking advantage of the drought relief benefits offered by the government to assist communities in dealing with the effects of drought. This could be because the information about the relief benefits is not disseminated properly to all the community members suffering the effects of drought. While farmers should be more proactive is making use of these resources provided by the government, policymakers should ensure that the benefits get to everyone affected by drought. This can be done through increasing awareness and effective communication during and after a drought. This will increase uptake and help mitigate the effects of drought. The Municipality should also use different methods such as information sessions and education and training of smallholder farmers to inform them about the different relief programmes geared towards assisting them mitigate the effects of drought. The Municipality must also increase the urgency of providing these relief benefits when a drought occurs.

Education is the factor driving the rate of adoption and utilisation of effective drought adaptation and mitigation strategies. This study found that the majority of the farmers have no formal education or have at most a high school qualification. Educating and training these farmers will increase their chances of developing better coping capacities to drought; therefore, the Municipality should engage in education and training programmes for these farmers in order to increase their skills and knowledge and assist them to deal better with the effects of drought. The uptake of agricultural insurance as an adaption strategy is very slow in Africa. The Municipality can collaborate with insurance companies to offer group policies to farmers to cover their farming operations against natural disasters such as drought. This will greatly increase their adaptive capacity and help them bounce back faster and better.

Early warning and climatic advisory services can also greatly increase the adaptive capacity of farmers. The results should that farmers are not receiving early warnings and climatic advisory services. The government should invest in adequate communication services in order to inform farmers regularly on drought issues. This will assist farmers prepare better and develop coping mechanisms for dealing with drought when it happens.

6.4 Suggestions for further studies

Smallholder farmers' perceptions of drought were the focus of this study. A similar study could be conducted with commercial farmers to gain a better understanding of the subject matter. This will give a different perspective on how the current drought is affecting farmers. Furthermore, research on how smallholder farmers in places other than Sekhukhune District Municipality view drought and how it affects them can be conducted. This provides a foundation for comparing the underlying perceptions of drought among smallholder farmers in different regions.

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Appendix 1: Ethical clearance letter

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS UV

GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

03-Oct-2021

Dear Ms Karabo Motene

Application Approved

Research Project Title:
Assessing Drought Perception its Impacts on Rural Communities' Livelihood: A case of Sekhukhune District Municipality

Ethical Clearance number:
UFS-HSD2021/1501/21

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be submitted to the ethics office to ensure ethical transparency. furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension. Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Outcome: Approved

The application is approved, but the researcher should make the following changes: There is a slight disconnect between the form and the proposal in that in the form, the population group is 35 to 65 year olds while in the proposal it stands as 18 to 55. The PI should check this and fix it accordingly.

Yours sincerely

Dr Adri Du Plessis
Chairperson: General/Human Research Ethics Committee

Dr Adri du Plessis
Digitally signed by Dr Adri du Plessis
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Appendix 2: Editors letter

Effective ENGLISH EDITS

/Users/SARAH/Dropbox/Effective English Edits/Ef
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CERTIFICATE OF EDITING

THIS IS TO CERTIFY THAT THE FOLLOWING DOCUMENT

ASSESSING DROUGHT PERCEPTION AND ITS IMPACT ON RURAL COMMUNITIES' LIVELIHOOD: A CASE STUDY OF SEKHUKHUNE DISTRICT MUNICIPALITY

BY

K. MOTENE

HAS BEEN PROFESSIONALLY EDITED FOR ENGLISH LANGUAGE USAGE BY

EFFECTIVE ENGLISH EDITS

Date: 29 November 2021

Signed: *Sarah Coutts*
Owner & Senior Proofreader

For any queries regarding this certificate, please contact Sarah Coutts (sarahcoutts1@gmail.com) or on +27 (0)61 652 7283.
Professional Editors' Guild Member (COU001)

EEE/2021/32

Appendix 3: Data collection tool

Questionnaire

Assessing Drought Perception its Impacts on Rural Communities' Livelihood: A case of Sekhukhune District Municipality.

