THE IMPACTS OF DROUGHT ON THE RURAL COMMUNITIES OF MSINGA IN KWA-ZULU NATAL, SOUTH AFRICA.

By

Annika Maniram

(215037229)

Submitted in fulfilment of the academic requirements for Masters of Science in Geography and Environmental Management.

Discipline of Geography

School of Agriculture, Earth and Environmental Science

College of Agriculture, Engineering and Environmental Science

December, 2022

DECLARATION

I, Annika Maniram, declare that:

(i) The research reported in this dissertation, except where otherwise indicated, is my original research.

(ii) This dissertation has not been submitted for any degree or examination at any other university.

(iii) This dissertation does not contain other person's data, pictures, graphs or other information, unless specifically acknowledged as being sourced from those persons.

(iv) This dissertation does not contain other author's writing, unless specifically acknowledged as being sourced from other authors. Where other written sources have been quoted, then:

A) Their words have been re-written, but the general information attributed to them has been referenced.

B) Where their exact words have been used, their writing has been placed inside quotation marks and referenced.

(v) This dissertation does not contain text, graphics or tables copied and pasted from the internet, unless specifically acknowledged, and the source being detailed in the dissertation and in the reference sections

Signed: [redacted] Date: 02 December 2022

(Annika Maniram)

As the candidate's supervisors, I agree to the submission of this dissertation/thesis.

Signed… [redacted] Date: 02 December 2022

(Dr Romano Lottering)

Signed [redacted] Date: 02 December 2022

(Dr Shenelle Sewell Lottering)

ACKNOWLEDGMENTS

- Appreciation and deepest gratitude are extended to the following people who have contributed to the completion of this study:

- Firstly, I would like to thank God for keeping me safe during the covid-19 pandemic and for giving me the strength to complete this project.

- Thank you to my supervisor, Dr Romano Lottering and Co-Supervisor Dr Shenelle Lottering for all the help, constructive criticism, insight, and guidance throughout this study.

- A huge thank you to my parents (Asha and Anil Maniram) for all the love, encouragement, and support throughout this study.

- A special thank you to Andrisha Maniram for all the guidance and assistance throughout this study.

ABSTRACT

Drought is viewed as an important feature of climate change that results in extended periods of dryness, increasing temperatures and heatwaves. Additionally, drought is an extreme event in the hydrological cycle, and it is considered to be one of the most detrimental natural disasters occurring around the world. With the increasing impacts of climate change and anthropogenic activities, the seriousness and frequency of drought is expected to rise in the upcoming decades. Furthermore, a drought is defined as a period of below-average precipitation which results in drier than normal conditions. Globally, droughts are viewed as one of the most distressing natural disasters, which affects food production, water resources, biodiversity and livelihoods. Approximately, 1.5 billion people have been directly impacted by drought this century, whilst every year an estimated 55 million people are affected around the world (Harvey, 2021 & WHO, 2021). Droughts are a key feature of South African climatic conditions, because of its topography, location and below average rainfall. In 2015/2016, South Africa had experienced one of the worst droughts in 30 years because of the extreme weather system, El Nino. The South African drought had resulted in threatened livelihoods, water shortages, loss of agricultural production and increased food prices. Additionally, drought is one of the most difficult challenges affecting developing countries, with the most detrimental effects being felt by rural communities and subsistence farmers, since they mainly rely on rain-fed agriculture. The main aim of this study is to determine the impacts of drought on the rural communities of Msinga in Kwa-Zulu Natal, South Africa. The objectives for this study are to determine the socio-economic impacts of drought, to examine the perceived seriousness and frequency of drought and to investigate the adaptation strategies of drought.

This research study also focuses on a theoretical framework. It discusses the sustainable livelihoods approach and the drought perception theory. The SLA assumes that all individuals have assets and abilities that can improve their livelihoods, whilst the drought perception theory discusses how farmers perceive drought based on four elements. The data obtained for this research study is archival data that was collected in June 2019 till August 2019 at the Msinga Municipality in Kwa-Zulu Natal, South Africa. However, this research project was conducted over a period of three years during 2020 – 2022. The data that was used for this project was collected using a quantitative research method. Additionally, the collection of data was conducted using a purposive sampling method, which is utilised when the researcher uses their own judgement to choose a group of participants that requires the people with the most characteristics based on their relevance to the research study. From the Msinga region – 180

respondents were chosen. Furthermore, the tools that were used in this study included a questionnaire which provided a deeper understanding of the community dynamics. Questionnaires are a research tool that consists of a series of questions that aim to collect data from a respondent. Furthermore, to analyse the data that was collected, a programme called Statistical Package for the Social Sciences (SPSS) was used. Data from the completed questionnaires were entered onto the SPSS programme.

The demographic results have indicated that majority of residents within the Msinga Municipality were female, with a large portion of the surveyed population being single. The age distribution was disproportionate, with the older generation being the majority and the working-class population being the minority. The findings also showed a high level of uneducated residents, with majority of the population being unemployed and relying on social grants. The socio-economic impacts of droughts were also discussed, with the results showing high levels of malnutrition, food insecurity, limited food choices, crop failure, unemployment and poverty. The findings also presented adaptation and mitigation measures for dealing with drought, as well as strategies based on indigenous knowledge. The results also showed the different types of water that respondents used for irrigational purposes, as well as the perceived seriousness and frequency of droughts. Additionally, the results presented the percentages of respondents that received agricultural training and assistance from the government during a drought. It also discussed early warning systems and drought management programmes within the area. This project also presents some recommendations based on the results in the study. These included; women empowerment, environmental education, sustainable agricultural practices and governmental involvement and interventions.

DEFINITION OF TERMS

Adaptation – adaptation is defined as reducing a household's vulnerability and improving resilience when responding to the impacts of an agricultural drought (Bahta & Myeki, 2021)

Agriculture – agriculture is the science and art of cultivating the soil, raising livestock and growing crops (Oxford Dictionary, 2021).

Climate change – Climate change is a long-term shift in regional or global climate patterns (Djalante & Thomalla, 2010).

Drought - A drought is a period of below-average precipitation which results in drier than normal conditions (Brown, 2016).

Drought Early Warning Systems – DEWS use networks of academic, tribal and governmental data to make drought and climate science accessible for decision makers (NIDIS, 2021).

Food Security – Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food, which meets their dietary needs and food preferences for an active and healthy life (FAO, 1996).

Horn of Africa – includes Somalia, Kenya and Ethiopia.

Impacts - the definition of impact is when one thing has an effect on another (Oxford Dictionary, 2021).

Indigenous Knowledge – Indigenous Knowledge is defined as knowledge that is accumulated over generations and guides human societies in their numerous interactions with their surrounding environments (Mafongoya & Ajayi, 2017).

Mitigation – mitigation is the action of decreasing the painfulness, severity or seriousness of something (Oxford Dictionary, 2021).

ABBREVIATIONS

AI – Artificial Intelligence

CCAFS – Climate Change Agriculture and Food Security

CSA – Climate-Smart Agriculture

DEWS – Drought Early Warning Systems

DMP – Drought Management Plan

EPA – Environmental Protection Agency

FAO – Food and Agricultural Organisation

GDP – Gross Domestic Product

GEC – Global Environmental Change

GHG – Greenhouse Gases

IK – Indigenous Knowledge

IPCC – International Panel on Climate Change

IWMI – International Water Management Institute

MDG – Millennium Development Goals

NCCRS – National Climate Change Response Strategy

NCCRWP – National Climate Change Response White Paper

NDP – National Development Plan

PACSA – Pietermaritzburg Agency for Community Social Action

PDSI – Palmer Drought Severity Index

RHI – Rural Health Hub

RSA – Republic of South Africa

SADC – South African Development Community

SADRI – Southern African Drought Resilience Initiative

SASSA – South African Social Security Agency

SDG – Sustainable Development Goals

SLA – Sustainable Livelihood Approach

SEDI – Socio-Economic Drought Index

SPI – Standardised Precipitation Index

SPSS – Statistical Package for the Social Sciences

SSA – Sub- Saharan Africa

UNAIDS – United Nations HIV/AIDS Programme

UNCCD – United Nations Convention to Combat Desertification

UNDP – United Nations Development Programme

UNESCO – United Nations Educational, Scientific and Cultural Organisation

UNFCCC – United Nations Framework Convention on Climate Change

UNICEF – United Nations International Children's Emergency Fund

WBG – World Bank Group

WCG – Western Cape Government

WFP – World Food Programme

Table of Contents

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE – THE PROBLEM AND ITS SETTING

1. Introduction and background of the study

Climate change refers to the average long-term shifts of temperature and weather patterns over the entire earth's surface (Djalante & Thomalla, 2010). These include changes in precipitation, warming of the oceans, melting of the polar ice caps, higher sea levels, variations in plant and flower blooming times, rising temperatures, and the increased occurrence of natural disasters, such as floods, tropical cyclones and drought (Djalante & Thomalla, 2010). According to Made (2019) droughts are a natural phenomenon that occurs in the hydrological cycle. Scientists have reported that the past five years have been the hottest in the last century with global air temperatures increasing by an estimated 3 degrees Celsius (Mandela, 2019). According to Bates (2021), the changing climate of recent years will lead to an increase in the frequency, severity and pervasiveness of drought. Approximately 1.5 billion people have been directly impacted by drought this century, whilst WHO (2021) reports that every year an estimated 55 million people are affected by drought around the world (Harvey, 2021). Furthermore, Sena *et al.,* (2014) acknowledges that drought is a type of climatological process that is defined by temporal and spatial limits. However, it is also worsened by anthropogenic activities, such as population growth and inadequate water resource management (Sena *et al.,* 2014).

Globally, drought is an extreme and frequent climate event that affects the livelihoods of millions of people (Menghistu *et al.,* 2012). Additionally, drought occurs at a slow rate, which makes it difficult to quantify, manage and detect, thus resulting in economic, social and environmental impacts (Mtetwa, 2018). This study will mainly be focusing on socio-economic droughts. According to Liu *et al.,* (2020) socio-economic drought is a term that has been attracting the attention of economists, water managers, hydrologists and social scientists. Furthermore, Liu *et al.,* (2020) states that socio-economic drought is when water supply from a regional water source cannot meet the water demands of a society. Socio-economic drought also happens when physical water shortages affect health, quality of life and economic status of individuals (Mtetwa, 2018). According to Mtetwa (2018) socio-economic drought has elements of meteorological, hydrological and agricultural droughts. Additionally, the properties of socio-economic drought can also be measured by its severity, duration and intensity (Lui *et al.,* 2020). According to Lui *et al.,* (2020) the socio-economic drought index (SEDI) is used for identifying socio-economic drought; however, scientists have reported that the index can sometimes overestimate the impacts of a socio-economic drought event.

Furthermore, socio-economic impacts and environmental impacts caused by drought have been recorded in developed and developing countries; however, emerging economies feel a more significant impact (Mtetwa, 2018). Developing countries are more susceptible to drought because of their agriculturally based economies, limited infrastructural growth and low institutional capacity to mitigate and adapt to social, economic and environmental impacts (Mtetwa, 2018). The effects of drought are more complex than any other natural disaster, and its impacts are spread over a larger geographical area (Mtewa, 2018). Furthermore, since 1970, there has been a drying trend around the world, and an increase in the drought frequency as a result of climate change (Mtetwa, 2018). According to the Disaster Prevention Organization, an estimated 642 devastating drought events were reported around the world from 1970 to 2013 (Menghistu *et al.*, 2012 & Mtetwa, 2018). Additionally, in the last century, 45 major drought events were reported in Europe and 300 drought events were recorded in Africa (UNCCD, 2022).

On a global scale, drought is viewed as a natural disaster with widespread impacts that range from economic losses to loss of agriculture and livelihoods (NIDIS, 2022). In terms of severity and frequency, droughts have intensified in the past three decades (Mtetwa, 2018). Since the 1970s, there has been a drying trend around the world, with severe droughts been recorded in the United States of America, Australia and parts of Europe (Mtetwa, 2018). However, Mtetwa (2018) argues that the increase in drought occurrence might not only be due to climate change but could also be because of better reporting and tracking of weather systems, as compared to the past. Furthermore, Mtetwa (2018) states that droughts will intensify for many regions around the world as a result of an increase in temperatures. Additionally, droughts have also caused a decline in soil moisture in North America and significant drying over West Africa and the Sahel Region (Mtetwa, 2018). According to Masipa (2017) an estimated two thirds of Africa's arable land will be lost by 2025, due to droughts and lack of rainfall. The degradation of land or desertification in arid areas is a huge challenge to global social and economic security (Bernardo, 2018). Furthermore, drought is one of the main causes of desertification that can lead to irreversible land degradation. For example, the National Farmer's Association reported that over a quarter of Italy is currently at risk of desertification, due to the lack of rainfall (Bertacche, 2022). According to the United Nations Convention to Combat Desertification (UNCCD) drought combined with desertification has become a livelihood threat to 1 billion people in over 100 countries (Bernardo, 2018). The UNCCD reported that 12 million hectares of arable land is lost due to drought every year (Bernardo, 2018). FAO also acknowledged that

between 2005 and 2015, drought had caused 30% of agricultural losses, which amounted to $2.9 billion (Bernardo, 2018). Globally, the severity of land degradation as a result of drought has cost the economy an estimated $490 billion per annum (Bernardo, 2018). Additionally, the World Economic Forum has classified the water crises as a worldwide risk, due to its impacts on human health, extreme weather and ecosystem functions, conflict and food production (Getirana *et al.,* (2021). Furthermore, water scarcity impacts 40% of the world's population, which will put an estimated 700 million people at risk of displacement and mass migration by 2030 (WHO, 2021).

According to GDO (2021) Sub-Saharan Africa has a long record of droughts that has caused widespread damage. Since 1970-1979, the frequency of droughts in Sub-Saharan Africa has almost tripled between 2010-2019 (White, 2021). In many countries of Sub-Saharan Africa droughts are severe and frequent, and they contribute towards the devastating impacts on communities and the economy (Benson, 2009). Additionally, the poor capacity of African soils to retain moisture and the lack of rainfall in semiarid and arid areas is the reason why almost 60% of Sub-Saharan Africa is vulnerable to drought and 30% is categorised as being extremely vulnerable (Benson, 2009). Furthermore, the World Bank has released an annual report on the impacts of drought and the El Nino effect in Sub-Saharan Africa (White, 2021). The findings from the report showed that economic and social dependence on rain-fed agriculture makes Sub-Saharan Africa susceptible to drought (Benson, 2009). Additionally, the report stated that Africa's surface temperatures is rising at a faster pace than the rest of the world and that changing rainfall patterns and rising temperatures have led to an increased intensity and frequency of drought (White, 2021). According to GDO (2021) Southern Africa and Sub-Saharan Africa are impacted by drought-related disasters and consequent food insecurity. For example, the IPCC (2017) reports that agricultural production in Sub-Saharan Africa can decrease from 21% to 9% by 2080, due to the increased frequency of droughts. Furthermore, drought is perceived as a problem in the agricultural industry, specifically when dealing with food supply, increase in seed and food prices, lower harvests and livestock deaths – all of which could result in famine (Rukema, 2010 & Benson, 2009). The drought also affects economic activities in the fishing and tourism industries, which are extremely sensitive to climate shocks (White, 2021).

According to GDO (2021), 70% of countries in Sub-Saharan Africa have been affected by drought in the last decade. However, at present - Madagascar, Nigeria, Zambia and Angola are experiencing long-lasting droughts (GDO, 2021). Madagascar has been experiencing its worst

drought in the past 40 years, which has left more than 1.1 million people facing food shortages, due to rising food prices, insufficient rainfall and sandstorms (Ahmed, 2021). People who live in the Southern part of Madagascar mainly rely on agricultural production for food and income; however, due to the drought and the covid-19 pandemic, farmers could not produce what they normally eat or sell at the markets (Ahmed, 2021). According to a GDO (2021) report on drought, 60% of the country has lost all agricultural production, which means that over 1.31 million people are in need of humanitarian aid. Due to the ongoing drought, 1 in 6 children under the age of 5 are suffering from acute malnutrition in Madagascar (Garmirian, 2021). Another country in Sub-Saharan Africa that has been impacted by drought is Angola. The country is facing its worst drought in the last 40 years (IFRC, 2022). Since January 2021, an estimated 3.81 million people have witnessed an insufficient food supply due to the ongoing drought (GDO, 2021). Moreover, an estimated 7.3 million people are facing extreme food insecurity, whilst 114 000 children under the age of 5 are suffering from acute malnutrition and 3.9 million children are in need of humanitarian assistance (IFRC, 2022 & WFP, 2021).

International studies that focus on drought threats and the impacts on agriculture have reported that Southern Africa is at a high risk (Meza & Hagenlocher, 2021). Furthermore, Southern Africa has been experiencing recurring droughts since 2003 (Mesbhahzadeh *et al.*, 2019). According to Nield (2015), South Africa is also prone to recurring droughts, with the country being frequently affected over the last 4 decades. Major drought events in South Africa include; 1982-1984, 1991-1992, 1994-1995, 2004-2005, 2008-2009, 2015-2016 and most recently in 2018 (Meza & Hagenlocher, 2021). During these periods of drought, socio-economic and environmental factors in the agricultural industry were impacted, which created a pressure on the country's agro-economic and water supply systems (Meza & Hagenlocher, 2021). Within South Africa, farming is viewed as an essential component of the economy as it provides food security, foreign exchange and job creation (Meza & Hagenlocher, 2021). Furthermore, as the duration, frequency and severity of a drought increases – rural communities who depend on rainfed crops become susceptible as they rely on climate-sensitive resources (Meza & Hagenlocher, 2021). For example, 37% of rural communities in South Africa have been affected by the 2015/2016 drought, which was considered to be the worst in the last 100 years (Mandela, 2019). A closer look at studies based on drought in South Africa revealed that drought negatively impacts social services, such as health, administrative services, provision of water and education (Rukema, 2010). For example, the rivers that mostly rural communities

use dry up and children are not able to attend school as they have to collect water (Rukema, 2010).

According to the South African Weather Service the northern part of Kwa-Zulu Natal, which includes the Msinga municipality is susceptible to drought conditions (Rukema & Umubyeyi, 2019). This research study focuses on the Msinga Municipality, which is located in the uMzinyathi District on the northern border of Kwa-Zulu Natal. According to Made (2019) Msinga is mostly a rural area, and it is controlled by a traditional council which is led by a tribal chief and farmsteads. Additionally, the general population of Msinga is challenged by severe poverty, unemployment, housing shortages, inadequate infrastructure and sanitation, illiteracy and low wages – all of which are aggravated by drought conditions (Rukema, 2010). Furthermore, Rukema (2010) acknowledges that droughts are endemic in Msinga which means that drought-management policies are fundamental to local livelihood systems. According to the IDP (2020), Msinga suffers from periodic and intermittent droughts, with the last official drought being recorded in 2004. However, findings from Rukema & Umubyeyi (2019) reported that the rural communities of Msinga continue to experience severe effects of the drought conditions. In addition to the drought, households in Msinga rely on wood for cooking, which places an extra burden on the already vulnerable environment (Rukema & Umubyeyi, 2019). According to Rukema & Umubyeyi (2019), drought conditions are aggravated by the widespread social and economic situation in Msinga. Therefore, it is noted that droughts have caused socio-economic consequences and vulnerable livelihoods for the rural communities of Msinga (Rukema & Umubyeyi, 2019). Additionally, Msinga is one of the least developed municipalities in terms of socio-economic activities (Rukema, 2010). For example, a study reported that during a drought - fewer resources were allocated for economic and social development within the Msinga region (Rukema, 2010).

During a drought, infrequent informal activities and the selling of agricultural products are the main sources of income in Msinga (Rukema, 2010). A report by the institute of Natural Resources has stated that due to the increased frequency of drought - only 40% of Msinga's land has agricultural potential; however, subsistence farming is still classified as a major economic activity within the municipality (Rukema & Umubyeyi, 2019). Additionally, the Msinga municipality has a limited capacity of productive agricultural land due to poor soil quality, unsustainable farming practices and adverse climate conditions, such as drought (Rukema & Umubyeyi, 2019). Furthermore, drought has subjected the Msinga region to high rates of soil erosion, low carrying capacity and water shortages (Rukema & Umubyeyi, 2019).

In 2007, the institute of natural resources conducted a study that revealed that the annual rainfall of Msinga is between 600mm – 700mm (Rukema & Umubyeyi, 2019). In relation to international standards, this illustrates drought of a high magnitude (Rukema & Umubyeyi, 2019). According to Rukema & Umubyeyi (2019) the lack of rainfall and drought makes it difficult for the rural communities of Msinga to invest in crops, such as sorghum, vegetables and maize – which are the main sources of food.

1.1 Aims and Objectives of the study

The main aim of this research project is to determine the socio-economic impacts of drought on the rural communities of Msinga in KwaZulu-Natal, South Africa.

1.2. Objectives

- To assess perceptions regarding the socio-economic impacts of droughts within the rural communities of Msinga.
- To investigate the adaptation strategies that the rural communities of Msinga adopt during periods of drought.
- To examine the perceived seriousness and frequency of droughts within the rural communities of Msinga.

1.3. Research Questions

- What social and economic impacts does a drought have on the communities of Msinga?
- How do the communities of Msinga prepare for a drought during a normal year?
- What adaptation practices does the respondent use to deal with the impacts of drought?
- Has the respondent noticed a change in the frequency of drought within the last 10 years?
- Has the respondent received any governmental aid during a drought?

1.4. Problem Statement

It is well documented that drought directly impacts the basic survival of rural communities. For example, a drought will disrupt small-scale farmers and rural communities from earning a living and from providing food for their families. More extreme and frequent weather patterns, such as droughts can disturb the stability of individual and governmental food security which creates fluctuations in food accessibility, utilization, stability and availability. Furthermore, droughts increase social, economic and environmental impacts, as well as the disruptions of

livelihoods and ecosystems. Due to the unavailability of water during a drought, small-scale farmers and rural communities witness a decrease in agricultural activities, loss of livestock, and a drop in profit margins.

South Africa is a drought-prone country and its effects on rural communities are severe (Rukema, 2010). According to a report by the Presidents Council, the drought levels in Western Cape, Eastern Cape, Limpopo and Kwa-Zulu Natal is viewed as an ecological, social and economic problem (Rukema, 2010). The findings from the report further stated that the drought caused crop failure, job losses, malnutrition and poverty (Rukema, 2010). Additionally, a study conducted by Rukema (2010) in Kwa-Zulu Natal provided evidence that drought is a social, health and economic problem that has a severe impact on the rural communities of Msinga. Due to the drought and erratic rainfall, the Integrated Regional Information Networks revealed that agricultural production in Msinga has been decreasing over the past few decades, which has forced people to migrate in search of food, water sources and employment opportunities (Rukema, 2010).

1.5. Significance of the Study

On a global scale, drought is a significant challenge. It is, therefore, important to educate people on the challenges of drought and the effects that it has on humankind. This study also acknowledges the importance of women empowerment and environmental education to deal with drought and its impacts, particularly amongst female subsistence farmers who make up the majority of farmers in Sub Saharan Africa. Currently, the changing climate is causing a lot of damage to people, animals and the planet, therefore adaptation and mitigation measures need to be implemented. A drought is seen as a threat to farmers, rural communities, as well as individuals in society, therefore research, government interventions and early warning systems is important to decrease the socio-economic and environmental impacts of drought. This research study is also important to assist rural communities and encourage the development of faster and better measures of environmental, social and economic activity to deal with natural disasters, such as drought.

Recurring and prolonged drought destroys livelihoods, drives migration and displacement, broadens inequalities, weakens sustainable development and increases food insecurity levels (Mukerji, 2019). Therefore, this study also provides recommendations based on drought and how rural communities can be helped during times of prolonged drought. Furthermore, drought affects the universal food system in such a way that those who already suffer from malnutrition

and hunger are those most vulnerable to its threats, since drought decreases the availability of food. Additionally, understanding the effects of drought is important to understanding the impacts on food security. Furthermore, the United Nations states that the world needs to confront the current climate crisis, particularly the topic of climate justice and the inequalities that are raised by the occurrence of drought (Mukerji, 2019). Furthermore, drought has a substantial negative social and economic impact on rural communities and the local economy. Therefore, this study is significant as it provides an insight on the impacts of drought within the rural communities of Msinga. The study also looks at the importance of governmental responses to the climate crisis and the adaptation and mitigation strategies of drought. Additionally, there are also some gaps within literature that this research project aims to bridge. The study speaks about the socio-economic impacts of drought, as well as the adaptation measures that rural communities use to reduce the effects of drought.

According to Rukema (2010) there is an increase in the number of studies that highlights the socio-economic impacts of drought on marginalised rural communities; however, literature is still limited as most studies only focus on the environmental effects of drought. In terms of postgraduate research, this study also acknowledges that there is very little research based on the impacts of drought and policy makers. Therefore, this research study provides a better understanding of how drought evolves and how it affects the rural communities of Msinga. Furthermore, this study adds value to the field of research by focusing on the impacts of social and economic drought. The study also provides research based on modern drought practices and indigenous knowledge practices that are used by small-scale farmers during a drought. According to Meza & Hagenlocher (2021), a risk assessment plan based on the socio-economic impacts of drought needs to be implemented in South Africa. Additionally, a drought impacts the livelihoods of rural communities, as well as their income, employment and malnutrition levels. The study also addresses how drought reduces attainment of the sustainable development goals for rural communities, in terms of poverty, hunger, gender equality, clean water and sanitation and climate action. This study is also significant because it discusses the importance of women in agriculture and how female-headed houses are impacted more by drought. It also provided recommendations on women empowerment in terms of drought. Furthermore, there is not much research based on drought within the Msinga municipality; therefore, this study will fill in the gaps in literature.

1.6. Study Limitations

A limitation that occurred during the study was that some respondents were reluctant to participate and provide information based on the surveyed questionnaire. The respondents were reluctant mainly due to the fact that they did not know what to expect from the study or if they were required to do any experiments or any other tasks besides than answering questions. Furthermore, some respondents were unwilling to interact with strangers, which affected the data collection process. Due to the covid-19 pandemic, the researcher could not physically collect the data, therefore archival data was used. Another limitation was that the researcher did not measure rainfall patterns within the region. The study was conducted at the Msinga Municipality region; therefore, all results and findings cannot be generalised to other areas. Language was a huge barrier whilst conducting this study since the researcher's first language is English and all respondents only spoke IsiZulu. However, there was a translator that assisted with the language barrier.

1.7. Ethical Considerations

Ethical clearance was obtained for this research study. The ethical clearance protocol reference number was HSSREC/00003362/2021. The researcher (student) had to apply on UKZN's RIG system for ethical clearance. Once approved the researcher was allowed to go into the field for data collection. However, since this study used archival data, there were two applications needed. One ethical clearance application was for the current study and the second application was for the data that was used. Whilst collecting data for the research project, the dignity of all the respondents was a priority. Additionally, there was a written consent from all respondents before using them as subjects for the research study. There was also no harm brought to any of the respondents as a result of the research. The confidentiality of the respondents was always respected. During the course of this study, no major ethical issues were encountered.

1.8. Structure of Dissertation

Chapter one is an introductory chapter. It introduces the study, provides some background information and discusses research questions, limitations of the research project and it looks at the significance of the research study. ***Chapter two*** consists of reviewed literature based on climate change, drought and food security. This chapter discusses how drought has affected Africa, South Africa and other developing countries. It also looks at the impacts of drought on agricultural practices, food prices and gender dimensions. ***Chapter three*** on the other hand

comprises of the theoretical framework. This chapter focuses on the sustainable livelihoods approach and the drought perception theory. ***Chapter four*** discusses the methodology that was used for this research project. This chapter starts of by giving some background information of the research study site and it also discusses data collection methods and the research tools that were used whilst conducting this study. ***Chapter five*** is based on all findings and results of this project. It also includes the discussion of the research conducted that was based on drought. The last part of this research project is ***chapter six***, which includes the conclusion, theoretical reflections and recommendations of the study.

CHAPTER TWO - LITERATURE REVIEW

2. Introduction

Climate change has been described as the most detrimental environmental threat of the 21st century (Edame *et al*., 2011). Additionally, climate change is causing a surge of natural disasters across the globe, as it increases the frequency of climate-related disasters by up to 90% (Viola, 2020). These disasters can create a higher risk of hunger, food and nutrition crises and cause the breakdown of food systems and ecosystems (Viola, 2020). A common climate related threat that many countries around the world face is drought. According to the CDC (2020), droughts can limit the crop-growing seasons, impose health implications for humans and it can cause an increase in pests and diseases and food prices. Additionally, droughts adversely impact the socio-economic sectors, which includes human settlements, forestry and fisheries, water resources and ecological systems (Elasha *et al*., 2005). Drought also causes conflict, migration, water scarcity and displacements of individuals, especially in developing countries. According to Edame et al., (2011) & Chigavazira (2012) drought threats are more severe in developing countries due to them being located in tropical and subtropical regions, which are vulnerable to rising temperatures, low adaptive capacity, a decrease in water availability and a growing dependence on natural resources.

This review chapter will outline the relevant existing literature that is related to droughts and the impacts they are associated with. The chapter begins by looking at the definition of drought as well as the different types. It also will discuss the influences of climate change in Africa, with the focus being South Africa and the drought it faces. The social, economic and environmental impacts of drought will be highlighted, as well as the effects of drought in developing countries. The dimensions of food security will be discussed as well as the gender dimensions of how decreased crop yields and drought mostly affect women and children in rural areas. The literature review also focuses on the impacts of drought on food prices and food productivity. This chapter also speaks about how climate-smart agriculture and sustainable food systems affects food security and the environment and it discusses the impacts of indigenous knowledge and modern technology in agriculture. This chapter will also discuss how the covid-19 pandemic lockdowns impacted the environment. Lastly, governmental responses towards climate change, specifically drought will be discussed.

2.1. What is Drought?

A drought is a period of below-average precipitation which results in drier than normal conditions (Brown, 2016). These dry conditions usually cause water-related issues. A dry period can become a drought, if arid weather continues and water-supply difficulties keep on occurring (Brown, 2016). A drought occurs when transpiration and evaporation exceed precipitation for a long period of time (Augustyn, 2018). Low precipitation levels effects moisture in the soil and it also disrupts the amount of water in lakes, streams, rivers, wells and groundwater reservoirs (Cousteau, 2015). Drought causes soils to dry out, which eventually leads to plants and crops dying (Brown, 2016). According to Augustyn (2018), drought is the most severe physical hazard that effects agriculture. Droughts can occur in all types of climates and are becoming more frequent and extreme in nearly all parts of the world (Wolchover, 2019). However, the beginning of a drought is very tough to determine. Many weeks, months or even years may go by before experts know that a drought is occurring (Brown, 2016).

2.1.1. The Four Basic Kinds of Drought

Augustyn (2018) states that there are four basic kinds of drought. ***Permanent drought*** is the first kind of drought that has being acknowledged. This type of drought occurs in the driest of climates and can last for decades (Augustyn, 2018). Agricultural practices do not take place during permanent droughts, since it is impossible for crops to grow without continuous irrigation (Augustyn, 2018). ***Seasonal drought*** is the second kind of drought, and it occurs in climates that have distinct dry and rainy seasons. For the planting of crops to be successful, it needs to be adjusted so that the crops can develop and grow during the rainy season (Augustyn, 2018). The third kind of drought is called ***unpredictable drought***, which involves irregular rainfall (Augustyn, 2018). Unpredictable drought can happen anywhere; however, it mostly occurs in sub-humid and humid climates (Augustyn, 2018). It usually only affects a small area and is short and irregular, nevertheless, large scale unpredictable droughts are possible in drier regions with inadequate snowfall or rainfall (Logan, 2015). ***Invisible drought*** is the last kind of drought that is recognised. This type of drought is dominate in summers when rising temperatures cause high rates of transpiration and evaporation, which then leads to a decrease in crop production (WFP, 2019). It is argued that regular rainfall may not be enough to restore the amount of water lost during a drought.

2.1.2. The Four Different Categories of Drought

In the 1980s, two researchers discovered more than 150 definitions of drought, which are published in a journal called the ‘water international’ (Wolchover, 2019). However, the

researchers then tried to group all the definitions of drought into four basic categories. These categories are known as meteorological drought, hydrological drought, agricultural drought and socio-economic drought (Wolchover, 2019). The first 3 categories deal with drought as a physical phenomenon, whilst the last category sees it as a supply and demand problem (Wolchover, 2019). *Figure 2.1 (below)* shows a drought progression and the relationship between meteorological, agricultural and hydrological drought.

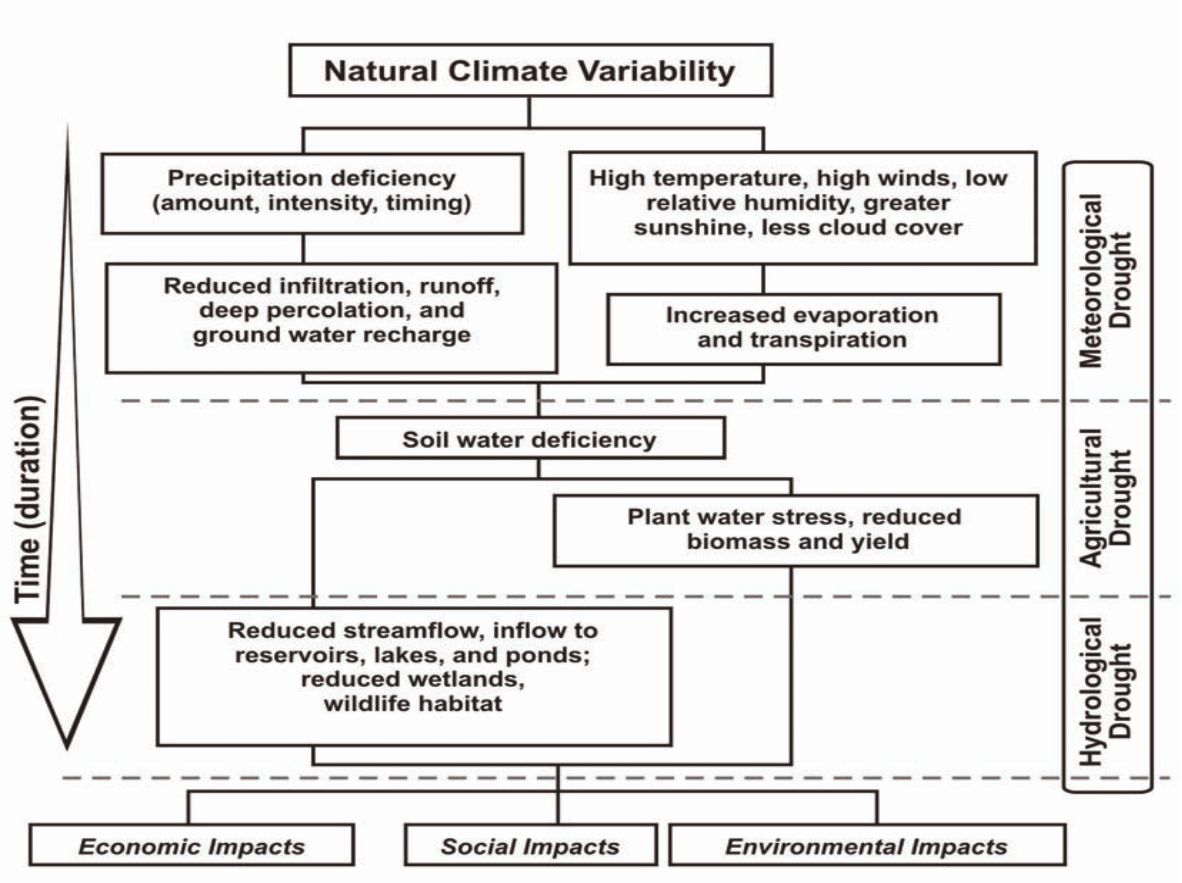
The first category is ***meteorological drought*** - which is specific to certain regions depending on the actual amount of annual precipitation in comparison to the average rainfall that an area receives (Wolchover, 2019). A meteorological drought is usually characterised by an extensive dry period with no snow or rain (Lies, 2021). A decline in rain or snow compared to the historical average for a specific region would qualify as a meteorological drought (Simon, 2022). It can be viewed as an alert to warn hydrologists, water managers and farmers that they need to be ready in case the dry conditions continue (Muller, 2019). A meteorological drought occurs when the dry conditions last for over a month (UNDP, 2020).

The second category is ***hydrological drought*** - which occurs when the amount of precipitation in a particular region decreases for a long period of time, which then leads to low water levels in rivers, streams, reservoirs, aquifers and wells (Lies, 2021). Hydrological drought is often associated with meteorological drought (Wolchover, 2019). This is because meteorological drought considerably reduces the availability of water resources in lakes, rivers and underground reservoirs (Muller, 2019). During a hydrological drought, hydrologists are concerned with how a decline in precipitation will affect the ecological chain further down the line (Lies, 2021). Hydrological drought can be worsened by human activities, such as drawdown of reservoirs (Wolchover, 2019).

The third category is ***agricultural drought***. This type of drought takes place when there is a lack of rainfall, which then leads to a decrease in soil moisture, which ends up affecting rain-fed crops and pastures (Muller, 2019). This is because low soil moisture during planting times may delay germination, which will lead to a decline in crop production and a low plant population (Brown, 2016). Whether there is an extensive drought or not, agricultural drought arises when there is a shortage of water during the crop's growth cycle (Lies, 2021). Agricultural drought mostly affects farmers and others in the agricultural industry. As a result of climate change, the number of agricultural droughts is increasing around the world (Lies, 2021). For example, in the United States of America, snow is melting at a faster rate since the

earth is warming and temperatures are increasing (Lies, 2021). This process will lead to faster run-off – which means that there won't be enough moisture available for plants when they actually need it (Lies, 2021). During an agricultural drought, livestock farmers are advised to buy extra feed or to reduce their herds so that they can compensate for the loss of grazing (Muller, 2019). Crop farmers could delay planting their harvests or they could leave more spaces in-between the crops to give each plant a chance of receiving water (Muller, 2019). Farmers could also take out insurance against crop failure in the event of an agricultural drought occurring (Muller, 2019).

The last category is ***socio-economic drought***. As mentioned in chapter 1, a socio-economic drought is the category of drought that this study is focusing on. This type of drought occurs when the demand for water exceeds the supply (Wolchover, 2019). It focuses on the financial aftermath of how the drought will impact the supply and demand of a product (Lies, 2021). Socio-economic drought is the one that has the hardest impact on humans, since it is always associated with an insufficient supply of water (Lies, 2021 & *Lui et al.,* 2020). Additionally, it affects them economically, as socio-economic drought is usually accompanied by an increase in food prices (Lies, 2021). However, socio-economic drought also occurs when water shortages affect agricultural production and consumption (Liu *et al.,* 2020). According to Liu *et al.,* (2020), socio-economic drought is closely related to rural communities, and it is one of the most frequent and severe natural disasters. For example, the global impacts of socio-economic drought causes an annual damage of $6-8 billion (Liu *et al.,* 2020). Additionally, drought places high demands on water resources in rural and urban areas, which affects social and economic development (Liu *et al.,* 2020). Furthermore, Liu *et al*., (2020) states that a multivariate standardized reliability and resilience index is used to determine, evaluate and assess the impacts of socio-economic drought. An example of this type of drought is when a decline in streamflow forces hydroelectric power plant workers to reduce energy production (Wolchover, 2019).



(Source: Caleni, 2017).

Figure 2.1. Flow chart showing drought progression and the relationship between meteorological, agricultural and hydrological drought.

2.1.3. Drought Indicators

Over the past several decades, many different guides have been developed to indicate the occurrence and severity of droughts (Arthur & Saffar, 2020). One of the most common indicators used to monitor and define drought is the ***Palmer Drought Severity Index*** *(PDSI)* (Arthur & Saffar, 2020). It was created in 1965 in the United States of America, and it has become the first comprehensive drought indicator (Wolchover, 2019). The PDSI combines precipitation, temperatures, evaporation, soil runoff, transpiration, and soil recharge information for a particular area to produce a single negative number that shows the drought conditions (Wolchover, 2019). The values for PDSI range from 4.0 which is considered to be extremely wet to values below -0.4 which is considered to be extremely dry (Arthur & Saffar, 2020). The PDSI is associated with the severity of a drought, and it serves as an estimation when determining soil moisture shortages (Wolchover, 2019).

The PDSI indicator is mostly effective for unirrigated cropland and is commonly used in drought research and monitoring (Wolchover, 2019). Additionally, in North America, the Palmer Drought Severity Index has been used in tree-ring based reconstructions to determine the severity of droughts in the past (Wolchover, 2019). There are also some commonly used indicators that are related to the PDSI. One of these indicators is the ***Palmar 2 Index***, which tries to measure short-term drought using a once-a-month time scale (Arthur & Saffar, 2020). Another indicator is the ***Palmar Crop Moisture Index,*** which aims at measuring short-term drought and quantifying the effects on agricultural productivity (Arthur & Saffar, 2020). Lastly, the ***Palmer Hydrological Index*** is used to estimate the long-term impacts of drought on groundwater levels and reservoir levels (Arthur & Saffar, 2020).

Another indicator for measuring drought is the ***Standardised Precipitation Index*** *(SPI).* It compares measured precipitation to the average of historical precipitation over a number of timescales, which range from 1 to 24 months (Arthur & Saffar, 2020). The SPI is mostly used to characterise meteorological drought on a variety of timescales (Keyantash, 2018). It is closely linked to soil moisture on the short time scale, while at the longer timescale, the SPI can be associated with reservoir and groundwater storages (Keyantash, 2018). The SPI can be compared across different areas that have significantly diverse climates (Keyantash, 2018). The indicator has also been acknowledged as the standard index that should be available all over the world for reporting and calculating meteorological drought (Keyantash, 2018). As dry conditions become more severe, the SPI becomes negative and as the wetter conditions prevail, the SPI becomes positive (Arthur & Saffar, 2020). Since it does not deal with evapotranspiration, there has been some issues with the fact the SPI is not accurate in measuring the changes to drought that has being associated with climate change (Keyantash, 2018).

2.2. The Impacts of Drought

2.2.1. Environmental Impacts of Drought

Drought also affects the environment in many different ways. It is an extreme event, which is viewed as a slow-onset phenomenon that impacts the environment, biodiversity, water quality, soil erosion and human life (Mesbhahzadeh *et al.,* 2019 & Cortes, 2012). Just like humans-animals and plants also depend on water, therefore when a drought occurs their food supply could decrease and their habitats can be destroyed (Ngumbi, 2019). For example, a series of below average rainfall led to severe drought and wildfires in the Amazon in Brazil, which caused the loss of 14 000 species habitats (Camargo, 2021). According to Fountain (2022), the Amazon is loosing its ability to recover from shocks, such as drought. Additionally, climate

change, deforestation and wildfires has negatively impacted the Amazon by making it warmer and drier (Fountain, 2022). The Amazon rainforest provides an important role in mitigating climate change, however loosing the rainforest could result in 90 billion tons of carbon dioxide getting released back into the atmosphere (Fountain, 2022). Furthermore, water shortages can also cause harm to biodiversity (Caleni, 2017). Environmental impacts of droughts can last a long time, which will eventually cause lower water levels in dams, lakes and reservoirs (Caleni, 2017). Additionally, dried up rivers will result in the loss of the wetlands that control and provide habitats for birds and aquatic life (Caleni, 2017). According to a report by Aljazeera (2022) wetlands, swamps, floodplains and estuaries are disappearing at a faster rate due to higher temperatures and the occurrence of drought. Additionally, there will be an increase in diseases of animals because of the reduction in water and food supplies (Ngumbi, 2019). Other environmental impacts include, migration of wildlife, wind and water erosion of soils, loss of trees that result in poor soil quality and more wildfires (Ngumbi, 2019 & Caleni, 2017). *Table 2.1* (below) presents a summary of environmental impacts and the effects it has on drought.

Table 2.1: Showing a Summary of Environmental Impacts and the Effects of Drought

Environmental impacts	Effects
Damage to natural habitats	Loss of biodiversity
Reduced forests, crop, and range land productivity	Reduced income and food shortages
Reduced water levels	Lower accessibility to water
Reduced cloud cover	Plant scorching
Increased day-time temperatures	Increased fire hazards
Increased evapotranspiration	Crop withering and drying
More dust and sand storms	Increased soil erosion and increased air pollution
Decreased soil productivity	Desertification and soil degradation (topsoil erosion)
Decreased water resources	Lack of feeding and drinking water
Reduced water quality	More waterborne disease; increased salt concentration
Increased incidences of animal diseases and mortality	Loss of income and food; reduced breeding stock
Soil desiccation	Increased soil 'blow activities'
Degradation of landscape quality	Permanent loss of biological productivity of the landscape
Species concentration near water	Increased vulnerability to predation

(Source: Caleni, 2017)

2.2.2. Social Impacts of Droughts

Droughts also bring about social impacts that can affect people's health and safety. According to Qazi (2019), safety is affected when wildfires occur as a result of dry weather and drought. Health issues related to poor water quality and low water levels could occur, and in some cases

even lead to loss of human life (Ngumbi, 2019). Additionally, the stress of reduced incomes and families been spilt up due to drought could also affect human health (Qazi, 2019). Social impacts also include conflicts between people when there is not enough water for agricultural or domestic purposes (Ngumbi, 2019). For example, in Australia, conflicts about low water supplies would erupt between different communities (Qazi, 2019). Reduced incomes, fewer recreational activities and depression or anxiety about economic losses caused by a drought are also examples of social impacts (Ngumbi, 2019). Additionally, social impacts as a result of drought include; migration, homelessness, malnutrition, changed food preferences and a decrease in the number of children attending school (Udmale *et al.*, 2014). According to NDMC (2022), when a social scientist studies drought, they look at how it affects communities, and ways to reduce its impacts and strengthen livelihoods. Social scientists also highlight how a drought affects families, different races and cultures, gender dimensions, food systems and food supplies (NDMC, 2022). In addition, they look at how drought affects developed countries in comparison to developing countries (NDMC, 2022). Social scientists also help rural communities and small-scale farmers understand the choices they need to make before, during and after a drought (NDMC, 2022). *Table 2.2* (below) presents a summary of social impacts and the effects it has on drought.

Table 2.2: Showing a Summary of Social Impacts and the Effects of Drought

Social impacts	Effects
Lack or poor distribution of resources (food and water)	Migration, resettlement, conflict between water users
Increased quest for water	Increased conflicts among water users
Marginal lands becoming unstable	Poverty and unemployment
Reduced grazing quality and crop yield	Overstocking; reduced quality of living
Employment lay-offs	Reduced or no income
Food insecurity	Malnutrition and farming; civil strikes and conflict
Increased pollutant concentration	Public health risks
Inequitable drought relief	Social unrest and distrust
Increased forest and range fires	Increased threats to human and animal life
Urbanisation	Social pressure and reduced safety

(Source: Caleni, 2017)

2.2.3. Economic Impacts of Droughts

Socio-economic impacts affect all countries that are hit by a drought. According to Sena *et al.*, (2014), if a drought is prolonged for more than two years - health impacts and economic losses can be brutally aggravated. For example, the 2015/2016 South African drought had caused

widespread economic and livelihood disruptions, which imposed multiple physical and health related challenges for rural people living with HIV/AIDS (Orivulu, 2022). Additionally, disruptions to food systems, livelihoods and incomes as a result of drought have increased risks to general health and vulnerabilities linked to unemployment and poverty (Orievulu, 2022). Furthermore, economic impacts of a drought cost businesses and individual's money. For example, farmers could lose money if a drought destroys their harvests (Ngumbi, 2019). According to Caleni (2017), the maize industry needs water for farming; however, if there are water shortages, a rise in food prices will occur. When the water supply for agricultural purposes is too low, farmers may have to spend more money on irrigation systems (Ngumbi, 2019). Additionally, drought also brings local level impacts, such as loss of income for rural communities. Another economic impact is that electricity companies that depend on hydroelectric power will have to spend more money on additional fuel sources if the drought causes the water supply to dry up (Ngumbi, 2019). For example, water sources are depleting in Italy which caused hydroelectric power supplies to decrease by 50% (Bertacche, 2022). Due to low water levels, ships may have trouble navigating through rivers, canals and streams, which could ultimately affect tourism and businesses that rely on water transportation for importing and exporting goods and materials (Ngumbi, 2019). For example, the current drought in Italy is threatening the tourism industry as cities ration water-use for non-essential purposes (Bertacche, 2022). According to NDMC (2022) economists study the impacts of drought on the economy. *Table 2.3* (below) presents a summary of economic impacts and its effects on drought.

Table 2.3: Summary of Economic Impacts and the Effects of Drought

Economic impacts	Effects
Reduced business with retailers	Increased prices for farming commodities
Food and energy shortages	Drastic price increase; expensive import/subsidies
Loss of crops for food and income	Increased expense of buying foods from shops
Reduction of livestock quality	Sale of livestock at reduced market prices
Water scarcity	Increased food cost
Loss of jobs, income and property	Deepening poverty; unemployment
Less income from tourism and recreation	Increased capital shortfall
Forced financial loans	Increased debt; increased credits for financial institution

(Source: Caleni, 2017)

2.3.4. Case Study of Socio-economic Impacts of Drought

Drought is one of the most crucial problems that Turkey is facing (Engindeniz *et al*., 2013). Turkey is located in the Eastern Mediterranean Basin where countries are at high risk of droughts (Engindeniz *et al*., 2013). In 2007/2008 low rainfall and high temperatures threatened almost all regions of Turkey (Engindeniz *et al*., 2013). Additionally, the drought had endangered agricultural production, which resulted in socio-economic impacts (Engindeniz *et al*., 2013). In 2008, a study was conducted in the Izmir province to determine the social and economic impacts that the drought had on communities and crop production (Engindeniz *et al*., 2013). The findings of this study illustrated that the drought had caused food insecurity, job losses, crop failure, loss of rural populations, water shortages and health problems (Engindeniz *et al*., 2013). For example, there was reports that 6000 children were unwell in Turkey due to water shortages and illnesses caused by the intake of unhealthy water (Iha, 2021). The 2008 study also reported that animal production for small-scale farmers was low during the drought because of the unavailability of livestock feed, reduced productivity of grasslands and high livestock mortality rates (Mtetwa, 2018). Due to livestock deaths and loss of income, many Turkish farmers reported high stress and anxiety levels (Iha, 2021). Furthermore, Engindeniz *et al*., (2013) states that social and economic drought had a large impact on rural livelihoods.

The drought in Turkey economically impacted the forestry and fisheries, energy, transportation, food and tourism sectors (Engindeniz *et al*., 2013). For example, due to the drought and reports of wildfires – the tourism industry noticed a decline in the country's GDP due to decreased visitations and cancellations of hotels (Mtetwa, 2018). According to the Turkish Ministry – Turkey suffered a drought loss of €1.83 billion (Engindeniz *et al*., 2013). Additionally, the Union of Turkish Chambers of Agriculture reported an estimated € 2.5 billion of agricultural losses due to the drought. According to Engindeniz *et al*., (2013) agricultural production decreased; however, the crop prices significantly increased. Findings from Iha (2021) states that hydroelectric power plants in Turkey have witnessed a dramatic drop in electricity output due to the drought. Experts in Tukey have been studying socio-economic impacts of droughts in the country to try and determine mitigation and adaptation policies (Engindeniz *et al*., 2013).

2.3. The Impacts of Drought in Africa

Drought is one of the most difficult challenges affecting African countries. This is mainly because of their geographical location, lack of resources, low income, and their dependence on

climate-sensitive sectors, such as agriculture. Additionally, African countries have a weak capacity to adapt to climate change due to increased levels of poverty, the continuous rise in population growth, low levels of socio-economic development and the lack of education, poor infrastructure and governance (Ochieng *et al.*, 2016). According to Gerber (2022), Africa is not responsible for climate change, but they bear the brunt of it. Additionally, Geber (2022) states that African countries are experiencing the worst impacts of climate change through increased disasters, such as floods, cyclones and drought. According to Smit (2015), drought is acknowledged as an emerging issue that is likely to have undesirable consequences on food security and livelihoods in Africa. Furthermore, in Africa, one-third of the population faces severe food insecurity, and many people regularly go more than a day without food (Kings, 2018). In recent years the food security situation has been worsening in Africa – due to recurring droughts. For example, a United Nations WFP Report (2022) stated that in the last 3 years, the amount of hungry people in West Africa and the Sahel Region has quadrupled and is currently reaching 43 million people. Additionally, the report acknowledges that the drought does not only affect rural communities as 16 million people in urban areas are also at risk of acute food insecurity (UN, 2022). According to FAO (2017), the number of undernourished people in Africa has increased from 20.8% to 22.7% in 2016. For example, the United Nations WFP (2022) Report mentions that 6 million children are undernourished in the Sahel Region due to extreme drought conditions. There are under a billion people in Sub-Saharan Africa and of these the number of food insecure and undernourished people rose from 200 million to 224 million in 2016 (FAO, 2017). There have been reports of progress in the fight against food insecurity by small-scale farmers; however, this was followed by a period of no improvements due to the impacts of climatic conditions, such as drought (FAO, 2017). Almost 1 in 4 people are estimated to be undernourished in Sub-Saharan Africa (Braimoh *et al*, 2019).

Agriculture is the primary livelihood source for most African countries. For example, in East Africa 80% of the population use agriculture as a main source of income, thus contributing to 40% of the Gross Domestic Product (Kahsay & Hansen, 2016). However, Geber (2022) argues that the impacts of climate change is costing African economies between 3% -5% of their GDPs. Since Africa is a developing continent, the effects of climate change on agriculture can be harmful. Drought has the most detrimental effects on rural subsistence farmers since they mainly rely on rain-fed agriculture (Smit, 2015). Agricultural practices are generally sensitive to weather variables, such as precipitation, changing temperatures, frost, floods, droughts and severe cyclone storms (Brown, 2008). Drought is an environmental driver that not only affects

food production, but also food distribution, processing and consumption. According to FAO (2012), by the middle of the 21st century, the effects of climate change, specifically drought could decrease maize production in West Africa. In recent years, maize production has decreased due to droughts, plant diseases and an increase in water scarcity (Mukerji, 2019). On the other hand, in some West African countries cold conditions and flooding can hamper maize storage whilst flood-related damages to roads and railway tracks could make it difficult when transporting goods (FAO, 2012).

Another example of how climate change effects African countries can be seen in the Horn of Africa. Large parts of Ethiopia, Somalia and Kenya are facing one of the most severe droughts in decades, with more than 15 million people being affected (UN, 2022). In addition to the drought, the Horn of Africa is also impacted by extreme weather, conflict, desert locusts and the covid-19 pandemic (UN, 2022) The region has also experienced insufficient rainfall and dried up water points, which led to disastrous consequences for people due to livestock deaths and loss of crops (Ahern, 2019). For example, in Kenya, 1.4 million animals have died, and thousands of crops have been destroyed as a result of drought (UN, 2022). Additionally, meteorologists have reported that a fourth consecutive rainy season has failed the Horn of Africa and experts have stated that more below-average rainy seasons will occur (Aljazeera, 2022). Within this region, drought has caused a high risk of malnutrition and famine, with an estimated 12 million people not having enough food to eat (UN, 2022 & Ahern, 2019). This is because small-scale farmers and rural communities mainly rely on rain as a water supply for their livestock and crops. The people of Turkana in Kenya have seen their second drought in 3 years (Ahern, 2019). Vulnerable communities in Turkana do not have sufficient time to recover losses from one drought before the next one hits. According to Ahern (2019), malnutrition rates in Turkana has reached 30%. For example, a family living in Turkana were severely malnourished as their land had dried up and the drought wiped out half of their herd of goats (Ahern, 2019). Now the family and the livestock rely on wild fruit to prevent starvation.

Somalia is also facing its worst drought in 40 years, which has caused 7.1 million people to face starvation as the drought worsens and food prices rise (Aljazeera, 2022). According to the Displacement Tracking Matrix, drought conditions could displace over 3 million Somalians (UN, 2022). Additionally, the Flow Monitoring Index has reported an increase in drought-induced movement from Somalia into Ethiopia for pastures and water; however, Ethiopia is also suffering from a severe drought, which has impacted the livelihoods of 4 million communities (UN, 2022). Droughts are not something new to the people of Africa, however

the severity and frequency at which they occur is concerning. According to Ahern (2019), droughts used to occur every 15-20 years in Africa. However, since the late 90s, droughts have been occurring every 5 years and over the last 10 years, it has been reduced to every second year (Ahern, 2019). To mitigate the risks - policies need to be put into place to protect arable land against the effects of climate change (Masipa, 2017). According to White (2021), the year 2020 was recorded as the 4th hottest year for the African continent since 1910. Additionally, Ngumbi (2019) states that drought is a very common climate crisis that occurs somewhere in Africa every year. For example, a drought in Ethiopia and Sudan had caused the deaths of 450 000 people in 1984, whilst drought in the Sahel region affected more than 325 000 people in 1974 (Vicente-Serrano *et al.*, 2012).

2.4. The Drought and Food (In)Security Situation in South Africa

"The right to access adequate food is entrenched in the Bill of Rights in the Constitution of the Republic of South Africa" (FAO, 1996). At a national level, South Africa is a food secure nation, however at a household level it is still food insecure (Stats SA, 2017). This is due to all households not having access to adequate food supplies. In the year 2002, there were 13.5 million food insecure people in South Africa and in 2017, that number dropped to 6.8 million (Stats SA, 2017). According to Statistics South Africa (2017), 20% of households had severe inadequate access to food. Insufficient food access is mostly found in households with more than 8 members and more than 500 000 households with children under the age of 5 experiencing food insecurity (Stats SA, 2017). Nearly two thirds of households that are vulnerable to hunger are found in urban areas (Stats, 2017). Many rural South African households have a greater risk of experiencing food insecurity due to them not adopting coping strategies that would affect their long-term food security (Ngidi & Hendriks, 2014). According to Statistics South Africa (2015), 18.3% of households rely on agricultural activities, 5.3% use agriculture as an extra source of income, whilst 1.9% of households rely on agricultural practices as a main source of income and 9.6% rely on agricultural activities as a main food source. South Africa faces a food security challenge at a household level where 5.9% of the population suffered from severe inaccessibility to food, whilst 16.6% of households experienced inadequate access to food and 26.2% of households experienced complex food access (Nkwana, 2015).

Many local areas in South Africa rely on agricultural productions to meet their food needs (Brown, 2008). In 2017, approximately 2.5 million households were involved in agricultural

activities (Stats SA, 2017). Rural provinces with high levels of poverty have the largest proportions of households that rely on agricultural activities. These include Kwa-Zulu Natal with 20%, Limpopo with 25% and Eastern Cape with 20% (Stats SA, 2017). Traditionally in South Africa, agricultural practices are dominated by small-scale farmers with under 2 hectares of land and low amounts of pesticides, fertilisers and physical capital (Kahsay & Hansen, 2016). These small-scale farmers are mostly involved in the production of grain, fruit, vegetables, poultry and livestock farming (Stats SA, 2017). Many farmers consume their own harvests, or they sell it at local markets. Additionally, climatic variations effect agricultural production which causes subsistence farmers and rural communities to produce fewer crops. This will cause a decrease in income, whilst their basic consumption costs go up. In South Africa, subsistence farmers and rural communities have fewer options in their agricultural systems, because they don't always have the finance, equipment or technological methods to cope with drought (Brown, 2008). This will affect the local economy and their food access. Additionally, drought will most probably affect food security at a global, regional, and local scale (EPA, 2017). Furthermore, drought can affect the quality of food, decrease access to food and disrupt food availability.

2.4.1. Drought in South Africa

In 2015/2016, South Africa had experienced one of the worst droughts in 30 years because of the extreme weather system, El Nino (Head, 2018). In South Africa, the El Nino system usually occurs in summer and spring. El Nino is the warming of sea surface temperatures in the equatorial Pacific Ocean, which influences atmospheric circulation, and as a result temperature and rainfall in specific areas around the world (FAO, 2017). According to the International Panel on Climate Change (IPCC) Southern Africa's temperatures are increasing at twice the average global rate (Climate Signals, 2015). In 2015/2016, the El Nino weather phenomenon had threatened millions in East and Southern Africa, causing over 11 million people to be at risk from water shortages, diseases, hunger and poverty (BCC, 2015). South Africa has been hit by drought and water shortages since 2015, which has caused some communities to go without running water for weeks on end (Mogoatlhe, 2020). Water shortages occurred as a result of delayed rainfall and a decline in dam levels which eventually led to a drought (Mogoatlhe, 2020).

According to the South African Weather Services, the 2015 drought was the worst that the country has ever experienced since 1982 (BBC, 2015). *Figure 2.2* (below) shows how severely

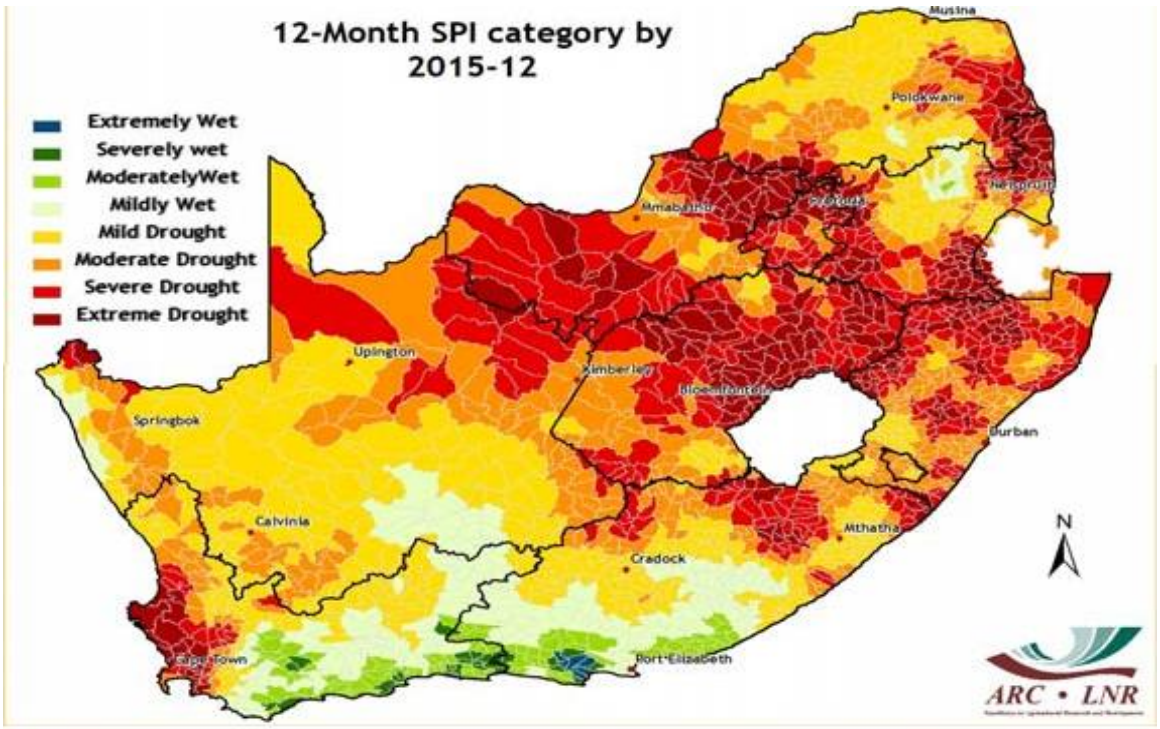
the different parts of South Africa were affected by the drought in 2015. Additionally, the government had declared five out of nine provinces as disaster areas, which included Kwa-Zulu Natal, Western Cape, Gauteng, Eastern Cape, Limpopo and the Free State (Mogoatlhe, 2020). Water restrictions were implemented in the major cities of these provinces and residents were warned to use water sparingly (BCC, 2015). For example, the City of Cape Town experienced severe water shortages, and as a result 'Day Zero' occurred, which caused taps to run dry by 2018 (Mogoatlhe, 2020). In October 2019, the Department of Water & Sanitation released a statement encouraging South Africans to use water sensibly, as dam levels were decreasing in many parts of the country (Mogoatlhe, 2020). Dam levels across South Africa had dropped by between 10% and 60% as compared to 2018. Living in a drought-stricken country requires all South Africans to do their part in mitigating the effects of drought (WRC, 2020).

Subsistence farmers and commercial farmers were most vulnerable to the 2015/2016 drought, because of their lack of resources and reliance on their own harvests for household food security (Agri SA, 2016). In South Africa, the Department of Agriculture, Forestry and Fisheries had reported that livestock and veld conditions were poor and that irrigated crops were under stress due to high temperatures and insufficient water (Agri SA, 2016). Most farmers could not plant their crops during the relevant seasons, as a result of low soil moisture levels. It was estimated that in South Africa 83% of maize, 73% of sugarcane and 53% of wheat crops were produced by dry-land agriculture (Agri SA, 2016). However, these crops were affected by the drought, with maize production being 25.2% lower than it was in previous years, whilst sugarcane productions decreased from an annual 19 million tons in 2014 to 14 million tons in 2016 (Agri SA, 2016). For livestock farming, below average rainfall had almost depleted natural grazing fields, which resulted in an estimated 40 000 cattle dying in Kwa-Zulu Natal by the end of 2015 (Agri SA, 2016). The drought also left devastating impacts on aquatic agricultural production, especially on fish stocks, because of the warmer ocean temperatures (Fin, 2015).

In South Africa, drought is no longer considered a national disaster. However, it is still classified as a water scarce country and the 30th driest in the world (Mogoatlhe, 2020). After the government studied the severity of the drought situation, they decided to declassify it as a disaster area on 16 July 2020 (Mogoatlhe, 2020). However, the announcement of drought as a countrywide disaster allowed struggling farmers to get money and supplies from the government to feed their livestock (Mogoatlhe, 2020). According to Agri SA (2016), the water

crisis is still continuing, with large parts of the Northern, Western and Eastern Cape still suffering from the effects of the most extreme drought in 100 years. In many parts of South Africa, the 2015/2016 drought is still having a severe impact on food security and the sustainability of many farmers (Mogoatlhe, 2020). Even though the predictions of rainfall seem favourable, the changing weather patterns that is caused by climate change could still affect the country's food security levels (BCC, 2015). Scientists predict that most parts of South Africa will move to an even drier climate by the 2050s until the 2080s, which will thereby increase the risks of drought (Climate Signals, 2015). Using global climate models, experts warn that this may not be the country's last dry spell (BCC, 2015).

On the other hand, there is the La Nina phenomenon which is the opposite of El Nino. La Nina is the cooling of sea surface temperatures in the equatorial Pacific Ocean, which influences atmospheric circulations, and as a result temperature and rainfall in certain parts of the world (Tanks, 2014). In South Africa, rainfall varies from 100 mm per annum in the West to 1500 mm in the East, with an average of 450 mm per annum (Chami & Moujabber, 2016). During the La Nina phenomenon, atmospheric pressure is lower than normal and trade winds are stronger which leads to colder average temperatures in South Africa (Fin, 2015). The effects of El Nino and La Nina events are becoming greater as the atmosphere is being pumped with greenhouse gases and carbon dioxide, which will have unequal impacts, especially in developing countries (Nield, 2015).



(Source: Climate Signals, 2015)

Figure 2.2. Map showing the occurrence of drought in South Africa for 2015.

2.5. Vulnerability Towards Drought in Developing Countries

Droughts are a natural disaster with the most negative consequences (Bruntrup *et al.*, 2018). According to a report by ISDR (2009), developing countries are vulnerable to drought because they lack drought preparedness measures, mitigation plans and drought management policies. Additionally, the report states that poor water use, war and conflict, poverty, lack of education and technology, overexploitation of natural resources and low economic development contribute towards the vulnerability of drought in developing countries (ISDR, 2009). According to Bruntrup *et al.*, (2018), rural households in developing countries are affected by drought and its impacts in multiple and complex ways. These include; the lack of water for crops, pastures, livestock and humans, a decrease of local food availability and accessibility, an increase in food prices, a failing energy supply, the destruction of assets and livelihoods, as well as a rise in deaths (Bruntrup., *et al,* 2018). Furthermore, drought also aggravates conflict over natural resources in developing countries.

2.5.1. Drought in Mali

In 2021, the African Risk Capacity (ARC) (2022) reported high levels of drought in Mali, which was aggravated by dry periods and below-average rainfall. According to Caspit *et al.*, (2021), over 95% of Mali is affected by drought, with some provinces only recording 1.2 mm of rainfall in a year. The National Drought Warning and Monitoring Centre reported that the country is facing its most detrimental rainfall season in 5 years (IFRC, 2022). According to Acted *et al.*, (2021), 4.5 million people have been impacted by drought, conflict and the covid-19 pandemic in Mali, which is an increase of 1.9 million from previous years. Mali is experiencing a hydrological/meteorological drought which threatened the country's food, socio-economic and water security (IFRC, 2022). The drought in Mali has caused the loss of 225 000 hectares of arable land, which has impacted more than 3 million people in the cities of Timbuktu, Mopti and Segou (Acted *et al.*, 2021). According to Acted *et al.*, (2021), 3.5 million people are food insecure in Mali and a further 965 464 children suffer from malnutrition. Furthermore, the drought crisis has driven up the prices of staple food items, such as rice and corn by 18 and 22% respectively (Acted *et al.*, 2021).

According to the World Meteorological Organisation, over the next 5 years (2021-2025), the average precipitation rate in Mali is expected to be 75% lower than normal, whilst the average

temperature is predicted to be 50% to 75% higher than the current levels (IFRC, 2022). Furthermore, water shortages and droughts have led to power cuts in areas that are supplied by hydroelectric plants (Acted *et al*., 2021). Additionally, an ARC (2022) report stated that the drought in Mali has aggravated the social marginalization and existing vulnerabilities of women, since it places extra burdens and responsibilities on them. For example, a mother of four in the village of Mopti was forced to migrate as the drought drove her family deeper into poverty (Acted *et al*, 2021).

2.5.2. Drought in Mexico

Mexico and droughts have a long history; since its climate and location makes it vulnerable to dry periods (Mendez, 2021). It is viewed as the second most water-stressed country in Latin America, which means that the demand is higher than the availability of water (Mendez, 2021). As of 15 April 2021, Mexico has been experiencing one of the most intense and widespread droughts in the last 30 years, with 85% of the country being affected (Patel, 2021). A water expert at the Chapingo University reported that in some Mexican states, irrigation systems are disappearing due to lack of precipitation (Garrison, 2021). According to Patel (2021), reservoirs across the country are extremely low which has put pressure on water resources for farming, irrigation and drinking. Additionally, in the northern and central parts of Mexico, another 60 reservoirs were below 25% capacity (Patel, 2021). As a result of low supply, the government has decreased water flow from the reservoirs, which has left households without running water and it has reduced water transfers to farms (Patel, 2021). Moreover, the drought also led to social water conflicts, since the farmers took control over the La Boquilla dam in 2020, which served as a strategic relationship between USA and Mexico (Mendez, 2021). A treaty that was signed in 1944 states that Mexico must deliver 2 200 million squared cubes of water to USA every 5 years (Mendez, 2021). Farmers argued that their harvests would suffer if water was sent to USA, therefore they shut down the main hydraulic system of the La Boquilla Dam (Mendez, 2021).

A USA report acknowledged that even though, rains were only 3% below the average rate in Mexico, the strain on water reserves was aggravated by an increase in domestic demands due to the covid-19 pandemic (Garrison, 2021). Furthermore, the National Water Commission reports that 1 295 municipalities have experienced drought conditions with temperatures in Mexico reaching 40 degrees Celsius (Garrison, 2021 & Mendez, 2021). The high temperatures and dry weather have led to 6 224 wildfires between January and June 2021, which is an increase from 5 551 wildfires throughout the whole of 2020 (Mendez, 2021). Drought in

Mexico had provoked a food crisis, with the loss of countless corn crops, an increase in food prices and the fact that farmers were struggling to grow enough fodder to feed their cattle (Mendez, 2021). Additionally, hospitals were full of people suffering from severe malnutrition (Mendez, 2021). Drought in Mexico has destabilized the agricultural industry, thus making the country dependent on foreign agriculture (Mendez, 2021). For example, Mexico imports 50% of the food that the population consumes, which reduced its possibility of becoming a self-sufficient nation (Mendez, 2021).

2.5.3 Drought in Brazil

According to the Atlas of National Disasters, Brazil has recorded close to 17 000 drought events in 2 944 municipalities between 1991 and 2010 (Sena *et al.,* 2014). These drought events have displaced 48 million people and caused the deaths of 2 475 individuals (Sena *et al.,* 2014). Between March and May 2021, dry weather in Brazil had led to a 267 km^3 water shortage in lakes, aquifers, rivers and soil as compared to the seasonal average of the past two decades (Getirana *et al.,* 2021). Furthermore, most of the major reservoirs in Brazil have reached less than 20% capacity, with an estimated 140 000 farmers being affected by the drought (Getirana *et al.,* 2021 & Vara & Mano, 2022). In Southern Brazil, soybean farmers have been experiencing a prolonged drought that some scientists believe will wipe out 90% of their harvest (Vara & Mano, 2022). Some farmers in the Rio Grande de Sul province have estimated a 35% loss of the soybean crop, which equates to 15 million tonnes, which is a decrease from 21 million tonnes (Vara & Mano, 2022). Additionally, severe heat and dryness have led to a nationwide decline of soybean output to 33-34 million tonnes, which is a decrease of 10-11 million tonnes (Vara & Mano, 2022). Moreover, farmers from Brazil's northwest region stated that they only collected six 60kg bags of soy per hectare, as compared to sixty 65kg bags per hectare in previous years (Vara & Mano, 2022). As a result of the drought and consequently low yields, soybean prices have increased by 67% from June 2020 to May 2021 (Getirana *et al.,* 2021). Additionally, Brazil's coffee prices have also risen by 30% since July 2021 (Getirana *et al.,* 2021).

According to the Ministry of Monitoring Committee, Brazil has recorded its lowest precipitation levels in the last 91 years from September 2020 to June 2021, which has impacted water supplies and electricity generation (Chaves & Ennes, 2021). For example, Brazil has the world's second largest installed hydroelectric power capacity, as it produces 65% of the country's electricity, however, due to the drought, electricity prices have increased by 130% (Getirana *et al.,* 2021). In Brazil, migration has intensified as more severe and frequent

droughts arise, which could increase the risk of water insecurity, as well as poverty and unemployment in the major cities (Getirana *et al.,* 2021). For example, the Acre Provinces in Western Brazil has been experiencing its second worst drought in record history with extremely low water levels, which caused thousands of individuals to leave their homes (Getirana., *et al,* 2021). Brazil's drought crisis poses a threat to the survival of humans, wildlife and the agricultural industry (Chaves & Ennes, 2021). It also increases the risk of forest fires, decreased air quality and it affects the ecosystem (Chaves & Ennes, 2021).

2.5.4. Drought in Botswana

Botswana is one of the world's most drought-prone countries with increasing temperatures and low levels of rainfall (EU, 2021 & NRC, 2022). Globally, Botswana has a drought risk index of 3.6 and has been identified as one of the most vulnerable countries to drought, extreme temperatures and a decrease in water and food availability (Tiseo, 2022). An estimated 10 million people are affected by the on-going drought in Botswana (EU, 2021). Furthermore, the low levels of precipitation have resulted in crop production losses and crop failure within Botswana (EU, 2021). For example, 30% of farmers reported wheat crop losses on a national level, whilst at a household level – small-scale farmers witnessed a 25% decrease in maize production (Fisher *et al.*, 2015). Additionally, 70% of farmers reported a decrease in fruit and vegetable production compared to 40% in 2019 (NCR, 2022).

According to NRC (2022), farmers who rely on rain-fed agriculture and who do not have access to irrigational water have been impacted the most by the drought. Moreover, subsistence farmers reported the inability to feed their livestock because of the drought, water shortages and increasing prices of fodder, which forced the farmers to sell their livestock at reduced prices (NCR, 2022). For example, the region of Ngamiland in Botswana recorded the deaths of 40 000 cattle with an additional 20 animals dying every week as a result of water shortages and prolonged droughts (Davies *et al*., 2017). In Botswana, farmers have witnessed a decrease in income, due to detrimental crop losses. Furthermore, drought has had socio-economic consequences that has impacted the people of Botswana. For example, 81% of food vendors have acknowledged a rise in food prices since June 2021, whilst 56% reported that the increase in prices have affected the quality and quantity of food purchased (NRC, 2022). Additionally, drought conditions have also increased displacement, with 1 in 5 household members being forced to migrate in search of employment and economic opportunities (Davies *et al.,* 2017).

2.6. The Impacts of Drought on Agriculture

The past three decades have been the warmest in history, and each decade has been hotter than the previous one (Ochieng *et al.*, 2015). For example, in June 2022, Spain had recorded unusual temperatures of over 40°C. Additionally, the severity of climate change over the last 30 years has put the agricultural sector in many developing countries at risk of becoming food insecure (Niyogi, 2018). Present and future impacts of drought are expected to rise as temperatures continue to increase and precipitation becomes more unreliable (Ochieng *et al.*, 2015). The rising temperatures would expose millions of people to drought, hunger and food insecurity. For example, drought will have a negative effect on food security, with an estimation of 5 to 170 million people being at risk of hunger by the year 2080 (Masipa, 2017). Climatic unpredictability will always present a threat to food security - through its effect on crop production, soil moisture, rainfall and drought. Additionally, climate change aggravates the risks of malnutrition and hunger through extreme weather events, as it increases the intensity and frequencies of floods, storms and droughts (Qazi, 2019). These climatic disasters can lead to the destruction of crops, agricultural equipment and infrastructure, which will have an adverse impact on food access (WFP, 2019).

Due to climate change, seasons are now changing - they are getting hotter and sometimes they start earlier than expected (Simmons, 2019). Therefore, drought and warmer seasons could cause obstacles such as an increase in pests and diseases. Many pests, insects, fungi and weeds flourish under warmer temperatures and increased CO_2 levels (EPA, 2017). For example, large locust swarms have destroyed crops in Eastern Africa, especially in Nigeria (George, 2020). Additionally, the scorching heat and drought had caused grasshoppers to invade 30 000 hectares of crops in Sardina, Italy (Bertacche, 2022). The distribution and ranges of pests and weeds are likely to rise as a result of droughts. Additionally, drought and insufficient water levels in the soil can cause plants to lose their biological functions and become even more susceptible to diseases, insects and pests (Zayan 2019). For example, changing climatic conditions affects the "disease triangle", which involves a pathogen, the presence of a susceptible host and suitable environmental conditions (Zayan, 2019). If the warmer temperatures surpass a crop's optimal temperature - harvests could decrease or an invasion of pathogens might occur (Zayan, 2019). Drought and higher temperatures alter exposures to some toxins, pathogens and carbon dioxide. This can decrease zinc, protein, iron and other micronutrients in certain crops (UN, 2020).

2.6.1. Agriculture and the Sustainable Development Goals

On 25 September 2015, 193 members of the United Nations adopted the *17 Sustainable Development Goals* (SDG) of the 2030 Agenda for sustainable development (FAO, 2019). It is expected to guide the actions of countries over the next 15 years (2015-2030). One of the SDGs is ***Goal 13: To take urgent action to combat climate change and its impacts –*** every country is experiencing the drastic effects of climate change. Due to the changing weather patterns, rising sea levels, increased greenhouse gas emissions and extreme climatic disasters, such as drought – the agricultural industry has been affected and national economies have been disrupted (UNOOSA, 2019). Additionally, greenhouse gas emissions are more than 50% higher than in 1990 (UNDP, 2020). Furthermore, global warming is causing long-term changes to the earth's climate system, which could cause irreversible damage to the agricultural industry if no action is taken (SDGF, 2014).

2.6.2. Droughts and Agricultural Practices

Rising temperatures and droughts usually occur simultaneously. Heat waves, which are on the rise as a result of climate change, could directly threaten subsistence farmer's livestock (EPA, 2017). For example, the heatwaves in USA and Europe have impacted global grain supplies (Bertacche, 2022). Additionally, in 2011 high temperatures and low rainfall caused $1 million heat-related losses to agricultural subsistence farmers in the United States of America (EPA, 2017). Heat stress directly and indirectly affects animals, which causes an increase in vulnerability to diseases and can reduce fertility (Masipa, 2017). Drought may also threaten feed supplies and pastures and it reduces the amount of quality fodder available to grazing livestock. Some regions experience longer, more intense droughts as a result of higher temperatures. For example, in Africa, malnutrition has reached unprecedented levels because of water scarcity and the recurring drought, which has affected 80% of rice growing areas (Logan, 2015). Drought has a greater effect on extreme poverty and hunger within rural communities, who did the least to cause it. According to Masipa (2017), agricultural productivity in Sub-Saharan Africa will decline from 21% to 9% by 2080. About two-thirds of Africa's arable land is expected to be lost by 2025, because of the drought and the lack of rainfall (Masipa, 2017).

More carbon dioxide in the atmosphere can increase crop harvest in some areas, since plants use carbon dioxide to make their food (Cho, 2018). However, severe drought and heat stress can offset plant growth. Changes in temperature and atmospheric carbon dioxide could have major impacts on crop production. For certain crops, the effects of climate change depend on

the crop's optimal temperature for reproduction and growth (EPA, 2017). In some regions, rising temperatures may benefit the types of crops that are planted there, or it may allow farmers to move to crops that are grown in hotter areas (EPA, 2017). On the other hand, if the higher temperature surpasses a crop's optimum temperature, harvests will decrease. Additionally, drought and hotter weather will lead to faster evaporation, which will result in water shortages for irrigational purposes (Cho, 2018). Increasing temperatures cause soils to become drier and in some cases moisture within the soil may also be reduced.

Findings from Cho (2018) revealed that aquifers are being drained faster than they're refilling in places such as India and Pakistan. Depletion of groundwater is slowly building pressure on the world's food systems. Droughts also impose many health-related issues because of the scarcity of water and the poor quality of drinking water (CDC, 2020). A decline in river and stream flow can increase pollutants in water which can affect the health of humans and livestock (CDC, 2020). Higher water temperatures in reservoirs and lakes result in a reduction of oxygen, which will affect water quality and aquatic life (CDC, 2020). A decrease in oxygen levels from runoff caused by drought-related wildfires could end up killing aquatic life (CDC, 2020). Additionally, the 4th IPCC National Climate Assessment Report states that severe heat, warming temperatures, major droughts and wildfires will increasingly threaten livelihoods, disrupt agricultural production and reduce food security quality and price stability (Simmons, 2019).

An example of how drought impacts agricultural production can be seen in Italy. Since 24 March 2022, Italy has been severely hit by one of its worst droughts, with the country's largest river Po reaching its lowest levels in the past 70 years (Bertacche, 2022). According to Amante (2022) & Bertachhe (2022), Northern Italian areas are at risk of loosing half of their agricultural yields due to the drought, whilst local farmers have reported that the water crisis has threatened their rice crop productions. Additionally, failure from crops, such as wheat, sunflower and corn has resulted in a 2 billion Euro loss for Italian farmers, since water availability has been halved (Bertacche, 2022). According to experts, the drought will cause an estimated 30% - 40% decrease in fodder, grain and barley (Bertacche, 2022). Moreover, the drought will exacerbate the surge in production costs for farmers and food prices for consumers (Bertacche, 2022). Due to water shortages, the production of wine, soya and hazelnuts could also be affected (Bertacche, 2022). The Italian Agricultural CIA has demanded immediate action by requesting for emergency irrigation to save crops, such as watermelons and tomatoes, as well as the creation of new infrastructure, such as basins for rainwater storage (Amante, 2022).

2.7. How Does Drought Affect Food Security and its Dimensions?

"Food security exists when all people, at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996). The World Food Summit has identified 4 main pillars of food security. These include food availability, food accessibility, food utilisation and food stability. They guide communities and countries by helping them achieve food security. For food security goals to be recognised, all four pillars must be achieved simultaneously (FAO, 2008). The United Nations Development Report stated that in Sub-Saharan Africa, 1 in 4 households could not access safe and sufficient food (Masipa, 2017).

Food availability refers to the physical existence of food. It addresses the supply side of food security, and it is determined by the level of net trade, stock levels and food production (FAO, 2008). It also looks at the diversity of food as well as the quality and quantity. Food availability can be defined by the adequate quantities of food and suitable quality that is supplied through imports or domestic production (Wheeler & von Braun, 2013). On a countrywide level, food availability is a mixture of domestic food production, commercial food exports and imports, domestic food stocks and food aid (Rio, 2018). On a household level, food availability could be from a family's own production, or it could be bought from local markets (Rio, 2018). Droughts affect food production and agriculture in different ways. These impacts include land degradation, pressure on natural resources, reduced soil moisture, and lack of water resources, which leads to a decrease in food availability (Rio, 2018). Changes in precipitation and temperatures associated with drought will bring variations to crop yields and land suitability (Schmidhuber & Tubiello, 2007). An increase in climate-related disasters, such as droughts could cause a reduction in food products, and a rise in livestock mortality, which ultimately affects food availability (Schmidhuber & Tubiello, 2007). As temperatures increase, so do pests and diseases, thus affecting food availability.

Food accessibility refers to an individual's access to sufficient resources for attaining appropriate foods for a nutritious diet (Wheeler & von Braun, 2013). It can also be defined as the ability of a country, communities and households to acquire adequate food on a sustainable basis (Masipa, 2017). A sufficient supply of food at a national or international level does not mean food security at a household level (FAO, 2008). Food accessibility is about an individual's ability to purchase food in appropriate quantities and quality, and it depends on a household's resources and food prices (Rio, 2018). It can be affected by the social, political and physical environment; therefore, any major climatic disruptions can threaten food

accessibility (Rio, 2018). Many developing countries are affected by droughts, which causes a rise in food prices, affecting food accessibility and food availability.

Food utilisation refers to the way the body makes the most of the different nutrients within food (FAO, 2008). Food utilisation depends on how food is used. It is also argued that although food accessibility and food availability are essential conditions for food utilisation, they are not sufficient enough to reduce malnutrition (Masipa, 2017). It is also about the utilisation of food through suitable diets, sanitation, clean water and health care to reach a state of food and nutritional security where all physiological needs are met (Wheeler & von Braun, 2013). Water plays an important role in agriculture and in the preparation of food. However, due to the occurrence of droughts and dry spells, 884 million people globally have no access to suitable water resources (Rio, 2018). Food utilisation also describes the socio-economic characteristics of a household's food and nutrition security (Rio, 2018). For example, utilisation assumes that food is accessible and available, so therefore the household needs to decide what food is purchased, prepared, how to allocate it and how to consume it (Rio, 2018).

Food stability refers to the sequential dimension of food and nutrition security, particularly the time frame over which food security is being considered (Rio, 2018). Stability of food is given when a household's supply remains constant throughout the year and in the long run (Rio, 2018). Political instability, economic factors and adverse weather can have an impact on a person's food security status (FAO, 2008). Therefore, when obtaining food stability, it is necessary to decrease external shocks, such as epidemics, an increase in food prices, natural disasters and climate change (Rio, 2018). International and national weather conditions are expected to become even more unpredictable, with an increase in climate-related disasters, such as droughts, hailstorms and floods, which could affect food stability (Schmidhuber & Tubiello, 2007). Furthermore, erratic weather conditions bring variations in local food supply and crop yields, which can bring higher risks of soil erosion and landslides - which will adversely affect the stability of food security (Schmidhuber & Tubiello, 2007). To be food secure, a country, household or individual must have access to sufficient food at all times (Masipa, 2017).

2.7.1. The effects of Drought on Food Security

It has been witnessed that climate change is already affecting food security through changing precipitation, increase in temperatures and a higher frequency of extreme weather events, such as droughts (CSIS, 2019). Globally, there is a progressive rise in food insecure nations, with

most of its population residing in developing countries. For example, prolonged drought in developing countries will result in social issues, such as displacement, malnutrition, food insecurity and loss of lives, whilst in developed countries it will mainly cause economic losses (Sena *et al.*, 2014). According to FAO (2019), in 2018, 9.2% of the world's population, which amounted to a little over 700 million people were exposed to severe droughts that affected their food security levels. A deeper look at the extent of food insecurity as a result of drought revealed that an additional 17.2% of the world's population have experienced food insecurity at a moderate level (FAO, 2019). Furthermore, drought could decrease agricultural production by 20% in developing countries, whilst industrial countries could experience a decline of 6% by 2080 (Edame *et al.*, 2011). Across the globe, an estimated 5.7 million children under the age of 5 are on the brink of starvation due to severe drought levels, whilst 13 million children under 18 are facing extreme food shortages (Garmirian, 2021). Combined with conflicts and wars, the covid-19 pandemic and the impacts of climate change - malnutrition and hunger levels have reached a worldwide high (Garmirian, 2021). The UN-FAO annual African Regional Overview of Food Security and Nutrition Report stated that droughts are one of the major factors that contributes towards the increasing number of food insecure people in Sub-Saharan Africa (Ngumbi, 2019). This is because 96% of Sub-Saharan Africa's population relies on rain-fed agriculture (Chigavazira, 2012).

Changing diets and a growing population are increasing the demand for food. Farmers are struggling to keep up as crop yields drop, ocean health decreases and because natural resources, which includes biodiversity, water and soil are stressed dangerously thin (Nield, 2015). The global population is expected to rise to almost 10 billion people by 2050, which means that the demand for food could increase by between 59%–98%, as there could be about 3.4 billion more mouths to feed (Climate Reality, 2018). This means that worldwide agricultural yields need to be increased; however, due to the impacts of drought, the quality and quantity of food supplies would be endangered (Climate Reality, 2018). As mentioned before, agricultural production has an extreme vulnerability towards climate change. For example, droughts can reduce the quality and availability of water for farming, ranches and grazing, which could impact the agricultural industry in a negative way (NIDIS, 2021).

2.8. The Impacts of Drought on Food Prices and Productivity

Rising food prices is going to be one of the most persistent climate-related issues. Although it is difficult to predict the long-term environmental impacts – unpredictable weather means

unstable food prices and decreased productivity (Demarco, 2016). In the last few decades, drought has harmed the global food production and has driven food prices up by 20% (Carrington, 2011). According to the World Bank, the 2008 - 2011 increase in food prices forced an estimated 110 million people into poverty and caused 44 million to become food insecure (Mkhawani *et al.*, 2016 & McLachlan, 2015). For example, it was found that in South Africa, 31% of households experienced hunger with a further 27% being at risk due to rising food prices (Mkhawani *et al.*, 2016). Additionally, Cho (2018) states that in the upcoming years, food products are going to be even more scarce and expensive. Furthermore, surging food prices is viewed as a global problem. The World Food Programme (WFP) reported that climate change combined with an increasing population means that food prices will rise significantly (DeMarco, 2016). Increasing prices and food supply shocks have the power to displace people and threaten governments (Clayton, 2018).