Section A: Basic Information

1. Gender: _____ (1= Male; 2= Female)
2. Age: _____ Years
3. Education: What is the highest degree or level of school you have competed? No schooling
   [ ] High School [ ] Diploma [ ] Degree [ ] Post – graduate degree [ ]
4. Do you have any farming skills? Yes [ ] No [ ]
5. What is the total average monthly income level in your household? [ ] Less than R1000 [ ] R1000-R5000 [ ] R6000-R10,000 [ ] Above R10,000 [ ]
6. Marital Status: Single [ ] Married [ ] Domestic partnership [ ] Widowed [ ] Divorced [ ] Separated [ ]
7. How many years of farming experience do you have? _____
8. Is your farming business seasonal? Yes [ ] No [ ] If yes, which months? _____
9. Number of people in your household? _____

Section B: Farmers' perception of drought and climate change and its impacts

10. Drought is a natural disaster. strongly agree [ ] Agree [ ] undecided [ ] Disagree [ ] Strongly disagree [ ]
11. Drought is a manmade disaster. strongly agree [ ] Agree [ ] undecided [ ] Disagree [ ] strongly disagree [ ]
12. Have you ever experienced drought in the past 5 years? Yes [ ] No [ ] If yes, please specify which years: _____
13. What are the impacts of drought? Please rank your choices from 1 to 5 in order of the severity of the loss, 1 being not severe and 5 being very severe. (Tick to rank)

		1	2	3	4	5
1	Drying of water resources					

2	Makes surrounding dryer					
3	Crop failures					
4	Loss of livestock					
5	Poor health of livestock and people					
6	Increase In food prices					
7	Decline in livestock prices					
8	Anxiety or depression about economic losses caused by drought					
9	People may have to move from farms into cities, or from one city to another					
10	Poor soil quality					
11	Loss of human life					
12	Other impacts on livelihood					

14. In monetary terms, what was the combined estimated value of the damage and losses on your property/ movable assets due to the major drought experienced over the past five years? Not Affected[ ] R 0 – R 2,000 [ ] R 5,001 – R 10,000 [ ] R 10,001 – R 20,000 [ ] R 20,001 and above [ ]

15. Do you think droughts are becoming less or more frequent in last 10-12 years? More [ ] Less [ ] No difference [ ] Do not know [ ]

16. Please Rate the following drought impacts

		Very High	High	Medium	Less	Very Less
1	Drought threatened household food security					
2	Drought has caused food scarcity					
3	Drought caused no choice in food Preferences					
4	Drought caused malnutrition					
5	Drought affected health					
6	Drought caused unemployment					
7	Drought caused reduction in household income					
8	Drought caused reduction in spending on festivals					
9	Drought caused population migration					
10	Drought affected school of children					
11	Drought caused hopelessness and sense of loss					
12	Drought caused conflict of water in society					
13	Drought caused increase of rates in farmers' suicide					

17. Which of the following do you perceive as the result of effects of drought on the environment? Rank your choices from 1 to 5, 1 being not important and 5 being very important.

		1	2	3	4	5
1	Natural loss of vegetation					
2	Drying of water pans for harvesting					
3	Resource conflicts					
4	Migration of wildlife					
5	Soil erosion					
6	More wildfires					
7	Lack of food and drinking water for wild animals					
8	Others: please specify					

18. What do farmers do if rains are insufficient for planting? Plant a different crop [ ] Plant anyway [ ] Not plant at all [ ]

19. How important is the issue of climate change to you personally? Very important [ ] Quite important [ ] Not very important [ ] Not at all important [ ]

20. What do you think the effects of climate changes are? Please select/tick as many as possible.

1	Sea level rise	
2	Drought	
3	Flooding	
4	Increasing intensity and frequency of extreme weather events	
5	Coastal erosion	
6	Rising temperatures	
7	Desertification	
8	None	

21. Do you think climate change is something that is affecting or going to affect your farming operations? Yes [ ] No [ ] Do not know [ ]

22. What adaptation practices are currently in place to reduce the vulnerability of South Africa's water resources to climate change impacts? Please select/tick as many as possible.