A rise in food prices, low productivity and drought can cause some countries to experience political unrest and food riots (Clayton, 2018). For example, in Syria agricultural issues, climate-related disasters, famine and food price increases quickly spiraled into devastating war and conflict, which claimed almost half a million lives, displaced nearly 7 million people and created 4.8 million refugees (Clayton, 2018). Rising food prices due to drought can become a serious burden to many families around the world. Due to the fact that food is a commodity that is traded worldwide, climate-related events in one region could increase prices and cause shortages globally (Clayton, 2018). For example, in 2006, drought in wheat producing countries caused an intense spike in food prices (DeMarco, 2016). For instance, USA produces 40% of the world's corn so climate shocks such as droughts can influence prices around the world (DeMarco, 2016). The 2019 IPCC Land Use Report had stated that 25% to 30% of food produced globally is wasted each year (Simmons, 2019). These losses cost around $1 trillion and accounts for 10% of greenhouse gas emissions from food systems (Simmons, 2019). The best way to decrease these risks to global food supply is to implement plans and policies to cut down GHG emissions.

In South Africa, high temperatures and the drought have considerably influenced food prices. This is because the agricultural system is extremely susceptible to drought (Umraw, 2016). According to the Pietermaritzburg Agency for Community Social Action (PACSA), low-income households are struggling to put food on the table (Umraw, 2016). Studies by PACSA showed that food prices increased severely from November 2015 when the drought began (Umraw, 2016). Further research showed that the overall increase in prices of 36 essential food

items on the PASCA's "food basket" was calculated at 15% which equated to a R243.63 difference from R1 616.97 in September 2015 to R1 860.60 in 2016 (Umraw, 2016). It was discovered that the prices of 25 out of 36 food items increased by 22% during the 2015/2016 drought (Umraw, 2016). For example, the price of a 10kg pocket of potatoes increased by 68%, whilst a 10kg bag of onions increased by 75% (Umraw, 2016). Maize meal is an important item in the South African food chain, as it is the staple diet of the poor, and it is a major source of energy for animal feed (Vink, 2016). The 2015/2016 drought had resulted in smaller maize yields and therefore higher prices, which negatively affected poor people (Vink, 2016). The Bureau for Food and Agriculture Policy had reported that maize meal prices increased by 32% (Vink, 2016). Citrus farmers were also affected by the drought, which led to a surge in the price of fruits, causing an adverse effect to the consumer's pocket (PMA, 2017). In 2016, the lack of rainfall resulted in a decrease of 7.5 million cartons of citrus produce, as compared to previous years (PMA, 2017). Additionally, the scarcity of food and the increase in prices during the drought indicated an economic disaster for poor people and for the South African economy (Vink, 2016). If more droughts occur, food prices in the future will depend on whether farmers will be able to plant and produce enough crops (Umraw, 2016).

2.9. Climate-Smart Agriculture and Drought

Climate-Smart Agriculture (CSA) is an approach for reorienting and transforming agricultural development and food security under the new realities of climate change (Papuso & Faraby, 2013). It helps investors on local, national and international levels to identify agricultural strategies suitable to their locations (FAO, 2014). With the help of climate-smart agriculture, FAO's (2014) goal is to make agriculture, forestry and fisheries more sustainable and productive. CSA interlinks the challenges of climate change and food security. According to the World Bank (2019), climate-smart agriculture tries to achieve 3 outcomes simultaneously – increased productivity, enhanced resilience and reduced emissions.

Increased productivity is about producing more food to improve food and nutrition security and to increase the income of the world's rural poor who rely on subsistence agriculture for their livelihoods (World Bank, 2019). The main aim of CSA is to sustainably increase incomes, productivity, and agriculture without having a negative effect on the environment (Papuso & Farby, 2013). ***Enhanced resilience*** is about reducing a farmer's vulnerability to drought, diseases, pests and other climate-related shocks. It is about strengthening their resilience by building their capacity to grow and adapt to longer term environmental stress, such as erratic

weather patterns and shortened seasons (World Bank, 2019). Specific attention is given to protecting the ecosystem and its services. These ecosystem services are important when maintaining productivity and a farmer's ability to adapt to climate change (World Bank, 2019). Ecosystems provide farmers with water, food, clean air and materials. ***Reduced emissions*** are about reducing emissions for each kilo of food, fuel and fibre that is produced (Papuso & Farby, 2013). It is also about finding ways to draw carbon dioxide out of the atmosphere and to avoid deforestation from agriculture (World Bank, 2019). Trees and soils are managed in ways that maximises their potential to absorb carbon dioxide from the atmosphere (Papuso & Farby, 2013). CSA should help to remove or reduce greenhouse gas emissions.

Climate-smart agriculture focuses on climate change. Unlike other agricultural development methods, CSA systematically incorporates climate change into the development and planning of sustainable agricultural systems (Papuso & Farby, 2013). It is important that CSA interventions do not contribute to their degradation. CSA also considers the interactions and exchanges that exists between productivity, mitigation and adaptation (World Bank, 2019). Transition to a more sustainable food system is important, while at the same time, farmers need to adapt to climate change (Niyogi, 2018). Rural communities that are extremely food insecure or vulnerable to the changing climate will highlight adaptation and they will need to make changes to enhance resilience and increase efficiency and productivity (Niyogi, 2018). The agricultural sector in third world countries must undergo a transformation to become more climate-smart in order to prevent the changing climate from further worsening food insecurity amongst the rural poor (Frank & Buckly, 2012). To adapt to drought, small-scale farmers will need new and improved knowledge, skills and technologies. These include, rainwater harvesting, improved water management, use of renewable energy, soil erosion control, soil conservation and soil stabilisation techniques (Frank & Buckly, 2012).

A 3-day event forum that was held in Rome on CSA showcased innovative ways in which farmers around the world were adopting practices to become more climate smart (Niyogi, 2018). It was about how climate-smart agriculture will play a role in addressing any future climate-related challenges, such as drought, and about how it will provide socio-economic and socio-environmental benefits. During this event, the benefits and challenges of the agricultural sector were discussed by a number of stakeholders, such as farmers, private organisations, civil society and the government (Niyogi, 2018). For example, in Niger, a World Bank project was designed to deliver CSA benefits to 500 000 farmers in 44 communities through the distribution of drought-resistance seeds, extended use of agroforestry, conservation agricultural techniques

and more efficient irrigation systems (World Bank, 2019). In West Africa, a local programme involving 13 countries has helped develop 160 climate-smart agricultural changes to staple crops, such as maize and rice. These climate-smart tools included crop processing and post-harvest technologies, training of farmers on CSA and ensuring that communities get access to efficient water harvesting schemes (World Bank, 2019). The CSA project has helped lower greenhouse gas emissions, supported more than 9 million people, and has assisted in making 4 million hectares of land become more resilient and productive (World Bank, 2019). Due to the effects of climate-smart agriculture, income and crop yields have increased by 30% and it has improved food security for about 50 million people in West Africa (World Bank, 2019).

Currently, the World Bank Group (WBG) is increasing its climate-smart agricultural practices. For the first Climate Change Action Plan from 2016 to 2020 and for the upcoming strategies covering 2021 to 2025, the World Bank is committed to helping countries achieve smart-climate agriculture that promote increased productivity, enhanced resilience and reduced emissions (World Bank, 2021). In 2020, 52% of the World Bank's agricultural funding went towards drought mitigation and adaptation (World Bank, 2021). Additionally, the World Bank (2021) has developed more than 10 CSA investment plans that costs around $2.5 billion. These investment plans have the possibility of helping 80 million people in many different countries, such as Pakistan and Afghanistan (World Bank, 2021).

According to Ahmad (2021), Pakistan is one of the most drought-prone countries and is ranked in the top 10 by the Global Climate Risk Index to be adversely affected by climate change. The ongoing drought and dry conditions intensified the effects on livestock and agriculture in vulnerable areas, resulting in water stress and a limited supply of irrigation for crops (Ahmad, 2021). Therefore, the World Bank (2021) introduced climate-smart agriculture to Pakistan. Their main aim was to improve productivity of water for agricultural practices. The organisation did this by installing high-efficiency irrigation systems, which covered 23 500 hectares of land, with an additional 3 677 hectares in progress (World Bank, 2021). Since 2019, a further 11 916 watercourses have been enhanced, 621 ponds have been created and 5000 laser land-levelling units have been set up in the regions most affected by the drought (World Bank, 2021). The project has helped over half a million rural families, it created 15 000 full time jobs and over 5.7 million acres of agricultural land have been improved by the additional water management systems (World Bank, 2021).

Another country that has been affected by continuous drought is Afghanistan. Recently, the government had declared a national drought on 23 June 2021, with 80% of the country suffering from severe dry conditions (DRC, 2021). However, the country had suffered from devastating droughts in previous years as well. During the 2018 drought, the World Bank (2021) supported the recovery of the agricultural industry by strengthening CSA practices through providing better-quality water, crop and watershed management. According to the DRC (2021), it would take around three years for a farmer to recover from a drought. However, farmers in the Western region of Afghanistan barely recovered from the 2018 drought, and now they have to deal with another disaster (DRC, 2021).

2.9.1. Sustainable Food Systems

According to FAO (2015), a sustainable food system tries to deliver food and nutrition security to everyone in such a way that the environmental, social and economic bases are upheld so that food and nutrition security for future generations are not compromised. A sustainable food system is viewed as a dynamic process in which reaching food security at present should also contribute to food security for the future (FAO, 2015). Furthermore, the definition acknowledges the importance of maintaining sustainability at every stage of the food system, which includes; agricultural production, manufacturing, transportation, food waste management, storage and consumption (FAO, 2015). According to FAO (2015), farming has the potential to play a vital role in the agricultural sector through mitigation. Therefore, the sustainable food system is classified as 'climate-smart', which increases agricultural productivity, enhances climate resilience and reduces GHG emissions. A food systems sustainability is influenced by human and natural factors that interact with each other (FAO, 2015). For example, the availability of land and water for food production is impacted by human actions, whilst human decisions are influenced by environmental conditions (FAO, 2015).

Achieving sustainable food systems depends on the success of other elements, such as wastage of food, 100% accessibility to food and the sustainable development goals (FAO, 2015). According to FAO (2015), the SDGs could help monitor the progress of the sustainable food system. ***Goal 2: To end hunger, achieve food security and improved nutrition and promote sustainable agriculture –*** the number of undernourished people started rising in 2015 and today more than 820 million people are food insecure and another 135 million suffer from severe hunger (UN, 2020). This is mainly due to economic recessions, conflicts, climate change and most recently the Covid-19 pandemic. According to the WFP, Covid-19 could put another 130

million people at risk of suffering from severe food insecurity by the end of 2020 (UN, 2020). With more than a quarter of a billion people possibly at the brink of starvation, immediate action needs to be taken to provide food and humanitarian aid to the most vulnerable regions (UN, 2020). Therefore, increasing agricultural efficiency and sustainable food production is vital in trying to eradicate extreme poverty and hunger, since agriculture provides jobs, income and livelihoods to 40% of the earth's population (UN, 2020).

2.10. The Gender Dimensions of Drought and Agriculture

There are many invisible and visible factors that affect a women's vulnerability in the field of agriculture, which contributes to their households being food insecure (Menale, 2014). Globally, an estimated 43% of agricultural labour in developing countries are women, which makes them the driving force of the food production system (Sultana, 2020). For example, 60% of women in Sub-Saharan Africa and South Asia work in the agricultural industry (FAO, IFAD & WFP, 2021). Additionally, in South Africa, women make up 61% of the population that is involved in agriculture (Hart, 2010). Evidence suggests that female-headed households are disadvantaged when it comes to the accessibility of livestock, land, equipment, health, finance, training, markets and extension services (Menale, 2014). Additionally, traditional customs about asset division usually contribute towards the marginalisation of women (Menale, 2014). These cultural practices and patriarchy cause women to have a low security in ownership of assets, decreased human capital and a decline in income opportunities, which in turn affects their livelihoods. For example, in Kenya, land deeds have always favoured men due to traditions (Menale, 2014). Additionally, in Mali, only 5% of women are titled landholders (Mourdoukoutas, 2016). Even though, the legal system has changed, women still shy away from claiming their legal rights because of old customs and social norms (Menale, 2014).

Due to past policies, women did not have the same educational opportunities as men. In rural areas, education affects food security through the unavailability of climate change information and sustainable agricultural practices (Mutisya, 2016). In urban areas, women who lack education, will in turn have fewer employment opportunities and decision-making skills. These factors have effects on the availability, accessibility, stability and utilisation of food for women (Mutisya, 2016). Therefore, female-headed households with education deficits, are more likely to be food insecure, because of their low purchasing power or lack of agricultural knowledge. Furthermore, in some cultures, the men are served first and if there is any food left over, women eat. In other cultures, men are served bigger portions of meat, rice or vegetables. According to

Babatunde *et al.*, (2008), drought, unequal access to land, the changing climate, unproductive resources and a lack of money due to past policies can cause women to be food insecure. Furthermore, unequal access pushes women more and more to the edge of society, which increases their vulnerability (de Schutter, 2009).

It is clear that men and women experience the impacts of climate change differently because of their socially constructed responsibilities and roles. For example, in addition to their agricultural work, women are also burdened with household chores and family responsibilities - which has increased during the covid-19 pandemic (FAO, IFAD & WFP, 2021). Gender-differentiated impacts of climate change is noticeable amongst rural women as they rely more on biomass, such as wood, forest resources and agricultural crops (FAO, 2018). In developing countries, the changing climate affects availability of surface water, and since rural women are usually the ones who fetch water, they have to walk greater distances to collect it. (FAO, 2018). For example, a mother and daughter in Somalia used to walk 40km daily to collect water (Svesson & Rex, 2022). Scientists reported that 37% of Africa's population is more than 30 minutes away from a safe drinking water source (Mourdoukoutas, 2016). Additionally, in rural Kenya a study revealed that 78.8% of women were more likely to be affected by a decrease in freshwater (Njenga *et al*, 2012). According to Svesson & Rex (2022), drought could exacerbate the risks of gender-based violence. This is because women and girls walk long distances to fetch water, which puts them at risk of assault and exploitation (Svesson & Rex, 2022). Additionally, the United Nations (2017) stated that it is important to understand the relationships between the impacts of drought and the persistence of violence against women, which includes socio-cultural practices, such as child marriages. For example, economic hardships and the prolonged drought in Mozambique have led to parents marrying of their teenage daughters because there will be one less person to feed (United Nations. 2017). As a result of the drought in Mozambique, 14% of girls are married before the age of 15 and 48% are married before they are 18 years old (United Nation, 2017).

When there is prolonged drought, women spend more time looking for water which limits their time for planting crops (Njenga *et al.*, 2012). Rural women depend more on ecosystems for food security than men do. They are more vulnerable to the impacts of climate change, since they are more involved in agricultural practices, management of natural resources and they have fewer options of adaptation (Ki-Moon, 2015). For example, there have been reports that show links between female mortality and climate-related disasters, with women and children more likely to die during these climate events (FAO, 2018). Women lack human capital, social

capital, availability and accessibility to technology, formal rural institutions and agricultural advisory services (FAO, 2018). These factors play a major role when women have to make climate-related decisions or adopt climate-smart agricultural practices. With every catastrophic event, such as drought, conflict and the covid-19 pandemic, there is risk of widening the gender gap in terms of violence, education and employment (Svesson & Rex, 2022). Furthermore, drought has displaced many rural women from their homes, thus making them cross-border refugees (Mourdoukoutas, 2016). For example, droughts and drying river basins in Eastern and Southern Africa have forced many women to migrate and live in refugee camps, which makes them vulnerable to gender-based violence and being trafficked for sex (Mourdoukoutas, 2016).

Droughts can have social, economic, environmental and health impacts on women in developing countries (Tichagwa, 1994). According to Sahu (2019), rural women are affected the most during a drought because of food and water shortages, loss of income and a variety of health problems resulting from it. For example, a study conducted in Brazil on gender differences and health reported that there were higher levels of anxiety in women living in areas affected by drought, which therefore impaired their roles as providers (Sena *et al.*, 2014). Studies show that during a drought, the availability and accessibility of food and water is critical for female-headed households (Sahu, 2019). However, the effects of drought on these households can vary, depending on their geographic location and the local socio-economic conditions (Sahu, 2019). Droughts contribute towards a decline in food supply for consumption and for selling, which leaves rural women hungry, malnourished and with a reduced physical capacity to work (Tichagwa, 1994). During a drought, migration of males occurs more frequently, which creates an increase in the women's workload, as well as their stress levels (Tichagwa, 1994 & Sena *et al.*, 2014). For example, droughts can decrease livestock and deplete pastures, resulting in women ploughing the fields by hand, which reduces the cultivated area (Tichagwa, 1994). It also results in a decrease towards water management systems, which forces women to collect water from remote areas (Tichagwa, 1994). For example, in Malawi during the drought, women were forced to fetch low-quality water because the nearby boreholes were dried up (Parker, 2016). Rural women are affected by drought due to lack of clean water and changes in diets, which could also cause health related issues, such as fatigue, fever and reproductive problems (Sahu, 2019).

According to Tichagwa (1994), programs should be put into place to help women meet their food needs and to make them more environmentally sustainable. Additionally, Tichagwa

(1994) states that in many countries, droughts occur more frequently, therefore the government needs to have contingency programmes, such as food banks and a tangible food distribution and storage systems in place. For example, the World Bank responded to drought in Somalia by setting up livelihood support groups for women (Svensson & Rex, 2022). During this project, displaced and marginalised women received farming tools and seeds that they used to enhance their livelihoods and promote sustainable farming practices (United Nations, 2022). Furthermore, in Botswana, environmental projects, such as reforestation, controlled grazing systems, construction of dams for irrigation purposes and creation of silt traps were implemented for drought prevention (Tichagwa, 1994). Another programme in the Sahel Region called Women Empowerment through Climate Resilient Agriculture helps female farmers use new technologies and techniques to decrease crop wastage and to ensure that their harvests are able to survive drought events (Mourdoukoutas, 2016). The projects implemented in Botswana, Somalia and the Sahel Region will empower rural women and help them adapt better to drought conditions. Additionally, governments should develop opportunities for women to earn an income, which is not entirely dependent on agricultural production (Parker, 2016). According to Svensson & Rex (2022), a systematic approach is needed to support women throughout their lives. Therefore, the sustainable development goals were implemented and ***Goal 5 deals with gender equality***. This goal aims to achieve gender equality and empower all girls and women and it plans to end all forms of discrimination against them (United Nations, 2020). The SDG- Goal 5 was implemented to give women equal rights to economic resources, access to ownership, financial services and natural resources (United Nations, 2020). Just as women are disproportionately impacted by the changing climate, they also play a vital role in preventing climate change (Mourdoukoutas, 2016).

2.11. The Impacts of Indigenous Knowledge and Modern Technology in Agriculture

2.11.1. Indigenous Knowledge in Agriculture (IK)

The lack of scientific knowledge in rural areas created value in the use of indigenous knowledge to manage food security, changing seasons and disaster situations (Siabombe *et al.*, 2018). The term indigenous knowledge (IK) is defined as knowledge that is accumulated over generations and guides human societies in their numerous interactions with their surrounding environments (Mafongoya & Ajayi, 2017). Indigenous knowledge refers to the practices, skills and innovations of rural communities around the world (Mafongoya & Ajayi, 2017). It was

established from experiences gained over centuries and adjusted to local environments and culture. IK is local and was created by people living in those places. According to Siabombe *et al*., (2018), valuable indigenous knowledge of the importance of climate change adaptation and assessment is held by rural societies. Moreover, the knowledge systems are passed on and renewed by future generations, which will ensure the well-being of people by providing food security, early warning systems for drought risk management and environmental conservation (Mafongoya & Ajayi, 2017). IK is verbally transmitted because it is believed that writing it down could change some of its essential properties. Indigenous knowledge is seen as social capital for the poor and is relied upon for food production and to ensure survival. It deals with practical engagements of everyday life and is frequently developed by experiences and trial and error (Mafongoya & Ajayi, 2017). IK is 'real-world' experiences rather than theoretical knowledge. Indigenous knowledge systems can make an important contribution towards sustainable development through the viable use of biodiversity and conservation (Singh, 2008).

Indigenous knowledge methods for agricultural environmental conservation include practices, such as intercropping, shifting cultivation, planting early maturing crops, mixed cropping, minimum agroforestry, tillage systems and planting drought resistant crops (Kumar, 2014). In South Africa, examples of drought resistant crops that continue to grow even though there is no rainfall include, rice, cowpeas and maize (Ngumbi, 2019). These agricultural practices and technologies are used in many parts of Sub-Saharan Africa along with several other farm practices to promote higher harvests levels, while at the same time conserving the environment (Mafongoya & Ajayi, 2017). While facing severe climatic variability, indigenous knowledge has been developed to cope with severe heat and prolonged droughts in rural villages (Kumar, 2014). Therefore, integrating indigenous knowledge into climate change policies can lead to the development of effective mitigation and adaptation strategies that are cost-effective and sustainable (Nyong, *et al*, 2007). IK can promote poverty eradication through traditional food production and conservation and healing through traditional medicinal practices (Mafongoya & Ajayi, 2017). It is viewed as an underutilised resource in many rural areas.

The role of indigenous knowledge systems is a sustainable option for developing countries to decrease the impacts of drought (Muyambo *et al.,* 2017). It equips farmers to deal with drought and it can also provide early warning systems (Muyambo *et al.,* 2017). For example, farmers in the O.R Tambo district in Eastern Cape noticed an army of locusts coming towards their crops, which meant that a drought was approaching (Muyambo *et al.,* 2017). The farmers

explained that predictions of rainfall or drought could be interpreted by looking at the behaviour of different species (Muyambo *et al.,* 2017). For example, the presence of ants during dry periods indicated that the worst of a drought is yet to come (Muyambo *et al.,* 2017). In some villages, farmers and other community members would go up mountains and request the ancestors to bring rain using a traditional dance called Imingqungqo (Muyambo *et al.,* 2017). However, the present generation do not conduct these 'rain ceremonies' anymore.

2.11.2. Modern Technology in Agriculture

Most Indigenous Knowledge Systems disappeared as a result of modern technologies and foreign teachings which aimed to develop goals and solutions for sustainable agriculture (Mafongoya & Ajayi, 2017). The use of western science and modern technologies began in the mid-20th century (Mafongoya & Ajayi, 2017). The consequences of losing IK can be detrimental to rural areas when teachings, skills and expertise are lost. However, some scientists have argued that the promotion of IK is anti-science. Even in Africa, IK has been regarded as being backwards, stagnant and a limitation to modernisation (Mafongoya & Ajayi, 2017). IK is also losing its importance in farming and as a drought risk reduction tool, because the younger generation do not value it anymore (Muyambo., *et al*, 2017). However, in recent times the agricultural industry has experienced a huge technological change. These changes involved sensors, drones and farm management software - which might be the future of farming (Heikkila, 2018). Mentioned below are some of the innovative practices that are changing the world of the agricultural industry.

Urban Agriculture, Smart Design and Vertical Farms – the biggest advantage of urban farming is the utilisation of space. However, the recycled wastewater in urban farming helps with combatting the freshwater crisis and also protects rivers and canals from being polluted (Chatterjee, *et al,* 2019). The use of wastewater for irrigational purposes can decrease the risk of water scarcity and help with the climate threats of floods and droughts (Chatterjee., *et al,* 2019). On the other hand, vertical farming does not change agricultural practices, it only makes it more efficient (Heikkila, 2018). It aims to increase yields and reduce waste. During the practice of vertical farming, crops are grown in a controlled environment, which protects them from climate conditions, such as hail, floods and droughts (Chatterjee., *et al,* 2019).

The Drones and the Bees – it has been recorded that bees are heading towards extinction, and since they play the important role of pollinators - agricultural production could decrease (Heikkila, 2018). In America, drones are being used in trials to enhance pollination efforts by

bees and for automated crop harvests (Heikkila, 2018). Drones can also safeguard crops from the effects of climate change by efficiently mapping out scarce water sources (Njagi, 2019). For example, in Ghana rice farmers use the drone devices to help them adapt to the drought that the country is facing (Njagi, 2019).

Artificial Intelligence and Automation – a company called Smart Ag had invented driverless vehicles to use on farms (Heikkila, 2018). The software application completely automates a grain tractor, which provides farmers with the help they need during the difficult harvest season (Heikkila, 2018). It allows farmers to automate their equipment which will maximise efficiency. Artificial Intelligence Systems (AI) are also used by Chinese farmers to detect diseases in crops and as temperature sensors (Heikkila, 2018). This new technology allows farmers to make decisions about increasing production and to anticipate the concerns of climate change threats, such as floods and droughts (Dedezade, 2019). AI is used to help combat issues of desertification and to conserve the environment (Dedezade, 2019). For example, an Argentinian company developed the first AI index to cover the effects of drought on farmers by analysing the risks that could occur during the crop-growing seasons (Dedezade, 2019).

Blockchain Technology – is used for resource management, such as tracking equipment or machinery maintenance records (Heikkila, 2018). This type of technology will be used to decentralise transactions and execute self-smart contracts (Heikkila, 2018). Blockchain ledgers can be used to record and update the status of crops, such as planting and harvesting to delivery and storage (Heikkila, 2018). Blockchain technology is also used to improve drought management systems and to help with drought fatalities (Poonia., *et al*, 2021).

Genetic Editing - Many farmers are using livestock genetics to improve breeding and increase productivity. The process of genetics uses elements within genes to enhance the animal's health, growth and the ability to utilise nutrients (Cindy, 2018). This genetic technology can reduce environmental impacts whilst increasing production (Cindy, 2018). Scientists have also begun to genetically modify crops that grow more food and require less water (Heikkila, 2018). The plant hormone ethylene plays an important role in drought tolerant crops (Chilcoat & Sander, 2017). Low levels of ethylene result in crops with a higher drought tolerance (Chilcoat & Sander, 2017).

Cloud seeding – is a type of weather modification. It is a process of injecting clouds with nuclear agents, such as silver iodine in an attempt to form precipitation (Arthur & Saffer, 2020).

Silver Iodine is a natural substance that is used to form ice crystals within the clouds (DRI, 2020). It is carried out by aircrafts or ground-based generators (DRI, 2020). Once the silver iodine reaches the clouds, it acts as a condensation nucleus that produces precipitation (DRI, 2020). The United States government and other American industrial groups use cloud seeding techniques to induce rainfall for agricultural purposes (Arthur & Saffer, 2020). The success of this technique is debatable, however, under the right conditions cloud seeding can increase the probability of precipitation in certain drought-stricken regions (Arthur & Saffer, 2020).

2.11.3. The Gap between Indigenous Knowledge and Modern Technology

It is important to bridge the gap between indigenous knowledge and modern technology. For many years, indigenous people have been responsible for the development of some technologies and have significantly contributed to science (Popp, 2018). For example, it has been noted that indigenous knowledge and western science have contributed towards modern technology in the agricultural sector (Popp, 2018). McCown (2001) states that farmers need an intermediary factor between modern technology and indigenous knowledge. Furthermore, bridging the gap between scientific and indigenous knowledge will advance the understanding in climate change vulnerability, mitigation and adaptation (Raygorodetsky, 2012). For example, UNDP and UNESCO have workshops to promote the respect of indigenous knowledge and to empower rural communities to have a greater say in developing international, national and local policies of climate change and modern agricultural practices (Raygorodetsky, 2012). For rural communities, these workshops provide opportunities to gain knowledge and experiences on global climate processes (Ravgorodetsky, 2012). Some rural people used indigenous knowledge to learn about climate-related experiences whilst others enhanced their scientific technology by using climate models and field work (McCowen, 2001). However, there is still a large gap between modern technology and indigenous knowledge.

2.12. Governmental Responses and Future Research

Like many developing countries, South Africa is vulnerable to the impacts of climate change. Therefore, the country has to balance the growth of the economy with the sustainable use of environmental resources whilst responding to climate change (SACCR, 2017). The lack of water is the ultimate medium to which climate change is being felt in South Africa. Since 2015, South Africa has been experiencing a serious drought, which has affected crop losses, food and water security and has caused water restrictions. Moreover, the drought has had the most

detrimental effect on small-scale farmers and rural communities. In 2015/2016, the South African government had set aside R300 million for commercial farmers that were affected by the drought, and they had given some feed to small-scale farmers for their livestock (BCC, 2015).

The South African constitution also states that "everyone has the right to clean water and proper sanitation" (Young, 2021). Therefore, in 2000, the government had established a Free Basic Water Policy, which directed city officials to provide low-income households with a sufficient amount of water at no additional costs (Young, 2021). Furthermore, since the 1990s, access to water has increased in South Africa; however, it is still viewed as a major issue with more than three million people still not having access to a safe basic water supply (Young, 2021). Additionally, South Africa's National Climate Change Response White Paper (NCCRWP) and the National Development Plan (NDP) shows a vision for an effective response to climate change (SACCR, 2017). They address the observed and instant threats that climate change has on the economy, society and the environment. The South African NCCRWP monitors, evaluates and reports its progress in response to climate change and its reduction of greenhouse gas emissions. It is important for the South African government to adopt a more interdisciplinary approach to the changing of climatic conditions on all levels of formal education (SACCR, 2017). Climate change is a complex topic and therefore, all subsistence farmers should be informed of its effects and ways of dealing with it.

On behalf of the South African government, the Minister of Environmental Affairs had signed the Paris Agreement on Climate Change at the United Nations in 2016 (DFFE, 2016). The Agreement was created as a resolution for climate change by the United Nations in Paris from 30 November 2015 to 13 December 2015 (DFFE, 2016). Globally, the Paris Agreement is considered an influential point in the development of the United Nations Framework Convention on Climate Change (UNFCC) regime (DFFE, 2016). Its aim is to guide international efforts to limit greenhouse gas emissions, to decrease global temperatures by 2 degrees Celsius and to fight all challenges associated with climate change (DFFE, 2016). The Paris Agreement is also an important tool in developing countries that is used to minimise damage and loss from climate change and to promote climate resilience (DFFE, 2016). South Africa has already taken steps towards combatting climate change by significantly investing in public transport, renewable energy, land restoration initiatives, efficient energy methods and proper waste management systems (DFFE, 2016). The country is also trying to lower its carbon

emissions and to adapt to the impacts of decreasing rainfall and rising temperatures (DFFE, 2016).

Drought causes major impacts on food security; therefore, these conditions often require governmental interventions in the form of emergency food relief and donations of food aid (FAO, 2018). In many countries, drought preparedness by the government is usually in the form of creating food assistance to compensate for the shortfalls in agricultural production and emergency relief. For example, the World Food Programme (WFP) works with different governmental organisations, researchers, international partners and local communities to understand and analyse the impacts of climate change (Viola, 2020). Furthermore, the World Food Programme is the world's largest humanitarian organisation, and it is the 'food-assistance' part of the United Nations, which addresses hunger and the promotion of food security (Viola, 2020). Every year, the WFP provides food aid to an average of 91.4 million people in 83 different countries (Viola, 2020). The WFP provides support to vulnerable communities and countries by highlighting and analysing the risks between climate change threats and food security (Viola, 2020). This will help them identify the most vulnerable communities so that specific plans and policies could develop to build resistance and reduce hunger. Donors, NGOs and United Nations Agencies, such as UNICEF, UNEP, WFP, UNDP and FAO's vision is to transform the food and agriculture sector to be more equitable, inclusive, resilient, socially, economically and environmentally sustainable (Viola, 2020).

In the last couple of years, donors and governments have recognised that action needs to be taken in the form of 'farmer organisations', which should increase the ability of small-scale farmers to compete and participate in markets and improve their livelihoods (Frank & Buckly, 2012). However, these organisations often work with limited resources in very challenging environments and therefore, needs external support in the form of skills, equipment, knowledge and finance to fulfil their potential as instruments of pro-poor rural growth (Frank & Buckly, 2012). According to Ochieng *et al.*, (2015), due to the seriousness of climate change challenges, the Kenyan government have put in place the National Climate Change Response Strategy (NCCRS). Its objective is to respond to the opportunities and challenges posed by climate change. The aim of the NCCRS is to build up nationally focused actions towards mitigation and adaption against climate change, by ensuring engagement and commitment of the whole country in combating the impacts of the changing climate (Ochieng *et al.*, 2015). The NCCRS also takes into account the vulnerable environmental, societal, ecological and natural resources.

Protection of the environment has become one of the most important national priorities in the context of Kenya Vision 2030 (Ochieng *et al.*, 2015).

As people around the world feel the effects of climate change, the collective call for action grows increasingly louder. Approximately 15% of natural disaster damages are caused by drought, with it also accounting for 85.8% of livestock losses (United Nations, 2016). According to Harvey (2021), drought is viewed as a global crisis that is at risk of becoming "the next pandemic", if countries do not take imperative action on land, agricultural and water management. Additionally, governments of all countries need to adopt adaptation and mitigation measures to deal with the socio-economic impacts of drought. Furthermore, the present and future climate intervention will assist rural communities with alleviating poverty and sustaining their livelihoods.

CHAPTER THREE - THEORETICAL FRAMEWORK

3. Introduction

This chapter focuses on the theoretical frameworks of the research study. Experts develop theories to draw connections, make predictions, explain phenomenon and to challenge existing knowledge (Vinz, 2015). Therefore, the theoretical framework is a structure that can support or hold a theory of a research study (Trochim, 2006). In this chapter, the theoretical framework describes and introduces the theories that underpin the theoretical foundation of this study. It also aims to explain why the research problem exists (Trochim, 2006). The theoretical framework will be utilised to understand the impacts of drought on the rural communities of Msinga. There has been a number of proposed theories that deal with the issues of climate change, specifically the drought phenomenon and how it impacts the world. However, in this study, the Sustainable Livelihoods Approach and Drought Perception Theory will be discussed.

3.1. Sustainable Livelihoods Approach

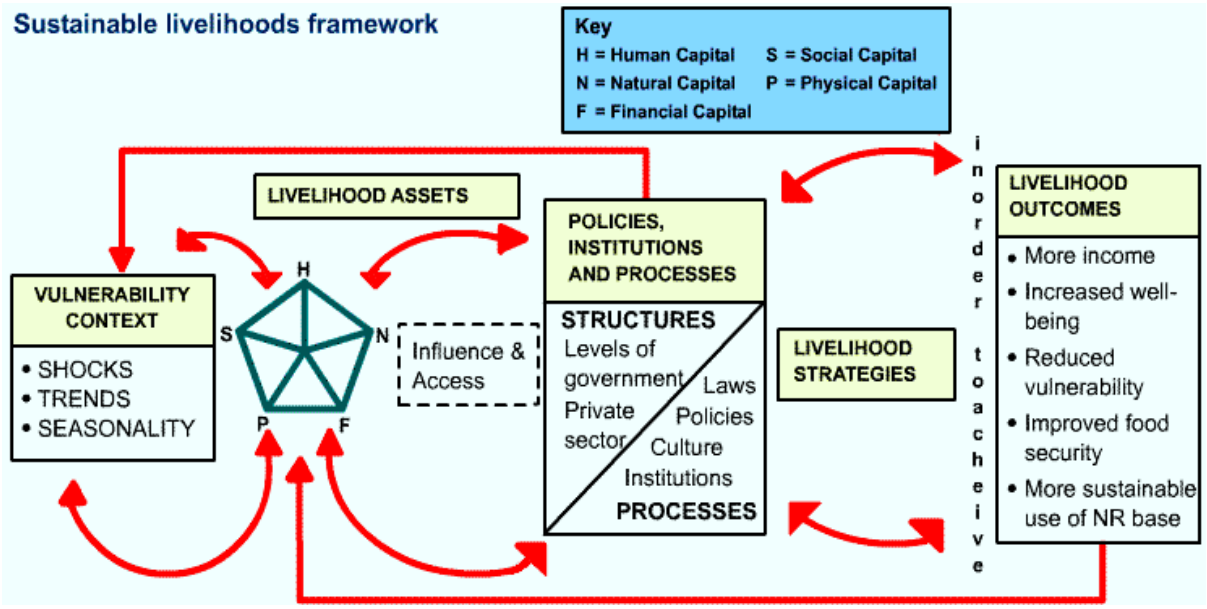
The sustainable livelihoods approach (SLA) was first introduced by the Brundtland Commission of Environment and Development, and in 1992, the United Nations Conference on Environmental Affairs and Development expanded this concept (Krantz, 2001). *Figure 3.1 (below)* presents a diagram of the SLA. The United Nations argued that the SLA was seen as a broad goal for poverty eradication. Additionally, it is viewed as a process of changing and analysing the lives of people living in poverty. The sustainable livelihoods approach is based on the assumption that all people have assets and abilities that can help to develop and improve their lives (Ahluwalia, 2013). It does not aim to address all aspects of the livelihoods of poor people, but it rather offers a more holistic perspective in the analysis of their livelihoods (Krantz, 2001). The SLA identifies issues where an intervention might be strategically necessary for effective poverty alleviation, either at a local or policy level (Krantz, 2001).

3.1.1. What is the Sustainable Livelihoods Approach?

The sustainable livelihoods approach identifies 5 types of capital (Seerat, 2017): - ***1. Natural Capital*** – this includes all environmental services (biodiversity, access to land, fishing and the hydrological cycle) and natural resources (water, air and soil) from which resources flow and valuable services for livelihoods are derived. ***2. Financial Capital*** – this includes savings, credit, debts, cash, pensions, production equipment and wages which is important for the detection of any livelihood strategy. ***3. Human Capital*** – this type of capital comprises of knowledge, skills, ability to work, nutrition, good health and education - all of which is

necessary for the successful pursuit of a livelihood strategy. ***4. Social Capital*** – this involves all social resources (formal and informal groups, social relations, networks and leadership programmes) which people draw on when trying to find a livelihood strategy. ***5. Physical Capital*** – this type of capital includes infrastructure, transportation, secure shelters, energy, tools and equipment, seed fertilisers and technology (Seerat, 2017).

The sustainable livelihoods approach also looks at stresses and shocks. Krantz (2001) defines ***stresses*** as pressures which are cumulative, continuous and to some extend predictable. Examples of stresses include the increasing population, declining of resources and seasonal shortages of certain crops. On the other hand, Krantz (2001) defines ***shocks*** as impacts that are unpredictable, traumatic and sudden. Examples of shocks are fires, death, natural disasters, civil unrest and pandemics, such as covid-19. A livelihood is sustainable when it can cope with and recover from shocks and stresses. It is also sustainable when it enhances or maintains its assets and capabilities now and, in the future, without damaging the environment and its natural resources (Ahluwalia, 2013). The sustainable livelihoods approach also looks at ***policies*** (NGOs and governments), ***institutions*** (political parties, executive agencies and commercial enterprises) and ***processes*** (social norms, customs, gender and decision-making processes) (Krantz, 2001).



(Source: DFID, 2006)

Figure 3.1 Showing a diagram of the Sustainable Livelihoods Approach.

3.1.2. Characteristics of the Sustainable Livelihood Approach

There is no unified method of applying the SLA concept. However, there are 3 basic features (Krantz, 2001). Firstly, the sustainable livelihoods approach focuses on the livelihoods of the poor. Secondly, the approach rejects the conventional methods of only focusing on specific sectors, such as water, health and agriculture. Lastly, the SLA tries to involve poor people in the identification and implementation of activities where necessary. Just like any other theory, the sustainable livelihoods approach also has its advantages and disadvantages. One of its strengths is that it produces a holistic view on what resources are important to the poor (Krantz, 2001). These resources do not only include natural and physical assets, but also human and social capital. The SLA offers a more realistic framework when addressing the direct and indirect effects of rural people's living conditions (Krantz, 2001). Another advantage is that the SLA tries to facilitate an understanding of the primary causes of poverty. It does this by focussing on a wide range of factors at different levels, which indirectly or directly constrain or determine poor people's access to resources, thus affecting their livelihoods (Krantz, 2001). On the other hand, one of the disadvantages is that the SLA usually starts with an open-ended and comprehensive analysis, however, this requires a very flexible planning situation which hardly ever exists (Krantz, 2001). Another weakness is that the SLA does not deal with the issue of how to identify the poor that you are trying to help (Krantz, 2001). The approach does not pay enough attention to the inequalities of power (Serrat, 2017). It also underestimates the fact that improving the livelihoods of one group can undermine those of another (Seerat, 2017).

3.1.3. Drought and the Sustainable Livelihoods Approach

Researchers have stated that the cause of poverty are multi-dimensional and that it comprises of political, social, economic and environmental processes (Booth, *et al*, 2000). Over the past few decades, the sustainable livelihoods approach has been vital to rural development practices (Scoones, 2009). The environmental and development program of the 1980s and 1990s argued that there needs to be a link that focuses on poverty reduction and long-term environmental stresses and shocks, such as drought (Scoones, 2009). For example, Rukema (2010) mentions that rural communities are characterised by few or no buffers against drought; therefore, when struck by drought, Msinga residents cannot afford to absorb the effects of the shocks, thus resulting in greater poverty. Extreme weather events, such as drought and climate variability have negative effects on communities, causing human distress, loss of lives and destruction of natural resources and infrastructure - which could result in the destruction of livelihoods (Steiner, 2004). According to Rukema (2010), low formal education rates, high unemployment

levels and poor economic status is the reason for limited and unstainable livelihoods within the rural communities of Msinga. Additionally, Rukema (2010) states that social capital may not be enough to equip Msinga communities to adjust to external shocks, such as drought. Therefore, finance, health and education systems in Msinga need to be developed to assist with the building of sustainable livelihoods (Rukema, 2010).

For developing countries, the impacts of climate-related disasters, such as drought will place huge amounts of stress on their economies, thus creating a spiral of poverty and debt (Steiner, 2004). However, in these countries, life will be aggravated for those communities who are already susceptible to the impacts of drought. This is because more intense and frequent weather-related events will threaten their livelihoods and impose even greater harm (Steiner, 2004). Therefore, responses to drought in Msinga must include methods that will decrease current vulnerabilities and increase resilience to projected weather changes (Steiner, 2004). Additionally, the sustainable livelihoods approach looks at how different people in different areas live, and it also focuses on the 'real world' and tries to understand poverty from a local perspective (Scoones, 2009).

According to Rukema (2010), one of the main problems in dealing with external shocks, such as drought is the lack of assets, social support and quality livelihoods. Moreover, the quality of livelihoods within the Msinga municipality is poor due to drought (Rukema, 2010). Therefore, Steiner (2004) argues that mitigation measures need to be implemented to address the devastating environmental conditions that weaken their livelihoods and ability to cope with droughts. Furthermore, Steiner (2004) acknowledges that as the quality and availability of resources decrease, so does the security and the sustainability of rural livelihoods. Rukema (2010) argues that if human, social, physical, financial and natural assets are combined and well-managed – it will generate resistance to external shocks, such as drought. When assets are eroded because of drought, the rural communities of Msinga have nothing to fall back on (Rukema, 2010). It is quite evident that drought is occurring more frequently, therefore the rural communities of Msinga need to take the necessary precautions to adjust and prepare for its impacts. However, Rukema (2010) states that there is limited governmental assistance programmes to combat drought-related issues in Msinga.

3.1.4. Case Studies of a Sustainable Livelihoods Approach

In recent times, the increasing intensity of climate change has put a harmful pressure on ecosystems and human life, which in turn leads to a devastating effect on rural livelihoods

(World Bank, 2015). It is evident that in many parts of the world drought will adversely affect socio-economic sectors, which include agriculture, water resources, forestry and fisheries, human settlements, human health, ecological systems and food security (Elasha *et al.*, 2005). Developing countries are the most vulnerable to drought. The use of the SLA for drought shows the efforts of local community's in addressing environmental management issues and food security. The sustainable livelihoods approach is very relevant in addressing the impacts of drought as it helps with the design of policies and the assessment of projects that are necessary for combating adverse effects of environmental degradations (Seerat, 2017).

During the 2015/2016 drought, the rural communities of the Msinga Municipality have witnessed devastating environmental, social and economic impacts of drought (Vanderhaeghen & Hornby, 2016). The drought within Msinga had caused food insecurity and further affected the social conditions of communities due to an increase in inequality, unemployment and poverty (Vukuzenele, 2021). For example, a small-scale farmer named Hambaseni Mncube stated that his family lives through their cattle; however, due to the drought - 40 out of his 70 cows were lost (Vanderhaeghen & Hornby, 2016). In addition to livestock farming, Hambaseni has also planted crops, such as maize, indigenous pumpkin, white beans and wild imfino (Vanderhaeghen & Hornby, 2016). However, due to the lack of rainfall, a broken borehole and the ongoing drought, these crops were destroyed, which therefore impacted his livelihood (Vanderhaeghen & Hornby, 2016). According to Vanderhaeghen & Hornby (2016), small-scale farmers within the Msinga Municipality have acknowledged the need to farm differently, as a result of climate change events increasing. Additionally, a rise in seed and food prices have been an issue for Msinga residents because of the drought, which has affected food security and agricultural productivity (Vanderhaeghen & Hornby, 2016). Furthermore, no water and grass have resulted in cows not being able to produce milk, which further affected food security levels. Hambaseni has stated that the drought and no water meant that farmers had to sell their cattle. Hambaseni also mentioned that some of his family members have migrated to the city in search of work (Vanderhaeghen & Hornby, 2016). According to the rural communities of Msinga, the Aballimi Phambili Farmer Support Programme has helped them during times of drought.

The Aballimi Phambili Farmer Support Programme (APP) has brought drought relief to the rural communities of Msinga, as well as to over 12 500 small-scale farmers in 19 other South African rural districts (Masiwa, 2019). The programme was founded by Lynette Parsons after

witnessing the challenges that small-scale farmers faced, as a result of drought (Masiwa, 2019). These challenges included; poor irrigation infrastructure, no access to credit and markets, unstainable farming practices and a lack of resources and environmental knowledge (Masiwa, 2019). According to Masiwa (2019), the Aballimi Support Programme targets disadvantaged rural farmers and offers them comprehensive support by providing irrigation infrastructure, technical training on drought adaptation measures, access to suppliers and markets and agricultural resources. Furthermore, the programme has helped those small-scale farmers who were affected by drought with poultry production, irrigated cropping, fruit farming and dryland cropping (Masiwa, 2019). In 2017, the Aballimi Phambili Support Programme had approved R11 million worth of loans to 557 small-scale farmers who were impacted by the 2015/2016 drought (Masiwa, 2019). Additionally, the programme had also created over 10 200 permanent agricultural jobs, 2377 temporary agricultural jobs and it provided free training to 9700 farmers on financial management and agricultural production. The Aballimi Programme also provided food aid to those rural communities that were affected by drought (Masiwa, 2019).

Another example of how drought has impacted rural communities could be seen in India. Many rural farmers in the Maharashtra State of India have sunk deeper into poverty due to the on-going drought and lack of rain (Gaikwad, 2020). The Indian State has been experiencing a drought since 2013, which has caused nearly 600 million people to face extreme water stress and severe food insecurity (Vice India, 2022). The drought negatively impacted on livestock, crops, aquaculture, forestry and fisheries and it even caused severe economic and social consequences in the form of adverse health impacts, reduced incomes, trade disruptions and eroded livelihoods (Charabarty, 2016). However, for many subsistence farmers, an NGO called the Naam Foundation came as a ray of hope. The Naam Foundation was launched in 2015 and has worked towards the improvement of farmer's livelihoods in drought-prone rural areas, such as Pune and Latur in Maharashtra (Rujvi, 2017). It is an on-going project which aims to improve the socio-economic status of the poor, especially women and disadvantaged groups (World Bank, 2015). The Naam Foundation focuses on rural development, drip and sprinkler irrigation, educating farmers on the use of stored and ground water, river rejuvenation, group farming and the reviving of abandoned water projects (Rujvi, 2017 & Patekar, 2020). The NGO has promoted water conservation by finding long-term adaptation and mitigation strategies for the impacts of drought (Darshan, 2021). For example, the Naam Foundation has helped 297 drought-stricken villages and over 1.5 million people have benefitted from the water conservation schemes in Pune (Darshan, 2021).

The project was designed to improve the livelihoods of rural farmers. It did this by creating community investment funds, implementation of support and by providing specific livelihood resources (World Bank, 2015). The subsistence farmers were also educated on the dangers of climate change and its effects on food security. Additionally, they received agricultural training for dealing with droughts and floods. Another issue that the Naam Foundation deals with is the increasing number of farmer suicides within Maharashtra (Patekar, 2020). From June – October 2021, approximately 1 076 farmers have committed suicide due to drought, crop failures, low productivity, poor soil health and unpaid loans (NDTV, 2021). For example, in Latur, Sheela Suryavanshi's husband committed suicide as he was unable to repay the loan due to the drought and crop failure, which left her family with hardly any source of income (Darshan, 2021). However, the Naam Foundation had provided Sheela with Rs 15 000 and a sewing machine to start her own tailoring business (Darshan, 2021). As the business grew, she added more sewing machines and started training more women (Darshan, 2021). With her monthly income of approximately Rs 30 000 per month, Sheela provides for her family and pays for her children's education (Darshan, 2021). In addition to the drought, female farmers in Maharashtra were also affected by the covid-19 pandemic and the lockdown (Sharma, 2020). For example, these women used to make and sell leaf plates; however, due to the markets being closed, their livelihoods were severely impacted (Sharma, 2020). Furthermore, during the lockdown, the Naam Foundation distributed four tons of grocery items for one month to 340 drought affected families in Maharashtra (Gaikwad, 2020).

3.2. Drought Perception Theory

This section will present the theoretical foundation for drought. According to Aldunce *et al.,* (2017), droughts are a complex and frequent natural hazard that is expected to increase as a result of climate change. According to Dessai & Sims (2010) & Taylor *et al.*, (1988), perception refers to a range of beliefs, attitudes and judgements, and "in terms of drought, it is influenced by the characteristics of dry weather, as well as by the context of who experiences it". Additionally, Urguijo & De Stefano (2015) define perception as the "awareness of the elements of the environment through physical sensations". Moreover, Taylor *et al.,* (1988) states that environmental perception is viewed as a method of understanding human choices and decisions based on the impacts of climate change. Drought has different meanings and is perceived by farmers based on their physical environment type, level of financial security and involvement in agricultural activities (Udemale *et al.,* 2014). The drought perception theory will be

discussed in relation to how individuals who are impacted by drought perceive it based on four elements: memory, definition, experience and expectation.

3.2.1. The Four Elements of the Perception of Drought Theory

Farmers of the Ogallala Aquifer Region were interviewed in the Western part of United States of America regarding the weather and climate, aquifer conditions, perceptions of drought and the adaptative and mitigation strategies used to cope with these (Taylor *et al.,* 1988). Furthermore, a 1985 research study conducted by Thomas F Saarinen reported four vital elements of drought perception. These included drought experience, drought memory, drought definition and drought expectation.

3.2.2. Drought Experience

The aspects of drought experiences that Taylor *et al.,* (1988) discussed in the study were the meteorological events that took place during the farmer's careers. According to Taylor *et al*., (1998), each farmer's drought experience was measured by using the Palmer Drought Severity Index (PDSI) in their country over the time they were farming. The PDSI is calculated based on water balance using historical records of temperature, storage runoff, precipitation, soil moisture, potential evapotranspiration and current temperature and precipitation levels (Taylor *et al.,* 1988). Additionally, the PDSI categorizes weather conditions for each month according to climatically normal conditions for each location (Taylor *et al*., 1988). For the purpose of the 1985 study, the PDSI was used as a measure of meteorological drought in comparison with a farmer's experiences of drought (Taylor *et al*., 1988). Moreover, Taylor *et al*., (1988) stated that meteorological conditions during a drought has a profound effect on a farmer's beliefs on what moisture conditions are considered normal, dry or wet within a specific region. Additionally, results from the PDSI reported that an individual could farm for several years in a region and still have limited experience of the area's drought potential (Taylor *et al*., 1988). According to Taylor *et al.*, (1988), droughts experienced through oral, pictorial or written forms may also have an influence on a farmer's perception of drought.

A farmer's experiences also influence the way they perceive drought. According to Udmale *et al.,* (2014), farmers generally perceive drought as a natural phenomenon, whilst some perceive it as a mismanagement of water resources by the government. Therefore, understanding the public perception and experiences of drought is an important factor for sustainable water management and identifying adaptation options (Dessai & Sims, 2010 & Aldunce *et a.l*, 2017). Based on findings from Udmale *et al.,* (2014) the perception and experiences of drought is used

to prepare, adapt and mitigate the impacts of drought. Metz *et al.*, (2008) states that farmers perceive reduced rainfall as the main issue of drought. According to Menghista *et al.*, (2018), increase in food prices, drying of water resources, poor health, livestock production losses and mortality, decrease of livestock prices and crop failure contribute to a farmer's perception of drought. A perception index score is used as an indicator to determine a farmer's perception of drought and the government's role in drought risk management (Bahta *et al.*, 2016). A perception index score ranks social indicators based on how farmers perceive their vulnerability to drought (Bahta *et al.*, 2016).

3.2.3. Drought Memory

According to Taylor *et al.*, (1988), drought memory consists of drought events or dry periods that forms part of a farmer's direct experiences. Drought memory focuses on events that can be recalled. Results from the 1985 study revealed that farmers within the Ogallala Region tend to recall the prolonged drought episodes that occurred in the 1930s and 1950s (Taylor *et al.*, 1988). Although these drought events were recalled by majority of the respondents, they did not remember when the droughts began or ended (Taylor *et al.*, 1988). As droughts decrease in frequency, they become less recalled; however, farmers remember most recent droughts by year and the more severe ones by decade (Taylor *et al.*, 1988). Furthermore, analysis of drought memories showed that memories of all, but the most severe and prolonged droughts fade quickly (Taylor *et al.*, 1988). In general, the percentage of farmers that were actively farming during a time that was identified as a drought year was negatively linked to how long ago it occurred (Taylor *et al.*, 1988). The 1985 results revealed that since 1960-1980, there seemed to be a slight meaningful relationship between recorded droughts, memories of drought and personal drought experience (Taylor *et al.*, 1988). For example, majority of the respondents had forgotten about the 1963-1964 drought by 1985. However, the relatively less severe years in terms of drought were frequently recalled, with 42 out of 99 respondents identifying one or more years of drought events in the early 1980s (Taylor *et al.*, 1988).

Taylor *et al.*, (1988) also uses an analogy to further emphasise drought memory by stating that farmers in the Oaxaca Valley of Mexico only remembered the most recent wet years. According to Taylor *et al.*, (1988), the relationship between a farmer's drought memories and the meteorological measures of their experiences was examined by using a regression analysis to control the effect of a fading memory. The study also mentions memory and age, thus, Taylor *et al.*, (1988) acknowledges that the older farmers have experienced more droughts than the younger farmers, therefore they recall more drought events. From the Ogallala Region study,

the percentage of farmers who mentioned the 1930 and 1950 droughts increased with age, with farmers over 50 recalling two or more droughts (Taylor *et al.,* 1988). However, the percentage of farmers who identified drought years in the 1980s reported a reverse pattern that decreased with age (Taylor *et al*., 1988). Moreover, younger farmers also reported less damage from past drought events, since the 1980s drought was not very serious.

3.2.4. Drought Definition

According to Taylor *et al*., (1988), the first-time drought was mentioned in the 1985 study was when the farmers were asked "What do you think of as drought?" This was followed by a series of questions relating to weather and climate, natural disasters and climate change, which meant that answers were expected in meteorological terms (Taylor *et al*., 1988). Results from the 1985 study revealed that majority of the respondents defined drought in terms of decreased rainfall, a dry spell or lack of moisture, whilst some farmers defined it as less than average rainfall and other respondents mentioned high temperatures and an increase in winds and dryness (Taylor *et al.,* 1988). Additionally, some farmers defined drought in terms of crop failure, low crop yields or economic impacts (Taylor *et al.,* 1988). According to Taylor *et al.,* (1988), opinions varied on how long a dry spell must be before it is considered a drought, therefore, some farmers stated that a single season is enough, whilst some said one year, and other farmers specified that a dry period should last at least two years before it is called a drought. Furthermore, the location and the number of years spent practicing agriculture also influenced the farmers definition of drought (Taylor *et al*., 1988). For example, farmers under 40 defined drought as lasting seven months or less (Taylor *et al*., 1988). However, there were some farmers who did not base their definition of drought on location and experience. For example, those farmers who experienced a drought in the 1980s were much more likely to use a short-term definition of drought, whilst more experienced farmers were unlikely to identify the years of less moisture as drought (Taylor *et al*., 1988). The more experienced farmers tended to reserve the word drought for more severe cases.

According to Taylor *et al*., (1998), a farmer's definition of drought duration was not related to their experiences; however, it was consistent with the past droughts that they identified. Furthermore, the spectrum conditions for drought definitions ranged from short and mildly dry to long and severely dry (Taylor *et al*., 1988). According to Taylor *et al*., (1988), understanding the definitions of drought is important when discussing the frequency and identification of drought events. Drought could also be defined by its economic and social impacts (Taylor *et*

al., 1988). There is no specific definition of drought – it has different meanings to different people.

3.2.5. Expectation of Drought

To identify the expectations of drought - farmers were asked via an open-ended questionnaire to describe the climate in their area and to state the advantages and disadvantages for farming (Taylor *et al.,* 1988). The farmers were also asked to estimate the frequency of drought and how severe they expected them to be (Taylor *et al.,* 1988). According to Taylor *et al.,* (1988), the farmers expectations of future drought were linked to their farming locations and their definitions of drought. For example, farmers in the south of the Ogallala Aquifer Region expected more frequent droughts than the farmers living in the northern part of the area (Taylor *et al.,* 1988). Additionally, farmers who used a shorter duration and a less severe definition of drought expected it to occur more frequently (Taylor *et al.,* 1988). According to Taylor *et al.,* (1988), there is a negative relationship between the number of years a farmer has been farming for, and their estimation of drought frequency. Results from the 1985 Ogallala Region study reported that majority of the farmers felt that the frequency of drought was not changing, whilst some respondents felt that droughts had become less frequent and others noticed the frequency of drought increasing (Taylor *et al.,* 1988). However, Taylor *et al.,* (1988) states that farmers who experienced the 1930 and 1950 droughts were likely to feel that droughts had become less frequent. The expected impacts of drought were investigated by the question, "Have you found effective ways to overcome drought losses?" (Taylor *et al.,* 1988). According to Taylor *et al.,* (1988), the responses were related to experience and age; however, farmers over 60 felt that they found ways to overcome drought losses, whilst farmers under 40 found that the impacts of drought decreased due to the improvements of irrigation and agricultural technology.

3.3. General Perception of Drought

The drought perception theory directly links to this research study as drought is one of the most detrimental hazards that affect farmers in rural areas. According to Deressa *et al.,* (2010), climate change will disrupt future weather patterns; therefore, it is important to understand how the rural communities of Msinga perceive and adapt to drought. For example, farmers could perceive drought based on personal experiences or learnings from statistical descriptions and meteorological parameters (Weber, 2010). Additionally, it is necessary to understand how different individuals and rural communities perceive drought and its impacts when dealing with policy and decision making (Aldunce *et al.,* 2017). Yaro (2013) acknowledges that effective adaption to drought in Msinga is dependent on the perceptions of farmers and the experiences

and outcomes of policy makers. Additionally, the perception of drought memory and experiences of different farmers with different characteristics are also important (Yaro, 2013). For example, the elderly population of Msinga have more experience and recall more drought events within the area than the younger population (Rukema, 2010). Furthermore, the rural communities of Msinga have witnessed drought intervals of 2 years, with 1991-2001, 2003-2004 and 2006-2007 being the worst in living memory (Rukema, 2010). Studies conducted by Aldunce *et al.*, (2017) acknowledges that rural communities who perceive drought as a potential risk are more likely to adopt adaptation and mitigation strategies. However, Jarawura (2014) argues that effective adaptation to drought is dependent on a farmer's perception and how it is blended with scientific knowledge and indigenous policies. Therefore, Ishaya & Abaje (2008) argue that it is also important for the rural communities of Msinga to understand the indigenous perceptions of drought and its strategies towards adaptation and mitigation. The perception of drought is also determined by a farmer's interpretation and recognition of environmental phenomenon (Jarawura, 2014). For example, studies show that African farmers are capable of recognizing and understanding the changing climate, as they perceive drought as a common feature that impacts the continent (Jarawura, 2014). Additionally, the rural communities of Msinga have stated that drought has become a daily experience within the area (Rukema, 2010).

Studies based on climate change show that individuals in developed and developing countries perceive drought differently, based on socio-economic and environmental factors (Deressa *et al.*, 2010). For example, Rukema (2010) states that the rural communities of Msinga perceive drought as a serious social and economic problem. Furthermore, the severity of drought is perceived in terms of poverty, unemployment, malnutrition, crop failure and food insecurity (Rukema, 2010). Nevertheless, Msinga communities usually perceive drought through an increase in temperature and a lack of precipitation (Elum & Marr, 2017). However, findings from Akter & Bennet (2009) states that farmers also perceive drought through non-climatic factors, such as loss of biodiversity, water shortages and volume of water stored in reservoirs. Additionally, Urguijo & De Stefano (2015) argue that the type of water source plays a major role in influencing a farmer's perception of drought. A common approach to studying the perception of drought in developing countries is based on comparing farm questionnaires and focus group discussion results with data from meteorological stations (Deressa *et al.*, 2010). This is because drought is perceived as a problem in the agricultural sector, especially when dealing with food supply (Benson, 2009).

According to Deressa *et al.,* (2010), socio-demographic factors, such as age, employment status and education levels also impacts an individual's perception of drought. For example, it is indicated that individuals in Msinga with a higher income are more likely to know about drought and its impacts (Deressa *et al.,* 2010). Furthermore, Udmale *et al.,* (2014) observed a difference in perception of conflicts for water, based on a farmer's education level. For example, a few uneducated farmers in Msinga did not believe in climate change and refused to sell their cattle during the drought, which resulted in economic losses and food insecurity as food prices increased and they could not plant their own crops because of the drought (Rukema, 2010). Adaptation and mitigation strategies are also based on a farmer's education status (Maddison, 2007). Additional factors such as, ethnic background, geographical location, soil types, gender, access to extension services, newspaper readers and membership of environmental groups may also affect an individual's perception of drought (Deressa *et al.,* 2010).

3.3. Linking the Sustainable Livelihoods Approach to the Drought Perception Theory

Drought and its impacts on rural community livelihoods is considered one of the most vital challenges facing human society (Nasrnia & Ashktorab, 2021). Furthermore, drought has severely affected livelihoods in rural areas through social and economic damages. According to Nasrnia & Ashktorab (2021) drought management is regarded as one of the most important priorities in the agricultural industry. It is therefore acknowledged that droughts have considerably influenced rural community's livelihoods and the way they perceive drought. The sustainable livelihoods approach identifies five types of capital, whilst the drought perception theory is based on four elements. Nasrnia & Ashktorab (2021) states that it is important to understand livelihood resilience against drought events and how communities perceive drought. For example, improving the resilience of farmers would allow them to decrease the social and economic impacts of drought (Nasrnia & Ashktorab, 2021). A sustainable livelihood can be used as an integrated development policy for managing sustainable resources and eradicating poverty for rural communities and small-scale farmers (Nasrnia & Ashktorab, 2021). According to Nasrnia & Ashktorab (2021) the drought perception theory and sustainable livelihoods approach have the ability to empower rural communities during a drought.

CHAPTER FOUR - METHODOLOGY

4.1. Introduction

Chapter four will outline the methodological approaches that were used in this research study, and it will present the different research methods that were used during the collection of data. For the purpose of this project, archival data was used; however, this research study was conducted over a period of three years during 2020- 2022. This chapter will begin by discussing some background information about the study area which is the Msinga Municipality in Kwa-Zulu Natal, South Africa. It will also give a brief overview of the climatic conditions, basic services and agricultural practices within the study area. The data that was used for this project was collected using a quantitative research method – which is a process of collecting numerical data. Additionally, collection of data was conducted using a purposive sampling method and a questionnaire - which provided a deeper understanding of the community dynamics. This chapter also consists of a research design and the data analysis.

4.2. Description of Site

4.2.1. Geographic Location & Background Information

The Msinga Municipality is one of four municipalities within the uMzinyathi District (IDP, 2020). Figure 4.2 (*below*) displays the location of the Msinga Municipality. It is located in the northern part of Kwa-Zulu Natal, and it can be found in the town of Tugela Ferry (IDP, 2020). Additionally, the Msinga Municipality is located in the deep gorges of the Buffalo and Tugela rivers (IDP. 2012). The Msinga Municipality covers an area of 2500km^2 with 18 political wards and 36 councillors (IDP, 2020). This area has a total population of approximately 184 494, which is an increase from 167 274 in 2001 (Stats SA, 2011). Additionally, the Msinga Municipality has a total of 38 372 households, which makes up 33% of the total population of the uMzinyathi District (IDP, 2020). The average household size is between 4-6 people with 66.7% being female headed (IDP, 2020). The Msinga Municipality is mainly a rural area, with 69% being traditional land and the remaining 31% is used as commercial farmland (IDP, 2020). Additionally, the population dynamics report that there is a decrease in the number of urban areas within the Msinga Municipality because they cannot provide the same services that are found within an urbanised region (Rukema & Umubyeyi, 2019).

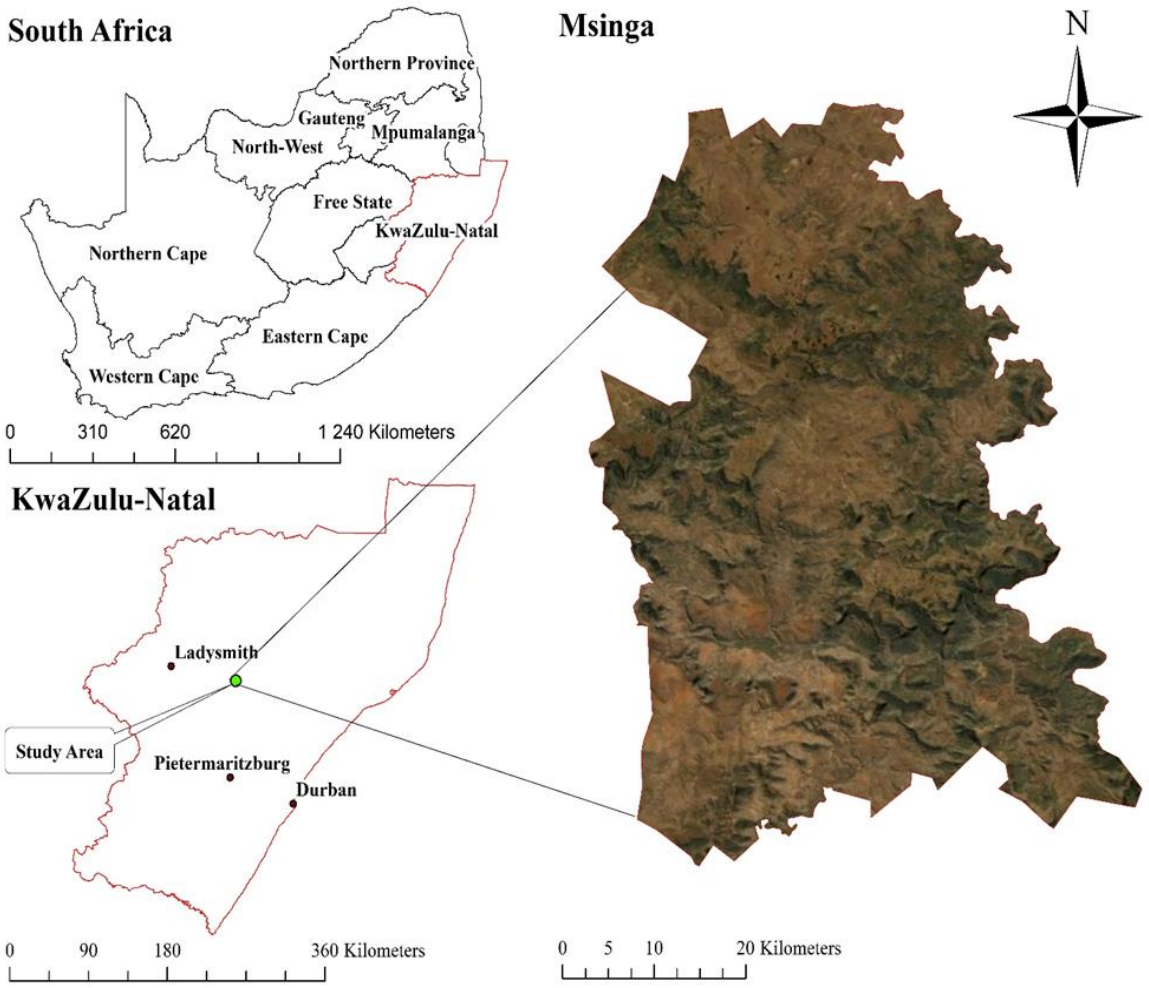


Figure 4.1: Map Showing the Location of the Msinga Municipality in Kwa-Zulu Natal, South Africa.

4.2.2. Basic Services and Infrastructure

The Msinga Municipality is an area that has very limited employment opportunities (IDP, 2020). It is classified as a poverty-stricken area with a lack of infrastructure, few economic opportunities and limited resources, which places a strain on the community. According to Rukema (2010), housing in Msinga mainly consist of traditional mud huts with grass roofs. Plate 4.2 and plate 4.3 *(below)* shows the underdeveloped housing structures within the Msinga Municipality. According to Stats SA (2011), only 23% of the Msinga population has access to clean water. For example, 70% of the population use polluted water from stagnant rivers and unprotected springs (Rukema, 2010). Additionally, some households in the area get water from fire hydrants and boreholes (IDP, 2020). Although, these water sources are sometimes depleted. Furthermore, the Msinga Municipality has a very small percentage of households that have access to electricity (IDP, 2020). In 2007, only 12.8% of households had access to

electricity, whilst in 2011, that number increased to 25% (Stats SA, 2011). However, there is also an estimated 2040 households that use solar energy in Msinga (Stats SA, 2011). According to Rukema (2010), 85% of the population use wood as a source of fuel for cooking and heating Additionally, private households and social services generate 29% of income for the Msinga region (IDP, 2020).

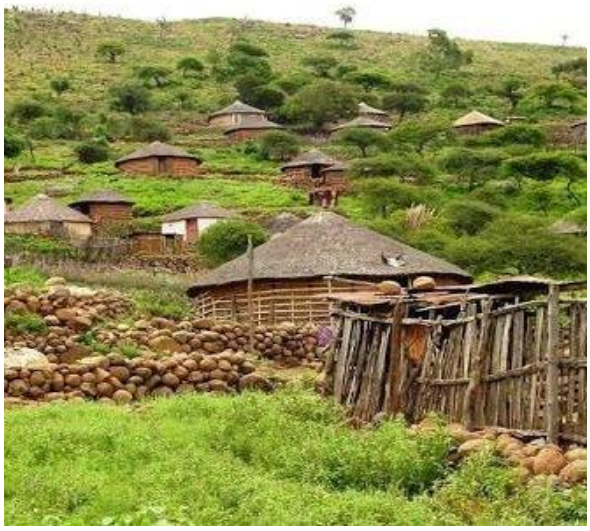


Plate 4.2 & 4.3: Images showing the rural area of Msinga Municipality *(Images obtained from the Official Msinga Twitter Page).*

4.2.3. Climatic Conditions

Most of the South African rural areas, including the Msinga Municipality is semi-arid, and they experience variable weather conditions, that includes extreme events, such as droughts and floods (Vilakazi *et al.,* 2019). Additionally, Msinga is identified as an area with a temperate climate that has mild to cool winters and warm to hot summers (IDP, 2020). A report by the Department of Agriculture states that Msinga temperatures reach between 21ºC – 23ºC in winter and between 27ºC - 29ºC in summer (Rukema, 2010). Msinga gets approximately 600mm of rainfall per annum and falls under the coastal summer rainfall areas (IDP, 2020). Furthermore, the area receives low rainfall in summer, with an average of 82mm -122mm per month, whilst winter months only receive between 2mm – 11mm (Rukema, 2010). The topography of Msinga impacts the climate in the form of annual floods which have claimed the lives of many residents (IDP, 2020). Severe thunderstorms hit Msinga in February 2013. Heavy rainfall and high wind speeds caused flash floods which resulted in extensive damage to infrastructure, housing and agriculture (IDP, 2020). However, the Msinga region is endemic to drought (Rukema, 2010).

4.2.4. Agriculture

A large portion of the Msinga population practices subsistence farming. Plate 4.4 and plate 4.5 *(below)* shows images of agricultural practices within the rural communities of Msinga. Furthermore, it is estimated that 19 999 are agricultural led households (IDP, 2020). Farming makes up 18% of the income for the Msinga area (TBP, 2021). There are various community gardens which is based on 89 hectares of land (TBP, 2021). The Msinga land can be very limited in terms of productivity, as a result of low soil quality, poor agricultural practices and adverse climatic conditions such as drought (IDP, 2020). Furthermore, the Msinga Municipality is predominately mountainous, with loose stones, rolling hills and rocks, which makes farming difficult (Rukema & Umubyeyi, 2019). Only 40% of the Msinga land has the potential for farming; however, subsistence farming remains the main economic activity (Rukema & Umubyeyi, 2019). According to Rukema (2010), staple crops within the area includes; maize, pumpkin, sorghum, sweet potatoes, beans, cabbages and tomatoes. The common natural vegetation of Msinga include; grasslands, shrub trees and aloe plants (Rukema, 2010).

Plate 4.4 & 4.5: Showing images of Agricultural Practices in the Msinga Municipality Area *(Images obtained from the Official Msinga Municipality Twitter Page).*

4.3. Methods

This portion of the methodology contains the research design, sampling methods and the tools that were used during the collection of data.

4.3.1. Research Design

As mentioned in previous chapters, the data obtained for this research study is archival data. According to McKoy (2003) there are two approaches to archival research data. These include analysing data in hand and meta-analysis (McKoy, 2003). Analysing data in hand refers to data that researchers access through work files, community partnerships or previously collected data samples (McKoy, 2003). Analysing data in hand is classified as primary data. Examples of analysing data in hand in this study include; journal articles, official government documents, maps and social media posts. The second approach to archival data is meta-analysis, which is the examination of multiple studies based on the same topic in already published journals (McKoy, 2003). This type of approach is identified as secondary data. An example of meta-analysis in this study could be the multiple journal articles, documents and websites used to acquire data based on drought, rural development, climate change and agriculture.

An introductory meeting was held at the Msinga Municipality. The meeting was aimed at assisting the researcher with understanding the traditions, values and norms of the Msinga community. This meeting was also conducted so that the researcher could plan visits to the area. The meeting was attended by the researcher from the University of Kwa-Zulu Natal and the extension officer that is responsible for the area. The extension officer advised the researcher to work with a local member of Msinga who would assist the researcher with getting a letter of acceptance into the community. During the meeting, the extension officer reviewed the questionnaire. The purpose of the review was to check if the questions were clear, not offensive in relation to the local living norms and not confusing. Where needed, questions were restructured, and some were eliminated or adjusted accordingly. Going through the questionnaire was useful to the researcher as it helped with the questions and to know the estimated time required to complete one of the survey questionnaires.

4.4. Research Instruments

According to Driscoll (2011), a research instrument is any tool that a researcher might use to collect, measure, record and analyse data that is relevant for a particular study. Additionally, Hox and Boeije (2005) argue that social scientists adopt a variety of research instruments and data collection methods, in order to get a better understanding and a more reliable and authentic outcome. Moreover, a research instrument is usually determined by the researcher and the study methodology (Driscoll, 2005). According to Surve (2020), the format of a research instrument consists of checklists, surveys, questionnaires, simple tests and interviews. Additionally, a research instrument needs to be able to answer the research questions, aims and objectives

(Surve, 2020). For the purpose of this research project - primary and secondary data sources were utilised.

4.4.1. Primary Data

According to Hox and Boeije (2005), primary data is original data that is collected for a specific research problem. Furthermore, Formplus (2020) states that primary data is obtained directly from a main source, without having to go through any existing data sources. For example, primary data sources include surveys, interviews and experiments, where the researcher is the first person to interact with the data (Driscoll, 2005). Additionally, primary data is often viewed as objective, reliable and authentic. The advantage of using primary data is that it is specific to the needs of the researcher and the data is current since it is collected in real-time (Formplus, 2020). Another benefit is that the researcher has full control over the primary data that is being collected, which means that they can decide what methods, design, data analysis and tools to use (Formplus, 2020). However, the main disadvantage of primary data is that it is extremely expensive and time consuming (Formplus, 2020). Due to its complexity and required commitment – it may not be practicable to collect primary data (Formplus, 2020). The primary research sources that were conducted for the purpose of this research study was a questionnaire. This primary source of data supported the researcher in gathering first-hand information regarding the rural communities of Msinga.

4.4.2. Secondary Data

In a time when information is becoming more accessible to researchers all around the world, the utilisation and practicality of secondary data has become more prevalent (Formplus, 2020). According to Bhattacherjee (2012), secondary data is information that has been previously collected, tabulated or stored by other researchers. Therefore, secondary data is easily and readily available for researchers, experts and scientists as they are shared on public platforms (Pillay, 2016). Examples of secondary data include; webpages, articles, blogs, books and journals. The advantages of secondary data is that it is affordable, less time consuming and it helps generate new insights of already existing primary data (Formplus, 2020). On the other hand, a disadvantage of secondary data is that it may not be reliable and authentic, which may require the researcher to further verify the information (Formplus, 2020). Another disadvantage is that secondary data sources can sometimes be irrelevant and outdated (Formplus, 2020). When conducting a research thesis, the researcher has to access past information within the field of study to add findings to the literature review (Bhattacherjee, 2012). According to Formplus (2020), theories and definitions are examples of secondary data that are used in a

research project. For the purpose of this research study, journals, books, webpages, blogs, social media and online newspaper articles were used. Secondary data used for this research project included a desktop study of a variety of drought, rural development, climate change and agricultural literature. Furthermore, secondary data helps with the validation of data collected from primary sources and it also assists with disproving, strengthening, or proving previously collected information (Fleetwood, 2020).

4.5. Methodological Approaches

This section consists of the data collection methods that were utilised during the research study.

4.6. Quantitative Research Methods

Quantitative research is a process of analysing and collecting numerical data (Bhandari, 2020). It is used to make predictions, to find averages and patterns of results and to test statistical, mathematical or computational techniques (Bhandari, 2020). Quantitative research methods are usually conducted in social sciences using calculated techniques (Fleetwood, 2020). The collection of information in a quantitative analysis is what sets it aside from other research methods (Pedamkar, 2020). It can be defined as a logical investigation of phenomenon that collects data from potential respondents using surveys, experiments or questionnaires (Fleetwood, 2020). A quantitative research structure is predicted using a scientific approach with results being in a numerical form (Pedamkar, 2020). Results that are attained from a quantitative research method is statistical, unbiased and logical (Fleetwood, 2020). Quantitative data is seen as oriented (Fleetwood, 2020).

One of the main advantages of quantitative research is that it can be checked and tested (Devault, 2020). It is also seen as a straightforward method of analysis that can be used to standardise the collection of data and generalise its findings (Bhandari, 2020). Another benefit is that quantitative results can be compared statistically, which makes the data more reliable and less vulnerable to disagreements (Devault, 2020). Quantitative research methods are useful because data from large samples can be analysed and processed using consistent and dependable techniques (Bhandari, 2020). However, the disadvantage of this method is that it can be difficult to set up research models for the collection of data (Devault, 2020). It can also prove to be inadequate when explaining complex research topics (Bhandari, 2020). Another disadvantage of a quantitative research method is that fixed variables and measurement procedures could mean that the researcher will ignore all other observations they may have

noticed (Bhandari, 2020). Additionally, quantitative research fails to consider cultural and historical perspectives that may affect the collection of data or the results (Bhandari, 2020).

4.7. Survey Questionnaires

One of the most flexible and widely used methods or tools for gaining information about people's experiences, feelings and views is the use of questionnaires (Johnson, 2004). Research questionnaires were developed in 1838 by the Statistical Society of London (Poynter, 2012). Questionnaires are a research tool that consists of a series of questions that aims to collect data from a respondent (Poynter, 2012). It could also be conducted in a form of an interview on paper or online (Aryal, 2020). The information collected from the questionnaires can either be quantitative or qualitative in nature (Poynter, 2012). However, there are two types of research questionnaires – *structured questionnaires* and *unstructured questionnaires*. A structured questionnaire collects quantitative data (Poynter, 2012). It includes pre-determined and pre-designed questions to collect specific information based on the research topic (Aryal, 2020). Additionally, structured questionnaires help to validate hypotheses and checks data that was previously accumulated (Poynter, 2012). On the other hand, unstructured questionnaires collect qualitative data. This type of questionnaire uses a simple structure and does not limit the responses from the participants (Poynter, 2012). Additionally, unstructured questionnaires are used when conducting focus group discussions (Aryal, 2020). A combination of unstructured and structured questionnaires is known as quasi-structured and is mainly used in social science research (Aryal, 2020).

There are two types of questions that can be used in a questionnaire – *open-ended questions* and *close-ended questions.* An open-ended questionnaire will allow the respondent to freely express their views, feelings and opinions regarding the topic being discussed (Fauvelle, 2019). These types of questions usually occur in an unstructured questionnaire (Poynter, 2012). On the other hand, close-ended questionnaires have a limited number of answers (Fauvelle, 2019). The intention is to provide easy, clearly identifiable, and precise answers to the questions being asked (Fauvelle, 2019). Close-ended questions requires the respondent to make a choice, such as Yes or No answers, multiple choice questions or checking items of a list (Aryal, 2020). These types of questions allow the researcher to collect the same data from a wide range of participants (Fauvelle, 2019). For the purpose of this study, the questionnaire was made up of close-ended questions.

There are also advantages and disadvantages of using a questionnaire. One of the main advantages of using a questionnaire is that the researcher can collect a large amount of information in a short amount of time (Poynter, 2012). Questionnaires are useful because it limits the amount of partiality within the study, since the researcher will use a standard set of questions for all respondents (Poynter, 2012). It is an economical way of data collection, and it also allows for international coverage by using online surveys or questionnaires via the telephone (Imam, 2014). Another advantage is that questionnaires are easy to plan and construct, and it allows participants to answer questions without revealing their identities (Poynter, 2012). Questionnaires can also be beneficial, because it can be asked in different languages (Imam, 2014). However, questionnaires do have some disadvantages. Its validity and dependability can sometimes be low (Imam, 2014). Nothing can be done if a respondent gives an incomplete answer or misinterprets a question (Imam, 2014). Another disadvantage is that respondents don't always have to answer all questions, which can impact the results of the research project (Imam, 2014).

Data collection was carried out through the use of a structured questionnaire. While the questionnaires were structured, the respondents could add any extra information relating to the study. The questionnaires were written in English; however, the questions were asked in IsiZulu, which is the local language in the Msinga Municipality. Using the local language ensured that the questions were understood by the respondents. Before the respondents were asked to partake in the questionnaire, they were informed that participation was voluntary and that they were allowed to withdraw from the study at any time if they wanted to. Respondents were also informed that any information they provided would be kept confidential and used only for educational purposes. The respondent's answers were recorded in the questionnaire by the researcher. The questionnaires were administered in the presence of the researcher. This was to ensure that everything went smoothly and to assist the respondents with any quarries they might have had.

4.8. Sampling Methods (Selection of the Respondents)

Data collection took place from June 2019 to August 2019. A purposive random sampling method was used for the selection of respondents. A purposive sampling method is used when the researcher uses their own judgement to choose a group of participants which requires the people with the most characteristics to represent the population (Johnson, 2004). The target population consisted of rural community members and small-scale farmers within the Msinga

region. This form of sampling is where individuals are chosen based on their relevance to the research questions (Bryman, 2014). Purposive sampling is a non-probability sampling method and is mainly used in qualitative research (Dudovsky, 2011). There are also many different types of purposive sampling methods (Wilinson, 2014). *1. Maximum Variation Sampling* looks at respondents from all available angles. For the purpose of this study - a maximum variation sampling method was used as respondents were chosen based on their specific traits of small-scale farming. *2. Homogeneous Sampling* focuses on respondents who share similar characteristics or specific traits. *3. Typical Case Sampling* is where respondents are selected based on their probability of behaving like everybody else**.** *4. Extreme/Deviant Case Sampling* focuses on respondents that are unusual. *5. Critical Case Sampling* is mainly used in the initial stages of data collection. *6. Total Population Sampling* is where the whole population meets the criteria for the research. *7. Expert Sampling* is where experts in the field of the study are being used as respondents.

From the community, 180 members were purposively selected and interviewed. According to Stats SA (2011) the population of the Msinga Municipality is approximately 177 577. Therefore, 180 community members were purposively chosen from the region for this research study. Each day, the researcher had chosen different parts of the area and they had picked community members purposively from each section. The main aim behind this purposive sampling method was to select rural community members that practice small-scale farming. The researcher was fully involved in the collection of data. Additionally, the main target population of this research project were small-scale farmers, families of small-scale farmers or households with home gardens. The study had targeted this group of respondents, because they were the most useful to the research being conducted, since small-scale farmers and rural communities are the most affected during a drought. These small-scale farmers are mostly involved in the production of poultry, grain, fruit, vegetables and livestock farming. Most of the residents within the Msinga area consume their own harvests or they sell it at local markets.

There are also advantages and disadvantages when using purposive sampling methods. One of the major advantages of purposive sampling is that it is cost-effective and less time consuming (Dudovsky, 2011). Since there are many different types of purposive sampling, it is beneficial to the researcher as they can use a variety of techniques to increase and build their research data (Wilkinson, 2014). Purposive sampling is also useful when collecting large amounts of information, as it gives you a better cross-section of data (Wilkinson, 2014). Purposive sampling methods also has some disadvantages. One of the main disadvantages is that there

can be errors in judgement by the researcher (Dudovsky, 2011). Another weakness of this sampling method is there is high levels of being biased and low levels of reliability, as each respondent is chosen by the judgement of the researcher (Wilkinson, 2014). Due to its non-probability nature, purposive sampling also has the inability of generalising the research findings (Dudovsky, 2011). Critics argue that if different choices were made in the field, a different outcome could have been achieved (Wilkinson, 2014).

4.9. Data Analysis

According to Lewis-Beck (1995), data analysis is the most important part of any research project. Data analysis is a process of summarising, evaluating and interpreting the collected data (Lewis-Beck, 1995). For the purpose of this research study, SPSS was used to analyse the collected data.

4.9.1. Statistical Package for the Social Sciences

Pillay (2016) acknowledges that data analysis often uses several software packages to assist in the formation of descriptive statistics, tables and graphs for analysis. In order to analyse the data that was collected, a programme called Statistical Package for the Social Sciences (SSPS) was utilised. Additionally, data from the completed questionnaires were entered onto the SPSS programme. SPSS – version 27 was used to analyse the data. According to Landau & Everitt (2004), SPSS is a statistical software that is used for presenting, manipulating and analysing data. Moreover, the use of SPSS is viewed as an efficient and easy way to capture large datasets (Pillay, 2016). According to Garth (2008), there are four types of data, i.e. nominal, ordinal interval and ratio data. Nominal data is placed into categories that have no numeric values and the results are often displayed on a pie chart (Garth, 2008). An example of nominal data is gender, where the set response will either be female or male (Glen, 2012). Additionally, ordinal data refers to data that can be ranked or put in order (Garth, 2008). An example of ordinal data in this research study is "What are the socio-economic impacts of drought within the Msinga Municipality?" which is ranked as: *1 = Very High. 2 = High. 3 = Moderate. 4 = Low*. Furthermore, interval data is measured using numerical data where the zero has no meaning, whilst the zero in ratio data has a real meaning (Garth, 2008). An example of interval or ratio data is the Age category (Garth, 2008).

There are also advantages and disadvantages when using SPSS. One of the main advantages is that analysing data is easy and quick since there is no programming required (West, 2020). SPSS is useful when organising and categorising large amounts of data (West, 2020). Another

advantage is that SPSS shows the results in easy-to-read graphs and charts (West, 2020). This programme also has its disadvantages. The main downfall of SPSS is that it is not free and there is only a 30-day free trial (West, 2020). The programme uses up a lot of processing power and can sometimes run slowly (West, 2020). Additionally, SPSS can only be used for statistical operations (West, 2020).

For the purpose of this study, descriptive statistics were used to analyse the data obtained. According to Rawat (2021), a descriptive analysis assists in describing, displaying or summarising the data in a constructive manner. Additionally, Greasley (2008) argues that descriptive statistics are used to summarise data that is obtained from a questionnaire by performing calculations and tests and by formulating graphs and tables. According to Rawat (2021), a descriptive analysis is one of the most vital steps for conducting statistical data analysis. Furthermore, it helps the researcher with the distribution of the data and to identify the similarities among variables (Rawat, 2021). For the purpose of this study, the data was entered into SPSS and then frequencies were created to analyse the data. According to Greasley (2008), frequencies are the first step which researchers undertake when analysing data. Furthermore, descriptive statistics and frequencies involved the researcher summarising the results using the percentages of the data obtained, which is referred to as a *variable*. For example, population dynamics, drought perceptions and adaptation, as well as irrigation and agricultural practices were conducted by using a descriptive and frequency analysis, which was shown as bar graphs, pie charts and tables. Descriptive statistics and frequency analysis were conducted based on data that was collected from the focus group discussion and questionnaire.

Analyse→ Descriptive Statistics→ Statistics→ Frequencies

For the purpose of this project, a lickert data scale was also used. The likert data scale was coined by an American psychologist and educator named Rensis Likert in 1932 (Poynter, 2009). A likert data scale is classified as a rating scale that is used to evaluate and measure a respondent's feelings, attitudes, behaviours and opinions (Bhandari, 2020). A likert scale is common when using survey research as it allows the researcher to easily operationalise perceptions and personality traits (Bhandari, 2020). To collect data, the researcher must present respondents with likert-type statements or questions, which usually consist of 5-7 items (Bhandari, 2020). For example, statements or questions are usually coded as: strongly disagree, disagree, neutral, agree and strongly agree (Preedy, 2010). Additionally, each item is assigned

a numerical score so that the data can be studied and analysed quantitatively (Bhandari, 2020). For example, 1= strongly agree, 2= disagree, 3= neutral, 4= agree and 5= strongly agree (Glen, 2017). These numerical values allow the researcher to assign meaning to the responses (Glen, 2017). According to Preddy (2010), respondents use this type of psychometric scale to specify their level of agreement to a particular question or statement. For the purpose of this research project a likert data scale was used to state how the socio-economic impacts of drought affects the communities of Msinga, i.e. very high, high, moderate and low. Additionally, the likert data scale was used to describe the severity of drought in Msinga, i.e. very high, high and moderate, as well as the frequency of drought in the last 10 years, i.e. more frequent, less frequent, no difference and uncertain. Moreover, the likert data scale does not require the respondents to generate new ideas or validate their answers and opinions (Bhandari, 2020).