1	Improved sanitation disposal to prevent contamination of water resources during drought	

2	Groundwater recharge	
3	Domestic water conservation promotion	
4	Surface water source protection	
5	Promotion of industrial and agricultural processes that minimize water demand	
6	None	

23. Who should be responsible for financing climate change adaptation measures?

1	South African government	
2	Developed countries	
3	Donor agencies	
4	Conservation Non-Governmental Organizations (NGO's)	
5	Industries	
6	Others(specify):	

Section C: Drought and Vulnerability

24. How would you rate your farming operation's level of risk to drought? Very high [ ] High [ ] Moderate [ ] Low [ ] None [ ]

25. How did previous drought affect your social activities? Rank your choices in order of severity; 1- being not severe and 5- being very severe.

	Action	In order of priority
1	Loss of employment	
2	Reduced expenses on education/training	
3	Psychological stress	
4	Increase stress and conflicts in the family	

26. Do you receive Early Warning System information and climatic advisory about drought? Yes [ ] No [ ]

27. If yes, what were the sources of your information? _____

28. If yes, what did you do to reduce the risk of losing your farm?

1	Sell to others and put money for future use	
2	Assess your proprieties	
3	Identify target groups and conflicting relief program criteria and goals	
4	Just wait for drought relief	
5	Others (please specify)	

29. Is your farm registered for drought relief benefits? Yes [ ] No [ ]

30. Do you have facilities on your farm? Yes [ ] No [ ]

31. How often have you used the facilities provided by the government to help during the drought process? 1 to 5 times [ ] 6 to 10 times [ ] 11 to 20 times [ ] More than 20 times [ ] Not applicable [ ]

32. If yes, where do you get income from?

1	off-farm employment	
2	work-at-home opportunities	
3	occasional or seasonal work for hire	
4	your own small or large business that provides you some income	
5	freelancing or contracting in a field of expertise	

33. How has the food consumption patterns during drought events been? Decreased [ ] Remained constant [ ] Increased [ ] Do not know [ ]

Section D: Adaptation and coping mechanism

1. What coping mechanisms does your farming enterprise get/make use of during drought?

Please select/tick the ones appropriate to you.

1	NGO intervention in the community	
2	Insurance	
3	Seek new source of food, like wild fruits and animals	
4	Seek employment elsewhere	
5	Keeping reserves	
6	Rain water harvesting	
7	Maintaining flexibility(i.e. Flexibility in decision-making)	
8	Get assistance from the government	
9	Other (Specify):	

34. What drought - related services would you find helpful?

1	On site water use management	
2	Development of a conversation plan	
3	Irrigation system assessment	
4	Other (Please specify)	

35. Which of the following government programs have you used to help adapt/cope with drought? Please select/tick the ones appropriate to you.

1	The Drought Relief Assistance Scheme	
2	Farm household allowance	

3	Rural financial counseling service	
4	Farm business concessional loans	
5	Drought communities programme	
6	Managing farm risk programme	
7	Enhanced social support	
8	Others; specify	

SECTON D: Community members Perceptions on the Prevailing Drought

1. What do you understand by drought?

Researcher probes:

i. Are they natural disasters? ii. Are they man-made disasters? iii. Are they both natural and man-made disasters?

2. Are drought a form of disaster that can be anticipated from their onset?

Researcher probes:

i. If yes, please explain why you say so ii. If no, please expand why drought are not anticipated from their onset 3. Do you think drought will occur in future more frequent than expected?

Researcher probes:

i. Participants should explain why they say yes or no. For those who say yes, how have the past drought affected them? They should also provide the years they have been affected by drought. ii. What strategies have you applied to mitigate the challenges you face due to prevailing drought?

……
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……
……
……

iii. How can the government assist you in dealing with the impact of drought?

……
……
……
……
……

Appendix 4: Similarity report

ASSESSING DROUGHT PERCEPTION ITS IMPACTS ON RURAL COMMUNITIES'LIVELIHOOD: A CASE OF SEKHUKHUNE DISTRICT MUNICIPALITY

ORIGINALITY REPORT

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