An advantage of the likert data scale is that it is an accessible, inexpensive and practical data collection method (Bhandari, 2020 & LaMarca, 2011). Additionally, it is the most universal method for data collection, and it is easily understood (LaMarca, 2011). According to Bhandari (2020), likert type of questions do not require a simple yes/no or true/false answer, therefore the researcher can obtain detailed insights into the respondent's behaviours, opinions and perceptions. Another advantage of a likert data scale is that it has a high versality, therefore questions could be asked over the internet, posted through the mail or given in person (LaMarca, 2011). It is also easy to draw conclusions, graphs, reports and results when using a likert data scale (LaMarca, 2011). On the other hand, a disadvantage of a likert data scale is that it can be difficult for the researcher to treat neutral responses as agree, disagree or neither (Llaurado, 2015). Another weakness is that respondents tend to agree to the statements provided, which is known as acquiescence bias (Llaurado, 2015). According to Bhandari (2020), respondents could get bored and loose interest in the questions. Additionally, a likert data scale is very vague and it can be interpreted differently by each respondent (Bhandari, 2020). Another disadvantage is that likert type questions are close ended, therefore respondents have to choose the most appropriate answer, even if it may not reflect their actual opinions (Bhandari, 2020).

4.10. Reliability and Validity

According to Middleton (2019), validity and reliability are concepts that are used to evaluate the quality of research. Additionally, reliability and validity indicate how well a test, technique or method measures the data (Middleton, 2019). When conducting a research study, it is

important to consider validity and reliability when generating a research design, planning the methods or when presenting the results (Middleton, 2019).

4.10.1. Reliability

Reliability deals with the extent to which results are consistent over time, as well as the accurate representation of the total population for the study (Golafshani, 2003 & Caleni, 2017). This basically means that if the same results can be consistently obtained by using the same methods and under the same conditions then the measurements are considered reliable (Middleton, 2019). Additionally, reliability is viewed as a test where the measurement attained has no error (Naicker, 2021). Middleton (2019) further states that ensuring reliability should be considered throughout the process of data collection and the use of tools and techniques should produce results that are constant and precise. To ensure reliability for this study, the questionnaire was cross-checked and compared with other studies to establish consistency (Nonjola, 2021). Furthermore, a purposive sampling method was used to ensure that the study was credible. Additionally, the primary data that was collected by the researcher was compared to information from the literature review for further credibility and reliability (Nonjola, 2021 & Caleni, 2017).

4.10.2. Validity

According to Middleton (2019), validity is about the accuracy of a measure. Furthermore, Nonjola (2021) states that validity determines how truthful the research results are or whether it is actually evaluating what it intended to measure. Phelan & Wren (2006) argue that for a test to be reliable, it also needs to be valid. Additionally, Middleton (2019) states that if the research has a high validity, then the results will correspond to the social and physical world. There are four main types of validity (Middleton, 2022). *1. Construct validity* is about guaranteeing that the test measurement matches what it aims to measure. *2. Content validity* determines if a test is fully representative of all aspects it intends to measure. *3. Face validity* considers how suitable the test is for the study. *4. Criterion validity* checks how well the test can predict an outcome that they are designed to measure. To ensure the validity of this study, the questionnaire was reviewed by the extension officer and by the target population with similar characteristics.

4.11. Conclusion

This chapter has explained the methodology that was used whilst conducting the research study. It offers an explanation of quantitative research as a method for data collection and data

analysis. Additionally, the different tools that were utilised during the collection of data was also discussed in this chapter, as well as the sampling selection process. The tool that was used included a questionnaire, whilst a purposive sampling method was adopted. Furthermore, methods that were used to conduct the analysis of the data were also discussed. This chapter also outlined the advantages and disadvantages of each method and data analysis that was used.

CHAPTER FIVE – RESULTS AND DISCUSSION

5. Introduction

For the purpose of this research study, 180 respondents were interviewed using a structured questionnaire. This chapter will present, interpret and analyse the results of the study. Additionally, this chapter will discuss the results of the research objectives for the study.

Furthermore, this chapter will be divided based on the themes of the questionnaire:

a) Demographics of the Surveyed Population
b) Agricultural Practices
c) Adaptation and Mitigation Measures
d) Drought Perceptions = Socio-Economic Impacts

(A) Household Personal Details

5.1.

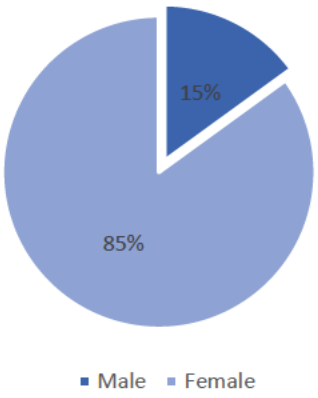


Figure 5.1. Graph Showing Gender Distributions of the Surveyed Population

The findings of this study show that from the 180 respondents, 15% of the surveyed population were male, whilst 85% were female *(figure 5.1)*. The larger female population could be due to the fact that there are many more female-headed households within the Msinga Municipality region. In South African rural areas, female-headed households are common because of rural-urban migration. According to Mlambo (2018), rural-urban migration is the movement of men and youth from rural areas to urban areas, in search of employment, higher incomes, better education and improved healthcare facilities. However, due to the Covid-19 pandemic and the

lockdown - restrictions on movement were implemented, which caused a global decrease in migration (Joubert, 2021). The pattern of female-headed households is further explained by the IDP (2020) with 57.2% of the total Msinga population being female and 42.8% being male. From the age of 20-64, the male population in Msinga decreased, due to the weak economy, which resulted in men leaving for better employment opportunities in urban areas (IDP, 2020). Within South Africa, the laws of apartheid were largely connected to rural-urban migration and female-headed households, since young males were recruited to work in the mines (Mlambo, 2011). This resulted in women and the elderly being left behind to take care of the children and the rural areas (Mlambo, 2011). However, in post-apartheid South Africa, more and more rural households are being headed by women (Joubert, 2021). According to Rogan (2016), female-headed households are more susceptible to poverty than male-headed households, due to fewer income earners, spouse deaths, rural-urban migration, disability or addiction of their husbands and divorces. Poverty and the inequalities of living standards between men and women are often referred to as the "feminisation of poverty" (Joubert, 2021).

5.2.

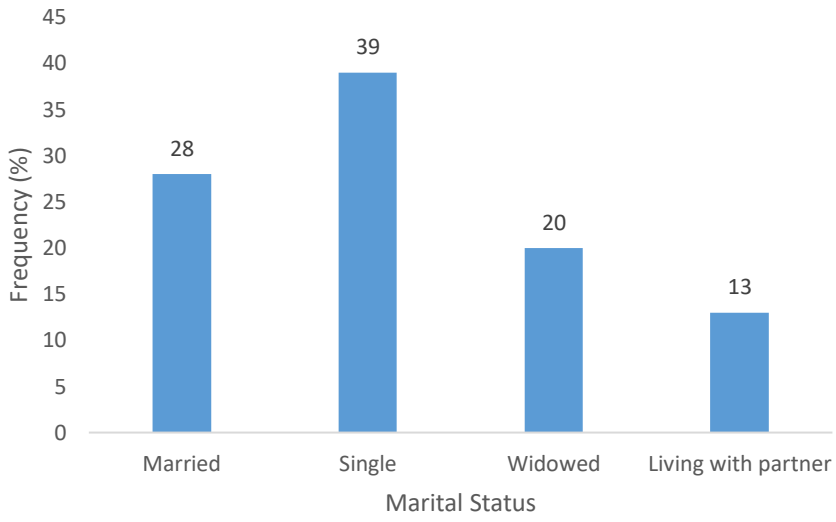


Figure 5.2. Graph Showing Marital Status of the Surveyed Population

From the surveyed population, 28% of respondents were married, 39% were single, 20% were widowed and 13% were living with a partner *(figure 5.2)*. A high proportion of the surveyed population was the elderly, which contributed towards the moderate percentage of married respondents. The high percentage rate of single respondents was due to the fact that many young people don't believe in the consistution of marriage. According to Posel *et al.*, (2011),

many black South Africans find the traditional practice of Lobola a hinderance to marriage. Lobola is an African custom were the groom's family makes a payment of cash or cattle to the brides's family before the wedding (Posel *et al.*, 2011). Moreover, amongst the isiZulu culture, marriage is regarded as a crucial step to increase the status of the male (Posel *et al.*, 2011). Nevertheless, marriages within the elderly African communities are still perceived as sacred and are seen as a blessing. However, due to the high percentage of elderly people in rural areas, there was a moderate level of widowed respondents.

5.3.

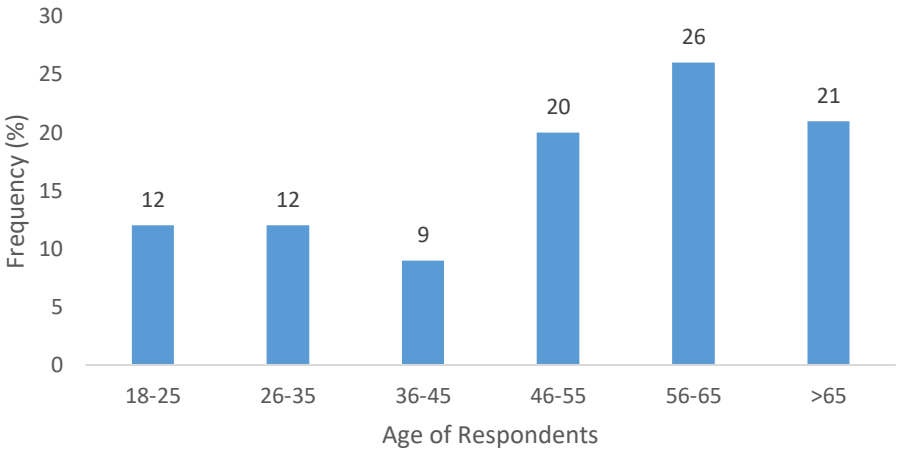


Figure 5.3. Graph Showing the Ages of the Surveyed Population

With regard to the results presented in *(figure 5.3)*, the age groups within the area are disproportionate, with the older generation making up the majority of the population and the working class being the minority. According to the Rural Health Information Hub (2019), the unevenness of rural populations is very common in developing countries. The young population of the Msinga Municipality was also very limited, with the age groups 18-25 and 26-35 being only 12% *(figure 5.3)*. According to the Msinga IDP (2020), there has been a decrease in the number of men from the age of 20, due to economic opportunities or death. In rural developing countries, the disproportion of the different age groups is usually caused by high levels of HIV/AIDS. Globally, 37.7 million people were living with HIV/AIDS (UNAIDS, 2021). There has been around 1.5 million newly infected people in 2020, with around 600 000 AIDS-related deaths worldwide (UNAIDS, 2021). According to Avert (2020), 7.5 million people are living with HIV/AIDS in South Africa, with 19% of infections occurring

in people between the ages of 15-49. In 2018, there was 240 000 new HIV/AIDS infections and over 71 000 deaths (Avert, 2020). In 2016, 26% of South African women were infected with HIV/AIDS, as compared to approximately 15% of men (Avert, 2020). In Kwa-Zulu Natal, 27% of the population was infected by HIV/AIDS, with most of these infections occurring in the rural areas (Avert, 2020). Studies from South Africa and England have reported that there is a higher risk of people dying from Covid-19 if they are HIV positive, as they experience more severe symptoms (UNAIDS, 2021). With the Covid-19 lockdown and restrictions, HIV testing had come to a standstill, which led to an increase in deaths and a decrease in diagnoses, medical appointments, and treatments (UNAIDS, 2021). According to the Department of Health, the uMzinyathi district had 31.7% of HIV/AIDS infections (IDP, 2020). Additionally, the HIV/AIDS pandemic will have an intense impact on the social, wealth and health services of the Msinga Municipality over the next 20 years (IDP, 2020). During this time, the adult population is expected to decrease, which will result in many more orphans (IDP, 2020). Within Msinga, children are often raised by their grandparents, due to the absence of their parents. However, the Msinga Municipality and the Department of Health are working closely to educate the community on HIV/AIDS and to spread awareness (IDP, 2020).

According to *(figure 5.3)*, the economically active category of 36-45 year olds was only 9%. This low percentage is the result of rural-urban migration, since most of the population leave the rural areas to seek employment and study opportunities in urban areas. South African rural areas are characterised by high rates of circular migration and extremely mobile populations (Hosegood *et al.*, 2005). However, due to the Covid-19 restrictions and lockdown, movement and migration have decreased significantly (Avert, 2020). Furthermore, 20% of the surveyed population were respondents from the age group 46-55, whilst the 56-65 age group category made up 26% of the Msinga area *(figure 5.3)*. According to the 2019/2020 IDP, the elderly members of the Msinga Municipality comprised of 6% of the overall area, which is approximately 9000 people. However, from the surveyed population, 21% of respondents were over the age of 65. Rural communities tend to have a high proportion of senior citizens; however, these areas provide fewer services, such as housing, healthcare and transportation (RHIH, 2019). One of the major problems that developing countries experience, is that the older population live longer, which results in a higher percentage of pensioners who are no longer productive to the economy, and who depend on the government for financial support (Jourbert, 2021). In rural areas, food insecurity is also a challenge that impacts the well-being and health of the older population, with drought conditions only intensifying the issue.

5.4.

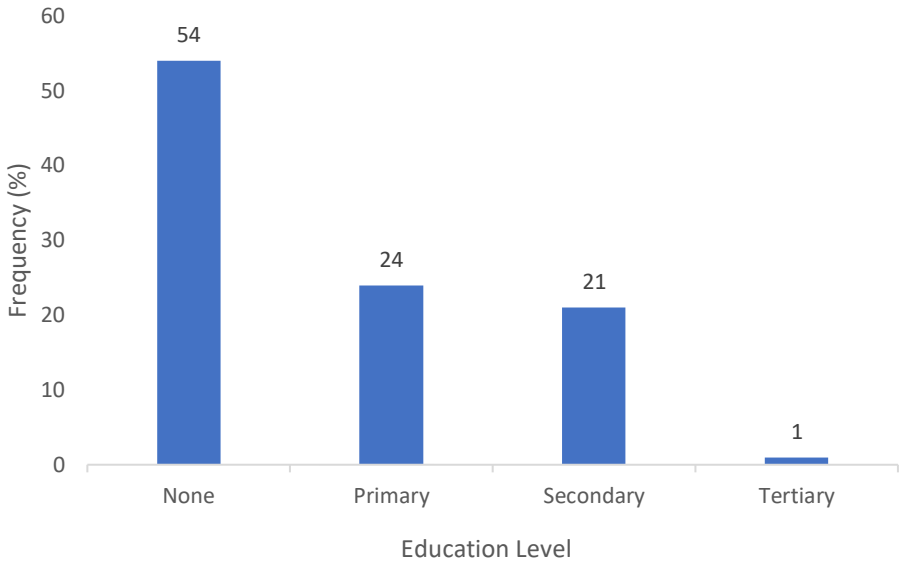


Figure 5.4. Graph Showing the Education Levels of the Surveyed Population

From the findings of this research study *(figure 5.4)*, it is revealed that 54% of respondents had no education, 24% had a primary level education, 21% had completed high school and only 1 respondent had a tertiary level education. The South African Schools Act, various education policies and the constitution states that all South African learners should have equal access to learning, teaching and the same quality of educational opportunities (Gardiner, 2008). The South African Bill of Rights, Section 29(1) (a) states that "everyone has the right to basic education" and Section 29(1) (b) says that "everyone has the right to further education" (Hall, 2018). However, this has not been reached as yet. In 2019, the adult literacy rate of South Africans was 12%, with 4.4 million people still being illiterate (Khuluvhe, 2021). However, illiteracy rates tend to be higher in females at 12.5% and the male illiteracy rate is a little lower at 11.6% (Khuluvhe, 2021). According to Hogan (2020), South Africa has 19.6 million children, with 98% of them attending some form of educational facility. Education is compulsory till grade 9, and over the years there has been an increase in the number of dropouts, whilst only 38.4% of children below the age of five have attended pre-school (Hogan, 2020).

Hogan (2020) reports that there is a strong correlation between education and poverty in South Africa. Furthermore, Gardiner (2008) states that majority of rural children come from impoverished households, which influences the way in which they understand and participate in educational activities. For example, many learners, especially girls are responsible for

completing household chores before reaching school, which combined with long travel distances can lead to reduced concentration and severe fatigue (Ocampo, 2004). Poor education is the leading factor in contributing to the cycle of poverty, which results in South African children struggling to become part of the workforce (Hogan, 2020). As mentioned in chapter 3, some uneducated farmers in Msinga refused to sell their cattle during the drought, which resulted in social and economic losses (Rukema, 2010). On the other hand, findings from UNDRR (2020) states that when faced with drought, educated people search for environmental information and change their behaviour accordingly, which makes them more resilient to the effects of drought. Additional evidence from UNDRR (2020) acknowledges that the importance of environmental education is not utilised enough; however, a little bit of learning could help rural communities adapt to drought. For example, if an individual has basic literacy skills, they will be able to read the instructions on a fertilizer bottle. Educated communities can also reduce the death tolls from extreme events, such as droughts, high temperatures and wildfires (UNDRR, 2020). According to UNDRR (2020), educated farmers use more sustainable agricultural practices to cope with reduced rainfall and drier conditions. Furthermore, having an education is also important for seeking alternative livelihood options if farming is affected due to drought conditions.

According to Ocampo (2004), the apartheid policies have created educational inequalities. Due to the uneven distribution of funding in South African schools, rural scholars continue to experience curriculum issues, a lack of quality education, a shortage of resources and infrastructure, few school libraries, lack of water and electricity, slow landline telephones, no access to the internet and the lack of trained teachers and overcrowded classrooms (Gallo, 2020 & Gardiner, 2008). Within the Msinga Municipality, there are 58 learners per classroom with only one educator (IDP, 2020). As a result of the unequal laws and services amongst the rural black population in South Africa, it is expected that majority of rural residents, especially the elderly will have no formal or low levels of education (Ocampo, 2004). According to the adjusted IDP (2022), 31.7% of the Msinga population only have a primary school education, whilst 30% have no education. Additionally, findings from the adjusted IDP (2022) revealed that 35% of the Msinga population had matriculated, whilst only 2.5% had obtained a tertiary education. According to the IDP (2020), there is a severe lack of education facilities, therefore an additional 241 classrooms would be needed to accommodate the 14 000 children who are not attending school within the Msinga Municipality. Furthermore, the Department of

Education had reported that 107 schools within the Msinga Municipality have no electricity, 30 have structural defects and 40 schools have no water (IDP, 2022).

5.5.

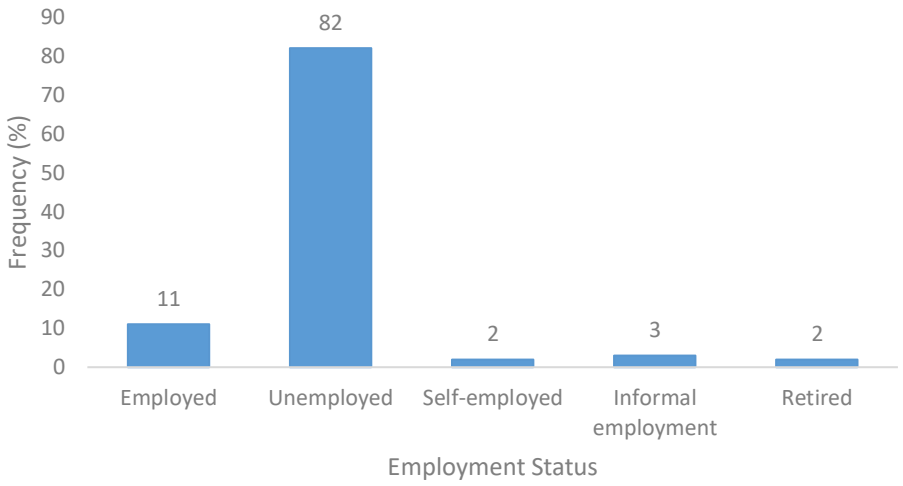


Figure 5.5. Graph Showing the Employment Status of the Surveyed Population

The results from *(figure 5.5)* revealed that from the surveyed population, only 11% of respondents were employed, 2% were self-employed, 3% were employed informally and 2% of the respondents were retired. South Africa's unemployment rate is one of the highest from a global list of 82 countries, with rural unemployment being prevalent (Naidoo, 2021). Millions of South Africans, especially the youth are struggling to find employment, despite having qualifications or spending months or even years trying. The results also illustrated that a staggering 82% of the surveyed population was unemployed. Combined with inequality and poverty, South Africa's high unemployment rates is seen as a national crisis (Ranchhod, 2018). Bloomberg has reported that South Africa's unemployment rate has rose to 34.4% in the second quarter of 2021, as opposed to 32.6% during the first quarter of the year (Naidoo, 2021). Unemployment rates, which included people who were eligible to work, but not looking for a job rose to 44.4% in the second quarter of the year from 43.2% in the beginning of 2021 (Naidoo, 2021). Additionally, the category of 25-34 year olds recorded the highest unemployment rates at 64.4% (Mukwevho, 2021). The Covid-19 pandemic and the lockdown has also affected the unemployment rates in South Africa (Naidoo, 2021). Furthermore, unemployment rates were also impacted by the eruption of riots and looting in the Gauteng and

Kwa-Zulu Natal provinces in July 2021 (Naidoo, 2021). Since the beginning of 2021, approximately 12 million people have fallen into the unemployment category (Pillay, 2021).

Due to the high unemployment levels, many rural communities practice small-scale farming as a livelihood strategy. According to Nxumalo & Ntobongwana (2021), 58% of land-use within the Msinga Municipality is dominated by agricultural practices. Furthermore, Dunkhorst & Mollel (1999) state that it has been proven in many developing countries that small-scale farming has the potential to create employment and generate income for rural communities. Additionally, small-scale farmers in South Africa have been identified as the sector through which the goals of rural development and poverty reduction can be achieved (Pienaar & Traub, 2015). Furthermore, small-scale farmers can play a vital role in reducing the vulnerability of food insecure households in rural communities, as well as improving their livelihoods and helping with the mitigation of increased food prices (Baiphethi & Jacobs, 2009). Food expenses account for 60-80% of a low-income household, therefore the practice of small-scale farming could increase productivity and ensure long-term food security (Baiphethi & Jacobs, 2009). According to Baiphethi & Jacobs (2009), an estimated 90% of rural communities are involved in agricultural practices. Additionally, the South African NDP has reported that small-scale agriculture is important for rural development and to improve the livelihoods of 370 000 rural communities (Pienaar & Traub, 2015). In South Africa, the commercial farming sector employs 35 000 farmers who produce 95% of agricultural output on 87% of land, whilst small-scale farming employs 4 million farmers on 13% of land (Pienaar & Traub, 2015). According to Cousins (2018) & Naidoo (2021), one million new jobs can be created in the agricultural industry, with 69 000 jobs already being added to the sector. Therefore, by 2020, the government wanted to expand the number of small-scale farmers who sell their produce to 500 000 (Pienaar & Traub, 2015).

The Msinga Municipality is situated in the rural part of Kwa-Zulu Natal and has very limited employment opportunities (IDP, 2020). According to Rukema (2010), 2 in 5 people are unemployed in Msinga. There are no industrial sites within the area, therefore residents are mainly employed by social or informal sectors (IDP, 2021). According to the IDP (2020), the agricultural sector contributes 12.5% towards employment within the Msinga region. Additionally, the unemployment rate in the Msinga Municipality has decreased significantly from 78.7% in 2001 to 55% in 2007 (IDP, 2020). However, by 2011, the overall unemployment rate of the Msinga Municipality was 49.5% (Stats SA, 2011).

5.6.

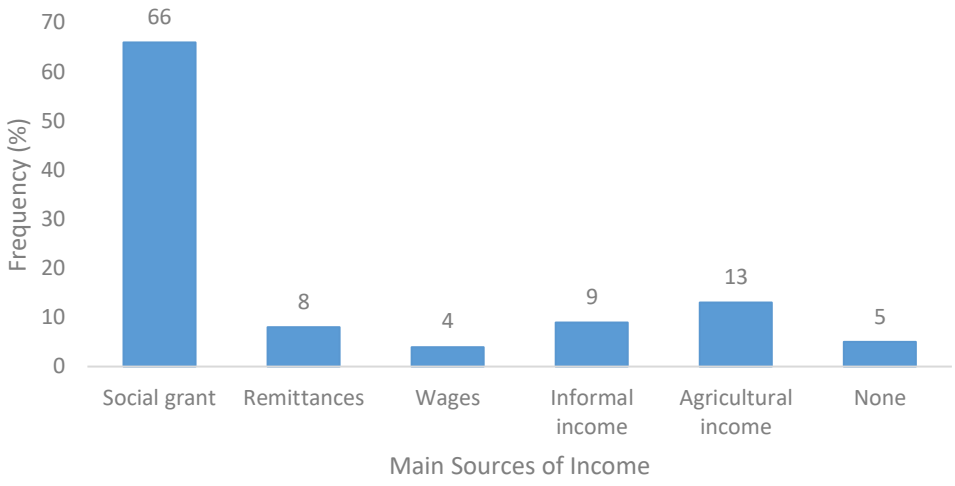


Figure 5.6. Graph Showing Main Sources of Income for the Surveyed Poplulation

Rural households earn an income from various sources. According to Sokhela (2021), the Msinga Municipality is dominated by low-income levels, with 63% of the population falling within the income levels of R1- R400. With reference to *(figure 5.6)*, 66% of respondents earn an income from social grants. The introduction of social grants started after the abolishment of apartheid, with the South African Social Security Agency (SASSA) being introduced in 2005 (WCG, 2020). A social grant is money paid by the government to South African citizens who are in need of financial assistance (WCG, 2020). According to Omarjee (2021), the number of people that rely on some form of financial assistance from the South African government, outnumber the amount of people that are employed. In 1996, only 7% of the population received social grants, as opposed to 31% in 2021 (Merrington, 2021). Additionally, economist states that an estimated 19 million South Africans are currently living of social grants (Omarjee, 2021). Economists also takes into account the 1.5 million South Africans who lost their jobs due to the covid-19 pandemic, which could take the total to approximately 20.5 million social grant recipients (Omarjee, 2021). For many households, social grant payments have replaced salaries as their main source of income (Merrington, 2021). The increasing levels of unemployment in South Africa has placed a massive pressure on the social justice system (Meyer, 2021). The increase in social grants is caused by high levels of unemployment, poverty and inequality (Meyer, 2021). According to the National Treasury, R195.5 billion was

allocated to social grants for the 2021/2022 financial year and that amount is set to increase to R205.3 billion in 2022/2023 (Meyer, 2021).

Over the years, there has been many issues regarding the grant system. Some critics believe that social grants keep people content in poverty, but it does not lift them out of it (Meyer, 2021). The system is also criticised for encouraging people's dependence on the government, spending money on non-essential items and for increasing number of teenage pregnancies for child grants (Meyer, 2021). Currently, the child support grant category is the largest, with 13 million recipients (Meyer, 2021). On the other hand, it is argued that the social grant system has positively contributed to supporting the poor and vulnerable. It also allows improved access to essential services, savings and consumption, as well as contributions towards enhanced livelihoods (Meyer, 2021). According WCG (2020), the social grant system is the most effective form of poverty alleviation in South Africa.

Other findings from *(figure 5.6)* revealed that 8% of respondents received remittance as a source of income, only 4% earned wages, and 9% of the surveyed population received an informal income. According to Laframboise (2019), informal jobs are a vital source of income for many households, with 18% of working South Africans being employed in the informal sector, which is a total of 3 million people. Additionally, the informal industry accounts for 18% of South Africa's GDP (Laframboise, 2019). The informal sector is recognised by the government as an important and viable form of employment for the poor. Results from the surveyed population of Msinga reported that 13% of respondents received an income from the agricultural sector. According to Ndlovu (2017), subsistence farming is vital when trying to achieve sustainable development and improve livelihoods for rural households. Furthermore, Dunkhorst & Mollel (1999) state that agricultural activities account for 10% of rural household income. However, drought, inadequate government support, not enough finance, insufficient infrastructure, HIV/AIDS and lack of agricultural expertise have contributed to the decline in agricultural productivity in South African rural areas (Puri, 2013). By 2050, 1 billion farmer's livelihoods are most likely to be affected by climate change, which will ultimately impact food security globally (Puri, 2013). However, mainly small-scale farming is practiced in Msinga. As mentioned in previous chapters, the land has a limited capacity for productive agricultural growth, due to poor farming practices, low soil quality and adverse climactic conditions. The Msinga region is dry with less vegetation, however livestock (goat) farming thrives in this kind of environment (IDP, 2020). According to Rukema (2010), livestock farming in Msinga is practiced extensively for commercial purposes. Agricultural harvest grown by residents are

usually sold to markets in nearby municipalities (IDP, 2020). Additional findings from *(figure 5.6)*, illustrated that 5% of respondents did not receive any form of income. According to the adjusted IDP (2022), 39.7% of the overall Msinga population receive no income.

(B) Agricultural Practices

5.7.

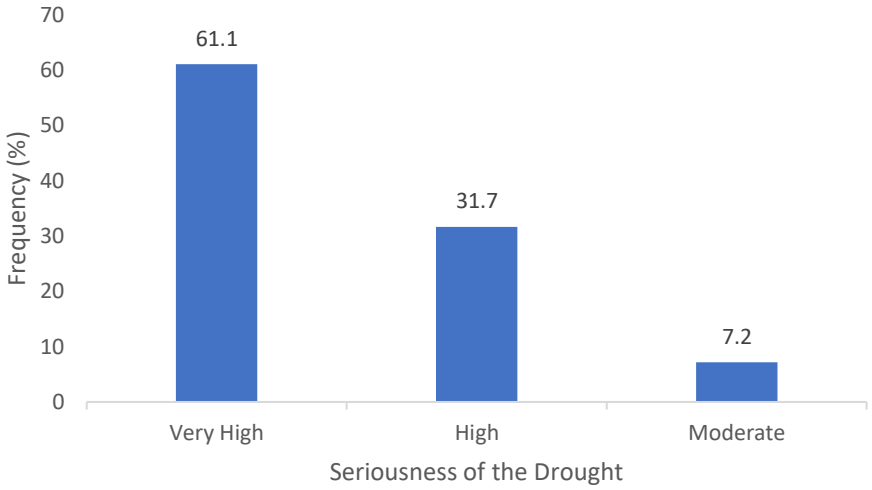


Figure 5.7: Graph Showing the Perceptions of the Seriousness of a Drought

Results from the surveyed population *(figure 5.7)* revealed that 61.1% of respondents reported that the severity of the drought was very high, 31.7% stated that it was high and 7.2% of respondents said that the seriousness of the drought was moderate. Droughts can have a serious impact on agriculture, energy, economies, health, food security and the environment (WHO, 2021). According to WHO (2021), drought brings a serious hazard to crops and livestock all over the world, with millions of people being affected by drought every year. To further emphasize this statement, Rukema (2010) revealed that residents of Msinga had measured the seriousness of drought in terms of seasonal farm employment, crop failure and loss of livestock. A drought also increases the risk of diseases and death, threatens livelihoods and contributes towards mass migration (WHO, 2021). For example, a respondent from Msinga had migrated to the city in search of work; however, due to high unemployment rates, the respondent was forced to return to the drought-stricken area (Rukema, 2010). Furthermore, most respondents stated that drought is a serious social and economic problem within the Msinga region. Another serious impact of a drought is water shortages. When temperatures rise, water evaporates at a faster rate, which increases the risk of prolonged drought (WHO, 2021). An inadequate water

supply and prolonged drought can lead to public health problems (CDC, 2021). During a drought, there are many dust storms and wildfires, which affects air quality and therefore human health (CDC, 2021). Water scarcity and drought also have major impacts on the energy sector since large amounts of water is needed for thermoelectric electricity and for hydroelectric power generation (NIDIS, 2021). Low water levels can reduce the plant's efficiency and productivity. Additionally, water scarcity could also lead to conflict over threatened resources. For example, in the early 1980s, conflict over grazing rights and water resources in Msinga led to tribal wars which took the lives of many innocent people (Rukema, 2010).

The seriousness of drought and how it is perceived is based on how people experience it and how they are affected by it, which is based on the drought perception theory discussed in chapter 3. Drought is classified as a serious situation within the Msinga Municipality, which contributes towards food insecurity. The unpredictable nature of rainfall within the area makes it difficult to grow crops, such as, sorghum, maize and vegetables - which are the main sources of food (Joseph & Hamilton, 2013). Furthermore, the ground is too dry for harvesting, which causes tractors to plough through dusty soils, thus increasing crop failure. (Owen, 2015). A drought also diminishes food and nutrition quality (CDC, 2021). According to Anadolu (2019), every rise in temperature by 1^{o}C, decreases harvest of corn by 7.4%, wheat by 6% and rice by 3.2% globally. An increase of 2 degrees could put an estimated 84 million people at risk of being food insecure by 2050 (Anadolu, 2019). Findings from Rukema (2010) reported that drought in Msinga has a long history and its impacts continue to be severe. Furthermore, respondents have stated that droughts have become a daily experience within the area. According to Rukema (2010), respondents have also revealed that the 2004 drought was much more severe than any drought that occurred in the nineties.

5.8.

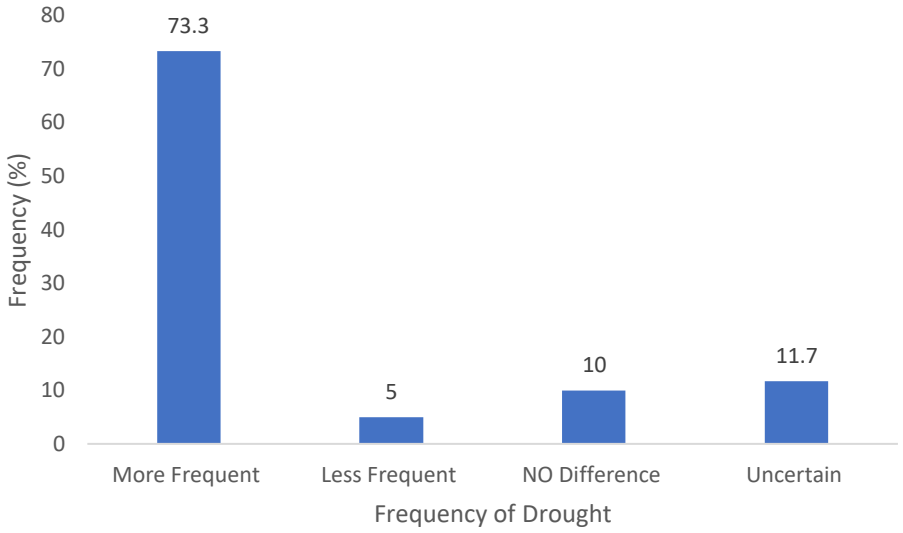


Figure 5.8: Graph Showing the Frequency of Droughts over the Last Ten Years

From the results *(figure 5.8),* it was acknowledged that 73.3% of respondents stated that droughts had occurred more frequently in the last ten years and 5% revealed that droughts occurred less frequently. Additionally, 10% of respondents reported that there was no difference in the frequency of droughts, whilst 11.7% of the surveyed population were uncertain. A warmer environment increases the risk of climate extremes, which therefore, alters the duration, magnitude, spatial extent and frequency of natural disasters, such as floods and droughts (Udmale *et al.,* 2014). These results indicate that the impacts of climate change, such as droughts are now occurring more frequently. According to the IDP (2020), Msinga is characterized by frequent droughts and low levels of rainfall. As mentioned in chapter 3, the rural communities of Msinga have witnessed drought intervals of 2 years, with 1991-2001, 2003-2004 and 2006-2007 being the worst in living memory (Rukema, 2010). A drought is ranked first amongst all-natural threats, as it directly affects the most amount of people (Udmale *et al.*, 2014). According to Anadolu (2019), the frequency of droughts has increased from every ten years to every five years. For example, in India, at least one drought occurred every three years over the last few decades (Udmale *et al.*, 2014). India has been experiencing extensive and prolonged droughts since the mid- 1990s, with an increased frequency occurring in recent years (Udmale *et al.*, 2014). According to the SPEI Global Drought Monitor, all continents, besides Antarctica was affected by a drought in the last decade (Tebor, 2021). For

example, in USA, almost half of the country is experiencing dry conditions and heat waves since 2020 (Tebor, 2021). Another example is the drought that has been occurring in Brazil since the beginning of 2021, which has affected 400 000 hectares of crop production and it has caused a decrease in the utilisation of hydroelectric power plants, thus, increasing electricity bills (Tebor, 2021). Within the last decade, the United Nations have estimated that droughts have affected 1.5 billion people globally and it has caused economic losses of $124 billion (Tebor, 2021). Additionally, in the last 10 years, between 80% - 90% of natural hazards have resulted from tropical cyclones, floods, heatwaves and droughts – which are a result of climate change (WHO, 2021).

During the last ten years, the impact and frequency of natural disasters in the agriculture sector in South Africa have increased significantly, with droughts being the most common type of disaster (Makala, 2012). South Africa had recorded its first drought in the 1800s, however, since then, a number of drought events have been reported and continue to be recorded in the country (Ncube, 2016). However, as mentioned in previous chapters, one of the most recent droughts in South Africa was recorded in 2015/2016 and it was the worst to hit the country since 1982 (Owen, 2015). According to Joseph & Hamilton (2013), the Msinga Municipality has experienced climate variability over the years, with less rainfall and an increased drought frequency occurring. In 2007, a study conducted by the Institute of Natural Resources reported that Msinga is categorised by an annual rainfall of between 600mm – 700mm, which indicates a high magnitude of droughts (Joseph & Hamilton, 2013). Although, the last severe drought in the area was recorded in 2004, Msinga continues to suffer from erratic and periodic droughts (Joseph & Hamilton, 2013). As mentioned in chapter one, residents within the Msinga Municipality still experience the severe effects of drought. Due to the high frequencies of drought, respondents have stated that drought has become a part of daily life in Msinga.

5.9.

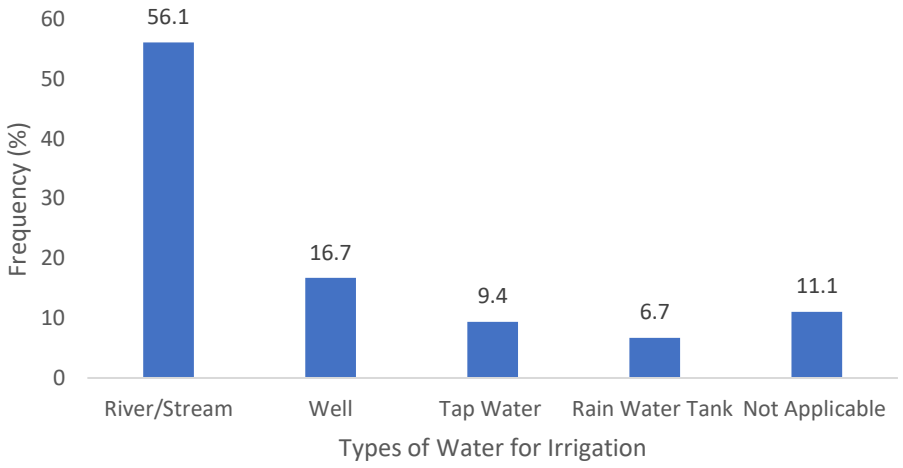


Figure 5.9: Graph Showing Where Respondents Obtain Water for Irrigation.

With regard to the results presented in *(figure 5.9)*, 56.1% of respondents obtained water from a river or stream for irrigational purposes, whilst 16.7% took water from a well and 9.4% of respondents used normal tap water. Additionally, 6.7% of respondents used a rainwater tank for irrigation and 11.1% of the surveyed population stated that water for irrigation was not applicable to them. According to Moller (2020), irrigation is defined as the artificatial application of water to soil to help with the growing of crops. Globally, agricultural production uses 70% of all water sources, with 40% being lost to the environment through evaporation, lack of water management, run-off and poor irrigation systems (Balsom, 2020). A Report by UNESCO (2021) revealed that globally 900 million people lack access to a basic water supply, with 79% living in rural areas. Additionally, 2.1 billion people around the world have little or no access to a safe and efficient irrigation system (Omarova *et al.*, 2019). This translates to 14.9% of urban areas and 45.2% of rural areas not having access to proper water infrastructure (Omarova *et al.*, 2019). According to a study conducted by Rosegrant (2019), irrigation within Msinga is a critical component in agricultural production, and it plays a key role in increasing food security and farm incomes, as well as improving resilience against climate variability (Rosegrant, 2019). Additional findings from Rosegrant (2019) revealed that an effective irrigation system within Msinga could possibly increase the quantity, diversity and nutrition of food that is harvested. Furthermore, water supply problems in rural areas, such as Msinga are due to recurring droughts, poor economic conditions, cost recovery challenges and their environmentally fragile locations (UNESCO, 2021). According to UNESCO (2021), most of

the water infrastructure in Msinga are categorised by decentralised systems, such as community water collection points, standpipes and local water sources, which include rivers, wells and hand pumps.

According to the IDP (2020), infrastructure in Msinga is limited, with only 23% of the population having access to portable water. Additionally, respondents have also stated that members of the community have to travel long distances to collect water from the rivers or wells. Women and children are usually tasked with this responsibility, which adds to their burdens of household chores (Rukema, 2010). Other parts of the Municipality gain access to water from boreholes, standpipes and protected springs (IDP, 2020). However, most times the springs are not maintained, and livestock also drink from it, which causes them to become contaminated (IDP, 2020). Additionally, pumps and water tanks are provided by the farmers support group during times of drought. However, due to the drought - agricultural production decreases since there is not enough water for irrigation. To a large extent, the Msinga residents rely on rivers/streams for irrigation, which shows that drought has a massive impact on their agricultural practices. Therefore, when droughts condition occur, these water sources dry up and there are no other alternative sources which the rural communities of Msinga can use for irrigation. Within the Msinga region, water resources have not been fully developed, therefore strict management is required to ensure that it is used effectively and economically (IDP, 2020). According to Rukema (2010), there are water pipes that pass through Msinga; however, water is not distributed to residents for irrigational and domestic use. Additionally, municipal officials have reported that when water is available - the lack of skilled people and financial resources pose a problem (Rukema, 2010). According to Young (2021), climate change has made “Day Zero” five to six times more likely, which is why the South African government is trying to promote conservation of water to avoid future droughts and ensure that everyone has continued access to clean water.

5.10.

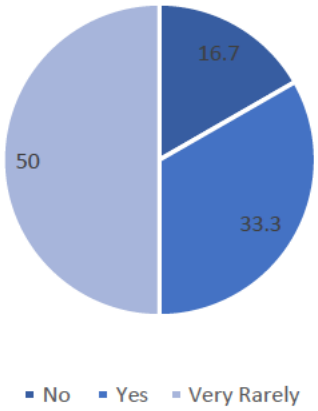


Figure 5.10: Graph Showing if Respondents Irrigate their Farms during a Drought

Irrigation is a process that farmers use to water their crops (Balsom, 2020). According to the United Nations, the human right to water entitles everyone to safe, acceptable, sufficient, accessible, and affordable water for personal and agricultural use (Omarova *et al.*, 2019). Findings from the study *(figure 5.10)* reported that 16.7% of respondents do not irrigate their farms during a drought, 33.3% do irrigate their farms and 50% of respondents stated that they very rarely irrigate their farms when a drought occurs. However, due to the low irrigation levels, it was also acknowldged that there is a need for alternative water sources that can be used during times of a drought. For example, water harvesting – which is when farmers collect runoff and use it to irrigate trees, grasslands and crops to improve agricultural production (FAO, 2021). Another alternate irrigation source is the use of a treadle pump, which allows crops to be harvested during the dry season (FAO, 2021). The treadle pump is mostly used by women for irrigation in Asian countries. According to Domenech (2015), irrigation is also an important path towards women empowerment. Furthermore, FAO (2021) states that water scarcity and lack of irrigation cause a decrease in food production and an increase in hunger and poverty within rural communities, such as Msinga. However, small-scale irrigation systems and the revitalisation of under-utilised irrigation schemes can play a major role in poverty alleviation and food security (SAG, 2021). According to FAO (2021), improvements to water management could play a major role in feeding an additional 300 million people by 2030.

During a drought, farmers try to use every drop of water for irrigational purposes. For example, in California, farmers strategically apply water to crops to try and maintain their growth, and

they also irrigate their farms to supply the crops with evapotranspiration (Lund, 2021). In most areas, the additional irrigation from the crops becomes groundwater, which helps prepare for future droughts (Lund, 2021). According to Moller (2020), irrigated agriculture plays a significant role in stabilizing the production of food and therefore food security. In South Africa, 60% of available water is used for irrigational purposes (Moller, 2020). Examples of irrigation systems in South Africa include; flood irrigation, pivots, canals, drip irrigation, sprinklers and micro irrigation (Moller, 2020). The Msinga Municipality relies on a surface water irrigation system, which is a river. The IDP (2020) states that water resources and irrigation systems within the area have not been developed to its full potential, and that strict management is needed to ensure that they are used effectively and efficiently. However, during a drought, streams and rivers can dry up, which increases the demand for water (Scherer, 2017). Furthermore, respondents have reported that some households receive water for irrigational purposes from a water vendor for a daily payment (Rukema, 2010). Agriculture plays an important role for the rural communities of Msinga; however, the effects of drought results in water scarcity, which increases the need for irrigation (Engindeniz *et al*., 2013). According to SAG (2021), water availability for farmers and agriculture is limited in Msinga, therefore good irrigation practices are important to make the most of the little available water during a drought.

5.11. ***Table 5.11 : Table Showing if respondents received agricultural training, governmnetal assisstance or drought early warning systems.***

	Yes (n=%)	No (n=%)	Total (n=100)
1.Have you received any agricultural training in the last 3 years?	75.6%	24.4%	100
2. Do you receive any assistance from the government during times of drought?	13.9%	86.1%	100
3. Are there any active drought management programmes in your community?	41.7%	58.3%	100
4. Do you receive early drought warnings?	13.9%	86.1%	100

5.11.1. Did the Respondents Receive any Agricultural Training in the Last 3 Years?

With regard to the results presented in *(figure 5.11),* 75.6% of respondents stated that they have received agricultural training within the last three years and 24.4% said that they did not receive any training. According to Nxumalo & Ntobongwana (2021), agricultural support systems and farm management training has helped the rural communities of Msinga to develop sustainable agricultural practices Additionally, Puri (2018) states that it is important for subsistence farmers and rural communities in developing countries to receive agricultural training, as they often live in environments that are dominated by unpredictable weather, pests and diseases, fluctuating prices, lack of education and food insecurity. Additionally, the USDA (2019) acknowledges that farmers require ongoing agricultural training to help them adopt practices that will increase profits, reduce the need for water and chemicals, decrease food contamination, cause less harm to the environment and to improve their quality of life. For example, in India, the government provides agricultural guidance, which includes training in; seed production, soil health, water management, plant protection programmes and maintenance of machinery (Jyoti, 2018).

According to Stats SA (2019), only 1.3% of households received agricultural training. However, in South Africa, the inter-governmental programme provides relief to households affected by drought and food insecurity, in the form of agriculture training, financial assistance, equipment, seedlings and fertilizers (SAG, 2021). Farmers also received assistance from the Comprehensive Agricultural Support Programme (CASP) which offers help to disadvantaged households by promoting financial aid, agricultural training and technical support (SAG, 2021). According to Rukema (2010), rural communities of Msinga received agricultural training on home gardens; however, it was not well established because of the dry conditions and limited water supplies, nevertheless, it was still viewed as a potential income generating activity. Additional findings from Rukema (2010) indicated that rural communities within Msinga have agricultural knowledge of drought management. However, this knowledge does not contribute towards the management of drought within the area (Rukema, 2010).

5.11.2. Do the Respondents Receive Assistance from the Government During Times of Drought?

From the surveyed population *(figure 5.11),* 13.9% of respondents revealed that they have received assistance from the government during a drought, whilst 86.1% indicated that they did not receive any assistance. Approximately, 37% of rural communities in South Africa have

been affected by drought (Mandela, 2019). In order to address the issues of drought in the South African agricultural industry, the government has over the past decade implemented several drought relief programmes as part of a national effort to support affected farmers (Makala, 2012). For example, one relief scheme had supplied fodder at a subsidised rate to small-scale farmers and the government also made provision for the repair of water infrastructure for commercial farmers (Makala, 2012). Furthermore, the rural communities of Msinga had reported that the feed - which was a mixture of grass and maize was given to small-scale farmers; however, those farmers who had more than ten cattle were given cheques for supplementary fodder (Vanderhaeghen & Hornby, 2016). Another more recent example of a financial assistance scheme was launched by the Department of Agriculture, Land Reform and Rural Development which aimed to distribute R1 billion to small-scale farmers by 2021 (Daniel, 2021). However, residents of Msinga had reported that there were a lot of forms to fill for this governmental aid and the lines were to long (Vanderhaeghen & Hornby, 2016).

Additionally, South Africa's community gardeners and small-scale farmers, who play an important role in ensuring food security at a local level received financial support for livestock, poultry, fruit, and vegetables worth R1000 – R9000, depending on the size of the farm (Daniel, 2021). However, due to applications being done via online platforms, many small-scale farmers were not aware of the programme or did not know how to apply for the financial assistance (Daniel, 2021). As mentioned in previous chapters, droughts are endemic to Msinga; however, findings from Rukema (2010) stated that drought management assistance from the government is essential for local livelihood systems. Additionally, Rukema (2010) acknowledges that Msinga receives fewer governmental resources to deal with the social and economic impacts of drought. According to Stats SA (2019), only 10% of South African rural households have received some form of agricultural-related support from the government. Therefore, it is important for the government to develop local level policies for drought management.

5.11.3. Active Drought Management Programmes within the Community?

The results *(figure 5.11)* also acknowledged that 41.7% of respondents said that there are active drought management programmes within the area and 58.3% stated that there were no programmes available. The drought management programmes that were implemented in Msinga were developed by NGOs, such as the Farmer Support Groups and not by the government. As mentioned in chapter 3, the Aballimi Phambili Farmer Support Programme supported the rural communities of Msinga during times of drought. Rukema (2010) also states

that NGOs within Msinga need to be empowered and involved in drought management programmes. According to the IDP (2020), the main source of agriculture in the Msinga Municipality is subsistence farming, with 18% contributing towards the overall GDP of the area. Msinga is characterized by low levels of rainfall and more frequent droughts; therefore, residents have been forced to adopt different strategies to survive and for dealing with climate change (IDP, 2020). According to Joseph & Hamilton (2013), there is poor management from the government to deal with drought and its impacts within the Msinga area. In 2002, the South African government implemented the Disaster Management Act which focused on pre-disaster risk management and the adoption of mitigation practices (IDP, 2020). However, the government did not effectively implement the policies within the area.

According to Joseph & Hamilton (2013), drought strategies and government policies within the area lack political commitment and community participation, which could result in serious repercussions for the rural communities of Msinga. Additionally, the South African government had dedicated R500 million to deal with drought; however, policy makers within Msinga received almost no administrative or financial support (Joseph & Hamilton, 2013). Local ward councilors have also indicated that they have no money to help the residents, and that they can only provide municipal water tanks during a drought (Joseph & Hamilton, 2013). Additional findings from Joseph & Hamilton (2013) revealed that there was no record of the damage from the drought and no assessment of its impact on the community. South Africa is well equipped to deal with natural disasters in theory; however, they are not well prepared to put the theories into practice, due to a lack of financial resources, political will and skilled people (Joseph & Hamilton, 2013).

5.11.4. Do the Respondents Receive Drought Early Warning Systems?

According to the results *(figure 5.11)* 13.9% of respondents revealed that they do receive early drought warnings, whilst 86.1% stated that they do not receive any warnings. It is well established that a provision of reliable and timely early warning systems is a critical component of drought planning, as it supports a farmer's decision making (Makala, 2012). Drought Early Warning Systems (DEWS) usually comprise of physical indicators of recent meteorological conditions (Monnik, 2000). According to IDMP (2021), a DEWS identifies water supply and climate trends, it detects the probability or emergence of a drought occurrence and its possible severity and impacts. Additionally, effective early warning systems must integrate precipitation and other climatic limitations with water information such as, soil moisture,

reservoir and lake levels, stream flow and ground water levels into a comprehensive assessment of current and future water supply and drought conditions (IDMP, 2021). To increase the level of drought preparedness, the South African Development Community (SADC) and the International Water Management Institute (IWMI) have teamed up with the World Bank to provide humanitarian interventions, drought analytic initiatives, multi-year drought resilience programmes and crisis management services for farmers (Maria, 2021). According to Maria (2021), there are three pillars of drought risk management that focus on interconnected, multi-disciplinary and multi-institutional activities. These pillars include; *1. Vulnerability and Impact Assessments* which looks at the negative effects that droughts have on agriculture (Maria, 2021). *2. Monitoring and Early Warning Systems* which focuses on establishing drought early warning systems (Maria, 2021). *3. Mitigation, Preparedness and Response* includes actions and measures that a country can take to decrease their vulnerability to drought and minimize its impacts (Maria, 2021).

The Southern African Drought Resilience Initiative (SADRI) also provides drought early warning systems and preparedness strategies for farmers within the region (Maria, 2021). Governments need to maintain DEWS to warn their citizens and farmers about looming drought conditions (IDMP, 2021). According to the adjusted IDP (2022), the uMzinyathi district disaster management centre uses a bulk SMS system to broadcast drought early warning systems to the Msinga Municipality residents. Furthermore, Rukema & Umubyeyi (2019) argue that is it important for the rural communities of Msinga to have drought early warning systems as it is a way of achieving and sustaining their livelihoods, as well as reducing the impacts of external shocks. For example, a study conducted by Vanderhaeghen & Hornby (2016) reported that if respondents had received early drought warnings, they would have had bought extra hay or stocked up on fodder for the cattle. In addition to scientific early warning systems, the rural communities of Msinga reported that the occurrence of drought could be predicted by animal behaviour (Rukema, 2010). For example, cows will go weak as the grass dies, indigenous animals will migrate to other areas, cows and goats will walk around houses or go inside and the cries of birds and wild dogs could determine if a drought is close (Rukema, 2010).

(C) Adaptation and Mitigation Measures

5.12.

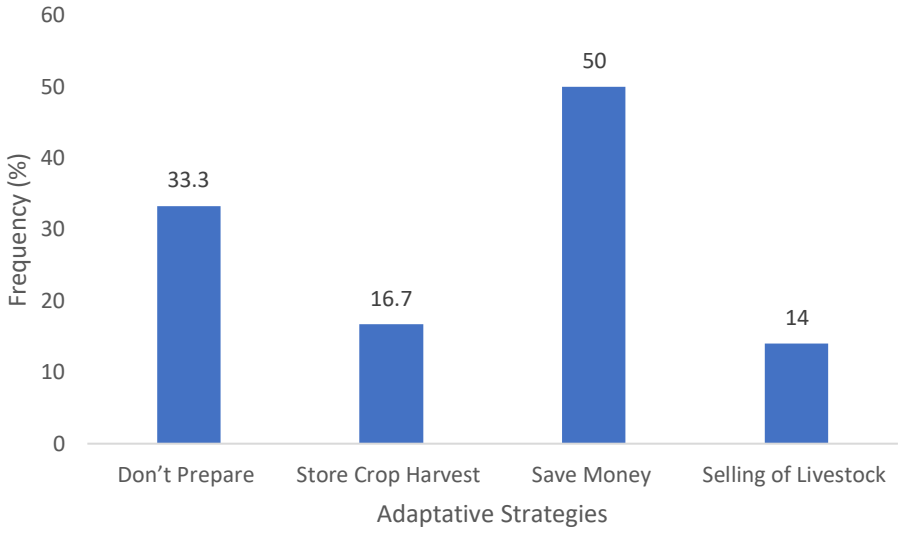


Figure 5.12: Graph Showing Adaptative Strategies for a Drought

With regard to the results in *(figure 5.12)* respondents reported that 33.3% of the surveyed population did not prepare for a drought, whilst 16.7% of respondents stored crop harvests as an adaptive strategy. Additionally, 50% of respondents used saving money as an adaptation strategy in preparation for a drought and 14% sold their livestock. Recurring drought is a challenge for many countries around the world, it is therefore necessary for farmers to have some adaptive strategies put into place. Bahta & Myeki (2021) define adaptation as reducing a household's vulnerability and improving resilience when responding to the impacts of agricultural drought. According to Udmale *et al.,* (2014), drought adaptation is a two-step process, which primarily requires the perception that a drought is occurring, and the second step is responding to its numerous impacts through adaptation and mitigation activities. According to Mbow *et al.,* (2019), adaptation strategies can help to decrease the negative impacts of climate change on ecosystems and food systems. On the other hand, mitigation measures can reduce the GHG emissions that come from agricultural production and ecosystems (Mbow *et al.*, 2019). A study conducted in Maharashtra, India by Udmale *et al.,* (2014) revealed that subsistence farmers use various adaptation measures to deal with drought, such as selling of livestock, climate-smart agriculture, rural-urban migration, seeking non-agricultural income sources and selecting less water consuming crops. Furthermore, the UNFCCC acknowledged that subsistence farmers also use indigenous knowledge as a drought

adaptation measure. These indigenous measures included food processing and storage, afforestation, planting of drought-resilient crops, livestock breeding, improved cropping systems, disaster preparedness, weed control, indigenous forecasting, early warning systems and disaster rehabilitation (Ngcube & Lagardien, 2015).

A study conducted by Rukema & Umubyeyi (2019) revealed that within the Msinga Municipality, indigenous knowledge was also used as an adaptive measure to deal with drought. For example, some respondents have stated that praying to ancestors could predict, prevent and mitigate the effects of drought (Rukema & Umubyeyi, 2019). During a severe drought, the elderly women often pray and seek protection from the ancestors on top of a mountain (Rukema & Umubyeyi, 2019). Another major indigenous drought adaptation strategy that is implemented by several households in Msinga is the cutting down of food intake. It was reported that some respondents had gone one or more days without eating because of the lack of food during a drought. Additionally, rural communities of Msinga have used drought tolerant crops, such as broad leaf spinach and sweet potatoes as alternative crops to plant during a drought. The advantage of using these indigenous methods is that it helps with environmental conservation, ensuring food security and developing sustainable agricultural practices (Pillay, 2021). However, Rukema & Umubyeyi (2019) reports that conflicts between the use of indigenous knowledge and modern technology contributes to the limitations of drought adaptation and mitigation methods within the area. Respondents further stated that the younger generation are no longer interested in indigenous methods. Additionally, the storing of crop harvests during a drought is very common in rural areas. For example, in Tanzania, the storing of food in times of abundance is an adaptive measure that is used for times when food and money is scarce (Rukema & Umubyeyi, 2019).

Within the agricultural industry, South Africa has struggled to effectively plan and deal with the impacts of drought (Ncube, 2016). However, in 2005, a National Drought Management Plan (DMP) was developed as an adaptative strategy (Ncube, 2016). The National Plan implements early warning systems, evaluation and monitoring of droughts, conducting research on climate change, providing all provincial agricultural departments with technical assistance on drought assessments and it also aims to encourage participation in drought reduction programmes within the government (DMP, 2005). However, most respondents have stated that the government does not provide the rural communities of Msinga with early warning systems for drought.

(D) Drought Perceptions = Socio-Economic Impacts

5.13.

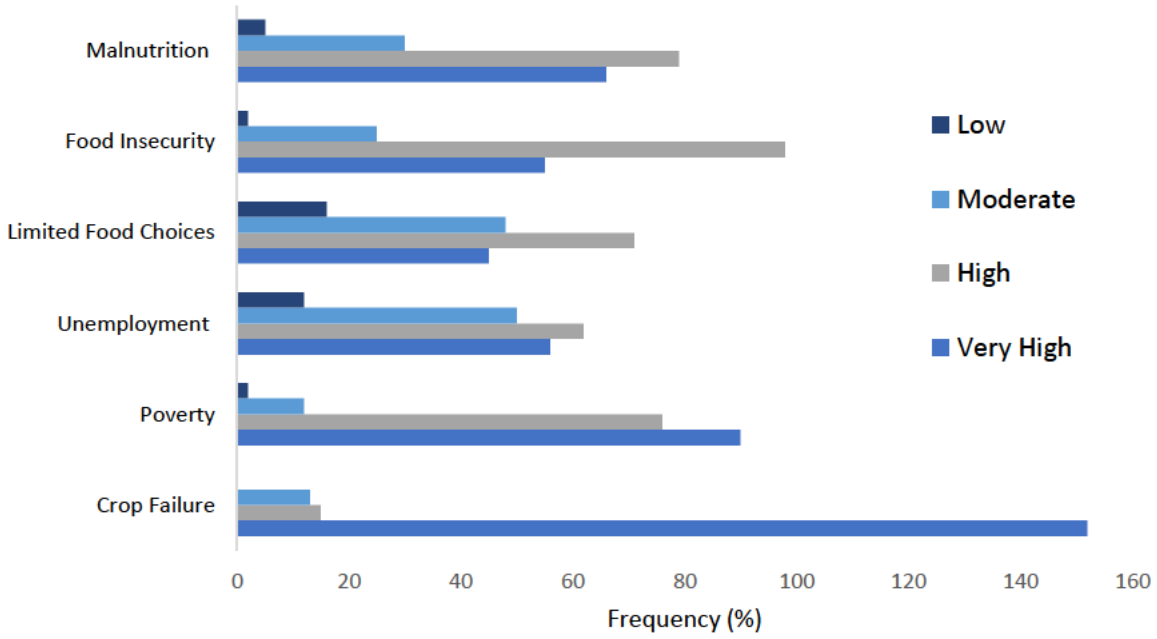


Figure 5.13. Graph Showing Socio-Economic Impacts of Drought

According to Rukema & Umubyeyi (2019), drought conditions within Msinga are aggravated by the prevailing social and economic situation in the region. Therefore, it is acknowledged that drought causes socio-economic impacts for the rural communities of Msinga, which ultimately affects their vulnerability and livelihoods (Rukema & Umubyeyi, 2019). In terms of socio-economic impacts, the Msinga municipality is one of the least developed regions in the uMzimyathi district (Rukema, 2010). Furthermore, Rukema (2010) states that fewer resources are allocated for economic and social development in Msinga.

Drought has caused malnutrition

With regard to the results *(figure 5.13),* 66 respondents stated that their malnutrition levels as a result of drought were very high, 79 respondents were classified by high levels of malnutrition, 30 respondents were moderately malnourished, and 5 respondents experienced low levels of malnutrition. According to a global UNICEF (2021), report, young people and children in South Africa are amongst those at risk of the impacts of climate change, which ultimately threatens their education, protection and health. Furthermore, during a drought, high

levels of malnutrition are detected in developing countries. Nortier (2021) defines malnutrition as a health problem that is caused by a lack of nutrients, healthy food or calories. According to Belesova & Wilkinson (2019), climate change and extreme weather events, such as droughts are projected to increase the current burden of child malnutrition to 10.1 million by 2050. Droughts can deplete water supplies, which will affect water and sanitation, thus causing malnutrition to worsen (UNICEF, 2021).

In South Africa, an estimated 27% of children under five are malnourished, which further emphasises the importance of protecting water resources (UNICEF, 2021). In 2017, global malnutrition was estimated to be the cause of 45% of 5.4 million deaths in children under five (Belesova & Wilkinson, 2019). According to Mason (2005), HIV/AIDS and prolonged drought amplifies the effects of malnutrition in many African countries. For example, 12.8 million children suffer from acute malnourishment and a further 4 million are classified as undernourished across East Africa (Reid, 2021). Residents of Msinga have reported that due to the drought, stunted growth of crops and the reduced quality of harvests – malnutrition has been aggravated within the area (Rukema & Umubyeyi, 2019). It was also witnessed that higher temperatures, inadequate sanitation and increased levels of poverty have also contributed towards malnutrition within the Msinga Municipality (Meredith *et al*., 2021).

Drought has caused food insecurity

From *(figure 5.13)* it was acknowledged that 55 respondents stated that their food insecurity levels due to drought was very high, whilst 98 respondents described their food insecurity at a high level. Additionally, 25 respondents reported moderate food insecurity levels and 2 respondents experienced low levels of food insecurity. Almost, a quarter of the world's population do not have enough food for daily consumption and approximately 1 billion people go hungry every year (Kogan *et al.,* 2018). One of the major reasons for food insecurity and hunger is drought, which reduces agricultural practices. Findings from Rukema & Umubyeyi (2019) reported that during times of drought, parents send their children away, so that there are less people to feed. Additionally, some respondents stated that they travel long distances to areas unaffected by the drought to borrow food items from relatives or friends (Rukema & Umubyeyi 2019). It was acknowledged that during a drought, some respondents adopted the use of drought resistance crops or seasonal migration to avoid food insecurity (Rukema & Umubyeyi 2019). The Msinga respondents also exchange livestock, crops, grain, animal products and milk with neighbours to avoid food insecurity (Rukema & Umubyeyi, 2019).

Additionally, food insecurity was also reported by respondents since the drought impacted the growth of vegetables, sorghum and maize - which are the main sources of food within the Msinga municipality (Rukema & Umubyeyi, 2019).

Droughts have become a regular occurrence across the world, and it presents a constant threat to food security and malnutrition (FAO, 2013). Globally, drought has caused famine, migration, displacement of individuals and loss of human life in developing countries (FAO, 2011). It is classified as the single most common cause of severe food shortages in developing countries (FAO, 2011). For example, within Africa, in the last 40 years, there has been at least 382 droughts reported, which has affected more than 326 million people (Shiferaw & Menkir, 2014). Since 2019, the Horn of Africa has approximately 12 million people who are food insecure and an estimated 1.8 million people who are displaced because of prolonged droughts (Acaps, 2019). Additionally, a drought affects all four dimensions of food security – availability, accessibility, utilisation and stability. For example, in Africa, nearly 20% of the population, which amounts to 250 million people experience food insecurity, as a result of drought, conflict and the Covid-19 pandemic (Reid, 2021). A drought's impact on agricultural practices includes; a decline in livestock and crop production, harvest losses, a rise in pests, animal and plant diseases, land degradation, forest fires and an increase in soil erosion (FAO, 2011). Droughts cannot be prevented; however, it can be detected early, which will prevent damages to crops, thus reducing food insecurity (Kogan *et al.*, 2018).

Drought has caused limited food choices

With regard to *(figure 5.13)* drought had caused very high levels of limited food choices to 55 respondents, whilst 71 respondents experienced high levels of limited food choices and 48 respondents reported moderate levels. Furthermore, the results illustrated that 16 respondents experienced low levels of limited food choices. Globally, agriculture is the most dominant form of land use, and due to its nature, it remains highly sensitive to climate change and extreme weather events, such as drought and floods, which in turn affects food availability and food accessibility (Shiferaw & Menkir, 2014). For example, during the 2015/2016 South African drought, Grain SA (2016) struggled to produce enough affordable food for the country, which limited food options for many people. Additionally, it was reported that the increase in food prices limited what Msinga respondents ate. Furthermore, findings from PACSA stated that in South Africa, food prices increased severely from November 2015 when the drought began (Grain SA, 2016).

According to Umraw (2016), if more droughts occur, food prices in the future will depend on whether farmers will be able to plant and produce enough crops, which will ultimately affect food choices. Additionally, food shortages could also force the South African government to import more, which pushes up prices even further, resulting in limited food choices (Mmatlou, 2019). On the other hand, it is acknowledged by Shiferaw & Menkir (2014) that poverty in Msinga makes people vulnerable, thus limiting their food choices. According to findings from Rukema & Umubyeyi (2019), the drought had forced respondents to consume traditional leafy vegetables, such as moringa, pumpkin leaves, blackjack and cowpeas. Additionally, Vorster (2007) states that during a drought, rural communities often face shortages of vegetables and limited food choices, therefore preservation of traditional leafy vegetables is one strategy that can be used to face these times. In East Africa, more than 18 million people are at risk of food shortages and limited food options, due to the frequent droughts (Shiferaw & Menkir, 2014). According to Springer (2016), it takes a lot more water to produce meat products than plant-based foods, therefore it is advised to eat less meat during a drought. Alternatively, people could eat plants that require a little water to grow, such as eggplants and cucumbers (Springer, 2016).

Drought has Caused Unemployment

Results from the surveyed population *(figure 5.13)* revealed that drought had caused very high levels of unemployment for 56 respondents and 62 respondents described high levels of unemployment. The results also reported that 50 respondents were moderately unemployed, and 12 respondents experienced low levels of unemployment. In the past few decades, recurring drought has caused major problems in African countries, with the depletion of assets, forced migration, poverty, environmental degradation and unemployment (Shiferaw & Menkir, 2014). According to Rukema & Umubyeyi (2019), Msinga respondents have stated that some community members who work in the agricultural sector have lost their jobs due to the drought, poor productivity, poor animal health and a rise in livestock mortality – which has resulted in the loss of income. Additionally, respondents have reported that unemployment due to drought resulted in some residents having to borrow money from other family members (Rukema & Umubyeyi, 2019). During times of drought, women within Msinga have also resorted to the brewing and selling of traditional Zulu beer for additional income (Rukema & Umubyeyi, 2019). However, some Msinga residents have stated that the loss of maize and sorghum crops during a drought has made it difficult to brew traditional beer, which has resulted in economic losses for the brewers (Rukema, 2010). Other respondents have stated that they sell cakes,

sugar, chips, sweets and soap to earn a living and escape the effects of drought (Rukema & Umubyeyi, 2019). As a result of unemployment, due to climate shocks, rural households are forced to remove children from schools, default on loan payments and engage in the exploitation of environmental management practices for their survival (Shiferaw & Menkir, 2014). On the other hand, businesses that rely on farming, such as the tractor and food industries, as well as companies that sell fishing equipment and boats could lose money due to the drought, which could result in retrenchments, leading to unemployment (Ngumbi, 2019). According to findings from Rukema (2010), some residents of Msinga seek seasonal employment in commercial farms; however, some respondents have been retrenched from those commercial farm jobs as a result of drought.

According to Mmatlou (2019), the Western Cape government was forced to implement water restrictions during South Africa's 2015/2016 drought. These restrictions included limiting water use for irrigation purposes, as dam levels dropped to below 20%, which directly affected agricultural practices, food production and it caused ripple effects to the economy and unemployment (Mmatlou, 2019). Within the province, the economy had lost R5 billion due to the drought, which affected the country as a whole, since Western Cape contributes 22% towards the national agricultural GDP (Mmatlou, 2019). As a result of the drought and water restrictions, many people had lost their jobs in the fruit and wine industries. Furthermore, in 2018, the tourism industry had also seen a decline and hotel bookings decreased by 10% - 15%, which resulted in short time and retrenchments (Mmatlou, 2019). In 2017, the agricultural industry had seen job losses of 27.04% nationally, with 20 000 job losses being in the Western Cape, 19 000 job losses in Limpopo, whilst Free State and Mpumalanga lost 1000 and 4000 jobs respectively (Capazorio, 2016 & Mmatlou, 2019). The drought had also resulted in the loss of 36 000 jobs within the food manufacturing and processing industry (Capazorio, 2016). According to Truter (2018), some employees cannot function during interruptions to water supplies, which ultimately affects productivity. Truter (2018) also mentioned that attendance in the workplace was an issue, since employees had to stand in long queues to fetch water, resulting in them leaving early, not going to work or arriving late, which eventually led to a "no work, no pay" policy.

Drought has caused increased levels of poverty

Based on findings from *(figure 5.13)*, it was stated that drought had caused very high levels of poverty for 90 respondents, 76 respondents experienced high levels of poverty, whilst 12

respondents were moderately poverty-stricken and only 2 respondents reported low levels of poverty. Droughts affect approximately 55 million people a year, whilst water scarcity impacts 40% of the world's population, which will amount to 700 million people being at risk by 2030 (WHO, 2021). Frequent droughts have contributed towards the decrease in GDP growth in many African countries, which has threatened rural livelihoods (Shiferaw & Menkir). Drought directly affects poverty-stricken rural communities within Msinga through; shortages of harvest, health issues, loss to livelihoods and damage to assets and infrastructure that contribute towards food security (Shiferaw & Menkir, 2014). Severe food insecurity and livelihood stress, due to drought had caused some rural communities in Msinga to liquidate valuable assets, such as land and livestock in exchange for food (Shiferaw & Menkir, 2014). This is because those rural households that experience poverty are often unable to recover from climate shocks without financial support (Ruff, 2017). The changing temperatures and drought caused detrimental effects for Msinga farmers, as their crop yields and livestock were destroyed, resulting in loss of livelihoods - which sent them and their families further into poverty (Ruff, 2017). Respondents have also reported that the drought had forced them to migrate or spend money on irrigation systems, which ultimately increased their poverty levels. Additionally, some community members have reported a loss of income due to the drought and there not being enough crops to sell (Rukema, 2010).

Combined with extreme weather events, and the health and economic impacts of the Covid-19 pandemic, millions of people in developing countries have been driven deeper into despair and poverty (Reid, 2021). An estimated 40% or 1.3 billion people rely on agricultural practices as their main source of income, therefore, with recurring drought millions of livelihoods are put at risk (FAO, 2018). Additionally, a study published by Mahapatra (2016) revealed that severe drought had caused rural communities in Odisha, Jharkhand and Chhattisgarh in India to lose over US$ 400 million. According to Mahapatra (2016), approximately 13 million people in the three states found themselves under the poverty line, due to drought-reduce income losses. In addition to economic loss and poverty, drought also causes mass migration, displacement of people and loss of human life (FAO, 2011). According to Rukema (2010), respondents argued that drought in Msinga is aggravated by the existing high levels of poverty. As mentioned in previous chapters, poverty as a result of drought has become a part of the Msinga residents' lives.

Drought has caused crop failure

With regard to *(figure 5.13)* 152 respondents stated that the drought had caused very high levels of crop failure. Additionally, high levels of crop failure were experienced by 15 respondents, whilst moderate crop failure was observed by 13 respondents and 0 respondents reported low levels of crop failure. Crop failure occurs when there is an increased pressure on fragile and limited land resources (Shiferaw & Menkir, 2014). According to Holupchinski *et al.,* (2019), there are many climate events that threaten agricultural production within the Msinga Municipality, however drought is one that brings the most devastation, since majority of crops in South Africa are rain-fed. Additionally, respondents have stated that compared to floods or landslides, drought conditions have led to reduced crop yields much quicker (Holupchinski *et al.,* 2019). Furthermore, Shiferaw & Menkir (2014) state that when crop failure occurs, rural communities of Msinga have fewer or no alternatives to feed themselves and their families, which leads to them exploiting land resources for survival, thus causing them to become victims of desertification and environmental degradation. Respondents have also reported that the lack of water caused a decrease in soil moisture, which made crops more vulnerable to pests and diseases, thus resulting in crop failure.

A drought that occurred in South Africa and Lesotho led to crop failure during the growing seasons of January - March 2007, which resulted in more imports and price hikes for both countries (Otto *et al.,* 2021). For example, due to crop losses during the 2004-2007 drought, many rural communities within Msinga were left starving and destitute (Rukema, 2010). Additionally, Rukema (2010) reveals that 70% of crop production was lost due to the drought. It is also acknowledged by Rukema (2010) that crop failure caused starvation, which led to mass migration. The failure of crops also led to the rural communities of Msinga loosing their source of income. Respondents have also acknowledged that the drought had reduced water quality and availability, which resulted in crop failure and high food prices. Additionally, due to a 2015 drought in Puerto Rico, 85% of crops, such as fodder, grass and plantains were impacted, which resulted in $14 million of agricultural losses (Holupchinski *et al.,* 2019). Droughts can cause a significant amount of damage when it occurs during the important stages of crop development, such as after planting or during flowering, as it could possibly stunt the growth of crops, which will result in a decrease in size and quality of the harvest (Holupchinski *et al.,* 2019). For example, in 2018, severe drought had cut agricultural production by 20% in the Western Cape, which resulted in damaged wheat crops and a decline in pear, apple and grape exports to European countries (Hutchings, 2018).

CHAPTER SIX – CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

The main aim of this chapter is to provide a summary of the main research findings of the study and to determine how previously reviewed literature links to the research topic. The findings and results of this study are discussed in relation to the objectives and the proposed researched questions. As mentioned in chapter one, the main aim of the study is to determine the impacts of droughts on the rural communities of Msinga in Kwa-Zulu Natal, South Africa. Additionally, this research project focused on the socio-economic impacts of drought. This chapter will also provide recommendations, theoretical reflections and concluding remarks about the study project.

6.2. Summary of Key Findings

The results and important findings of the research study are presented and summarized below in relation to the objectives of the research study.

6.2.1. Objective One: To assess the perceptions regarding the socio-economic impacts of droughts within the rural communities of Msinga.

The purpose of this objective is to determine the social and economic impacts of a drought. To a large extent, the rural communities of Msinga were impacted socially and economically by the drought. Therefore, the aim of this objective is to gain a deeper insight into the visible and invisible factors of how the drought has affected rural communities in Msinga. Additionally, socio-economic impacts also focus on the financial aftermath of how droughts affect livelihoods. Important questions surrounding this objective were related to how the respondents were impacted by the drought in terms of malnutrition, food security, limited food choices, crop failure, unemployment and poverty. Findings from this study revealed that the drought had affected malnutrition in the community, with majority of respondents reporting high to moderate levels of malnutrition. Droughts have become a regular occurrence across the globe, and it presents a constant threat to malnutrition and food security. From the results, it was acknowledged that drought affects the four pillars of food security, and that majority of the respondents reported very high to high levels of food insecurity. This objective was also important in determining the impacts that a drought brings to individuals. Furthermore, the drought had also caused crop failure and limited food choices. The results revealed that due to

water scarcities and the drought, many respondents experienced food shortages and a lack of harvested crops to provide for their families.

The results also indicated that all respondents reported crop failure, since they rely on rainfed agriculture. According to Pawlak & Kolodziejczak (2020,) the world experiences extremely uneven patterns of socio-economic development, which ultimately leads to food shortages and loss of livelihoods. This was seen by the high levels of unemployment and poverty within the Msinga Municipality. Drought impacts were felt the most by female-headed households whose livelihoods derived from farming activity. As a result of climate shocks and unemployment, school drop outs became a coping mechanism, as parent could not afford the fees (Mtetwa, 2018). Furthermore, the covid-19 pandemic, lockdowns and the looting have put more people out of jobs (Naidoo, 2021). Findings from the study revealed that all respondents were unemployed, whilst majority of the population were experiencing very high to high levels of poverty. In addition to unemployment and poverty, drought also caused migration, displacement of people and loss of human life. According to Rukema & Umubyeyi (2019), drought conditions in Msinga are aggravated by the prevailing social and economic situation in the region. Therefore, droughts have caused complex socio-economic consequences for communities in Msinga and it has caused vulnerability to livelihoods.

6.2.2. Objective Two: To investigate the adaptation strategies that the rural communities of Msinga adopt during periods of drought.

The purpose of this objective is to determine what measures rural communities take to deal with the effects of drought. Questions surrounding this objective were related to how respondents prepared for a drought, if they received early drought warnings and if they received agricultural training or governmental assistance. According to Rukema & Umubyeyi (2019), droughts are endemic to the Msinga region, therefore it is necessary to have management strategies put in place. However, findings from this study reported that 33.3% of respondents did not prepare for droughts, whilst 16.7% stored crop harvests as an adaptive strategy, 14% sold their livestock and 50% of respondents used saving money as an adaptation measure. Rukema & Umubyeyi (2019) states that communities within Msinga have knowledge about droughts, however, they do not have drought management skills. Since majority of respondents are not educated, most of the adaptation and mitigation strategies used by respondents were based on indigenous knowledge to help them alleviate the impacts of drought on their agricultural production. The most common traditional methods of drought adaptation and mitigation in Msinga were food rationing or reduced food intake, conservation of water for dry

times, using savings to buy food, storing of crop harvests and the selling of assets, such as livestock. Furthermore, it is indicated that there is conflict between traditional knowledge and science; however, most young people are more into modern science practices than indigenous knowledge. Findings from this study also stated that if respondents received agricultural training or assistance from the government, they would be would better equipped to deal with the impacts of drought. According to Joseph & Hamilton (2013), there is poor management from the government to deal with drought and its impacts within the Msinga Municipality. Additionally, the availability of drought early warning systems could help farmers prepare in advance and implement adaptation and mitigation strategies.

6.2.3. Objective three: To examine the perceived seriousness and frequency of droughts within the rural communities of Msinga.

The purpose of this objective is to establish the perceived seriousness and frequency of droughts within the Msinga Municipality. Important questions surrounding this objective were related to what the respondents understood by the terms "seriousness and frequency" of droughts, and whether they had noticed any changes in temperature and rainfall patterns over the last decade, or if they believed that the drought had any impact on their livelihoods. However, it is important to note that even though majority of the population was female and had a limited educational background, most of the respondents had some sort of knowledge about the seriousness and increased frequency of droughts. Findings from the study revealed that 61.1% of respondents stated that the severity of droughts was very high, 31.7% said that it was high and 7.2% reported that the seriousness of drought was moderate. The seriousness of drought and how it is perceived is based on how people experience it and how they are affected by it. Within Msinga, the seriousness of drought was noticed by the decreased levels of rainfall, agricultural production and food security. Additionally, the severity of drought increased because community members lacked environmental education and were not well equipped to deal with the devastating impacts (Pillay, 2016).

As a result of the changing climate, the intensity and frequency of droughts are expected to increase in the upcoming decades (Chami & Moujabber, 2016). Majority of the respondents acknowledged that there was a rise in the frequency of droughts; however, the results stated that some respondents reported no difference in the frequency of drought, or they were uncertain. Additionally, results from the study noted that majority of respondents stated that droughts had occurred more frequently, whilst a small percentage of respondents reported that droughts occurred less frequently. The increased frequency of drought was noticed by the lack

of rainfall, increased temperatures and the occurrence of heat waves. Crop production also faced alarming challenges due to dry conditions and the lack of sustainable agricultural practices. The increased frequency of drought was also determined by lack of rainfall, water shortages, rural-urban migration, loss of livelihoods, outbreak of diseases and livestock deaths. According to Mtetwa (2018), frequent droughts are making it harder for rural households to cope with its impacts. Respondents have stated that they barely recover from one drought before another one hits. A drought is usually characterised by its duration, severity frequency and on the vulnerability of the region (Mesbahzadeh *et al., 2019*). Additionally, climate science reports that in the future, the world will be warmer, and the occurrence of droughts would become more frequent (Bates, 2021). However, it is impossible to determine exactly where and when a drought will occur or how serious its impacts will be (Bates, 2021).

6.2.4. General Findings

This study recognises that the occurrence of droughts has increased in recent decades, with it being more pronounced in arid and semi-arid regions. Furthermore, droughts are viewed as a prolonged dry period in the natural climate cycle. This research study also discussed the different kinds of drought, as well as the different categories of drought. Furthermore, it was acknowledged that drought occurs at a slow rate, which makes it difficult to quantify, manage and detect, thus resulting in economic, social and environmental impacts. However, the Palmer Drought Severity Index and the Standardised Precipitation Index are indicators that scientist use for measuring drought. Additionally, this study discussed how droughts have affected developing countries and it also stated that prolonged drought resulted in displacement, health-related issues, malnutrition and loss of lives, whilst in developed countries it mainly caused economic losses. Globally, drought is an extreme and frequent climate event that affects the livelihoods of millions of people. Furthermore, the biggest effects of drought are felt by rural communities, small-scale farmers and the agricultural sector. The study acknowledges that droughts have led to water shortages, pests and diseases, crop failure, livestock deaths, loss of soil moisture and a rise in food prices. Additionally, a drought has an impact on all four dimensions of food security. Moreover, climate-smart agriculture and sustainable food systems are used to prevent the changing climate from further worsening food insecurity amongst rural communities. As a result of droughts - the food security levels, and livelihoods of women have been negatively impacted.

The data obtained for this research study was archival data, which was conducted at the Msinga Municipality in Kwa-Zulu Natal. For the purpose of this study, a quantitative research method

was used to study the impacts of drought on the rural communities of Msinga. Additionally, a structured questionnaire was used for the collection of data. A purposive sampling method was adopted, and a programme called Statistical Package for the Social Sciences was used to analyse the data. The results indicate that majority of the Msinga population is female, with a large portion of the population being single. Additionally, majority of the population was made up of the elderly, uneducated and unemployed respondents. However, many respondents relied on social grants or on subsistence agriculture to earn an income and provide for their families. The results also presented the different types of irrigation systems used within the Msinga Municipality.

6.3. Theoretical Reflections

This section discusses the theoretical reflections in terms of the sustainable livelihood approach and the drought perception theory. Furthermore, the theoretical framework was used to determine and understand the socio-economic impacts of drought on rural communities.

6.3.1. Sustainable Livelihoods Approach

The sustainable livelihoods approach, which was discussed in chapter three, acknowledges that poor individuals have the important skills, knowledge and abilities to create a sustainable livelihood to alleviate poverty. The SLA also argued that when dealing with poor communities, it is important to place them at the centre of discussion to allow for the maximum exchange of information (Pillay, 2016). It is seen as a broad goal for poverty eradication. The SLA uses a combination of the five forms of capital *(natural, financial, human, social & physical)* to determine different livelihood strategies for rural communities. Additionally, the SLA does not simply classify poverty as a lack of income, it also considers the assets that poor households need or possess in order for them to obtain an adequate income to live. The SLA looks at stresses and shocks, and it acknowledges that a livelihood is sustainable when it can cope with and recover from these. However, there needs to be a link that focuses on poverty reduction and long-term environmental stresses and shocks (Pillay, 2016). For developing countries, the impacts of climate-related disasters place huge amounts of stress on the economy, thus creating a spiral of poverty and debt. The SLA addresses the devastating environmental conditions that weaken the livelihoods of rural communities, and their abilities to cope with natural disasters, such as droughts. Case studies of rural farmers within the Msinga region and India was used as examples to further explain the SLA and drought. For example, the drought in Msinga had caused many subsistence farmers and rural communities to loose their livelihoods. However,

the Aballimi Phambili Farmer Support Programme was designed to improve livelihoods and educated the rural farmers on climate change, food security and agricultural production. The SLA also discusses policies, institutions and processes.

6.3.2. Drought Perception Theory

This section presents the theoretical foundation for the perception of drought theory. In terms of drought, perception is influenced by the characteristics of dry weather and by the individuals who experience it. However, Udemale *et al*., (2014) argues that drought has different meanings, and it is perceived by farmers based on their physical environment type, level of financial security and involvement in agricultural activities. The drought perception theory was discussed in relation to how individuals who are impacted by drought perceive it. Furthermore, farmers of the Ogallala Region in the United States of America were interviewed, and the results indicated that there are four important elements of drought perception. These included drought experience, drought memory, drought definition and drought expectation.

The aspects of ***drought experiences*** that was mentioned in the study were the meteorological events that took place during the farmer's careers. According to Taylor *et al.*, (1998), each farmer's drought experience was measured by using the Palmer Drought Severity Index (PDSI) over the time they were farming. Additionally, the PDSI was used as a measure of meteorological drought in comparison with a farmer's experiences of drought. According to Taylor *et al.,* (1988), droughts experienced through oral, pictorial or written forms may also have an influence on a farmer's perception of drought. Additionally, the study revealed that ***drought memory*** consisted of drought events or dry periods that formed part of a farmer's direct experiences. Furthermore, drought memory focuses on events that can be recalled. Taylor *et al*., (1998) states that drought memories showed that memories of all, but the most severe and prolonged droughts fade quickly. The study also mentions memory and age, thus, Taylor *et al.,* (1988) acknowledged that the older farmers have experienced more droughts than the younger farmers, therefore they recalled more drought events.

According to Taylor *et al.,* (1988), the first-time ***drought definition*** was mentioned was when the farmers were asked "What do you think of as drought?" This was followed by a series of questions relating to weather and climate, natural disasters and climate change. Furthermore, Taylor *et al.,* (1988) revealed that drought was defined in terms of decreased rainfall, a dry spell or lack of moisture, high temperatures, an increase in winds and dryness, crop failure, social and economic impacts and low crop yields. However, there is no specific definition of

drought – it has different meanings to different people. Lastly, to identify the ***expectations of drought*** - farmers were asked to describe the climate in their area and to state the advantages and disadvantages for farming. According to Taylor *et al.,* (1988), a farmer's expectations of future droughts were linked to their farming locations and their definitions of drought. According to Deressa *et al.,* (2010), climate change will disrupt future weather patterns, therefore it is important to understand how farmers perceive and adapt to drought. Additionally, it is necessary to understand how different individuals perceive drought and its impacts when dealing with policy and decision making (Aldunce *et al.,* 2017).

6.4. Recommendations

This section presents some recommendations based on the results and analysis from the research study. It discusses women empowerment, environmental education, sustainable agricultural practices, and it looks at government involvement and interventions.

6.4.1. Women Empowerment (Sustainable Development Goal 5 – Gender Equality)

Women play a vital role in the agricultural sector and are therefore vulnerable to climate change and its impacts on food security and livelihoods. According to Beaudet (2018), women in rural areas are more acutely affected by drought. Additionally, Beaudet (2018) argues that an efficient way to tackle gender inequality that results from water scarcity and drought is to involve women in the decision-making process of food production, natural resources and water management. For example, in Madhya Pradesh in India, women have been included in water management and climate-related decision making (Beaudet, 2018). During the drought, many of these women would walk 3-9 hours to fetch water, therefore a Self-Help Group was formed by a local organisation to discuss water-related issues (Beaudet, 2018). The organisation designed programs on water literacy, the hydrological cycle and they educated the women on the reasons behind water scarcity and adaptation strategies and how to overcome it (Beaudet, 2018). Since the project was introduced, the women of Madhya Pradesh no longer face water-related issues and more girls are attending schools as they do not have to walk long distances to collect water (Beaudet, 2018). Furthermore, improving gender equality and budgeting during periods of drought and water scarcity could mitigate the risks that women face (Beaudet, 2018).

According to FAO, IFAD & WFP (2021), empowering girls and women during a drought is important to ensure sustainable livelihoods at a household level, especially in the aftermath of covid-19. It is acknowledged that women, especially in developing countries are vital to eradicating malnutrition and poverty. For example, the role of women in agricultural

production is fundamental, therefore sustainable food security requires closing the gender gap in the agricultural industry, which will empower women and increase their crop yields (Sultana, 2020). Furthermore, paying women a decent salary, improving their access to fertilizers, credit, job opportunities, equipment and guaranteeing their right to own land will have a huge impact on poverty reduction and food security (ADB & FAO, 2013). For example, studies show that if female farmers had the same resources as men, crop yields could increase by 20% - 30%, which could decrease the amount of food insecure people by 100 – 150 million (FAO, IFAD & WFP, 2021). According to FAO, IFAD & WFP (2021), drought and hunger will continue in South Arica, and there will be unequal recovery from the effects of covid-19, unless more women can hold leadership positions with increased decision-making power. The participation of South African women in decision-making and leadership roles will make them more aware and adaptive to deal with the threats of drought (Beaudet, 2018). Educating women in South Africa about the environment could influence their contributions to the agricultural industry by allowing them to make decisions on how to allocate water resources and incomes for all household members during a drought (Salazar & Fahsbender, 2019). To deal with gender inequalities within Msinga, the Local Economic Development Strategy intends to address the issues that marginalised and disadvantaged women face during a drought (LED Strategy, 2012).

According to the FAO Director, rural women can play a key role in the response to covid-19, and specifically in transforming the agricultural food system (FAO, IFAD & WFP, 2021). The President of IFAD also stated that involving rural women in the creation of a post covid-19 world and investing in their leadership positions is important to ensure that they can build decent livelihoods (FAO, IFAD & WFP, 2021). Additionally, the WFP Director argued that when women are free to make their own decisions and when they have better access to knowledge, natural resources and economic opportunities – nutrition levels improve and hunger rates drop (FAO, IFAD & WFP, 2021). Globally, the empowerment of women will lead to the elimination of poverty, improved food security, enhanced productivity, and a high recovery rate of livelihoods from the covid-19 pandemic (FAO, IFAD & WFP, 2021).

6.4.2. Environmental Education

A lot of current environmental problems, such as climate change and its impacts are caused by human activities. Therefore, Mclusky & Sessa (2015) argued that even though human behaviour is the cause of these problems, it can also be the solution towards the changing climate. It is evident that the driving force of this change is environmental education.

According to EPA (2021), environmental education is a process that allows people to explore environmental topics, participate in problem-solving and take action to improve the environment. This will lead to a deeper understanding of environmental issues, and it will help individuals make informed decisions about climate change and agricultural practices. Environmental education will involve five components (EPA, 2021): *1. Awareness and sensitivity* towards the environment, *2. Knowledge and understanding* of the environment, *3. Attitudes* towards the environment, *4. Skills* to help resolve environmental challenges, *5. Participation* in activities that lead to the resolution of environmental issues (EPA, 2021). Additionally, environmental education will teach critical thinking and enhance decision making and problem-solving skills (EPA, 2021).

According to Mclusky & Sessa (2015), there is a strong link between education and food security, as research shows that the world's hungriest and poorest people are also the least educated. Evidence suggests that educated people have better job opportunities, good health, a higher resilience to the adversity of climate change and improved food security (Mclusky & Sessa, 2015). For example, countries that have higher education levels will suffer fewer economic and human losses when natural disasters, such as droughts occur (FFSA, 2018). Environmental education is viewed as one of the most cost-effective ways to alleviate poverty. For example, a study conducted in Nicaragua showed that environmental education was the most effective way to deal with crop failures, the increase in temperatures and food shortages (Mclusky & Sessa, 2015). The main aim of an environmental education program will be to decrease vulnerability and increase adaptability to protect livelihoods from the impacts of climate change. For example, research by the Centre for Global Development and the World Bank have reported that educating women in agricultural production, the provision of early warning systems and about the environment is one of the most efficient ways of adapting to drought, which will reduce poverty and food insecurity (Mclusky & Sessa, 2015).

6.4.3. Sustainable Agriculture Practices

As communities become more educated - their food demands increase and vary (Cuesta, 2015). It is therefore necessary to teach sustainable agricultural practices at a school level to ensure individuals develop skills and knowledge that promote food security (Njura *et al.*, 2020). Knot *et al.,* (2014) argued that sustainable agricultural practices are a gradual process. However, with support and aid from the government, external stakeholders and organisations - the transition to sustainable agricultural practices can be accomplished (Pillay, 2016). According to Feenstra (2021), there are many practices that can be used to promote sustainable agriculture.

For example, farmers could minimise water use and lower pollution levels on the farm, whilst consumers can purchase foods that are grown using environmentally sustainable methods (Feenstra, 2021). Additionally, practices that encourage soil health and biodiversity could increase the water availability for crops and improve sustainable agricultural practices (Chami & Moujabber, 2016).

Climate Smart Agriculture is an example of an approach that small-scale farmers can adopt to try and promote sustainable agricultural practices. CSA and sustainable agricultural practices also have the potential to educate farmers on how sustainable farming methods can minimise the impacts that agriculture has on the changing climate (Pillay, 2016). CSA programmes are aimed at increasing the resilience of subsistence farmers to the risks and shocks that are associated with climate change. However, sustainable farming practices are needed because agriculture is a large contributor of greenhouse gas emissions. Therefore, if emissions such as carbon dioxide, nitrous oxide and methane are managed and controlled effectively, agriculture could become an important sector in mitigating the long-term impacts of climate change (FAO, 2015). However, if sustainable agricultural practices become successful in reducing the problem of climate change, it could also contribute towards increasing the pressures of future natural resources (Cuesta, 2015).

6.4.4. Government Involvement and Interventions

With more intense and frequent droughts being predicted and an increased pressure on water resources, government interventions are needed. Therefore, a strategic approach that will focus on reducing the effects of drought is required. It is also necessary for policy makers to improve resilience to the impacts of drought (Meadu, 2013). According to the United Nations (2016), a proactive approach for enhancing drought resilience includes; *1. Drought monitoring and early warning systems* – which will provide effective and timely information to reduce the risk of drought and to prepare for its impacts. Drought early warning systems will also reduce hunger and mass migration. *2. A risk and vulnerability assessment* **–** is a condition that will decrease the economic, social and environmental effects of a drought. *3. Drought risk mitigation measures* – will be used as an adaptive strategy and to reduce the impacts of drought. Given the scale of devastation caused by the impacts of drought, local governments need to develop pre-planned risk reduction programmes instead of only crisis management plans (Meadu, 2013). For example, agricultural and conservation measures need to be implemented to improve drought resilience (FFSA, 2018). Other drought responses that could be practiced, include; scientific management of soils, crops and water resources, reclamation of degraded

land and improved weather forecasts for farmers and agriculture infrastructure (Meadu, 2013). Additionally, the director of CCAFS emphasised that countries around the world need to invest in the use of mobile devices to share weather forecasts and natural disaster warnings (Meadu, 2013). The director also stated that research collaborations between the governmental departments of meteorology and agriculture need to be encouraged for sustainable drought planning (Measu, 2013).

As mentioned in previous chapters, there are several governmental programmes that deal with drought. In South Africa, the lack of water is the ultimate medium to which climate change is being felt. During the 2015/2016 drought, the South African government had set aside R300 million for commercial farmers and they had given some feed to small-scale farmers for their livestock (BCC, 2015). Another step to combat climate change was taken when South Africa signed the Paris Agreement in 2016. The main aim was to guide international efforts to limit greenhouse gas emissions, to decrease global temperatures and to fight all challenges associated with climate change (DFFE, 2016). However, these steps are not enough to ensure household resilience to drought impacts. According to DFFE (2016), the South African government need to start taking steps towards decreasing the impacts of climate change by significantly investing in public transport, renewable energy, land restoration initiatives, efficient energy methods and proper waste management systems. Additionally, local government programs that provide relief to households that are impacted by drought need to be easily accessed and available. Furthermore, to ensure water accessibility during dry times, water infrastructure, such as pipes, JoJo tanks and boreholes need to be maintained (SAG, 2021).

To increase the level of drought preparedness in South African - annual drought resilience programs and crisis management services need to be implemented (Maria, 2021). According to Joseph & Hamilton (2013), South Africa is well equipped to deal with natural disasters in theory; however, they are not well prepared to put these theories into practice, since there are a lack of financial resources, political will and skilled people. However, local municipalities still need to ensure all communities have an effective water management system. According to Caleni (2017), there is a need for the governments to conduct community-based disaster risk assessments within rural areas. These risk assessments will ensure that community members are aware of which areas are prone to drought, which will assist with the adaptation and mitigation process (Caleni, 2017). According to Vogt *et al.,* (2018), disaster risk assessments need to be implemented to support water managers and policy makers in developing drought

management plans and coping mechanisms. These assessments are also expected to safeguard economic losses and damages from a drought. Additionally, droughts cause a major impact on food security; therefore, these conditions often require government interventions in the form of emergency food relief and donations of food aid (FAO, 2018). In many countries, drought preparedness by the government is usually in the form of creating food assistance to compensate for the shortfalls in agricultural production and emergency relief (FAO, 2018). The present and future climate intervention will assist rural communities with alleviating poverty and sustaining their livelihoods.

6.5. Conclusion

This research study has indicated that as a result of climate change - droughts are becoming more detrimental and are occurring more frequently. In recent times, droughts have been lasting for months or even years, whilst affecting wider regions and a larger amount of people (Vogt *et al.,* 2018). Besides the economic and social impacts - droughts also threaten ecosystems and compromises food security levels in the most vulnerable countries. Additionally, droughts have proven to be harmful for farmers, as water supply for their crops and livestock dry out, which ultimately affects food shortages, food choices, malnutrition levels, incomes, and their livelihoods. Due to the impacts of climate change, ensuring food security is an issue that many countries face. Furthermore, due to drought, higher food demand, the covid-19 pandemic, reduced crop yields and increased food prices – the availability and accessibility of food has been negatively impacted for many vulnerable communities (Pawlak & Kolodziejczak, 2020).

Droughts are a natural disaster that humans cannot stop from occurring; however, adaptation and mitigation strategies can be implemented to deal with its impacts. In addition to science practices, indigenous knowledge is also used to combat the impacts of drought. Mitigation strategies are influenced by an individual's environmental education level. The aim of environmental education is to decrease vulnerability and increase adaptability to protect livelihoods from the impacts of drought. Moreover, empowering women and involving them in the decision-making process could lessen the dangers they face. A region that is affected by a drought will require time to recover, which will lead to a decreased quality of life (FAO, 2018). However, the main goal is to make developed and developing countries drought resilient. For this to happen, adaptation strategies, water infrastructure and drought management plans need to be implemented. Furthermore, it is evident that in many parts of the world drought will adversely affect socio-economic sectors, which include; agriculture, water

resources, forestry and fisheries, human settlements, human health, ecological systems and food security.

REFERENCE LIST

Acaps. 2019. *Horn of Africa – Drought – Thematic Report.* Available online http://www.20190722_acaps.pdf . Accessed on 12 November 2021.

ACTED, CARE & DCA. 2021. Mali: Alarming Food Crisis Leaves 1.2 million Hungry. Published by Reliefweb. Available online http://www.reliefweb.int . Accessed on 20 July 2022.

African Risk Capacity. 2022. Drought- Stricken Mali Receives first-ever ARC Limited Climate Risk Insurance Pay-Out. Published by Reliefweb -OCHA. Available online http://www.reliefweb.int . Accessed on 19 July 2022.

Agriculture South Africa. 2016. *Report to the Multi-Stakeholder Task Team on the Drought Agric SA's Status Report on the Current Drought Crisis*. Published by Agri SA in South Africa.

Ahern, C. 2019. *Consequences of the Climate Crisis in Northern Kenya*. Available online: http://www.concernusa.org . Accessed on 16 August 2020.

Ahluwalia, S. 2013. *The Sustainable Livelihoods Approach: Toolkit for Wales*. Available on http://www.toolkitforwales . Accessed on 04 October 2020.

Ahmad, B. 2021. *Drought Situation Report, Pakistan.* 1(1). Available online http://www.reliefweb.int . Accessed on 15 August 2021.

Ahmed, K. 2021. *At least 1 Million People Facing Starvation as Madagascar Drought Worsen*. The Guardian. 10 May 2021. Available online http://www.amp-theguardian.com.cdn.ampproject.org . Accessed on 26 August 2021.

Aldune., P, Araya., D, Sapiain, R., Ramos, I., Lillo, G., Urquiza, A & Garreaud, R. 2017. *Local Perception of Drought Impacts in a Changing Climate: The Mega-Drought in Central Chile.* Sustainability. Published by the Department of Environmental Science and Natural Resources, University of Chile. 9(11). Doi: 10.3390/su9112053.

Aljazeera. 2022. *How Wetlands Can Help Fight Climate Change?* A Report Available online http://www.instagra,com/aljazeeraenglish . (@aljazeeraenglish). Accessed on 08 February 2022.

Amante, A. 2022. *Drought Threatens Northern Italy's Crops, Lobby Warns*. Published by Reuters. Available online http://www.reuters.com . Accessed on 21 June 2022.

Anadolu, A. 2019. F*ood Security at Risk as Drought Frequency Surges, says Association Head.* Published by Hurriyet Daily News. Available online http://www.hurriyetdailynews.com .Accessed on 13 December 2021.

Arthur, M & Saffer, D. 2020. *Water- Science & Society: Measuring the Severity of Drought*. Published at Pennsylvania State University: The College of Earth & Mineral Sciences.

Aryal, S. 2020. *Questionnaires- Types, Formats, Questions*. Available from http://www.microbenotes.com . Accessed on 31 May 2021.

Augustyn, A. 2018. *Saving Earth Encyclopaedia – Four Basic Kinds of Drought.* Available online http://www.britannica.com. Accessed on 09 August 2021.

Avert. 2020. Global Information and Education on HIV and AIDS. *HIV and AIDS in South Africa.* Available online http://www.avert.org. Accessed on 31 October 2021.

Babatunde. R.O, Omotesho, O.A, Olorunsanya, E.O, Owotoki, G.M. 2008. *Determinants of Vulnerability to Food Insecurity: A Gender Based Analysis of Farming Households in Nigeria.* 63 (1): 44-50.

Bahta, A & Myeki, V. 2021. *Adaptation, Coping Strategies and Resilience of Agricultural Drought in South Africa: Implication for the Sustainability of Livestock Sector.* 7(11). Available online http://doi.org/10.1016/j.heliyon.2021.e08280 . Accessed on 09 December 2021.

Bahta, Y.T., Jordaan, A & Muyambo, F. 2016. *Communal Farmer's Perception of Drought in South Africa: Policy Implications for Drought Risk Reduction*. Published by the University of Free State: Department of Agricultural Economics.

Baiphethi, M.N & Jacobs, P.T. 2009. *The Contribution of Subsistence Farming to Food Security in South Africa.* Agricultural Economics Research, Policy and Practice in Southern Africa. 48(4): 459-482. Available online http://doi.org/10.1080/03031853.2009.9523836. Accessed on 28 June 2022.

Balsom, P. 2020. *Water Usage in the Agricultural Industry.* Published by High Tide Technologies. Available online http://www.htt.io.com . Accessed on 18 January 2022.

Bates, S. 2021. *Drought Makes its Home on the Range.* Published by NASA – Global Climate Change. Available online http://www.climate.nasa.gov . Accessed on 02 February 2022.

Beaudet, C. 2018. *Include Women in Decision Making to Mitigate the Effects of Drought*. Available online http://www.athenainfonomics.com/drought-women-india/ . Accessed on 03 February 2022.

Belesova, K. & Wilkinson, P. 2019. *Drought Exposure as a Risk Factor for Child Undernutrition in Low-and-Middle Income Countries: A Systematic Review and Assessment of Empirical Evidence.* Environmental International. Volume 131. Available online http://doi.org/10.1016/j.envint.2019.104973 . Accessed on 9 November 2021.

Benson, C. 2009. *Drought and Sub-Saharan Africa Economies*. Published by World Bank Group. Available online http://www.openknowldge.worldbank.org . Accessed on 27 August 2022. No. 118.

Bernardo, E.B. 2018. *Climate-Smart Agriculture as a Means to Combat Drought and Desertification.* Available online http://www.ccafs.cigiar.org . Accessed on 15 August 2021.

Bertacche, M. 2022. *Worst Drought in 70 Years Threatens Northern Italy's Food, Power*. Published by Bloomberg – G.Captain. available online http://www.gcaptain.com . Accessed on 21 June 2022.

Bhandari, P. 2020. *An Introduction to Quantitative Research.* Available from http://www.scribbr/whatisquantitativereserch/definition/uses/methods.co.za .Accessed on 21 May 2020.

Bhandari, P. 2020. *What is Likert Scale? Examples and Analysis*. Published by Scribbr. Available online http://www.scribbr.com . Accessed on 26 July 2022.

Bhattacherjee, A. 2012. *Social Science Research: Principles, Methods and Practices*. USF Tampa Library Open Access Collections. Published at the University of South Florida. Textbooks Collection 3. Available online http://www.scholarcommons.usf.edu/oa_textbooks/3 Accessed on 15 June 2022.

Booth, D., Hannmer, L & Lovell, E. 2000. *Poverty and Transport: A Report Prepared for the World Bank in Collaboration with DFID.* Final Report and Poverty and Transport Toolkit.

Braimoh, A, Buck, L.E & Medina, G.D. 2019. *Food Access Deficiencies in Sub-Saharan Africa: Prevalence and Implications for Agricultural Interventions*. Frontiers in Sustainable Food Systems: Land, Livelihoods and Food Security. Doi: http://doi.org/10.3389/fsufs.2019.00104.

British Broadcasting Corporation. 2015. *South Africa Grapples with Worst Drought in 30 Years*. Published online by BCC News. Available online http://www.bbc.com/news/uk . Accessed on 11 August 2021.

Brown, T. 2016. *What Causes Drought?* USGS: Science for Changing World. Available online http://www.usgs.gov . Accessed on 29 July 2021.

Bruntrup, M., Tsegai, D & Entwicklungspolitik, D. 2018. *This is How Developing Countries Can Adapt Better to Droughts.* Weltohne Hunger. Available online http://www.weltohnehunger.org . Accessed on 25 May 2022.

Bryman, S. 2014. *Social Research Methods – 4th edition*. Pages 416-418. Published at Oxford University Press.

Caleni, S. 2017. *Assessing the Socio-Economic Impact of Drought in Goedgevonden Village, Ventersdorp Local Municipality in North West Province, South Africa.* Published at the University of Free State – Faculty of Natural and Agricultural Sciences. Disaster Management Training and Education Centre for Africa.

Camargo, S. 2021. *Fires in the Amazon Have Already Impacted 90% of Plant and Animal Species.* Published by Landscape News – Amazonia Digital Conference- The Tipping Point. Available online http://www.news.mongabay.com . Accessed on 02 February 2022.

Capazorio, B. 2016. *Drought Beginning to Impact on Unemployment.* Published by Sowetan Live. Available online http://www.soweranlive.co.za.cdn.ampproject.org . Accessed on 12 November 2021.

Carrington, D. 2011. *Food Prices Driven Up by Global Warming Study Show*. The Guardian. Available online http://www.theguardian.com . Accessed on 25 June 2020.

Caspit, B., Roll, I., Zaman, A & Ozcan, G. 2021. Unprecendented Drought Pushes Iran's Southeast to Brink. Published by AL-Monitor. Available online http://www.al.monitor.com . Accessed on 05 June 2022.

Centre for Disease Control and Prevention. 2020. *Drought and Health: Health Implications of Drought.* Available online http://www.cdc.gov . Accessed on 29 July 2021.

Centre for Disease Control and Prevention. 2021. *Drought and Your Health*. Published by the National Centre for Environmental Health. Available online http://www.cdc.gov . Accessed on 13 December 2021.

Centre for Strategic International Students. 2019. *Geopolitics and International Security*. Published at Washington DC.

Chakrabarty, M. 2016. *Climate Change and Food Security in India.* Published by the Climate Change and Development Initiative.

Chami, D.E & Moujabber, M.E. 2016. *Drought, Climate Change and Sustainability of Water in Agriculture: A Roadmap Towards the NWRS2*. South African Journal of Science. Published at the University of Free State, Bloemfontein, South Africa – Department of Agricultural Economics. 112(9). Available online http://dx.doi.org/10.17159/sajs.2016/20150457 . Accessed on 04 February 2022.

Chatterjee, A., Debnath, S & Pal, H. 2019. *Implications of Urban Agriculture and Vertical Farming for Future Sustainability.* Doi: 10.5772/intechopen.91133. Available online httpz://www.intechopen.com. Accessed on 18 August 2021.

Chaves, L & Ennes, J. 2021. *From Floods to Droughts, Brazil's Acre State Swings Between Weather Extremes*. Available online http://www.gabay.com.cdn.ampproject.org . Accessed on 23 May 2022.

Chigavazira, B.M. 2012. *Adapting to Climate Change to Achieve Household Food Security: A Case Study of Small-scale Farmers at Dzindi Smallholder Irrigation Scheme in Limpopo Province of South Africa.* Published by the Department of Development Studies, University of Fort Hare.

Chilcoat, D & Sander, J. 2017. Use of CRISPR/Cas9 for Crop Improvement in Maize and Soybean. Chapter 2. *Progress in Molecular Biology and Translational Science*. Volume 149, Pages 27- 46. Available from http://doi.org/10.1016/bs.pmbts.2017.04.005 . Accessed on 18 August 2021.

Cho, R. 2018. *State of the Planet – How Climate Change will Alter our Food?* Published at Columbia University. Available online http://www.blogs.ei.columbia.edu . Accessed on 25 June 2020.

Cindy, S. 2018. *5 Ways Technology Has Changed Farming*. Available online http://www.iowaagliteracy.com . Accessed on 29 June 2020.

Clayton, A. 2018. *Climate Change and Health: Food Security.* Available online http://www.climatechangehealth.co.za . Accessed on 24 June 2020.

Cleave, P. 2019. Better Analyse Your Survey Results Through Cross Tabulation. Published by Smart Survey. Available online http://www.smartsurvey.co.uk . Accessed on 18 June 2022.

Climate Reality Project. 2016. *The Facts About Climate Change and Drought*. What's the Link Between Climate Drought: Find Out the Key Facts in this Post. Available online http://www.climaterealityproject.org . Accessed on 06 February 2022.

Climate Signals Beta. 2015. *Ongoing Drought in Southern Africa Linked to Climate Change*. Southern African - Drought 2015. Available online http://www.climatesignals.org . Accessed on 12 August 2021.

Cortes, C. 2012. *Emergencies – Floods, Cyclones and Drought*. Section 2. Available online http://www.emergencies.com . Accessed on 02 February 2022.

Cousins, B. 2018. *Small-scale Farmers Should be at the Centre of Land Reform in South Africa.* The Conversation. Published at the University of Western Cape. Available online http://www.theconversation.com . Accessed on 28 June 2022.

Cousteau, A. 2015. *Blue Legacy- National Geographic Society.* Available online http://www.nationalgepgraphic.org . Accessed on 29 July 2021.

Cuesta, J. 2015. *Education and Food Security: One Success, two Warnings and three Paradoxes.* Published by Wise Qatar Foundation. Available online http://www.wse.qatar.org . Accessed on 01 February 2022.

Daniel, L. 2021. *Community Gardeners and Small-Scale Farmers Can Get Up to R9000 from Government. Here's How.* Published by Business Insider South Africa. Available online http://www.businessinsider.co.za . Accessed on 18 December 2021.

Danish Refugee Council. 2021. *Drought Crisis in Afghanistan Intensifies Risk of Displacement.* News and Press Relief. Available online http://www.reliefweb.int . Accessed on 15 August 2021.

Darby, M, 2016. *Meet the Women Who First Identified the Greenhouse Effect.* Available online http://www.greenhouseeffect.eu/climatechange. Accessed on 06 February 2022.

Darshan, V. 2021. *Our 5 Year Contribution*. Published by Naam Foundation. Available online http://www.naammh.org . Accessed on 17 January 2022.

Davies, J., Spear, D., Omari, K., Morchain, D., Urquhart, P & Zaremba, J. 2017. *Background Paper on Botswana's Draft Drought Management Strategy.* Published by the International Development Research Centre. Published at the University of Cape Town.

de Schutter, O. 2009. *Rural Development: Food Security, Women and Education.* Special Report on the Right to Food at the Food Agricultural Organisation Conference.

Dedezade, E. 2019. *Combating Drought with AI and the Cloud.* Available online http://www.news.microsoft.com . Accessed on 18 August 2021.

DeMarco, J. 2016. *How Climate Change Could Affect Food Prices.* The Christian Science Monitor. Available online http://www.csmonitor.com . Accessed on 25 June 2020.Department of Statistics, South Africa. 2020. *Loss of Income Resulting from the Covid-19 Pandemic may lead to Higher Levels of Food Insecurity in South Africa*. Available online http://www.statssa.gov.za . Accessed on 25 May 2020.

Department for International Development. 2006. Sustainable Livelihoods Approach (Image). Available from http://www.dfid.org . Accessed on 7 June 2021.

Department of Agriculture, Fisheries and Forestry. 2018. *State of food insecurity and vulnerability in the Republic of South Africa. 2018 Report.* Directorate of Subsistence Farming: SAVAC Secretariat.

Department of Forestry, Fisheries and the Environment. 2016. *South Africa Signs Paris Agreement on Climate Change in New York.* Published in the Republic of South Africa. Available online http://www.environment.gov.za . Accessed on 18 August 2021.

Deressa, T.T., Hassan, R.M & Ringler, C. 2010. *Perception of Adaptation to Climate Change by Farmers in the Nile Basin of Ethiopia*. Climate Change and Agriculture Paper. Journal of Agricultural Science. 149(23-31). Doi: 10.1017/S0021859610000687.

Desert Research Institute. 2020. *What is Cloud Seeding?* Cloud Seeding Program. Available online http://www.dri.edu. Accessed on 18 August 2021.

Dessai, S & Sims, C. 2011. *Public Perception of Drought and Climate Change in Southeast England.* Environmental Hazards. 9(4): 340-357. Available online http://www.tandfonline.com . Accessed on 05 April 2022.

Devault, G. 2020. *Advantages and Disadvantages of Quantitative Research.* Available from http://www.methodology/advantagesanddisadvantagesofquantitativereaserach.co.za . Accessed on 21 May 2020.

Di Caro, B. 2020. *How is Covid-19 Affecting Food Security*? Digital Media Specialist, World Economic Forum.

Domenech, L. 2015. *Improving Irrigation Access to Combat Food Insecurity and Undernutrition: A Review.* Global Food Security. 6:(24-33). Available online http://doi.org/10.1016/j.gfs.2015.09.001 . Accessed on 18 January 2022.

Driscoll, D.L. 2011. *Introduction to Primary Research: Observations, Surveys and Interviews.* Published by Parlor Press. Available online http://www.parlorpress.com/writingspaces . Accessed on 15 June 2022. Volume 2. ISBN: 978-1-60235-184-4.

Drought Management Plan. 2005. Published by the Department of Agriculture in the Republic of South Africa. Available online http://www.climatelaws.org . Accessed on 08 December 2021.

Dudovsky, J. 2011. *The Ultimate Guide to Writing a Dissertation in Business Studies: A Step-by-Step Assistance*. Available from http://www.methodology/purposivesampling.co.za . Accessed on 12 May 2021.

Dunkhorst, B.H & Mollel, N.M. 1999. *Small-scale Farming and Extension in South Africa's Northern Province*. Volume 28.

Edame, G.E., Ekpenyong, A.B & Fonta, W.M. 2011. *Climate Change, Food Security and Agricultural Productivity in Africa: Issues and Policy Directions.* Published at the University of Nigeria, Nsukka. 1(21).

Elasha, B.O, Elhassan, N.G. Ahmed, H & Zakieldin, S. 2005. *Sustainable Livelihoods Approach for Assessing Community Resilience to Climate Change: Case Studies from Sudan.* AIACC Working Paper No. 17. Higher Council for Environmental and Natural Resources, Sudan. Available online http://www.aiaccproject.org . Accessed on 04 October 2020.

Engindeniz, S., Cosar, G., Engindeniz, Y & Ucar, K. 2013. *Effects and Adaptation Measures of Drought in Turkish Agriculture: A Case Study of Tomato Farmers in Izmir Turkey*. 24th International Scientific-Expert Conference of Agriculture and Food Industry. Available online http://www.researchgate.net/publication/311616093 . Accessed on 04 September 2022.

Environmental Protection Agency. 2017. *Climate Impacts on Agriculture Food Supply*. Available online http://www.epa.gov . Accessed on 21 January 2020.

Environmental Protection Agency: United States of America. 2021. *What is Environmental Education?* Available online http://www.epa.gov/education . Accessed on 01 February 2022.

European Commission. 2020. *Causes of Climate Change.* Published by Climate Action. Available online http://www.ec.europa.eu . Accessed on 06 February 2022.

European Commission. 2021. *Drought Resilience Profiles – Botswana*. Published by the European Commission – Knowledge for Policy. Available online http://www.europa.eu . Accessed on 20 July 2022.

Fauvelle, L. 2019. *Qualitative Research: Open-ended and Close-ended Questions*. Available from http://www.intotheminds.com . Accessed on 31 May 2021.

Feenstra, G, 2021. *What is Agriculture?* UC Sustainable Agriculture Research and Education Program. Published by UC Agriculture and Natural Resources. Available online http://www.ucdavis.edu/sustainable-ag . Accessed on 03 February 2022.

Fin, G. 2015. *El Nino and La Nina season is here – how does it affect the world?* Available online http://www.finglobal.com . Accessed on 21 June 2020.

Fiondella, F. 2020. *Covid-19 Disruptions: Understanding Food Security Implications*. Available online http://www.blogsei.columbia.edu . Accessed on 27 May 2020.

Fisher, M., Abate, T & Madulu, R.B. 2015. *Drought Tolerant Maize for Farmer Adaptation to Drought in Sub-Saharan Africa: Determinants of Adoption in Eastern and Southern Africa*. Climate Change. 133: (283-299).

Fleetwood, D. 2020. *Quantitative Research: Definition, Methods, Types and Examples.* Available from http://www.questionpro.com . Accessed on 14 September 2021.

Food & Agricultural Organisation of the United Nations. 2018. Land & Water – Drought and Agriculture. Available online http://www.fao.org . Accessed on 14 November 2021.

Food & Agricultural Organisation. 2011. *Drought-Related Food Insecurity: A Focus on the Horn of Africa.* Available online http://www.reliefweb.int . Accessed on 10 November 2021.

Food & Agricultural Organisation. 2013. *The Underlying Causes of Food Insecurity*. Available online http://www.fao.org . Accessed on 10 November 2021.

Food & Agricultural Organisation. 2021. *Irrigation and Food Security.* Available online http://www.fao.org . Accessed on 18 January 2022.

Food & Agriculture Organisation of the United Nations. 2018. *The Role of Gender in Climate-Smart Agriculture*. Chapter 6, Gender-differentiated impacts of Climate Change. Available online http://www.fao.org . Accessed on 26 June 2020.

Food & Agriculture Organisation of the United Nations. 2019. *Millennium Development Goal 7: Ensure Environmental Sustainability.* Available online http://www.fao.org . Accessed on 28 June 2020.

Food & Agriculture Organisation. 1996. Rome declaration on world food security. World Food Summit.13-17 November. Rome: Food & Agriculture Organisation.

Food & Agriculture Organisation. 2012. *Impacts of Climate Change on Food Security*. Climate Change and Food Security. Available online http://www.fao.org . Accessed on 16 August 2020.

Food & Agriculture Organisation. 2017. *Food Security status in Africa*. Available Online http://www.fao.org . Accessed on 5 June 2020.

Food and Agricultural Organisation & ADB. 2013. *Gender Equality and Food Security – Women's Empowerment as a Tool Against Hunger*. Published by Reliefweb. Available online http://www.reliefweb.int . Accessed on 25 January 2022.

Food and Agricultural Organisation, International Fund for Agricultural Development and World Food Programme. 2021. *Empowering Women and Girls is Crucial to Ensuring Sustainable Food Security in the Aftermath of Covid-19*. Published by Reliefweb. Available online http://www.reliefweb.int/womenempowerment . Accessed on 25 January 2022.

Food and Agricultural Organisation. 2015. *The State of Food Insecurity in the World*. Available online http://www.fao.org/publications/sofi/2015/en . Accessed on 31 January 2022.

Food and Agricultural Organisation. 2018. *Drought and Climate Variability in the Limpopo River Basin*. Chapter 1. Available online http://www.fao.org . Accessed on 04 February 2022.

Food and Agricultural Organisation. UNCTAD. UNIDO & World Bank. 2015. *Compendium – Final Report. Zero Hunger: Challenge Working Groups*. The Sectary – Generals High Level Task Force on Global Food and Nutrition Security. Available online http://www.fao.org . Accessed on 07 June 2022.

Food and Agriculture Organisation. 2007. International conference on organic agriculture and food security: Organic agriculture and stability of food supply. Rome, Italy.

Food Forward South Africa. 2018. *Another Year of Creating a South Africa Without Hunger*. Annual Report 2018. Available online http://www.foodforwardsa.org . Accessed on 04 February 2022.

Formplus. 2020. *Primary vs Secondary Data: 15 Key Differences and Similarities*. Published by Formplus Blog. Available online http://www.formplus.us.cdn.ampproject.org . Accessed on 15 June 2022.

Forster, P. 2021. *A Year into the Pandemic: 3 Things we've Learnt About the Planet*. World Economic Forum. Published at the University of Leeds: Director of the Priestley International Centre for Climate. Available online http://www.weforum.org . Accessed on 07 February 2022.

Frank, J & Buckley, C. 2012. *Small-scale farmers and climate change - How can farmer organisations and Fairtrade build the adaptive capacity of smallholders?* Published in London. ISBN: 978–1–84369–891–3.

Gaikwad, S. 2020. *Naam Foundation Distributes Grocery Items Among Drought Hit Families.* Published by Times of India. Available online http://www.timesofindia.com.cdn.ampproject.org . Accessed on 17 January 2022.

Gallo, M.A. 2020. *Bantu Education, and its Living Educational and Socioeconomic Legacy in Apartheid and Post-Apartheid South Africa.* Published at Fordham University. Available online http://fordham.bepress.com/international_senior . Accessed on 1 November 2021.

Gardiner, M. 2008. *Education in Rural Areas.* Issues in Education Policy – Number 4. Published by Centre for Education Policy Development. ISBN: 978-0-9814095-5-9.

Garmirian, C. 2021. *Drought and Locusts Causing Mass Hunger and Misery for Children in Madagascar.* Save the Children. 2 August 2021. Available online http://www.reliefweb.com . Accessed on 26 August 2021.

Garrison, C. 2021. *Mexico Water Supply Buckles on Worsening Drought Putting Crops at Risk.* Available online http://www.reuters.com . Accessed on 25 May 2022.

Garth, A, 2008. Analysing Data Using SPSS. Published by Sheffield Hallam University. Available online

https://students.shu.ac.uk/lits/it/documents/pdf/analysing_data_using_spss.pdf . Accessed on 18 June 2022.

Geber, J. 2022. Africa is Not Responsible for Climate Change but Bears the Brunt of it – President Cyril Ramaphosa. Published by News24. Available online http://www.news24.com. Accessed on 07 February 2022.

George, L. 2020. *Covid-19 is Exacerbating Food Shortages in Africa.* World Economic Forum. Available online http://www.who.org . Accessed on 18 June 2020.

Getirana, A., Libonati, R & Marcio, C. 2021. *Brazil is in Water Crisis – it Needs a Drought Plan*. Available online http://www.nature.com . Accessed on 22 May 2022.

Glen, S. 2012. *"SPSS Nominal Ordinal Scale From".* The Hierarchy of Levels. Available online http://www.statisticshowto.com/spss-nominal-ordinal-scale/ Accessed on 18 June 2022.

Glen, S. 2017. *What is the Likert-Scale? Likert Scale Definitions and Examples*. Published by Statistics Definitions. Available online http://www.statisticshowto.com . Accessed on 26 July 2022.

Global Drought Observatory. 2021. *Analytical Report: Drought in Sub-Saharan Africa and Southern Africa.* Published by Relief Web. Available online http://www.reliefweb.int . Accessed on 28 August 2022.

Golafshani, N. 2003. *Understanding Reliability and Validity in Qualitative Research*. The Qualitative Report. Published at the University of Toronto, Ontario, Canada. 8(4): 597-607.

Grain South Africa. 2016. *Grain South Africa on Drought Impact and its Food Security Strategy*. Agriculture, Land Reform and Rural Development. Available online http://www.pmg.org.za . Accessed on 11 November 2021.

Greasley, P. 2008. *Quantitative Data Analysis Using SPSS- an Introduction for Health and Social Science*. Primary Health Care Research and Development. ISBN: 13:978-0-335-22305-3. Doi: 10.1017/S14634236080000790. 9(238).

Hall, K. 2018. *Children's Accessed to education.* Available online http://www.childrencourt.uct.ac.za . Accessed on 1 November 2021.

Harvey, F. 2021. *The Next Pandemic: Drought is a Hidden Global Crisis, UN Says.* Available online http://www.cdn.ampproject.org . Accessed on 02 February 2022.

Head, T. 2018. *El Nino: Hotter, dryer conditions "highly likely" to hit South Africa this summer*. Available online http://wwwsouthafrican-com.cdn.ampproject,org . Accessed on 21 June 2020.

Heikkila, A. 2018. *5 Innovative Agricultural Practices that are changing the World*. Available online http://www.ruptorleague.com.cdn.ampproject.org . Accessed on 29 June 2020.

Hogan, A. 2020. *Links between South African Poverty and Education*. Available online http://www.borgenproject.org . Accessed on 1 November 2021.

Holupchimski, E., Berrios, N.A., Gould, W & Fain, J. 2019. *Drought Impacts to Crops in the U.S. Caribbean.* Climate Adaptation Science Centres. Published by USGS – Science for a Changing World. Available online http://www.usgs.gov . Accessed on 14 November 2021.

Hosegood, V., Benzler, J & Geoff, C.S. 2005. *Population Mobility and Household Dynamics in Rural South Africa: Implications for Demographic and Health Research.* Southern African Journal of Demography. Published by: Population Association of Southern Africa. 10(1/2): 43-68. Available online http://www.jstor.org/stable/20853278 . Accessed on 31 October 2021.

Hox, J.J & Boeije, H.R. 2005. *Data Collection, Primary vs Secondary*. Encyclopaedia of Social Measures, Volume 1. Published at the University of Utrecht, The Netherlands.

Hutchings, M. Drought Inflicts Mounting Losses to Crops in South Africa's Western Cape. Published by Reuters. Available online http://www.mobile-reuters.com.cdn.ampproject.org . Accessed on 15 November 2021.

IFRC. 2022. Angola: Drought – Operation Update Report. Published by Reliefweb - OCHA. Available online http://www.reliefweb.int . Accessed on 30 August 2022.

Iha, A. 2021. *Drought Begins to Deeply Affect Turkey: Academic*. Published by Daily Sabah. Available online http://www.dailysabah.com . Accessed on 04 September 2022.

Imam, Z. 2014. *Advantages & Disadvantages of Questionnaires*. Available from http://www.methodology/advantagesanddisadvantagesofquestionnaires.com . Accessed on 31 May 2021.

Integrated Development Plan. 2019/2020. Msinga Municipality - uMzinyathi District. Available online http://www.msinga.gov.za . Accessed on 06 May 2021.

Integrated Development Plan. 2022. KZ2 44 Msinga Municipality's 4th Generation Integrated Development Plan 2017/2022. Available online http://www.msinga.gov.za . Accessed on 02 July 2022.

Integrated Drought Management Programme. 2021. *Monitoring and Early Warning Systems*. Published by the World Meteorological Organization. Available online http://www.droughtmanagement.info . Accessed on 18 December 2021.

Intergovernmental Panel on Climate Change. 2017. Special Report on Climate Change and Land. Chapter 5: Food Security. Published by the United Nations.

International Food Policy Research Institute, editor. 2002. Sustainable food security for all by 2020: proceedings of an international conference. Washington, D.C: International Food Policy Research Institutes.

International Strategy for Disaster Risk. 2009. *Drought Risk Reduction Framework and Practices Contributing to the Implementation of the Hyogo Framework*. Published by the United Nations.

Iranian Red Crescent Society. 2022. *Iran, Mena/Drought – Emergency Appeal.* Published by Reliefweb – OCHA. Available online http://www.reliefweb.com . Accessed on 05 June 2022.

Ishaya, S & Abaje, I.B. 2008. *Indigenous People's Perception on Climate Change and Adaptation Strategies in Jema'a Local Government Area of Kaduna State, Nigeria.* Journal of Geography and Religion Planning. Published at the Department of Geography, University of Abuja Gwagwalada, Nigeria. 1(8): 138-143. Available online http://www.acedemicjounals.org/JGRP ISSN 2070-1845 . Accessed on 06 April 2022.

Jamie, N. 2020. *4 Different Types of Quantitative Research.* Available from http://www.methodology/12.com . Accessed on 11 September 2021.

Jarawura, F.X. 2014. *Perceptions of Drought Among Rural Farmers in the Savelugu District in the Northern Savannah of Ghana*. Journal of Geography. Published at the University of Ghana: Centre for Migration Studies. 6(102-120).

Jason, C.W & Holcomb, B.K. 1985. *The Politics of Famine in Ethiopia*. Cultural Survival Quarterly Magazine. Available from http://www.clturalsurvival.org . Accessed on 28 July 2021.

Johnson, R.B. 2004. *Mixed Methods Research: A Research Paradigm Whose Time Has Come.* 33(7): 14-26. doi.org.10.3102/0013189X033007014.

Jones, C. *How Did Covid1-19 Lockdown Affect the Climate?* Published by Climate and Climate Change. Available online http://www.metooffic.gov.uk . Accessed on 07 February 2022.

Joseph, R.R & Hamilton, S.S. 2013. *Institutional Responses to Climate Change: Case of Drought in Msinga, South Africa.* East African Journal of Science and Technology. Published at the University of Kwa-Zulu Natal – Economic, History and Development Studies. 3(1).

Joubert, L. 2021. *Women-Headed Households – Disparities between Men and Women.* Available online http://www.southafrica.co.za . Accessed on 28 October 2021.

Jyoti, S. 2018. *Training of Farmers and Farmer's Group*. Pattern of Assistance in Various Schemes of Department of Agriculture & Cooperation, Min of Agriculture, Govt. of India. Available online http://www.rkvy.nic.in . Accessed on 19 December 2021.

Kahsay, G.A & Hansen, L.G. 2016 *The effect of climate change and adaptation policy on agricultural production in Eastern Africa*. Published at University of Copenhagen, Department of Food and Resource Economics, Denmark Centre for European Economic Research (ZEW), L7, 1, 68161 Mannheim, Germany.

Keyantash, J. 2018. *Standardised Precipitation Index- Climate Data*. Published online at the State University of California. Available online http://www.drought/standarisedprecipitationindex_ncar_cliamatedataguide . Accessed on 09 August 2021.

Khuluvhe, M. 2021. *Fact Sheet – Adult Illiteracy in South Africa*. Published by the Department of Higher Education and Training, Pretoria. Available online http://www.dhet.gov.za . Accessed on 1 November 2021.

Ki-Moon, B. 2015. The Millennium Development Goals Report. Published by the United Nations, New York. 2015- Time for Global Action for People and Planet.

Knot, J., De Wit, M.P., Blignaut, J.N., Midgley, S., Crookes, D. J., Drimie, S & Nkambule, N.P. 2014. *Sustainable farming as a viable option for enhanced food and nutritional security and a sustainable productive resource base. An investigation*. Field report. Prepared for the Green Fund, Development Bank Southern Africa. ASSET Research: Pretoria.

Kogan, F., Guo, W & Yang, W. 2018. Drought and Food Security Prediction from NOAA New Generation of Operational Satellites. Geomatics, Natural Hazards and Risks. 10(1): 651-666. Available online http://doi.org/10.1080/19475705.2018.1541257 .

Krantz, L. 2001. *The Sustainable Livelihoods Approach to Poverty Reduction: An Introduction.* Published at the Swedish International Development Co-operation Agency.

Kumar, V. 2014. *Role of Indigenous Knowledge in Climate Change Adaptation Strategies: A Study with Special Reference to NorthWestern India.* J Geogr Nat Disast 5: 131. doi:10.4172/2167-0587.1000131 54-56.

Laframboise, N. 2019. The Informal Economy in South Africa. Available online http://www.borgenproject.org . Accessed on 7 November 2021.

LaMarca, N. 2011. *The Likert Scale: Advantages and Disadvantages, Field Research in Organizational Psychology*. Available online http://www.psyc450.wordpress.com . Accessed on 25 July 2022.

Landau, S & Everitt, B. 2004. *A Handbook of Statistical Analyses using SPSS.* Published by Chapman & Hall/CRC. ISBN: 1-58488-368-3.

Lewis-Beck, M.S. 1995. *Data Analysis: An Introduction*. Research Guide: Data Analysis and Reporting Findings. Published at the University of Pretoria. Available online http://www.library.up.ac.za . Accessed on 16 June 2022. ISBN: 9780803957725.

Lies, E. 2021. *What is Drought? Discover all Types of Drought, Climate & Environmental Water Filters.* Available online http://www.aquasana.com . Accessed on 02 August 2021.

Liu, S., Shi, H & Sivakumar, B. *Socio-economic Drought Under Growing Population and Changing Climate: A New Index Considering the Resilience of a Regional Water Resources System*. Journal of Geophysical Atmospheres. 125(15). Available online http://doi.org/10.1029/2020JD033005 . Accessed on 03 April 2023.

Llaurado, O. 2015. *Likert Scale: What it is and how to use it?* Published by Netquest. Available online http://www.netquest.com . Accessed on 25 July 2022.

Logan, E. 2015. *5 Ways Climate Change is Challenging our Food Security.* Available online http://www.earthhour.int . Accessed on 25 June 2020.

Lui, S., Zhang, J., Wang, N & Wei, N. 2020. *Large Scale Linkages of Socio-economic Drought with Climate Variability and its Evolution Characteristics in Northwest China*. Advances in Meteorology. Available online http://www.hindawi.com . Accessed on 03 September 2022. Doi.org/10.1155/2020/2814539.

Lund, J. 2021. *Jobs and Irrigation during Drought in California.* Published by California Water Blog. Available online http://www.californiawaterblog.com . Accessed on 14 December 2021.

Mafongoya, P.L. & Ajayi, O.C. (editors). 2017. *Indigenous Knowledge Systems and Climate Change Management in Africa.* CTA, Wageningen. The Netherlands, 316pp

Mahapatra, R. 2016. *Drought Forever*. Published by Down to Earth. Available online http://www.downtoearth.org . Accessed on 14 November 2021.

Makala, J.N. 2012. *Drought Preparedness, Impact and Response: A Case of the Eastern Cape and Free State Provinces of South Africa.* Journal of Disaster Risk Studies. Published by the Department of Agriculture, Forestry and Fisheries, South Africa. 4(1): 10-47.

Mandela, N.Z. 2019. *Drought Update: Provinces State of Readiness for 2019/2020 Planting Season.* Published by Agriculture, Land Reform and Rural Development. Available online http://www.agriculturallandreformruraldev.gov . Accessed on 14 December 2021.

Maria, S. 2021. *With COP-26 Around the Corner, Explore How a Proactive Approach to Drought Management Could Help Southern Africa.* Available online http://www.droughtmanagemnetinsouthernafrica.co.za . Accessed on 18 December 2021.

Masipa, T.S. 2017. *The Impact of Climate Change on Food Security in South Africa: Current Realities and Challenges Ahead.* 9(1): 411- 421. DOI: 10.4102/jamba.v9i1.411.

Masiwa, D. 2019. *Small-Sale Farmer Support Programme Gives Rural Farmers a Second Chance.* Published by food for Mzansi. Available online http://www.foodformzansi.co.za . Accessed on 19 July 2022.

Mason, J.B. 2005. *AIDS, Drought, and Child Malnutrition in Southern Africa*. Published by the National Library of Medicine – National Centre for Biotechnology Information. Available online http://www.bmed.ncbi.nlm.gov . Accessed on 9 November 2021.

Max, S. 2017. *MDG 1: Eradicate Extreme Poverty and Hunger*. MDG Monitor. Available online http://www.mdgmonitor.org . Accessed on 28 June 2020.

Mbow, C., Rosenzweig, L.G., Barioni, T.G., Krishnapillai, E & Pradan, P. 2019. *Food Security: In Climate Change and Land: an IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security and Greenhouse Gas Fluxes in Terrestrial Ecosystems.* Available online http://www.ipcc.org/climatechangereport . Accessed on 18 January 2022.

McCown, R.L. 2001. *Learning to Bridge the Gap between Science-Based Decision Support and the Practice of Farming: Evolution in Paradigms of Model-Based Research and Intervention from Design to Dialogue*. Australian Journal of Agriculture Research. 52(549-571).

McGrath, M, 2020. *Climate Change: Lockdown has 'Negligible' Effect on Temperature*. Published in the Journal Nature Climate Change. Available online http://www.bbc.com . Accessed on 07 February 2022.

McKoy, S. 2003. *Archival Research and Data Analysis.* Available online http://www.archivalreserachanddateanalysis.com . Accessed on 04 April 2023.

McLachlan, M. 2015. *Food Security*. Published by Enviropaedia Rethinking Reality. Available online http://www.enviropaedia.com . Accessed on 25 January 2022.

Mclusky, S & Sessa, R. 2015. *Making it count: increasing the impact of climate change and food security education programmes*. Published by Food and Agricultural Organisation of the United Nations, Rome, Italy. Page 54. ISBN: 978-92-5-108778-7.

Meadu, V. 2013. *Combating Drought with Sustainable Agriculture*. Published by Climate Change, Agriculture and Food Security. Available online http://www.ccafs.cgiar.org . Accessed on 04 February 2022.

Means, T. 2021. *Climate Change and Droughts: What's the Connection?* Published by Climate Connections. Available online http://www.climateconnections-org.cdn.ampproject.org . Accessed on 06 February 2022.

Menale, K. 2014. *Food Security as a Gender Issue: Why are Female Headed Households Worse off Compared to Similar Male Headed Counterparts?* Policy Brief 1. Published at the Australian International Food Security Centre. Available on http://wwwaciar.gov.au/aifsc . Accessed on 25 June 2020.

Mendez, M. 2021. *Scorching Drought in Mexico: Is there Really Not Enough Water?* Earth Organisation. Available online http://www.earthorg.co.za . Accessed on 25 May 2022.

Menghistu, T., Mersha, T.T & Abraha, A.Z. 2018. *Farmer's Perception of Drought and its Socio-Economic Impact: The Case of Tigray and Afar Regions of Ethiopia*. Journal of Applied Animal Research. Published at the University of Mekelle, Ethiopia; Institute of Climate and Society. 46(1): 1023-1031. Available online http://doi.org.10.1080/09712119.2018.1450752. Accessed on 05 April 2022.

Meredith, T.N., Benjamin, F.S., Serge, W., Molly, E.B., Brendan, F & Taylor, H.R. 2021. *Climate Change is Hurting Children's Diets, Global Study Finds. Rising Temperatures Contribute to Child Malnutrition and Reduced Diet Quality*. Environmental Research Letters. Published at the University of Vermont. Doi: 10.1088/1748-9326/abd0ab.

Merrington, Z. 2021. DA Concerned that a Third of SA's Population Depends on Social Grants. Published by SABCNews. Available online http://sabcnews.com . Accessed on 7 November 2021.

Mesbahzadeh, T., Mirakbari, M., Saravi, M.M., Sardoo, F.S & Miglietta, M.M. 2019. *Meteorological Drought Analysis Using Copula Theory and Drought Indicators Under Climate Change Scenarios*. Published by Royal Meteorological Society. 27(1). Available online http://doi.org/10.1002/met.1856 . Accessed on 02 February 2022.

Metz, O., Mbow, C., Reenberg, A & Diouf, A. 2008. *Farmer's Perception of Climate Change and Agricultural Adaptation Strategies in Rural Sahel*. Environmental Management. 43(804-816). Doi: 10.1007/s00267-008-9197-0.

Meyer, D. 2021. *South Africa Must Ascertain How Social Grants Can Alleviate the Gruesome Threesome of Poverty, Unemployment and Inequality*. Daily Meverick. Available online http://www.za.cdn.ampproject.org . Accessed on 7 November 2021.

Meza, I & Hagenlocher, M. 2021. *Drought Risk for Agricultural Systems in South Africa: Drivers, Spatial Patterns and Implications for Drought Risk Management. Science of The Total Environment*. Available online http://doi.org/10.1016/j.scitotenv.2021.149505. Accessed on 29 August 2022. Volume 799 – 149505.

Middleton, F. 2019. *Reliability versus Validity in Research/ Differences, Types and Examples*. Published by Scribbr. Available online http://www.scribbr.com/methodology. Accessed on 20 June 2022.

Middleton, F. 2022. *The 4 Types of Validity/ Explained with Easy Examples*. Published by Scribbr. Available online http://www.scribbr.com/methodology . Accessed on 20 June 2022.

Mkhawani, K, Motadi, S.A, Mabapa, N.S, Mbhenyane X.R & Blaauw, R. 2016. *Effects of rising food prices on household food security on female-headed households in Runnymede Village, Mopani District, South Africa.* South African Journal of Clinical Nutrition, 29:2, 69-74. DOI: 10.1080/16070658.2016.1216504.

Mlambo, V.H. 2018. *An Overview of Rural-Urban Migration in South Africa: its Causes and Implications.* Archives of Business Research. Published at the University of Zululand. 6(4). DOI: 10.1478/abr.64.4407.

Mlambo, Y. 2011. *Women in Mining Legislation and Representation for Women in Mining*. Available online http://www.m.polity.org.za . Accessed on 28 October 2021.

Mmatlou, K. 2019. How Droughts will Affect South Africa's Broader Economy. Published by The Conversation. Available online http://www.theconversation.com/how-droughts-will-affect-south-africas-broader-economy-111378. Accessed on 12 November 2021.

Mogoatlhe, L. 2020. *South Africa Repeals State of Disaster for Drought. Here's Why it's a Grave Concern for Farmers*. Published by Global Citizen. Available online http://www.globalcitizen.org . Accessed on 10 August 2021.

Moller, J. 2020. Irrigation. Published by Agribook-Digital. Available online http://ww.agribook.co.za . Accessed on 14 December 2021.

Monnik, K. 2000. Role of Drought Early Warning Systems in South Africa Evolving Drought Policy. Published by the Bureau of Meteorology. Available online http://www.droughtearlywarningsystems.co.za . Accessed on 18 December 2021.

Mourdoukoutas, E. 2016. *Women Grabble with Harsh Weather*. Published by United Nations African Renewal. Available online http://www.un.org . Accessed on 08 June 2022.

Msinga Gazette (@MsingaG). 2016. Official Twitter Page for the Msinga Municipality. Plates 2, 3, 4 and 5 are available from http://pbs.twimg.com/profile_images/789906554904608770/1Zi7SZUG.jpg . Accessed on 19 October 2021.

Msinga Local Municipality: Local Economic Development Strategy. 2012. Published by Urban- Econ Development Economists.

Mtetwa, R.P. 2018. *Assessing Socio-Economic Impacts of Drought and Coping Mechanisms: A Case Study on Musikavanhu Area, Chipinge District, Zimbabwe.* Published at the University of Free State, Bloemfontein, South Africa.

Mukerji, R. 2019. *How Climate Change Threatens Food Security and why we're all at Risk?* Available at http://www.concernusa.org . Accessed on 15 February 2021.

Mukwevho, N. 2021. Unemployment: SA Youth Battle Country's 'Other Pandemic'. Available online http://www.health-e.org.za . Accessed on 2 November 2021.

Muller, M. 2019. *The Different Types of Drought.* Published online at the University of Witwatersrand. Available online htpp://www.wits.ac.za. Accessed on 30 July 2021.

Mutisya, M. 2016. *The Effect of Education on Household Food Security in two Informal Urban Settlements in Kenya: a Longitudinal Analysis*. 8 (4): 743-756.

Muyambo, F., Bahta, Y.T & Jordaan, A.J. 2017. The Role of Indigenous Knowledge in Drought Risk Reduction: A Case of Communal Farmers in South Africa. *Jamba: Journal of Disaster Risk Studies*. 9(1), a420. Available online http://doi.org/10.4102/jamba.v9i1.420 .

Naicker, M. 2021. *An Evaluation of Climate Change Effects on Community Gardens Crop Production Aimed at Enhancing Household Food Security in Dlangezwa, Umdoni Municipality.* African Centre for Food Security. Published at the University of Kwa-Zulu Natal.

Naidoo, P. 2021. *South Africa's Unemployment Rate is now highest in the World.* Available online http://www.aljazeera.com . Accessed on 2 November 2021.

NASA. 2022. *What is the Greenhouse Effect?* Available online http://www.climate.nasa.gov . Accessed on 06 February 2022.

Nasrnia, F & Ashktorab, N. 2021. *Sustainable Livelihoods Framework-based Assessment of Drought Resilience Patterns of Rural Households of Bakhtegan Basin, Iran*. Published by Science Direct – Ecological Indicators. 128(107-817). Available online http://doi.org/10.1016/j.ecolind.2021.107817 . accessed on 04 April 2023.

National Integrated Drought Information Systems. Published by the United States Government. Available online http://www.drought.gov . Accessed on 15 August 2021.

Ndlovu, M. 2017. *Op-Ed: Rural Transformation as a Solution to Poverty in South Africa*. Published by Daily Maverick. Available online http://www.dailymaverick.co.za . Accessed on 7 November 2021.

New Delhi Television. 2021. *1076 Farmers Died by Suicide in Maharashtra in Past Five Months: Minister*. Published by NDTV – India News. Available online http://wwwndtv.com . Accessed on 17 January 2022.

Ngcube, B & Lagardien, A. 2015. *Insights into Indigenous Coping Strategies to Drought for Adapation in Agriculture: A Karoo Scenario*. Published at Cape Peninsula University of Technology. ISBN 978-1-4312-0652-0.

Ngcube, B. 2016. *Coping and Adaptation Strategies for Agricultural Water Use during Drought Periods.* Review of drought coping and adaptation strategies in dryland cropping systems, irrigation, livestock and mixed systems. Published at Cape Peninsula University of Technology, Bellville, Cape Town.

Ngidi, M.S.C & Hendriks, S.L.2014. *Coping with food insecurity in rural South Africa: The case of Jozini, KwaZulu-Natal.* Mediterranean Journal of Social Science.5 (25).278-289.

Ngumbi, E. 2019. *Becoming Drought Resilient: Why African Farmers Must Consider Drought Tolerant Crops.* Published at the University of Nebraska, Lincoln. National Drought Mitigation Centre. Available online http://www.drought.unl.edu . Accessed on 25 August 2021.

NIDIS. 2021. *Drought Impacts on Energy Production.* Available online http://www.drought.gov . Accessed on 13 December 2021.

Nield, D. 2015. *As the Planet gets Hotter, Climate Change may wake up an ancient El Nino System.* Science Alert. Available online http://www.sciencealert.com .Accessed on 9 May 2020.

Niyogi, D.G. 2018. *Climate- Smart Agriculture- an Answer to Climate Change*. Available online http://www.downtoearth.us9.list-manage.com . Accessed on 25 May 2020.

Njagi, K. 2019. *Innovation Buzz: Drones Help Ghana's Farmers Ward off Birds – and Drought Risks.* Available online http://www.news.trust.org . Accessed on 18 August 2021.

Njenga, N.W, Muna, M.W & Muriuki, J.N. 2012. *Perceived Impacts of Climate Variability and Change on Small-Scale Farmers in North Kinangop Location, Kenya*. The International

Journal of Climate Change: Impacts and Responses. Published at the university Illinois, United States of America. ISSN: 1835-7156.

Njura, H.J., Kubai, K.I., Taaliu, S.T & Khakame, K.S. 2020. *The Relationship Between Agricultural Teaching Approaches in Kenya*. Published by Education Research International. Available online Doi.org/10.1155/2020/8847864. Accessed on 01 February 2022.

Nkwana, H.M. 2015. The implementation of the national food and nutrition security policy in South Africa. Strategies for multisectoral coordination. Administratio Publica, 23(4): 272-289.

Nonjola, O.C. 2021. *Reviewing Vulnerability and Drought Coping Capacity: A Case Study of Borakalalo Communal Farmers In North West Province, South Africa.* Faculty of Natural and Agricultural Sciences. Published at the University of Free State, Bloemfontein.

Nortier, C. 2021. *Malnutrition Hurts Millions of South Africa's Children Just as it Did 20 Years Ago*. Published by Daily Maverick. Available online http://www.dailymaverick.co.za . Accessed on 9 November 2021.

Norvvegian Refugee Council. 2022. *Iraq's Drought Crisis and the Damaging Effects on Communities*. Available online http://www.nfc.org . Accessed on 03 June 2022.

Nunez, C. 2019. Carbon Dioxide Levels are at a Record High. Here's What You Need to Know. Available online http://www.nationalgeograph.com . Accessed on 06 February 2022.

Nxumalo, D & Ntobongwana, S. 2021. Phase 3: The Development of a Single Land Use Scheme for Umsinga Municipality. Preparation of Msinga Municipality Land Use Scheme: Land Management Framework Report.

Nyong, A., Adesina, F & Osman, E.B. 2007. *The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel*. Mitigation and Adaptation Strategies for Global Change. Volume 12, pages787–797.

Ocampo, M.L. 2004. South Africa Seminar: Info Pages. Available online http://www.web.stanford.edu . Accessed on 1 November 2021.

Ochieng, F, Kirimi, L & Mathenga, M. 2016. *Effects of Climate Variability and Change on Agricultural Production: The case of small-scale farmers in Kenya*. Tegemeo Institution of Agricultural Policy and Development, Egerton. Published at the University of Nairobi, Kenya. NJAS-Wagenungen. Journal of Life Sciences. 77(2016): 71-78.

Omarjee, L. 2021. *More People Live off Grants than Salaries – with Millions of Applicants Still Waiting.* News24. Available online http://www.news24.com . Accessed on 7 November 2021.

Omarova, A., Tussupova, K., Hjorth, P., Kallishev, M & Dosmagambetova, R. 2019. *Water Supply Challenges in Rural Areas: A Case Study from Central Kazakhstan.* International Journal of Environmental Research and Public Health. 16(5): 688. doi: 10.3390/ijerph16050688.

Orievulu, K. 2022. *Economic, Social and Demographic Impacts of Drought on Treatment Adherence Among People Living with HIV in Rural South Africa: A Qualitative Analysis.* Climate Risk Management. Available online http://doi.org/10.1016/j.crm.2022.100423. Accessed on 20 July 2022. Volume 36.

Otto, F., Verschuur, J & Wolski, P. Guest Post: How Climate Change Drove Food Insecurity in the 2007 Lesotho Drought. Published by Carbon Brief – Clear on Climate. Available online http://www.carbonbrief.org . Accessed on 15 November 2021.

Owen, A. 2015. *South Africa Grapples with Worst Drought in 30 Years*. Published by BCC News. Available online http://www.bbcnews.uk.org . Accessed on 12 December 2021.

Oxford Dictionary. 2021. Available online http://www.oxforddictionary.com . Accessed on 12 December 2021.

Papuso, I & Faraby, J. 2013. *What is Climate-Smart Agriculture?* Seminar on Climate Change and Risk Management. Available online http://www.csa.guide . Accessed on 9 May 2020.

Parker, H. 2016. *Three Ways to Build Water Security for Rural Women*. Available online http://www.odi.org . Accessed on 16 August 2021.

Patekar, N. 2020. *Helping the Hands that Feed the Nation*. Published by Naam Foundation. Available online http://www.naammh.org . Accessed on 17 January 2022.

Patel, K. 2021. *Widespread drought in Mexico*. NASA: Earth Observatory. Available online http://www.earthobservatory.nasa.gov . Accessed on 25 May 2022.

Pawlak, K & Kolodziejczak, M. 2020. *The Role of Agriculture in Ensuring Food Security in Developing Countries: Considerations in the Context of the Problem of Sustainable Food Production.* Published at the University of Life Sciences, Poland – Department of Economics and Economic Policy in Agribusiness Faculty of Economics

Pedamkar, P. Types of Quantitative Research: Introduction to Quantitative Research. Available from http://www.methodology/12typesofquantitativeresearch.com . Accessed on 11 September 2021.

Phelan, C & Wren, J. 2006. *Exploring Reliability in Academic Assessment*. Published by the UNI Office of Academic Assessments. Available online http://www.chfasoa.uni.edu . Accessed on 20 June 2022.

Pienaar, L & Traub, L.N. 2015. *Understanding the Smallholder Farmer in South Africa: Towards a Sustainable Livelihoods Classification*. Agriculture in an Interconnected World. Published at the University of Stellenbosch. Western Cape Department of Agriculture

Pillay, S.E. 2016. *The Impact of a Change in Climate on Small-Scale Farmers: Case Studies of The Khokhwane, Sizanenjana and Richmond Communities in Kwazulu-Natal, South Africa.* Published at the University of Kwa-Zulu Natal.

Pillay, V. 2021. *12 Million Without Jobs: What's Really Behind South Africa's Shocking Unemployment Numbers*. Available online http://www.iol.co.za . Accessed on 3 November 2021.

PMA Research. 2017. *South Africa's Extreme Drought Brings Declining Production and Rising Food Prices.* Available online http://www.pma.com . Accessed on 14 August 2021.

Poonia, V., Goyal, M.K., Gupta, B.B., Gupta, A.K., Jha, S. & Das, J. 2021. Drought Occurrence in Different River Basins of India and Blockchain Technology Based Framework for Disaster Management. *Journal of Cleaner Production.* Available Online https://doi.org/10.1016/j.jclepro.2021.127737. Accessed on 18 August 2021.

Popp, J. 2018. *How Indigenous Knowledge Advances Modern Science and Technology.* Canadian Press. Published at the Department of Biology, Laurentian University.

Posel, D., Casale, D & Rudwick, S. 2011. *Is Marriage a Dying Institution in South Africa? Exploring Changes in Marriage in the Context of "IIobolo" Payments*. Published at the University of Witswatersrand. 25(1): 102-111. DOI: 10.1080/10130950.2011.575589.

Poynter, R. 2009. *The Likert Scale- Task 14 – Things all Researchers Should Know*. Available online http://www.thefutureplace.typepad.com . Accessed on 26 July 2022.

Poynter, R. 2012. *The Ultimate Guide to Great Questionnaires.* Available from http://www.methodology.whatisaquestionnaire.com . Accessed on 31 May 2021.

Preedy, V.R. 2010. *Handbook of Disease Burdens and Quality of Life Measures*. 5- Point Likert Scale. Published by Springer – New York. http://doi.org/10.1007/978-0-387-78665-0-6363. ISBN – 978-0-387-78665-0.

Puri, P.V. 2013. Country Profile – South Africa. Published by New Agriculturalists. Available online http://www.new-ag.info . Accessed on 7 November 2021.

Puri, S.J. 2018. *Farmer Training.* Agricultural Extension. Published by The Humanity Development Library. Available online http://www.farmertraining.co.za . Accessed on 16 December 2021.

Qazi, A. 2019. *Social Impacts: Droughts in Australia.* Available online http://www.australiaanddroughts.weebly.com . Accessed on 20 July 2022.

Ramanathan, V. *The Greenhouse Theory of Climate Change: A Test by an Inadvertent Global Experiment.* Science. Published by American Association for the Advancement of Science. 214(4850): 293-299. Available online http://www,jstor.org/stable/1701595 . Accessed on 06 February 2022.

Ranchhod, V. 2018. *Why is South Africa's Unemployment Rate so High*? Daily Maverick – Ground Up. Published at the University of Cape Town – School of Economics. Available online http://www.za.cdn.ampproject.org . Accessed on 2 November 2021.

Rasmussen, C. 2021. *Local Lockdown Brought Fast Global Ozone Reductions, NASA Finds*. Published by Global Climate Change. Available online http://wwwclimate.nasa.gov . Accessed on 07 February 2022.

Rawat, A.S. 2021. *An Overview of Descriptive Analysis*. Published by Analytic Steps. Available online http://www.analyticssteps.com . Accessed on 18 June 2022.

Raygorodetsky, G. 2011. *Why Traditional Knowledge Holds the Key to Climate Change*. Available online http://www.unitednations.co.za. Accessed on 15 August 2020.

Reid, K. 2021. *Africa Hunger, Famine: Facts, FAQs, and How to Help*. Published by World Vision. Available online http://www.worldvision.org . Accessed on 13 November 2021.

Reinhart. C.M & Subaraman, R. 2020. *How can we prevent a Covid-19 Food Crisis?* World Economic Forum. Available online http://www.weforum.org. Accessed on 16 May 2020.

Rio, A. 2018. *Definition and Dimension of Food Security.* Available on http://www.wocatpedia.net . Accessed on 27 June 2020.

Rogan, M. 2016. *Qualitative Perceptions of the Meaning of "headship" and Female-Headed Households in Post-Apartheid South Africa.* Social Dynamics- A Journal of African Studies. 42(1): 175-195. Available online http://doi,org10.1080/02533952.2016.1166550 .

Rosegrant, M, 2019. *Food Security Depends on Water Security – and We Need to Act Now*. Published by the International Food Policy Research Institute. Available online http://www.ifpri.org . Accessed on 18 January 2022.

Ruff, J. 2017. *5 Ways Climate Change Affects People Living in Poverty*. Available from http://www.onedayswages.org . Accessed on 13 November 2021.

Rujvi, R. 2017. *Naam Foundation Started by Mr Nana Petekar and Mr Makarand Anaspure.* Available online http://www.medium.com . Accessed on 17 January 2022.

Rukema, J.R & *Umubyeyi, B.S. 2019. Indigenous Knowledge Approach in Maintaining a Livelihood in the Face of Disastrous Climate Change: Case of Drought in Msinga Villages, Kwa-Zulu Natal.* doi: 10.4102/jamba.v11i1.758. 11(1):758.

Rukema, J.R. 2010. *An Exploration of Rural Communities and Government Response Strategies to Drought in South Africa: The Case of Msinga Villages in Kwa-Zulu Natal Province.* Published at University of Kwa-Zulu Natal. Philosophy and Social Policy Studies.

Rural Health Information Hub. 2019. *Aging in Place in Rural Communities.* Available online https://www.ruralhealthinfo.org/toolkits/aging/1/rural-issues. Accessed on 31 October 2021.

Russel, S. 2022. *Chi Square.* Practical Applications of Statistics in the Social Sciences. Published at the University of Southampton. Available online http://www.southampton.ac.uk . Accessed on 18 June 2022.

Sahu, 2019. *Coping with Droughts: Gender Matters*. India Water Portal. Available online http://www.indiaportal.org . Accessed on 16 August 2021.

Salazar, L & Fahsbender, J. 2019. *Improving Food Security Through Women's Empowerment*. Published by IDB. Available online http://www.blogs,iadb.org . Accessed on 25 January 2022.

Scherer, T. 2017. *Irrigation during a Drought.* Published by North Dakota State University. Available online http://www.ndsu.edu . Accessed on 14 December 2021.

Schmidhuber, J & Tubiello, F.N. 2007. *Global Food Security under Climate Change*. Global Perspective Studies Unit, Food and Agriculture Organisation. Published at the University of Rome, Italy.

Scoones, I. 2009. *Livelihoods Perspectives and Rural Development*. The Journal of Peasant Studies. 36(1):171-196.

Seerat, O. 2017. *The Sustainable Livelihoods Approach: Knowledge and Solutions.* Published in Springer, Singapore. https://doi.org/10.1007/978-981-10-0983-9_5. ISBN: 978-981-10-0983-9.

Sharma, A.K. 2020. *Lockdown Helped Them Scale New Heights*. Available online http://www.pradan.net . Accessed on 17 January 2022.

Shiferaw, B & Menkir, A. 2014. *Managing Vulnerability to Drought and Enhancing Livelihood Resilience in Sub-Saharan Africa: Technological, Institutional and Policy Options.* Weather and Climate Extremes. Volume 3, Pages 67-79. Available online http://doi.org/10.1016/j.wace.2014.04.004 . Accessed on 11 November 2021.

Siambombe, A, Mutale, Q & Muzingili, T. 2018. *Indigenous Knowledge Systems: A Synthesis of Batonga People's Traditional Knowledge on Weather Dynamism.* Published at the University of Zimbabwe. 8(2). ISSN Online 2409-5605.

Simmons, D. 2019. *A Brief Guide to the Impacts of Climate Change on Food Production.* Inter Press Services.

Simon, M. 2022. *Extreme Heat in the Oceans is Out of Control*. Published by Wired. Available online http://www.wired.com/story . Accessed on 07 February 2022.

Singh, R. 2008. *Indigenous Knowledge of Biodiversity highlighted by Environmental Affairs at Inaugural IKS Expo.* Published by the Department of Environmental Affairs, Republic of South Africa.

Smith, F.I. & Eyzaguire, P. 2006. African Leafy Vegetables: Their Role in the World Health Organisation Global Fruit and Vegetables Initiative. Rome, Italy.

Sokhela, S.L. 2021. Special Adjusted uMsinga Municipal 4th Generation Integrated Development Plan. 2021/22 – 2025/26. Published by the Development Planning Department. Available online http://www.msinga.gov.za . Accessed on 02 June 2022.

South African Government. 2021. Land and Agriculture. Available online http://ww.gov.za . Accessed on 19 December 2021.

South African Second National Climate Change Report. 2017. Available online http://www.environment.gov.za . Accessed on 22 January 2020.

Springer, K. 2016. *Drought-Friendly Food Choices*. Kelly's Choice – Nutritional Company. Available online http://www.kellyschoice.org . Accessed on 11 November 2021.

Statistics South Africa, 2017. The extent of food security in South Africa. Available online http://www/statssa.gov . Accessed on 30 May 2020.

Statistics South Africa. 2011. Available from http://www.statssa.gov.za . Accessed on 08 May 2021.

Statistics South Africa. 2019. Agriculture, Land Reform and Rural Development. Published by the South African Government. Available online http://www.gov.za . Accessed on 19 December 2021.

Statistics South Africa. 2020. *Loss of Income Resulting from the Covid-19 Pandemic May Lead to Higher Levels of Food Insecurity in South Africa*. Published by the Department of Statistics-South Africa. Avaiable online http://www.statssa.gov.za . Accessed on 18 May 2020.

Steiner, A. 2004. *Sustainable Livelihoods and Climate Change Adaptations.* A Review of Phase One Activities for the Project on "Climate Change, Vulnerable Communities and Adaptation.

Sultana, S. 2020. *The Power of Women Empowerment for Food Security*. World Food Prize Foundation. Published by the Borlaug Blog. Available online http://www.worldfoodprize.org. Accessed on 25 January 2022.

Surve, S. 2020. What is a Research Instrument? Published by Discover PHDs – Community Blogs. Available online http://www.discoverphd.com Accessed on 15 June 2022.

Sustainable Development Goal Fund. 2014. *Goal 13: Climate Action*. Available online http://www.sdgfund.org . Accessed on 29 June 2020.

Svensson, K & Rex, H.C. 2022. *Marketing International Women's Day. Why Women and Girl's Matter in Somalia's Climate Crisis*. Published by Nasikiliza: World Bank Blogs. Available online http://www.worldbank.org . Accessed on 08 June 2022.

Tanks, R. 2014. What are El Nino and La Nina*? How does El Nino and La Nina affect our weather patterns?* Available online http://www.rainbowtanks.co.za . Accessed on 21 June 2020.

Taylor, J.G., Stewart, T.R & Downton, M. 1988. *Perceptions of Drought in the Ogallala Aquifer Region.* Environment and Behaviour. 20(2): 150-175.

Tebor, C. 2021. The Current Drought is worldwide. Here's how Different Places are Fighting it. Published by Los Angeles Times. Available online http://www.latimes.com.cdn.ampproject.org . Accessed on 13 December 2021.

The Climate Reality Project. 2018. *Climate Change and Health: Food Security.* Available at http://www.climaterealityproject.org . Accessed on 14 February 2021.

The World Bank. 2019. *Climate Smart Agriculture Investment Plans: Bringing CSA to Life*. Available online http://www.worldbank.org . Accessed on 26 November 2020.

The World Bank. 2021. Climate Smart Agriculture. Available online http://www.worldbank.org . Accsessed on 15 August 2021.

The World Bank. *In Rural India, Women Lead the Way to Improve Livelihoods*. YouTube. 8 September 2015. 16 minutes and 18 seconds. http://www.youtube.com/ruralodisha .

Tichagwa, W. 1994. The Effects of Drought on the Condition of Women. Available online http://www.bmed.ncbi.nim.nih.gov . Accessed on 16 August 2021.

Tiseo, I. 2022. *Global Drought Risk Index 2020 by Country*. Energy and Environment: Water and Wastewater. Published by Statista. Available online http://www.statista.com . Accessed on 20 July 2022.

Trochim, W. M. K. 2006. *The Conceptual Framework.* Drafting an argument. Philosophy of Research: Research Methods Knowledge. Published at the Alabama State University, College of Education.

Truter, J. 2018. *Drought and the Employment Relationship*. Published by Labour wise – the Employer's Choice. Available online http://www.labourwise.co.za . Accessed on 12 November 2021.

Udmale, P., Chikawa, Y., Manandhar, S., Ishidaira, H & Kiem, S. 2014. *Farmers' Perception of Drought Impacts, Local Adaptation and Administrative Mitigation Measures in*

Maharashtra State, India. Volume 10, Part A. Pages: 250-269. Available online https://doi.org/10.1016/j.ijdrr.2014.09.011 . Accessed on 08 December 2021.

Umraw, A. 2016. *Drought Hits Food Prices*. The Witness. Published on 14 October 2016. Available online http://www.news24.com . Accessed on 14 August 2021.

UNCCD. 2022. *Drought in Numbers 2022 – Restoration for Readiness and Resilience.* Published by Reliefweb – OCHA. Available online http://www.reliefweb.int . Accessed on 30 August 2022.

UNDRR. 2020. *Education's Crucial Role in Community Climate Change Adaptation.* Climate Adaptation Platform. Published by Prevention Web. Available online http://www.preventionweb.net . Accessed on 01 September 2022.

UNICEF. 2021. Children in South Africa at High Risk of the Impacts of the Climate Crisis. Published by UNICEF- South Africa. Available online http://www.unicef.org . Accessed on 9 November 2021.

United Nations – Convention to Combat Desertification. 2016. *Drought: Reducing Impacts and Building Resilience.* Published by UNCCD. Available online http://www.knowledge.unccd.int . Accessed on 04 February 2022.

United Nations AIDS. 2021. *Global HIV & AIDS Statistics – Fact Sheet.* Available online http://www.unaids.org. Accessed on 31 October 2021.

United Nations Development Plan. 2020. *Goal 13: Climate Action*. Available online http://www.undp.org . Accessed on 29 June 2020.

United Nations Development Programme in Climate Change and Zero Hunger. 2020. *Transforming Food and Agriculture- Creating Food Security while fighting Climate Change.* Available online http://www.undp.org . Accessed on 5 June 2020.

United Nations Education Scientific and Cultural Organisation. 2021. *Rural Water Development.* Available online http://www.unesco.org . Accessed on 10 December 2021.

United Nations Office for Outer Space Affairs. 2019. *Sustainable Development Goal 13: Climate Action.* Available online http://wwwunoosa.org . Accessed on 29 June 2020.

United Nations Sustainable Development Goals. 2020. *Zero Hunger*. Available online http://www.un.org . Accessed on 29 June 2020.

United Nations. 2017. Rural Women Tackle Drought-Affected Mozambique's Rise in Child Marriages. Published by the United Nations-Women. Available online http://www.unwomen.org . Accessed on 08 June 2022.

United Nations. 2020. *Envision2030.* Published by the Department of Economic and Social Affairs. Available online http://www.un.org . Accessed on 08 June 2022.

United Nations. 2022. *Promoting Climate Resilience and Sustainable Livelihoods for Women in Drought-Affected South West State of Somalia.* Published by United Nations- Women in Africa. Available online http://www.africa.unwomen.org . Accessed on 08 June 2022.

United Nations. 2022. *Sub-Saharan Africa Under Threat from Multiple Humanitarian Crises*. Published by United Nations – News. Available online http://www.news.un.org . Accessed on 27 August 2022.

Urquijo, J & De Stefano, L. 2015. *Perception of Drought and Local Responses by Farmers: A Perspective from the Jucar River Basin, Spain.* Water Resource Management. 30(577-591). Available online http://springer.com . Accessed on 05 April 2022.

USDA. 2019. *Farmer Education*. Published by the National Institute of Food and Agriculture. Available online http://www.nifa.usda.gov . Accessed on 19 December 2021.

Vanderhaeghen, Y & Hornby, D. 2016. *After the Drought: The Rains Have Come to Msinga, but the Devastation Still Remains*. Published by South Africa, Maverick Life. Available online http://www.foodformzansi.co.za.cdn.ampproject.org . Accessed on 19 July 2022.

Vara, D & Mano, A. 2022. *Brazil Farmers Struggling as Drought Batters Southern Soy Crop*. Available on http://www.reuters.com . Accessed on 26 May 2022.

Varpio, L & Kiger, M.E. 2020. *Thematic Analysis of Qualitative Data: AMEE Guide No. 131.* Medical Teacher. Doi: 10.109010142159X.2020.1755030.

Vice India. 2022. These Photos Show Just How Bad India's Water Crisis Has Become. Published via Vice India official Instagram Page (@viceindia). Accessed on 17 January 2022.

Vilakazi, B., Zwngeni, R & Paramu, M. 2019. *Indigenous Strategies Used by Selected Farming Communities in Kwa-Zulu Natal, South Africa, to Manage Soil, Water, Climate Extremes and Make Weather Predictions.* Available online http://www.researchgate.net . Accessed on 20 June 2022.

Vink, N. 2016. *South Africa's Poor Face Rising Food Prices as Drought Intensifies. The Conversation.* Published on 13 January 2016. Stellenbosch University. Available online htttp://www.theconversation.com.cdn.ampproject.org. Accessed on 13 August 2021.

Vinz, S. 2015. *Developing your theoretical framework*. Scribbr-Team. Available on http://www.howtobuildatheoreticalframework/forresearch . Accessed on 01 October 2020.

Viola, C.G. 2020. World Food Programme. Available online http://www.wfp.org . Accessed on 10 May 2020. Article published in Parco dei Medici, Rome, Italy.

Vogt, J.V., Naumann, G., Masante, D & Spinoni, J. 2018. Drought Risk Assessment and Management. A Conceptual Framework. Published at the European Union, Luxembourg. ISBN : 988-92-79-97470-0.

Vorster, H.J. 2007. *The role and production of traditional leafy vegetables in three rural communities in South Africa*. Submitted in partial fulfilment of the requirements for the degree MSc Agric in the Faculty of Natural and Agricultural Science. Published at the University of Pretoria.

Vukizenzelr, G. 2021. *Support Programme Enabling KZN Small-Scale Farmers to Potential Commercial Farmers.* Published by Sowetan Live. Available online http://www.sowetanlive.co.za . Accessed on 19 July 2022.

Water Research Commission. 2020. *South Africa Extends Drought State of Disaster by a Month.* Drought South Africa. Available online http://www.droughts.org.za . Accessed on 30 July 2021.

Watts, J. 2020. *Could Covid Lockdown Have Helped Save the Planet?* Published by The Guardian. Available online http://www.theguardian.com. Accessed on 07 February 2022.

Weber, E.U. 2010. *What Shapes Perceptions of Climate Change?* Published at the Columbia University, United States of America. 1(3): 332-342. Available online http://dx.doi.org/10.1002/wcc41 . Accessed on 06 April 2022.

Webster, B. 1975. *Theory of Greenhouse Effect on Sun's Rays is Challenged.* Published by the New York Times. 3 November 1975. Available online from 1996 http://www.newyorktimes.com . Accessed on 06 February 2022.

West, C. 2020. IBM-SPSS- Easy to Learn without all the Hassles of Learning Python Code. Available from http://www.trustradius.com . Accessed on 01 June 2021.

Western Cape Government. 2020. Applying for a Social Welfare Grant. Available online http://www.westerncape.gov.za . Accessed on 7 November 2021.

Wheeler, T & von Braun, J. 2013. *Climate Change on Global Warming.* 341(6145): 508-513. Walker Institute for Climate System Research, Department of Agriculture. Published at the University of Reading, United Kingdom. DOI: 10.1126/science.1239402

White, T. 2021. *Increasing Droughts and Floods on the African Continent*. Africa in Focus. Published by Brookings. Available online http://www.brookings.edu.cdn.ampproject.org . Accessed on 29 August 2022.

Wilkinson, B. 2014. *What is Purposive Sample? When and How to Use it?* Available from http://www.methodology.enkivillage.co.za . Accessed on 12 May 2021.

Wolchover, N. 2019. *What is Drought?* Available online http://www.livescience . Accessed on 29 July 2021.

World Food Programme. 2019. *Climate Impacts on Food Security.* Available online http://www.wfo.org . Accessed on 25 June 2020.

World Food Programme. 2021. *Drought in South-Western Angola Drives Severe Hunger*. Published by Reliefweb – OCHA. Available online http://www.reliefweb.int . Accessed on 30 August 2022.

World Health Organisation. 2012. Millennium Development Goals. Available online http://www.who.int . Accessed on 28 June 2020.

World Health Organisation. 2021. *Drought.* Available online http://www.who.int . Accessed on 10 November 2021.

World Health Organisation. 2021. *Drought.* Available online http://www.who.org . Accessed on 02 February 2022.

Wyns, A. 2020. *How our Response to Climate Change and the Coronavirus are Linked?* Available online http://www.weforum.org . Accessed on 16 May 2020.

Yaro, J.A. 2013. *The Perception of and Adaptation to Climate Variability/Change in Ghana by Small-Scale and Commercial Farmers*. Reg Environment Change. Published at the University of Heidelberg, Berlin. Doi.10.1007/s10113-013-0443-5.

Young, C. 2021. *5 Facts about Access to Clean Water in South Africa*. Published by the Borgen Project. Available online http://www.borgenproject.org . Accessed on 10 December 2021.

Zayan, S.A. 2019. *Impact of Climate Change on Plant Diseases and IPM Strategies.* Plant Diseases – Current Threats and Management Trends. Unit of Forecasting and Early Warning, Plant Pathology Research Institute, Giza, Egypt. DOI: 10.5772/intechopen.87055.

Zwane, E.M. 2019. *Impact of Climate Change on Primary Agriculture, Water Sources and Food Security in Western Cape, South Africa.* Jamba. Journal of Disaster Risk Studies. 11(1). Doi: 10.4102/jamba.v11i1.562.

Appendix 1 - Questionnaire

UNIVERSITY OF KWAZULU-NATAL

Discipline of Geography

School of Agricultural, Earth and Environmental Sciences

Multi-stakeholder perceptions on the socio-economic and environmental impacts of droughts: A case study of Msinga rural community in KwaZulu-Natal, South Africa.

Name of interviewee…….

Name of Village…….

A. Household personal details

1. Gender

2. Male	
3. Female	

2. Level of Education

1. None	
2. Primary	
3. Secondary	
4. Tertiary	
5. Other (specify)	

3. Marital status

1. Currently married	
2. Single	
3. Widowed	
4. Separated	
5. Living with partner	
6. Divorced	

4. Employment status

1. Employed	
2. Unemployed	
3. Self-employed	
4. Retired	
5. Medically boarded	
6. Student	
7. Other (specify)	

5. Main source of monthly income

Sources	Amount in Rands
1. Pensions	
2. Remittances	
3. Wages	
4. Informal income	
5. Agriculture	
6. Disability grants	
7. Other state grants (specify)	

B. Agricultural practices

1. Have you received any agricultural training in the last 5 years?

1. Yes	
2. No	

3. Do you irrigate your farm during times of drought?

1. Yes	
2. No	
3. Other	

4. Where do you obtain water for irrigation?

1. River/stream	
2. Lake	
3. Dam	
4. Well	
5. Tap water	
6. Bore hole	
7. Rainwater tank	
8. Other	

C. Adaptation and mitigation measures

1. How do you prepare for a drought in a normal year?

1. Don't prepare	
2. Store crop harvest	
3. Save money	
4. Sell of some Livestock	

D. Drought perceptions

1. What is drought?

   ……..

2. Rate the seriousness of drought in your area?

1. High	
2. Moderate	
3. Low	
4. Other	

3. Do you think droughts have become more or less frequent in the past 10-12 years?

1. More frequent	
2. Less frequent	

3. No difference	
4. Not sure	

5. What are the main impacts of droughts?

1. Drying up of water sources	
2. Drying up of land	
3. Crop failure	
4. Causes food insecurity	
5. Loss of livestock	
6. Increases food prices	
7. Other (specify)	

8. Please rate how prepared you feel you are to deal with a drought?

1. Very high	
2. High	
3. Moderate	
4. Low	

Socio-economic impacts

9. Please rate how the following drought impacts affect you.

	Very high	High	Moderate	Low
1. Drought has caused malnutrition				
2. Drought has caused food insecurity				
3. Drought has caused limited food choices				
4. Drought caused unemployment				
5. Increased levels of poverty				
6. Drought has caused crop failure				

E. Administrative

1. Does the community have an active relationship with government institutions with regards to drought management?

1. Yes	
2. No	

1.a. if yes, how?

……..

1.b. if no, why?

……..

2. Is there any active drought management programme implemented in your community?

1. Yes	
2. No	

2.a. if your answer to the above question was no, please provide reasons.

……..

3. Have you received any disaster relief assistance when you were affected by a drought?

1. Yes	
2. No	
3. Not applicable	
4. Other (specify)	

4. From whom did you receive this assistance?

1. Governments	
2. NGO's	
3. Church	

4. Social safety nets	
5. Remittances	

6. If you have received assistance from government or any other institution, what type of assistance have you received?

1. Water supply tankers	
2. Crop insurance	
3. Loan subsidies	
4. Food supplies	
5. Emergency supplies	
6. More than one of the above (specify)	
7. Other (specify)	

7. Does the local council or any government authority relay early drought warnings to the rural communities ahead of a drought?

1. Yes	
2. No	
3. Not applicable	
4. Other (specify)	

8. Are you satisfied with the government's role towards drought mitigation and management?

1. Yes	
2. No	
3. Not applicable	
4. Other (specify)	

Thank you for your participation.

Appendix 2 – Ethical Clearance Approval

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

09 December 2021

Annika Maniram (215037229)
School Of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear A Maniram,

Protocol reference number: HSSREC/00003362/2021
Project title: How does Climate Change affect Food Security
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 17 September 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 09 December 2022.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Telephone: +27 (0)31 260 8350/4557/3587 **Email:** hssrec@ukzn.ac.za **Website:** http://research.ukzn.ac.za/Research-Ethics
Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville