ADAPTATION STRATEGIES OF SMALLHOLDER MAIZE FARMERS TO DROUGHT IN BUFFALO CITY METROPOLITAN MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA

Jotham Khumalo

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Supervisor: Mr. Yong Sebastian Nyam

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DECLARATION

I Jotham Khumalo hereby declare that this mini dissertation is a product of my own. This mini dissertation is submitted for the fulfilment of the master's degree at the University of the Free State Bloemfontein. I further declare that I have not submitted before at any other University. All sources used have been referenced.

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ABSTRACT

Recently, South Africa has experienced the worst drought in decades. Due to this, an understanding of people's views of drought is an important factor in sustainable environmental policy in this country. As a result, this study was conducted within a farming community in Keyser's Beach, Buffalo City Metropolitan Municipality, South Africa with the aim of understanding the perception of smallholder maize farmers on drought. The study was also underpinned by three research objectives which centred on farmers' perceptions of drought, its impacts and the coping mechanisms. The study employed a mixed-methods research approach to collect and analyse data. Quantitative data was collected using a survey questionnaire while qualitative data was collected through in-depth interviews. The data was analysed using thematic analysis and descriptive statistics. The data analysis framework also incorporated the vulnerability index where the susceptibility of smallholder maize farmers to the prevailing drought was calculated.

The study revealed that there are different expectations of drought among smallholder farmers where it was associated with man-made and natural causes. The study found that drought has a variety of impacts, including changes in water supply, soil health, jobs and household income, as well as other social factors. The drought coping mechanisms therefore appeared to vary between farmers. The study found that smallholder maize farmers store produce and livestock for consumption and selling, save money, change crop calendars and adjust to drought-resistant crops, among other coping strategies. The research proposes that more studies be performed between commercial farmers or smallholder farmers in areas other than Buffalo City Metropolitan Municipality. The study recommends that funds have to be channelled towards disaster management in order to assist smallholder maize farmers in Keyser's Beach.

Key words: Drought; Smallholder Maize Farmers; Farmers' Perspectives; Keyser's Beach; Buffalo City Metropolitan Municipality

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DEFINITION OF TERMS

Drought – this term can be defined in various ways and in different configurations, including its types, characteristics and susceptibility (Slette, Post, Awad, Even, Punzalan, Williams, Smith, and Knapp 2019). It can also be described by geographic area and its effect at the time. There are two types of definitions, namely conceptual and operational (Van Loon, Stahl, Baldassarre, Clark, Rangecroft, Wanders, Gleeson, Van Dijk, Tallaksen, Hannaford and Uijlenhoet (2016). Conceptual definitions help to explain the significance and consequences of drought and operational definitions help to define the beginning, end and degree of magnitude of drought (Van Loon et al. 2016). Meteorologists widely describe drought as protracted dry conditions caused by a lack of rainfall, resulting in extreme water shortages for any operation, populace, or ecosystems (Van Loon et al., 2016). Similarly, Coles and Eslamian (2017) define drought as a situation in which water supplies in a country or geographic area decline to the point where the population lacks adequate or proper access to water.

Perception – this term refers to the ability to perceive, hear, or become conscious of something by the senses of the natural limits of human experience. It also applies to the manner in which something is perceived, understood or interpreted (Aaron and Witt 2011).

Smallholder farmer – a smallholder or smallholding is a small farm that works under a small-scale farming model. Definitions vary broadly on what distinguishes a smallholder or small-scale farmer, including considerations such as age, food processing technique or technology, family participation in the labour market and economic effects (Burnham and Ma 2016).

CHAPTER 1: INTRODUCTION

1.1 Introduction

The 1996 World Food Summit set the target of lowering the number of malnourished people in the world by half by 2015 target (World Health Organisation, 2020). Sub-Saharan Africa, where the bulk of the population relies on subsistence agriculture, faces the largest obstacle to achieving this aim (Chatzopoulos, Domínguez, Zampieri and Toreti 2020). Over the past 40 years, total per capita food production has decreased, and around a third of the constantly rising population of this region is reportedly food insecure (Chatzopoulos et al. 2020; Sasson 2012). Literature suggests different causes for the decline in the food supplies of which one of the major, and which this research focuses on, is drought (Eslamian, Ostad-Ali-Askari, Singh, Dalezios, Ghane, Yihdego and Matouq 2017; Guo, Huang, Huang, Leng, Fang, Wang and Wang 2020). In addition, the sub-Saharan area is also characterised by poor quality soil, and about half of it is found in the arid and semi-arid areas (Duque-Acevedo, Belmonte-Ureña, Cortés-García and Camacho 2020; Kamara, Conteh, Rhodes and Cooke 2019). Thus, it is necessary to address any challenges that limit efficient and sustainable agricultural production since the region heavily relies on agriculture for sustainability.

There has been little progress in solving these issues, which can be largely due to the continuing debate on the precise causes of the decrease in production. Drought is one of the major drivers influencing smallholder food production in sub-Saharan Africa (Chatzopoulos et al. 2020; Duque-Acevedo et al. 2020; Hassan and Nhemachena 2008; Jin, Wang and Wang 2016; Lai, Zhong, Wang, Wu, Chen, Wang and Lian 2019). Among the natural disasters affecting the environment, drought is the one of the dynamic and complex but least understood aspect. In support of this argument, it is evident that, globally, more than a billion people were afflicted by drought between 1994 and 2013 (Gizaw and Gan 2017; Huang, Li, Huang, Leng, Hou and Ma 2017; Khanal, Wilson, Hoang and Lee 2018; Mrema, Kienzle and Mpagalile 2018). This is equated to about a quarter of the global population. This is despite the fact that in this era, drought events accounted for just 5% of catastrophe incidents (Zeleke 2017).

Particularly in comparison to tropical cyclones and hurricanes, threats associated with drought events are not severe and abrupt as with other natural hazards. Thus, as noted by Amejo, Gebere, Kassa and Tana (2018), Krüger (2018) and Kakeeto, Sibiya, Melis and Biruma (2019), drought is perceived as a less noticeable occurrence without routinely

reported casualties and impacts. This is due to the gradual adoption of modern methodology for measuring and assessment of data related to drought.

As the key reason for drought, people seem to concentrate more on the absence of sufficient rainfall while overlooking other causes, for example, political marginalisation and rural poverty, which help transform agricultural drought into a systemic catastrophe (Makate, Wang, Makate and Mango 2017). However, as it is technically conceptualised, drought is a condition related to insufficient rainfall due to a shift in the trends of rainfall or below-normal precipitation (Ubisi, Mafongoya, Kolanisi and Jiri 2017). Drought is not a persistent climatic phenomenon but rather a routinely recurring phenomenon (Liu, Zhu, Zhang, Yang, Pan and Sun 2020; Mango, Siziba and Makate 2019; Martey, Etwire and Kuwornu 2020; Mfitumukiza, Barasa and Ingrid 2017; Ubisi et al. 2017). The advent of drought is not sudden, but is characterised by a steady decline of rainfall conditions. When drought is over, it is not sudden, and only progressively can conditions change (Makate, Wang, Makate and Mango 2017; Martey, Etwire and Kuwornu 2020; Mdungela, Bahta and Jordaan 2017). This makes it impossible to calculate the beginning and end of drought events, thus causing the cycles of occurrence (Makate et al. 2017; Martey et al. 2020; Mdungela et al. 2017).

The onset of drought and its intensity are not detected in any single way (Amejo et al. 2018). Hence, Amejo et al. (2018), Madani, AghaKouchak and Mirchi (2016), Van Loon, Stahl, Baldassarre, Clark, Rangecroft, Wanders, Gleeson, Van Dijk, Tallaksen, Hannaford and Uijlenhoet (2016) and Marandure, Bennett, Dzama, Makombe and Mapiye (2020) note that it is generally impossible to quantify the effects of drought on communities as it is non-structural. Drought effects typically exist within large regions, making it a daunting challenge to determine and adapt effectively to the impacted populations (Marandure et al. 2020). If the drought continues from one season to the next, the consequences appear to intensify (Amejo et al. 2018; Madani et al. 2016; Marandure et al. 2020; Van Loon et al. 2016). Empirical studies show that the majority of studies conducted in sub-Saharan Africa on the complexities of drought mainly discuss the strategies implemented to navigate through the risks faced (Mrema et al. 2018; Sanogo, Binam, Bayala, Villamor, Kalinganire and Dodiomon 2017; Slette, Post, Awad, Even, Punzalan, Williams, Smith and Knapp 2019; Spinoni, Barbosa, De Jager, McCormick, Naumann, Vogt, Magni, Masante and Mazzeschi 2019). This is because drought is one of the environmental threats that poses a danger to the livelihoods of people and the socio-economic stability of the region (Musolino, de Carli and Massarutto, 2017; Mrema et al. 2018; Sanogo et al. 2017; Slette et al. 2019;

Spinoni et al. 2019; Twongyirwe, Mfitumukiza, Barasa, Naggayi, Odongo, Nyakato and Mutoni (2019)).

It varies according to characteristics and impacts in terms of how the public perceives drought. This is why there is no universally accepted definition of drought. According to Zaleke (2017), since drought is a danger of slow onset, it is essential to check its core causes which include the insecurity of people, unhealthy conditions linked to hunger, the power of the local economy, the lives and families at stake, the lack of policies and plans, weak institutional capabilities and resources. It is, therefore, possible that many factors/perceptions are at fore in explaining and conceptualising drought among smallholder maize farmers, including the coping mechanisms. Makate et al. (2017), Musolino et al. (2017), Twongyirwe et al. (2019), Wu, Liu, Yao, Chen, Chen, Zheng and He (2018) and Stagge, Kingston, Tallaksen and Hannah (2017) note that to measure and understand drought in the farming communities, there are many biophysical variables included. Such positivist principles fully transcend social, technological, cultural and political pressures on local farmers' lives and on how they view the condition of their physical environment (Tigkas, Vangelis and Tsakiris 2017; Ubisi et al. 2017; Wu, Chen, Yao, Gao, Chen and Liu 2017). Consequently, when it comes to describing a farmer's experience and understanding of drought, they are not especially helpful (Chatzopoulos et al. 2020; Duque-Acevedo et al. 2020).

A transition towards a more constructivist perspective accepts that the control of natural resources and; therefore, the occurrence and effects of drought events, are heavily affected by culturally and historically constructed mechanisms guided by humans. However, there exists limited literature on this subject, specifically within the small towns located in Buffalo City Metropolitan Municipality in the eastern region of South Africa. Therefore, it is possible to raise a question as to whether smallholder maize farmers refer to meteorological drought, that is, the sense in which it is generally used, or to anything else. These questions provide the basis on which this study is based. This analysis shows the effects of drought on the development of communities and the economy at large, such as economic upheaval, social power, political impact and its long-term effects. The study will also provide the adaptation strategies that are adopted by smallholder farmers during times of drought.

1.2 Background of the study

In the South African economy, agriculture is one of the most important industries, since it is essential to job generation, food security, livelihoods and rural development (Makate, Makate and Mango 2018). According to Kamara, Conteh and Rhodes (2019), in 2017, agriculture contributed more than 2.5% of South Africa's GDP and pulled in R127.69 billion by agricultural exports. In the same year, agricultural exports rose by 3.9%, resulting in a strong balance of trade of R42.09 billion and a net exporter status for all the commodities in this industry (Kamara 2019). This makes the agriculture industry in South Africa one of the most dynamic participants in the global economy. Moreover, Makate et al. (2018), Kamara (2019), Ubisi et al. (2017), Thinda, Ogundeji, Belle and Ojo (2020), Rapholo and Makia (2020) submit that the South African agricultural industry is classified as among the top 10 exporting nations.

However, perpetual droughts have severely affected the agricultural industry. The year 2015 was declared the driest year since 1904 (Badu-Apraku and Fakorede 2017). National dialogue in South Africa on water protection was catalysed because of the drought that perpetually affected South Africa since 2014. The dialogue enabled policy discourse on water resources management as one of the immediate solutions. The drought also highlighted emerging weaknesses in the South African water infrastructure, the dependency of agricultural production on the natural water supplies and the extent of the task of maintaining the country's water protection (Muyambo, Jordaan and Bahta 2017; Ndhleve, Nakin and Longo-Mbenza 2017).

The World-Wide Fund (WWF) in 2018 also reported that the country suffered an economic loss of R5.9 billion, 30,000 job losses and a decline in the exportation of agricultural commodities by 13-20% (Mango, Siziba and Makate 2019). South African smallholder maize farmers have also been heavily impacted by drought. The catastrophic drought has caused many farmers to believe that South Africa's government needs to be more involved in handling drought (Bahta, Jordaan and Muyambo 2016). The Eastern Cape province was also affected by these challenges. Owing to a mixture of commercial and smallholder farming operations, the Eastern Cape, which is considered one of the main agricultural producing provinces in South Africa, has been seriously impacted by the effects of drought (Graw, Ghazaryan, Dall, Delgado Gómez, Abdel-Hamid, Jordaan, Piroska, Post, Szarzynski, Walz and Dubovyk 2017; Mahlalela, Blamey, Hart and Reason 2020; Ngaka 2012). It is reported that the drought forced farmers to reduce their farming activities and others were forced to discontinue food production (Maziya et al. 2017; Ndhleve et al. 2017).

The major influence on maize production, which is an important grain crop in South Africa, was observed.

The government has seen the importance of incorporating multiple action strategies to manage the difficulties of drought. The Disaster Management Act No. 57 of 2002 comes into effect and allows for a legislative framework on disaster recovery that emphasises emergency preparedness that eliminates catastrophe risk (Mango et al. 2019). However, considering all these frameworks, the studies conducted in Buffalo City in the Eastern Cape, seem to have a literature gap to understand the impacts of drought among smallholder farmers. In fact, there have not been studies conducted within the Keyser's Beach area. Though, as already noted, the drought severity varies across various areas, how the smallholder maize farmers in Buffalo City were affected remains unclear. In addition, little information is available about the adaptation strategies of smallholder maize farmers on the effects of drought in the Buffalo City area. Therefore, this research is essential to close this gap.

1.3 Research problem

Studies indicate that the attitudes of farmers regarding drought and the adaptation strategies that can be used depend on different factors which include their experience, personal characteristics and locational variables (Bahta et al. 2016; Chatzopoulos et al. 2020; Zeleke et al. 2017). Martey et al. (2020) suggest, for example, that the experience of a new practice by farmers is closely connected to their perceptions of such a practice, which together frame their attitudes to whether or not to follow the practice. Mrema et al. (2018) and Maziya (2017) argue that personal characteristics of farmers, such as age and experience, also play a key role in influencing their views of adoption of drought adaptation strategies in place.

This study is conducted within this research background in order to understand the perceptions of smallholder farmers on the drought adaptation strategies. The challenge that is inherent in this regard is that there are different adaptation strategies applied by farmers and they differ based on various experiences, demographic characterisation, their experience and age groups among other variables identified in literature (Bahta et al. 2016; Chatzopoulos et al. 2020; Zeleke et al. 2017). Thus, the strategies used by particular farmers may not be the same in different circumstances. In this light, a research gap exists in the sense that there is not only little evidence on how farmers in Keyser's Beach, Eastern Cape adapt to drought, but few studies on this subject have been done in the entire

province. It is also; therefore, possible that the coping techniques adopted by farmers to alleviate the threats of drought would have distinct narratives. Therefore, this is pioneering research in Buffalo City Metropolitan Municipality aimed at improving smallholder maize farmers' perceptions and adaptation strategies to drought. The study is important as it helps in the forging of policies and provision of empirical evidence to assist farmers in adapting to drought. Additionally, the study will enable

1.4 Research questions

This study was undertaken to answer the questions below:

i. What are the perceptions of the smallholder maize farmers in Buffalo City Metropolitan Municipality on the impacts of the prevailing drought on their agricultural activities?
ii. What are the perceptions of smallholder maize farmers on the choice of the adaptation strategies implemented in Buffalo City Metropolitan Municipality?
iii. What strategies can be applied to mitigate the challenges faced by smallholder maize farmers in Buffalo City Metropolitan Municipality because of drought?

1.5 Research aim and objectives

1.5.1 Aim of the study

This research is mainly conducted to ascertain the perception of smallholder maize farmers in Buffalo City Metropolitan Municipality of the current drought and their preference for the adaptation strategies used. The research would thus provide possible solutions for narrating and reducing the impacts of drought on smallholder maize farmers.

1.5.2 Main objective

The main objective of this study is to understand smallholder maize farmers' perceptions of drought and the choice of their adaptation strategies in Buffalo City Metropolitan Municipality, Eastern Cape Province

1.5.3 Sub-objectives

The sub-objectives of this study are as follows:

i. To ascertain the perceptions of the smallholder maize farmers in Buffalo City Metropolitan Municipality on the impacts of the prevailing drought on their agricultural activities;
ii. To establish the perceptions of smallholder maize farmers on the choice of the adaptation strategies implemented in Buffalo City Metropolitan Municipality, and
iii. To recommend strategies that can be applied to mitigate the challenges faced by smallholder maize farmers in Buffalo City Metropolitan Municipality because of drought.

1.6 Significance of the study

This study is based on one of the significant facets in agricultural studies, particularly on the adaptation strategies. The research paves way for policymakers to consider all the factors that form threats associated with the catastrophe of this magnitude and by extension the potential responses by recognising these definitions. In addition, the research falls within the confines of disaster management and it will support different stakeholders if the conclusions and recommendations are taken into consideration and incorporated in their future growth and drought control strategies. The results of the study would also enable communities in this area to extract ways to access food sources to rely on during times of drought. In the event of drought, a range of preventive steps can be taken to enable people to move towards the creation of sustainable communities. Importantly, this research will contribute to the current literature, especially in Buffalo City Metropolitan Municipality, Eastern Cape, on this topic.

1.7 Structure of the report

The research report is structured into the following chapters:

Chapter 1: Introduction

The introductory chapter focuses on the meaning and inspiration of the area of research for embarking on this study. The statement of the problem as well as the research objectives and the questions contributing to this review included in this chapter. This chapter introduces the whole study.

Chapter 2: Smallholder maize farmers and Drought

As the thesis progresses and evolves, this chapter also discusses the analysis of the perspectives of other researchers on drought and its economic, social, political effects and

how it impacts livelihoods. This helps the research to check whether the project is justified and determine how the challenge of drought can be addressed, as informed by what other researchers have done.

Chapter 3: Research Methodology

This chapter looks at the analysis methods used for data collection and data processing. The advantages and drawbacks of the data collection and collation approach selected vis-a-vis the field of analysis, ethical issues and effects, as well as the time available for the project.

Chapter 4: Research Results and Analysis

A deep and focused analysis is performed in this section based on the data obtained from the survey. The chapter further addresses initiatives or strategies to reduce the effects of drought on society's livelihoods.

Chapter 5: Conclusions and Recommendations

This chapter draws the overall conclusions obtained from the study and provide recommendations to farmers and recommendations to scholars on additional studies that can be conducted.

CHAPTER 2: SMALLHOLDER MAIZE FARMERS AND DROUGHT

2.1 Introduction

The previous chapter presented the introduction and background of the study. It presented the research problem as well as the research questions and objectives. The chapter further outlined the significance of the study as well as the outline of the entire thesis. This chapter provides literature relevant to this study. The chapter starts with the definitions of drought including the different types, namely meteorological drought, socio-economic drought, hydrological drought and agricultural drought. The chapter also narrows down and provides an outline and description of 2015/16 meteorological, hydrological and agricultural drought that affected South Africa. This is then followed by an analysis of the effects of drought which are sub-divided into economic, environmental and social effects. The chapter also provides the adaptation strategies of drought with evidence from different places. Importantly, the chapter provides an empirical analysis of the factors influencing smallholder maize farmers' choice of adaptation to drought. The chapter is then concluded by the review of the underpinning theory used for this study, namely the sustainable livelihood framework.

2.2 Drought: definitions and types

The following section provides a review of the definitions of drought and the inherent types.

2.2.1 Definitions of drought

Drought can be defined in various ways and different configurations, including its types, characteristics and susceptibility (Slette et al. 2019). It can also be described by geographic area and its effect at the time. There are two types of definitions, namely conceptual and operational (Van Loon et al. 2016). Conceptual definitions help to explain the significance and consequences of drought, and operational definitions help to define the beginning, end and degree of magnitude of drought. Overall, drought is described as a risk that is manageable because it facilitates the recognition of vulnerability and the enhancement of resistance (Van Loon et al. 2016). This is achieved in agriculture by embracing a more holistic view of farming processes, leading to transformative changes such as changes in management intensity, new or alternative production systems that are more suited for the climate fluctuations of a given region and reforming organisations to respond to variability

(Yihdego, Vaheddoost and Al-Weshah, 2019). The following definitions of drought are identified from the relevant scholarship.

Drought is commonly defined by meteorologists as a prolonged dry weather cycle caused by a lack of precipitation leading to severe water scarcity for any activity, population, or ecological system (Van Loon et al. 2016). This definition is echoed by Yang et al. (2017) who describe drought as a lack of precipitation from planned or natural precipitation that is insufficient to satisfy the demands of human activities over a season or a longer duration, resulting in economic, social and environmental impacts. Concerning drought as natural phenomena occurrences, Hagenlocher (2019) describes drought as the effect of a natural decrease in the amount of rainfall received for a long period, typically a season or longer, although it is often associated with other climatic factors, such as high temperatures, high winds, and low relative humidity, in many parts of the world and can greatly exacerbate the intensity of the occurrence. In this light, Coles and Eslamian (2017) see drought as a situation resulting in a decline in the water supplies in a region or geographic area to the point that the population does not have adequate or sufficient access to water supplies.

To complement these definitions, Eslamian et al. (2017) note that drought is a prolonged and regionally widespread phenomenon of the supply of natural water below normal. Ojo and Baiyegunhi (2020) note that it is primarily caused by low precipitation and high evaporation rates, but temperatures below freezing can also give rise to a winter drought in regions with a cold climate. This makes it clear that not only is drought predicted in dry and hot regions, but also in regions with cool weather. Pattern and Newhart (2017) further submit that drought is proportional to average rainfall, and thus, without looking dry, exceptionally wet areas will undergo a drought. If such conditions persist for a comparatively long time than usual, a combination of below-normal rainfall and elevated temperatures facilitate drought conditions. Drought stems from long-term dry weather and/or inadequate irrigation, allowing soil moisture to be drained, the supply of underground water to be diminished and streamflow decreased (Ayanlade et al. 2018).

Considering these descriptions of drought, multiple dimensions can be brought out as inferences to this phenomenon. Drought impacts people or populations, for example, as a function of water shortages and the difference of water demand and availability. In addition, it can also be concluded that drought happens everywhere, regardless of the climatic conditions. Drought may occur in areas with low precipitation, semi-arid areas, or even areas with moderate precipitation. Besides, the meanings above also indicate that drought is a spreading condition that is hard to forecast its beginning or end.

2.2.2 Types of drought

There are four categories/types of drought which all result from inadequate precipitation. These types are, meteorological, hydrological, socio-economic and agricultural drought, and they are explained below.

2.2.2.1 Meteorological drought

The meteorological form of drought is expressed based on the degree of dryness and the length of the dry time attributable to a precipitation deficit (Guo et al. 2020). It is expressed over a long time in comparison to the average conditions of the area. Typically, if the situation is extended, it is an indicator of a possible water problem.

A meteorological drought will begin and end immediately. This indicates that it is a natural phenomenon and is caused by climatic conditions that change depending on location. Usually, it is caused by lower precipitation than the daily annual rainfall expected. Meteorologically, the degree of dryness compared to normal and dry weather makes it possible to determine the type of drought. The precipitation shortfall threshold over a defined time and the precipitation threshold chosen are frequently argued to be calculated by meteorological drought, for example, 75% of usual precipitation and a length of approximately six months, which can differ depending on the area and the needs of the region or users.

For a longer time than expected, this meteorological definition of drought focuses on precipitation levels dipping below average. Wu et al. (2018) agree with Guo et al. (2020) in terms of precipitation deficits, by perceiving meteorological drought in total proportions over a given period (Wu et al. 2018). The degree of dryness relative to the usual or typical amount of precipitation can also be defined by meteorological drought (Spinoni et al. 2019). Furthermore, Spinoni et al. (2019) suggest that the duration of the dry season and region-specific are other significant factors used to describe meteorological drought because different regions have different environments that lead to precipitation deficiency (Wu et al. 2017). Wu et al. (2017) insist, as other previous scholars such as Spinoni et al. (2019), on precipitation as the main component of the meteorological drought.

2.2.2.2 Agricultural drought

Agricultural droughts are of primary relevance in this study with the focus placed on maize farmers. Agricultural drought typically happens as the soil moisture level is affected due to a decline in ambient moisture. Crops and animals are affected when agricultural drought

occurs, as is evapotranspiration (Lai et al. 2019). Starvation drought is a type of severe agricultural drought in which extreme food scarcity result in the death or starvation of significant numbers of people. The supply of soil water to support crop and forage growth is defined more broadly than the departure over some given period of natural precipitation (Liu et al. 2020). This is why there is no clear correlation between precipitation and the infiltration of precipitation into the soil. This is supported by the fact that factors such as conditions of atmospheric moisture, slope, soil shape and precipitation event intensity decide infiltration (Tigkas et al. 2017). This suggests that because of conditions that are not conducive to successful infiltration, an area can receive above-normal rainfall or precipitation but also needs soil moisture. Therefore, according to these descriptions, agricultural drought does not depend much on precipitation, but rather on the abundance of soil moisture.

Agricultural drought is also used as a link between meteorological and hydrological drought components and how they affect agriculture, but with a specific focus on precipitation deficits, improvements in current and potential evapotranspiration, deficiency of soil water, reduced groundwater, or surface water reservoirs (Ajaz et al. 2019). This is consistent with the definitions of different theorists, where agricultural drought is interpreted as a lack of soil moisture and increased stress on plants (Ajaz et al. 2019). Usually, agricultural drought occurs when there is insufficient rainfall to support the average crop yield on farmland or other agricultural activities, which depends largely on the availability of soil moisture. It is also clear that agricultural drought is not strictly due to low rainfall, dry and hot spells, but can still exist even though usual precipitation is met.

Agricultural drought is found in situations when the soil's moisture does not meet the needs of certain crops at a given time. Agricultural drought is also found to accompany meteorological drought and to precede hydrological drought (Liu et al. 2020). This indicates that the first entities to be affected by drought are farming operations. While precipitation deficits are important in this situation, the intensity of this form of drought is more related to soil moisture deficiency, which is considered the most crucial factor in deciding crop production capacity in agriculture (Tigkas et al. 2017).

2.2.2.3 Hydrological drought

Hydrological drought is consistent with the consequences of cycles of rainfall scarcity on land or sub-surface water supply and water storage facilities. These droughts are associated with the decrease in surface and sub-surface water quantity and quality is the result of meteorological drought in a way (Musolino et al. 2017). A declining amount of

water supply, such as land and groundwater, dams and reservoirs, can be defined as hydrological drought (Krüger 2018). Because hydrological storage facilities are subject to numerous uses, such as agriculture, recreation, tourism, water storage, transport, power generation, domestic, ecological and environmental protection, it is important to bear in mind that underground and surface waters do not have a direct link with precipitation (Guo et al. 2020).

In general, relative to common situations this type of drought is seen as a decreased streamflow. Drought is essentially distinguished from aridity, a long-term climate condition, whereas dryness is a temporary condition of water scarcity (Zhang et al. 2018). This means that if the water levels are below the expected average, an arid area will undergo drought. It is noted that if drought conditions continue, climate change will lead to the advent of drier conditions, thus the need to re-evaluate what is considered natural (Huang et al. 2017). Huang et al. (2017) also characterise hydrological drought as a decline in the volume of groundwater, streamflow, lake storage and reservoirs. This is regardless of whether it is an arid region or not. It is also seen as a state in which water in a hydrological setting is inadequate, which is seen in lakes, reservoirs and groundwater below-average river streamflow and below normal temperatures.

2.2.2.4 Socio-economic drought

This type of drought is defined as a link between the supply and demand of goods and services, such as water and electricity, which, depending on the weather, will be interrupted and the drought will lead to a shortage of supplies of such economic goods (Madani et al. 2016). In this type of drought, the relationship between the availability and demand of services or economic goods such as water, livestock or hydropower is highly dependent on the amount of rainfall in the region (Ziolkowska et al. 2016). Socio-economic drought is also viewed as an imbalance that ultimately impacts social and economic activities between the supply of water and demand for the community. This also influences the relationship between human activity and drought, such as poor land use, which affects the risk of future drought (Ziolkowska et al. 2016). The definition is reinforced by the term that describes socio-economic scarcity as a situation in which there is a high demand for an economic commodity that exceeds supply due to weather-related water scarcity (Drysdale et al. 2020). This happens in most Southern African countries, where maize grain is in high demand during drought times. The relationship between these four types of drought is illustrated in Figure 2.1.

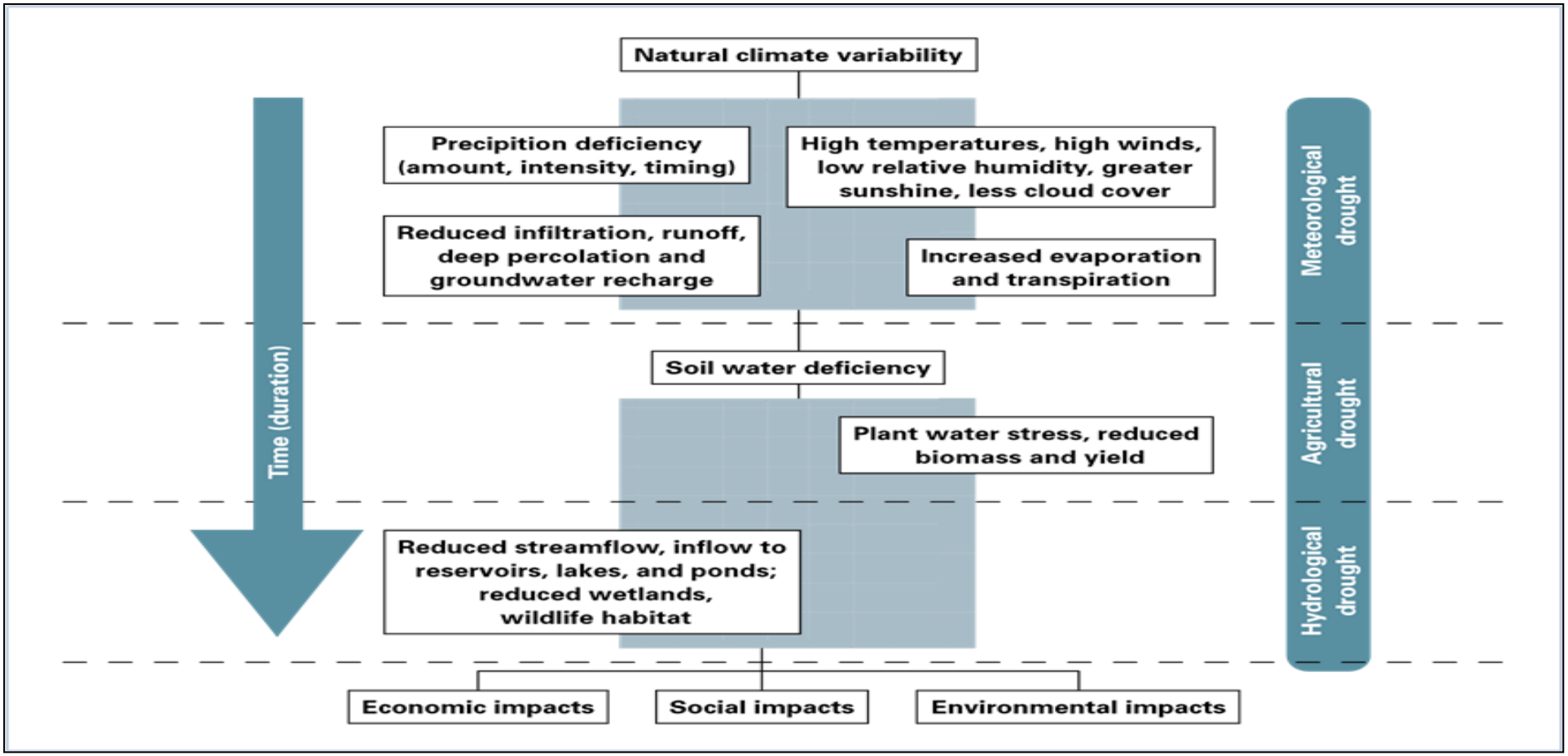

Figure 2.1: Relationship between various types of drought ***(Source: Adapted from the National Drought Mitigation Centre, 2020)***

2.3 Perpetual drought in South Africa: overview and causes

There are many causes of the drought which include unstable climatic conditions. For instance, Baudoin et al. (2017) note that meteorological drought is caused by air circulation disruptions. This is analogous to climate phenomena such as anticyclones or high-pressure systems that cause air and drought to subside for a long time to blanket an area (Blamey et al. 2018). In addition and with a particular focus on Africa, El Niño conditions are synonymous with drought (Gizaw and Gan 2017). Sea surface temperature variations consistent with El Niño southern oscillations in the Pacific are alleged to cause invasion of warm waters into so-called South American coastal waters which typically correlate with drought in Africa and other countries such as Australia and Brazil (Gizaw and Gan 2017). Moreover, through land-use patterns that encourage desertification, such as deforestation, monoculture, overgrazing, over agriculture and irrigation systems that are not well-maintained, human actions induce drought. This is also particular in Africa where demographic pressure has driven people to abandon traditional traditions such as nomadic pastoralism, which was a coping mechanism for drought relief (Baudoin et al. 2017).

Narrowing down to South Africa, wide variability in rainfall is one of the key causes of drought and it is asserted that around 30% of the rainfall variability accounts for the El Niño phenomena (Baudoin et al. 2017). The South Pacific Ocean events modify the temperature, pressure and airfields across Southern Africa. During the high and low phases of the El Niño Southern Oscillation (ENSO), different conditions are produced (Baudoin et al. 2017). The convergence zone of cloud bands, typically the source of strong precipitation, shifts offshore during the low phase or warm events of the Southern Oscillation (Blamey et al. 2018; Gizaw and Gan 2017). In the south-eastern areas of the subcontinent, the influence of the ENSO warm events on precipitation is greatest. Consequently, as was seen with the extreme drought of 1991/1992 and, to a lesser degree, in 1997/1998, these ENSO warm events are often associated with drought over most of Southern Africa (Blamey et al. 2018; Gizaw and Gan 2017).

Global drought triggered by ENSO may dramatically alter the access of donor governments to food for a developing world. Studies show that while there is a link between ENSO events and drought, these associations do not explain all drought events in South Africa (Baudoin et al. 2017; Blamey et al. 2018). Therefore, nations need drought control that covers all facets of climate variability, not just fluctuations in rainfall correlated with ENSO. Drought is a widespread feature of the South African climate and its impacts, especially

concerning the extra helpless community plus the farming subdivision, have therefore been straightforward.

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

Drought existed in South Africa with considerable regularity in the twentieth century. According to South African Weather Service (2020), any volume of rain that is less than 75% of average annual rainfall constitutes a meteorological drought. Dry days have been witnessed in South Africa over the past 20 years, during which the major part of the country has recorded below-normal rain (South African Weather Service 2020). The key years of drought were 1991/1992, 1997/1998, 2001/2002 and late 2015/2016 (Botai et al. 2016; Botai et al. 2017). Due to the impact on food production and vulnerable populations, the drought in the early 1990s was one of the most severe droughts on record in South Africa (Muyambo et al. 2017).

While the country has not endured a drought of equal enormousness as the drought of 1991/1992, recent estimates indicate that the scale, duration and severity of the drought of 2015/2016 was the same or worse than the drought of 1991/1992. The Water Research Commission (2017) characterised Southern Africa's regionally prevalent drought and investigated the processes that generate and regulate these droughts. The research also investigated how climate change could in the future impact the characteristics of regional drought. The projections forecast a general rise in drought coverage and the percentage of drought region may rise by up to 90% in the year 2100 depending on the scenarios and seasons (Water Research Commission 2017).

2.4 Effects of drought

Drought is measured based on event duration, intensity, region impacted, economic harm, environmental and social impacts and long-term extreme impacts. In contrast to other disasters (Kokera and Ndoma 2016), it is a very serious and harmful occurrence (Nhamo, Mabhaudhi and Modi 2019). It is possible to split the effects of natural disasters such as

drought on a region's economy into direct and indirect effects (Hannaford 2018). Drought consequences can be divided into sectors: economic, ecological and social (Lunduka, Mateva, Magorokosho and Manjeru 2019). According to Kokera and Ndoma (2016), direct impacts are distinguished by the abruptness of their harm and they relate to direct physical harm to development factors and goods caused by natural disasters. Furthermore, indirect effects are variations of the direct effects induced by natural disasters due to the effects of dislocation of demand and supply within economic sectors (Yingzhi et al. 2013). It is also important to remember that since agriculture is the economic base and drought is usually the first hit, the indirect effects of drought are always more serious than direct impacts (Kokera and Nhamo 2016).

According to Hannaford (2018), the immediate consequences of drought are also seen as contributing to a decline in productivity and a loss of income for agricultural farmers. The lost revenues of upstream and downstream entities are considered indirect impacts on the supply chain largely due to the decrease in production that are experienced by the producers (Kokera and Ndoma 2016). Drought consequences are categorised into three domains and this is confirmed by the National Disaster Management Centre (NDMC), which suggests that there are several different drought impacts including economic, environmental and social impacts. In planning for and adapting to drought conditions, all of these impacts must be addressed (NDMC 2016).

2.4.1 Economic effects

The economic evaluation of drought impacts is essential to define efficient and sustainable management and adaptation strategies (Kuwayama, Thompson, Bernknopf, Zaitchik and Vail 2019). This is rubberstamped by the idea that if the economic impacts of drought are quantified, it is necessary both to advise ongoing attempts to alleviate the impacts of the current drought and to assist in the creation of policies that will make these areas more informed and resilient to future drought cycles (Hannaford 2018).

It is noted that drought generally produces economic and financial difficulties for agricultural production and that if it lasts for many years, it can cause immense and crippling agro-economic problems, as well as extreme economic difficulties for agricultural development and rural farming enterprises (Hannaford 2018). Economic consequences are referred to as drought consequences that cost resources for individuals (or businesses) (NDMC 2016). Traditionally, drought is seen to cause direct and indirect financial, social and environmental issues around the globe (Ntombela, Nyhodo, Ngqangweni, Phahlane and Lubinga 2017).

The effect of drought on macroeconomic trends, such as economic growth rates, investment, the current balance of payments, inflation and wages, all appear to have financial consequences for farmers and the economy. (Ntombela et al. 2017). The authors went on to argue that the macro-econometric model of the South African Reserve Bank was used to measure the magnitude of the damage caused in 1992 by the previous drought. Drought-induced economic losses include those arising from impaired dairy and beef production, vegetables, forestry and fisheries; lack of electricity for industrial use; a downturn in agriculture-dependent industries; increased unemployment in agriculture and other drought-affected industries; the burden on financial institutions (capital deficiencies, credit risks); loss of revenue from state and local government (Ntombela et al. 2017).

Drought slows down a country's economic growth. Although most Southern African countries have agro-based economies, it is obvious that agriculture contributes most to the GDP of most of the region's countries, even though it does not depend solely on agriculture as a source of income. This is supported by the fact that GDP indicators indicate over time that economic downturns sometimes stem from a drought. For instance, the GDP for Mali, Niger and Ethiopia dropped by 9%, 18% and 7%, respectively, in the year after the 1984 drought in Sub-Saharan Africa. After the 1983 drought, Zimbabwe's GDP decreased by 3% (Nhamo et al. 2019).

Drought has a direct influence on agricultural production, lowering the planned yield, thus lowering the profits of farmers, which ends up having a ripple effect on the taxes that farmers would inject into the economy, both in terms of local sales and exports. Farmers export fresh vegetables, herbs, beef and poultry meat, as well as pork and mutton throughout the region, throughout the African continent and abroad.

Economic bilateral agreements between countries are affected by drought when countries fail to comply with their agreed quantity terms because of drought shortages. Local shortages within a nation often stem from the pressure to reach production targets, thereby causing prices to go up when output struggles to meet demand. Regardless of the reasons behind the reduction in stocks, the fact is that Zimbabwe faced problems with food shortages even before the planting of the 1991/92 crop (Kokera and Ndoma 2016). It is difficult to tell whether GoZ has been forced to minimise storage costs by economic reform interests, or has felt pressured to serve its regional supplier position by exporting maize to politically strategic countries such as Mozambique and Zambia, or has been reluctant to accept that its maize production has been declining (Kokera and Ndoma 2016).

As farmers scale down their labour force due to declining figures on demand, unemployment rates rise. Unemployment, which is so evident in the agricultural sector, is seen as one of the variables indirectly affected by drought. In Gil's analysis, while it is not evaluated in economic terms, it is more measured in terms of the number of jobs lost (Kuwayama et al. 2019). Drought also has economic consequences, such as work decreases, decreases in sectors directly dependent on agricultural production, declines in land values, unemployment due to drought-related performance declines, pressures on financial institutions (lock-outs, elevated credit risk, capital shortfalls), declines in economic growth, declines in agricultural producers (due to bankruptcies, new occupations), declines in economic growth (Dellal and McCarl 2010).

Research undertaken in Spain's Ebo River Basin reported gross drought-related livelihood losses of 11,275 workers and associated farming, forestry, and fishery losses of 8,094 workers (Ntombela et al. 2017). This implies a link between drought and agricultural employment. Agricultural production is a primary sector that in turn impacts the manufacturing firms since the availability of raw materials would be short. There will be no choice for secondary sector factories except to provide skeletal staff.

If the drought worsens, the amount of food imports rises, which will raise the country's debt in the region and abroad. This is shown in the case of Malawi, where drought also have macroeconomic effects, as shown by tobacco, which accounts for one-third of the country's export earnings. Thus, if the demand for maize imports increases as tobacco production and exports decline, Malawi's exchange rate would depreciate (Kokera and Ndoma 2016). During the drought of 2015/2016, Zimbabwe imported grain from South Africa and Zambia into the SADC region, thereby straining the economy that is already in an unpleasant situation due to the lack of production industries and poor production on farms even in good rainy years .

The generation of power is also not spared, as evidenced by the Lake Kariba case in Zimbabwe and Zambia, dam water levels continue to decrease during drought. Countries end up importing energy from countries such as South Africa, DRC and Mozambique. This increases government spending because of power imports to support industry and domestic energy consumption.

Loss of revenue for financial institutions due to farmers' unpaid loans because farmers were unable to obtain a harvest to sell to pay banks the money owed. Farmers could also risk their investments that they added to the farm's inputs and machinery as collateral for

the loan. Drought impacts the marketing assistance loan program. If there is no production, there is no loan collateral (Hannaford 2018).

2.4.2 Environmental effects

Drought affects soil quality in the sense that soil moisture is essential for the breakdown of organic matter. Drought reduces the quality of soils, by lessening organic activity, increasing wind erosion, and, as a result, soil insects or organisms perish (Lunduka et al. 2019).

Drought affects water sources such as streams, creeks, rivers and lagoons, drying them out and killing water-living creatures. It simply amounts to the loss of habitats, and the entire food cycles and ecosystems are destroyed, as marine species and other wildlife perish (Nhamo et al. 2019). Like what occurred in Botswana when Lake Ngami had water in the nineteenth century but was largely dry in the twentieth century, water sources may be affected by drought (Kokera and Ndoma 2016). In addition to a reduction in marine activity, drought often lowers water quality because decreased water flow lowers pollutant dilution but increases pollution of remaining water supplies (Ntombela et al. 2017).

Drought leads to desertification, which happens when agricultural lands such as vegetation lands or forests, primarily due to overgrazing and overstocking, deforestation and veld or runaway fires, become bare and infertile (Nash et al. 2019). These situations are compounded by drought that intensifies the desertification process and decreases any possibilities of land reclamation or regeneration (Kokera and Ndoma 2016).

The health and quality of freshwater biomes, such as lakes and wetlands, rivers and streams, are threatened by cycles of drought. Wetlands are also affected in a manner that endangers the lives of living species in certain ecosystems (Kokera and Ndoma 2016).

Drought refers to the relocation of species to new locations. In need of water, wild animals fly very long distances. This leads to animals growing up with potentially new encounters and risks in unfamiliar habitats, leaving them vulnerable (Kokera and Ndoma 2016). As a product of pollen, pollution and the loss of visibility due to drought, air quality declines. Extreme drought in the great plains of the USA from 1933-1940 resulted in major dust storms that for days left dense dust in the clouds (Nhamo et al. 2019). This cloud of dust was nicknamed the Black Blizzard. The extremely dry conditions exposed wind action to the top layers of the land (Hannaford 2018). The severe drought and the inability to implement crop farming practices that were prone to wind erosion are considered the true cause of the dust bowl.

2.4.3 Social effects

The social consequences of drought are more likely to be more severe since they specifically affect individuals. In developed countries, most individuals have no experience with what it feels like to survive without enough water, but this is a widespread nightmare in less developed countries (Nhamo et al. 2019). The reduction in the rural population, decreased access to schooling and extreme indices of health and well-being in rural communities are all well-established patterns in the event of a drought (Kokera and Ndoma 2016) .

Health has a direct relationship to any settlement's water supply (Bauer and Mburu 2017). Drought has a major impact on the quality of water that individuals use. Clean drinking, cleaning and irrigation of freshwater help communities avoid and control diseases. According to Hannaford (2018), the impacts of drought on poverty, starvation, anaemia and mortality are indirect. Drought causes low food production (crops and livestock), and people have less to eat, particularly in poorer regions (Bauer and Mburu 2017). Food nutrition is also a concern, resulting in insecurity, disease/ illness and deaths.

People migrate, in search of improved living environments, to other places with better opportunities during drought. The migration of young people leaves the world that they leave vulnerable, leaving the elderly and children in the hands that are unable to enhance growth in the region. The most affected are subsistence farm groups, while other members migrate. This stresses the life of farming families in rural areas around the globe (Hannaford 2018). It is argued that as many as 50 million could become environmental refugees if the world did not act to support sustainable development (Kokera and Ndoma 2016).

Stress, anxiety and the generally low and drained feeling of not knowing when things will improve can hurt individuals (Hannaford 2018). Furthermore, community networks are broken and social contact is jeopardised, resulting in poor morale and social alienation for individuals.

2.5 Adaptation measures to cope with drought

2.5.1 Agricultural institutions

For the long-term survival of agriculture, the availability of agricultural technological resources and extension facilities is crucial (Nhamo et al. 2019). As a way to reduce the consequences of drought in Zimbabwe, AREX's department was properly resourced and its

manpower capacity increased enough to satisfy high demand and farmers' needs (Kokera and Ndoma 2016).

It is argued that the entire world will benefit if nations rely on youthful energies and flexible thought, applying minds to agricultural science, but if this potential is overlooked, the risks of drought will lead to an ocean of suffering, starvation, destruction of the atmosphere and social unrest (Hannaford 2018). It encourages the reinforcement of agricultural institutions and the introduction of innovations from the new generation in the effort to mitigate the risks of drought.

2.5.2 Ensuring uninterrupted power supply

For agriculture, a stable supply of electricity is necessary and electricity is required not only for direct agricultural operations, but also for the consistent supply of inputs, including coal, fertilizers, pesticides and herbicides, which rely on electricity for the smooth running of industrial production (Nash, Klein, Endfield, Pribyl, Adamson and Grab 2019). Power outages are serious and continue to influence industries (industry), agriculture, mining and households (Nhamo et al. 2019). In the case of Zimbabwe, the regular load shedding has had a significant influence on farm output from the beginning of 2000 to date, so the Reserve Bank of Zimbabwe must help power companies to ensure that the power supply is less disrupted.

2.5.3 Dams and irrigation

Changes in atmospheric conditions and weather trends strongly reflect the SADC countries' recurrent drought conditions (Nhamo et al. 2019). This kind of context indicates that agricultural regeneration is now highly dependent on the construction of dams and irrigation infrastructure. To maintain reasonable development in the agriculture sector, drought-prone countries need to build a variety of dams to prevent worse circumstances during drought years.

2.5.4 Agricultural financing

Both working capital and initial capital investments require substantial funding for agricultural development. Government agriculture funding from the budgetary process should be sufficient to meet national requirements for agricultural financing (Kokera and Ndoma 2016). This suggests that, to ensure that food security continues even in poor years, agricultural development has to be among the high priority sectors .

2.5.5 Labour market

The agriculture sector is presently marked by a lack of both professional and unqualified workers (Kokera and Ndoma 2016). This calls for intensive labour preparation, both recent and already in the sector, to resolve labour shortages. Research into farm mechanisation, which addresses the needs of the vast majority of farmers, including community farmers, will also fix the issue of people shunning working on farms (Lunduka, Mateva, Magorokosho and Manjeru 2019).

2.6 Factors influencing smallholder maize farmers' choice of adaptation to drought: evidence from the empirical literature

The level of education of farmers is used to assess whether the education of farmers at the beginning of a farming season affects how they view the amount of rainfall. Accordingly, Khanal et al. (2018) note that the level of education affects the perception of the farmers concerning agricultural decisions and adaptation strategies. Farmers who have correctly interpreted the amount of rainfall predicted at the beginning of the farming season are those who, in their schooling, have either been educated in certain skills or have gone up to tertiary or at least secondary level. Most farmers without any sort of education, however, falsely perceive the amount of rainfall as low or average when, in fact, it is abundant or above average (Khanal et al. 2018).

Studies show that the perceptions of farmers implementing soil fertility management methods are closely related to their interactions and understanding of the methods (Ndamani and Watanabe 2016). For example, Ndamani and Watanabe (2016) suggest that farmers' understanding of a new practice is closely linked to their expectations of such a practice, which together frame the attitudes of farmers to either to follow the practice. Other studies suggest that the personal aspects of farmers, such as their age group and educational background, also play a crucial role in framing their adoption expectations (Jin et al. 2016).

Access to extension facilities and weather knowledge impacts how drought conditions are viewed by farmers. At the beginning of the farming season, some farmers with access to extension resources and weather data appear to accurately interpret the volume of rainfall. The study by Thinda et al. (2020) showed that the level of touch and preparation with extension were the deciding factors affecting techniques for perception and adaptation. This suggests that it is important to increase access to extension resources as a step

towards enhancing the views of drought and climate fluctuations of farmers (Thinda et al. 2020).

In addition, the empirical literature reviews that household income often affects the option of adaptation strategies for smallholder maize farmers. For example, a unit increase in household income raises, but not to a greater degree, the possibility of modification to a coping strategy (Belay et al. 2017). The farm income of the households surveyed has a positive effect on soil conservation, the use of various crop varieties and improvements in planting dates. The risk of adjusting is improved by a unit increase in farm income. When agriculture is the main source of income and the amount of land for agriculture is small, farmers prefer to invest in the smoothening of productivity (Mfitumukiza et al. 2017). A higher degree of income raises the risk of the experience of drought, as noted by Ojo and Baiyegunhi (2020). This, however, conflicts with Mfitumukiza et al.'s (2017) results, which indicated that farmers with expanded wealth and assets are less conscious of the possibility of drought.

Besides, it was also found that risks impact attitudes and expectations of adoption behaviour by farmers (Mdungela et al. 2017). Contemporary environmental activities that are considered to mitigate risk are readily embraced by risk-averse farmers and are in line with their economic motivations and priorities (Mdungela et al. 2017). Furthermore, research also shows that characteristics of private farmers, such as resources (livestock, property, cash), previous farming experience, have a major effect on their risk attitudes and expectations (Twongyirwe et al. 2019).

Farming experience, as a factor, is also echoed in studies conducted by Marandure et al. (2020) as one of the factors that positively influence farmers' decisions to take up adaptation measures. The head of the household is more seasoned and is expected to gain more weather forecasting expertise. This tends to improve the chance of numerous drought response techniques being implemented (Marandure et al. 2020). More experienced farmers are more likely than less experienced ones to adapt to drought-tolerant crop varieties. A unit improvement in years of practice will contribute to an increase in the possibility of the adoption of crop varieties resistant to drought (Rapholo and Makia 2020). For the analytical model, the general farming experience is not important, because most farmers assess their overall experience as beginning from the first day they began going out with their parents to the mangrove rice fields. What is relevant is the experience since the farmer becomes a decision-maker in his field.

To support the factors already mentioned this far, Kakeeto et al. (2019) submit that age and level of education of farmers impact how they interpret climatic variables. This is because the degree of education and age of farmers impact their understanding of climate fluctuations and transition. Old farmers have indigenous knowledge of how to interpret climate variables at the start of each farming season, particularly the amount of rainfall. This knowledge is not held by young farmers and needs to be delivered on to the younger population to help them understand critical prediction models such as rainfall correctly (Kakeeto et al. 2019).

Concerning education, it should be recalled that schooling often has a role to play in shaping the understanding of climate change and uncertainty by farmers. This is consistent with observations by Bahta et al. (2016) that farmers with a higher degree of education correctly interpret environmental factors and climate variables and vice versa. This suggests that attempts to help farmers view themselves correctly also need to concentrate on improving farmers' level of education, especially by equipping them with farming-related skills. This suggests that schooling must be stressed to better change how farmers view climate variables (Bahta et al. 2016).

Larger farm sizes decrease the possibility of increasing new crops but increase the likelihood of introducing crop varieties that survive drought and move the emphasis from crop production to livestock production (Kom 2020). Farm size has a positive influence on various drought coping strategies. The larger the farm, the more farmers have chosen to mix multiple coping strategies: agroforestry and perennial planting, diversification of crops and animals, better varieties and other relevant strategies. This is supported by Twongyirwee et al. (2019), who indicate that since large-scale farmers have large pieces of land and more capital base, they are more able to respond easily to drought.

Mixed impacts of farm-scale on adoption have been observed in empirical research. Research on soil conservation initiatives in South Africa, for example, indicates that farm size was not a major acceptance factor (Anim 1999). Nyangena (2007) found that farmers with a small area of land were more likely than those with a wide area to engage in soil conservation. Hassan and Nhemachena (2008) hypothesize that large-scale farmers would take steps involving large land areas, such as livestock systems, whereas small-scale farmers are required to diversify their choices when faced with drought.

In addition, an empirical literature review that the household size also influences the choice of smallholder maize farmers' choice of adaptation strategies (Sanogo et al. 2017). From two angles, the effect of household size on the option of an adaptation approach can be

seen. The first presumption is that to relieve the consumption burden exerted by a large family, households with large families may be required to redirect part of the workers to off-farm practices to gain income (Sanogo et al. 2017). The other hypothesis is that a higher labour endowment is typically correlated with large family sizes, which will allow a household to perform multiple agricultural tasks. For example, Rapholo and Makia (2020) suggest that households with a greater labour pool are more likely to accept and use agricultural technologies more intensively because at peak periods they have fewer labour shortages. Households of big families are projected to be more likely to respond to climate change.

Another major determinant of the implementation of agricultural technology and adaptation strategies is awareness of climate change and the possible advantages of taking action in that regard. Ojo and Baiyegunhi (2020) found that the understanding of farmers of changes in climate characteristics is critical for decision-making on adaptation. Several studies have found that the understanding and views of soil erosion issues among farmers have a positive effect on their choices to take soil conservation steps (Balay et al. 2017). Farmers who are conscious of and informed of climate change are expected to take adaptation steps to help them minimise losses or to take advantage of the benefits associated with these changes (Hassan and Nhemachena 2008).

2.7 Theoretical framework: Sustainable Livelihoods Framework

This study uses the sustainable livelihoods framework as its heuristic theoretical tool. A sustainable livelihood is defined as a livelihood that can improve people's lives without the destruction of future resources (Hussein and Nelson 1998). The United Nations Development Programme understands livelihoods as a resource that helps people make a living. UNDP defines sustainable livelihoods as economically effective, economically sound and socially equitable.

There are different sustainable livelihood frameworks. These include The UK Department for International Development framework (DFID), the Cooperation for Assistance and Relief Everywhere (CARE) framework, Oxfam's framework, United Nations Development Programme (UNDP) only to mention a few (Ashley and Carney 1999; Karki, 2021). CARE is an international Non-Governmental Organisation that uses the livelihoods approach as its core framework (Henry, 1999). Henry (1999) also states that the CARE framework follows three important attributes of livelihoods, which are the control of human capabilities, access to tangible and intangible assets, and the existence of economic activities. CARE's

approach is the same as that of the DFID in the sense that they consider various aspects of the framework. However, instead of using the 'five capitals' approach to assets (Krantz, 2001), Henry (1999) state that CARE's framework differentiates between assets, capabilities and activities. The CARE framework places less emphasis on macro-micro links within the framework, in as much as it is important in many aspects of its work (Henry, 1999). CARE livelihoods framework uses a framework that allows room for other approaches, in the process enhancing the evolution of livelihoods framework.

The DFID framework is one of the widely used livelihood framework in sustainability works (Mensah, 2011; Haidar, 2009). The DIFD framework focuses on people's survival skills within an environment that is characterised by various factors like shocks, trends and seasonality. The DFID framework also works on different types of livelihoods assets influenced by a vulnerability context in different institutions and processes (Mensah, 2011; DFID, 2002). Additionally, Haidar (2009) state that this framework is people-oriented for some of the policies that understand the poor and their livelihoods. The framework also states that the poor should participate and be involved in decision making contributing ideas that can change their lives. The DFID framework is holistic as it encourages ideas from different sectors as well as encouraging multiple livelihood strategies and desired results (Krantz, 2001; Mensah, 2011). The framework is dynamic for it focuses on people's strength rather than their weaknesses as well as change over time. Lastly, the DFID (2002) framework's main goal is centred on the sustainability of distinguished dimensions, namely social, economic, institutional and ecological.

This study uses the sustainable livelihood framework developed by Ashley and Carney in 1999. This framework argues that a livelihood is sustainable if it can utilise its resources for the enhancement of people's lives without depleting all the resources for future use (Farrington, Carney, Ashley and Turton, 1999; Ashley and Carney, 1999; DFID 2000). It is important to note that livelihood consists of the capabilities, assets and activities required for a means of living (Ashley and Carney, 1999; Farrington et al., 1999). This framework underpins several major principles, it is people-oriented in the sense that it puts people first rather than the resources they will use, holistic, and thus helps people overcome challenges, as well as dynamic in that it can adapt to changes and support positive effects whilst finding solutions for negative effects (Anand, Gasper and Forsyth, 2007; Kamaruddin and Samsudin, 2014; DFID 2000).

The sustainable livelihood framework is also centred on macro-micro links, the SLA aims to bridge the gap between micro and micro level as compared to development activities that

tend to focus at either the micro level or the micro-level (Ashley and Carney 1999; Mensah, 2011). Ashely and Carney (1999) also state that sustainability is an important core principle of SLF. Livelihood can be classified as sustainable, if it is resilient in the face of external shocks and stresses, if it is independent of external support if it can maintain the long-term productivity of natural resources and if it does not undermine the livelihood options of others (Kollmair and Juli, 2002; Kamaruddin and Samsudin, 2014). Figure 2.2 shows the Sustainable Livelihoods Framework by Ashley and Carney (1999).

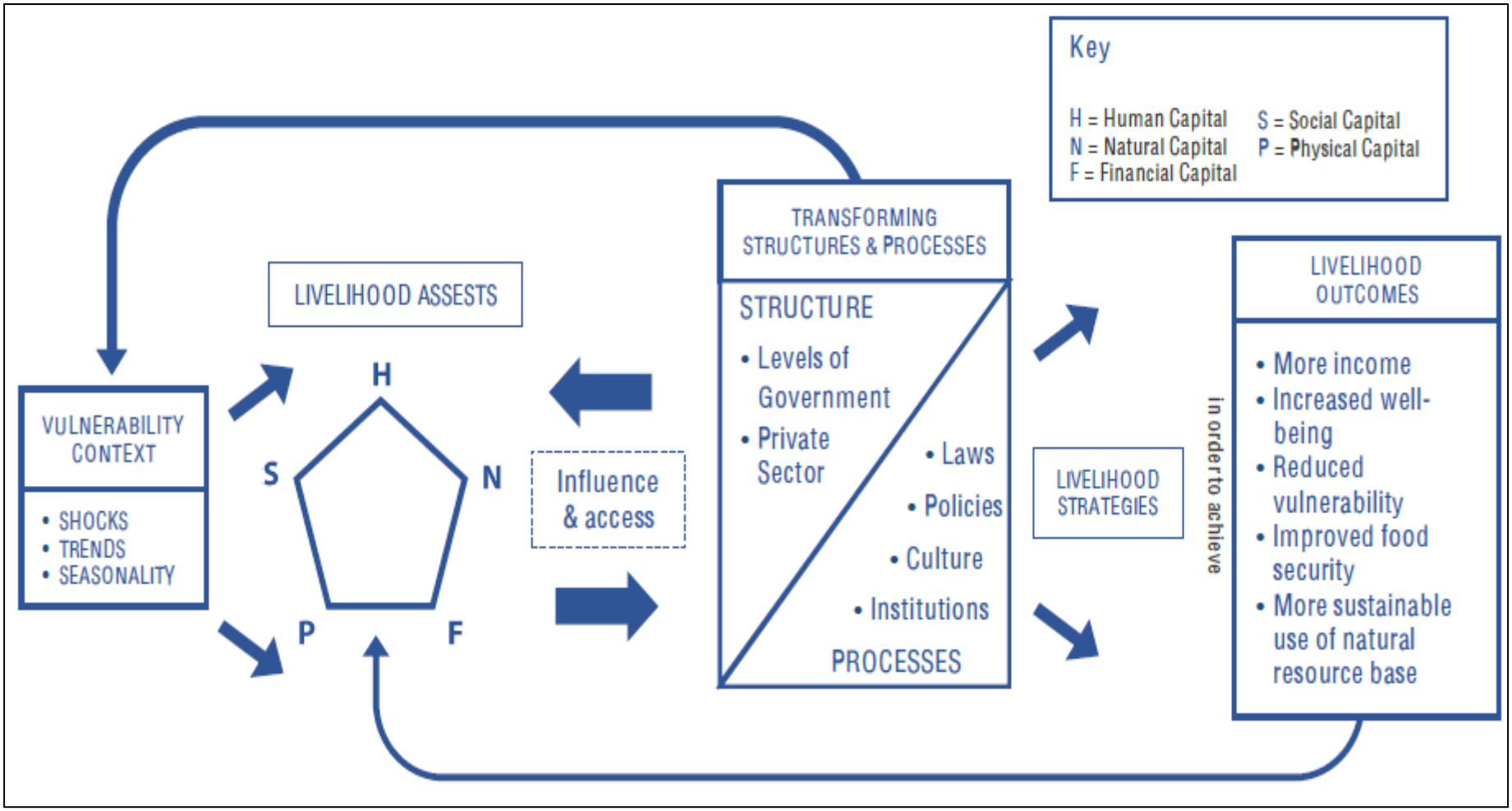

Figure 2.2: Sustainable Livelihoods Framework

Source: *Ashley and Carney (1999:56)*

Ashley and Carney (1999) submit that the sustainable livelihood framework offers diverse solutions and ideas on different constraints and opportunities on livelihoods. The SIF also ensures that important factors of rural livelihoods should be abandoned. The framework highlights almost every aspect that can be used to alleviate poverty (Goodwin 1999). It also includes vulnerability context, livelihoods assets, transforming structures and processes and livelihoods strategies as well as livelihoods outcomes, which are discussed below:

2.7.1 Vulnerability context

Serrat (2008) states that vulnerability context involves taking care of the well-being of individuals, households and communities in times of the turnaround of activities of the external environment. Vulnerability context is characterised by shocks, trends and seasonality. Shock can be referred to as human health for example disease epidemics such as the cholera outbreak of 2008 in Zimbabwe (Nyandoro, 2011); and natural shocks, for example, the Tohoku earthquake in Japan 2011 (Koshimura, Hayashi and Gokon, 2014) and conflicts such as wars and terrorism (Vatis, 2001). Seasonality indicates the effects of drought on prices, products and unemployment. It is regarded as a more direct risk at local level. Serrat (2008) stipulates trends are more of a concern at the national and regional level and these refer to demographic, environmental, economic, governance and technological trends.

2.7.2 Capital assets

Capital assets are of the utmost importance to livelihoods and are at the centre of the sustainable livelihoods framework. Capital assets consist of five elements, namely human, social, natural, physical and financial. Serrat (2008) says that human capital characterises the skills, knowledge, capacity to work, the capacity to adapt, education, nutrition and health, and if all these are combined, they will impact livelihoods positively.

Ashley and Carney (1999) describe social capital as the resources upon which people in pursuit of their livelihoods. The following are examples of social capital; leadership, mechanisms of participation in decision making, collective representation, networks and connection, relations of trust and mutual understanding and support, formal and informal groups and shared values and behaviours (Ashley and Carney 1999; Ashley 2000).

According to Ashley and Carney (1999) and other scholars on sustainability such as Kollmair and Juli (2002), natural capital refers to natural resources such as land, water and aquatic resources, trees and forest products, wildlife, wild food and fibres, biodiversity and environmental services. Natural capital is important for the poor because it is where

livelihoods benefit from and it is an important aspect for farming. Physical Capital are resources that can be used by a community to enhance their livelihoods objective (Kamaruddin and Samsudin, 2014). Ashley and Carney (1999) as well as Anand et al. (2007) state that physical capital consist of the following; infrastructure, tools and technology. Ashley and Carney (1999) furthermore highlight that capital asset is also called money, but most rural livelihoods lack this asset because they are poor. This view is seconder by Farrington et al. (1999) who mention that some examples of financial capital are savings, credit and debt (formal, informal, remittances, pensions and wages).

2.7.3 Transforming structures and processes

Transforming structures and processes play a vital role in shaping livelihood assets and outcomes (Ashley and Carney 1999). It is important to note that development intervention and strategy to be successful and sustainable, there is need for institutions that act as mediators to harmonise the development process. Institutions that initiate development processes in farming can be individuals, government, non-governmental organisations and private enterprises.

2.7.4 Livelihood strategies

The livelihood strategies of community people differ massively, however a common approach is for livelihoods to embark on a variety of activities which each in some way may yield one or more livelihoods needs. This is going to reflect on the transformative theory in relation to farming and drought because many households rely on various natural resource use and agriculture or remittances (Ashley and Carney 1999).

2.7.5 Livelihood outcomes

Livelihood outcomes are reflections of successes and objectives that livelihood approaches target to accomplish. Outcomes are important because they help in measuring livelihoods sustainability. Ashley and Carney (1999) highlight that increased income, improved well-being, reduced vulnerability and enriched food security, improved sustainable practice of natural resource base and recovered dignity are potential livelihoods outcomes. Similarly, Farrington et al. (1999) state that when the stakeholders manage to overcome the shocks they face in developmental agenda, they will be in a position to attain positive outcomes. In rural communities, this would be seen through local development and progression of rural development. In another study, Kamaruddin and Samsudin (2014) noted that the outcomes will be in line with different services that enhance the success and development of organisations and entrepreneurial activities. Thus, the main focus of livelihood outcomes in

this framework is a situation where stakeholders are put in a position where they will be able to progress in terms of any activities that they might be doing for their survival.

2.8 Conclusion

The chapter presented literature on smallholder maize farmers and drought. The chapter first provided different definitions of drought and the existing types, namely meteorological drought, socio-economic drought, hydrological drought and agricultural drought. This discussion was preceded by the analysis of drought in South Africa, its overview and the main causes. The chapter also analysed the various impact of drought on the general people and the economy and there were mainly categorised into economic, environmental and social effects. This was followed by an outline and discussion of various mechanism and strategies used to cope with drought. The chapter was then concluded by a review of the Sustainable Livelihood Framework that underpinned this study. The following chapter presents research methodology where the methods followed in this study in conducting primary research are outlined.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter reviewed literature on drought, its definitions, different types and impacts in South Africa and beyond. The main purpose of this chapter is to describe and explain the comprehensive methods used in this dissertation to provide answers to research questions and to satisfy the research objectives. The research methodology is a template used in an analysis to achieve the test goal. Creswell (2013) notes that the research methodology is a plan used to collect and evaluate primary and secondary data that is relevant for analysis to satisfy research goals and to address research questions. This chapter outlines the research design and research philosophy such as quantitative and qualitative and how these were applied in this study. This chapter also addresses the target population of research and sampling techniques. Details about how the pilot study was performed will also be discussed. Besides, this chapter addresses how the data is evaluated, including the reliability and quality of the findings collected. Ethical issues are also discussed in this chapter.

3.2 Research design

The research applied the mixed-methods approach, which consists of both qualitative and quantitative research methods. The word 'mixed-methods' refers to an evolving research approach that advances the systemic combination or mixing of quantitative and qualitative evidence within a single inquiry or on-going research (Apuke 2017). Mixed-methods also allows the integration of data during the compilation – usually during primary research, analysis and review, or in the discussion of findings. For example, to understand the perception of smallholder maize farmers on drought and their choices of the adaptation strategies, mixed-methods methodology helped through quantitative and qualitative means. On one hand, using quantitative research methodology as part of mixed-methods, the research employed surveys and had relatively little contact with the subjects under study. As a result, the findings collected were free from bias, as the research did not manipulate the respondents in the data collection process. The qualitative aspects of the mixed-methods approach, on the other hand, enabled the research to intensively understand this topic by engaging with the participants and be flexible in the execution of a research report (Cazeaux 2017). In addition, Cazeaux (2017) holds that the mixed-methods approach helps the research to gain adequate and comprehensive information on the subject matter – and

in this case, the main goal is to understand the various perceptions of the farmers in terms of their adaptation to drought in Buffalo City Metropolitan Municipality.

3.3 Research philosophy

This research adopted both positivism and interpretivism research philosophies. The positivism philosophy was specifically used in this study due to its ability to enable the research to investigate different phenomena by questioning the respondents to get their opinions on the topic at hand. Issues such as the perception of smallholder maize farmers on the impacts of drought are more objectively analysed to produce reliable and accurate outcomes. Besides, positivism theory was also used in this thesis because of its ability to separate the principal researcher's subjective perspective from the objective reality under study (see Van de Ven and Poole 2017). Thus, the positivism philosophy enabled the research to distinguish the subjective viewpoint of the scholar from the empirical proof that was then studied. This process, according to Van de Ven and Poole (2017), further enabled the research to maintain highly precise observations in this form of science – or more precisely, quantitative approaches.

Furthermore, interpretivism research philosophy was also used in this study because social reality cannot be limited to singular meanings, but rather is shaped by people's living realities, their experiences, or different social dynamics (Creswell 2013). The different social contexts and the different realities experienced by people lead to the development of different meanings of experiences or objects. In this case, to understand the smallholder maize farmers' perception of drought, different interpretations were gathered and an analysis was conducted to have one explanation of this phenomenon. As a result, using an interpretive research philosophy, the research had to look at the complexities of the views to clarify social reality in the entire study area, rather than confine it to a few meanings

3.4 Research strategy

Due to the nature of this research, surveys have been used for the primary collection of data. Surveys include the identification of a survey group from the whole population and the issue of questionnaires for the primary data set. This method was carried out independently of the intervention of the research team to prevent bias during the analysis. It was only during the qualitative section of the questionnaire that more information was provided to the participants so that they understand how to answer the questions asked. This means that the descriptive research design was used in this study. This is a scientific approach used in

science to observe and explain events under study without influencing respondents or effects in any way (Slater 2018). This research design meant that the investigator was isolated from the data collection and did not have any control, intervention, or manipulation during the data collection process. For this cause, among others, research results are determined to be free from bias and maybe a valid reflection of the population under examination.

3.5 Description of the study area

This study was conducted within Buffalo City Metropolitan Municipality in South Africa. Buffalo City is a metro municipality, situated on the east coast of the Eastern Cape of South Africa. The metro is split into three major regions, namely coastal, midland, and inland areas (Buffalo City Metropolitan Municipality 2021). The metro has a combination of regions that are rural and urban. The city has two major waterways, one known as the Buffalo River, which has a river mouth at the Port of East London, which crosses the sea (Buffalo City Metropolitan Municipality 2021). Buffalo City has a population of about 781,873, 85.5% of which are African, 8.1% white, 6% brown and 0.4% Indian (Statistics South Africa 2020). The Eastern Cape is famed for its agriculture and industrial operations, and low rainfall has recently affected it. On the grains, farmers had to lower the scale and store. Figure 3.1 shows the location and demarcations of the study area.

Keyser's Beach and the locations which demarcated this study

Figure 3.3: Study Location – Keyser's Beach, Buffalo City Metropolitan Municipality, Eastern Cape

3.6 Target population and sampling

The population of this study was smallholder maize farmers located in Keyser's Beach in the areas demarcated in Figure 3.1. According to the information provided by the Department of Agriculture, there are approximately 76 smallholder maize farmers in this region. This study used non-probability sampling to select the respondents of this study. Specifically, this research used a purposive sampling technique to select the participants who were deemed appropriate for the study. Consequently, this form of sampling required the discretion of the fieldworker to pick the subjects deemed suitable for a test study. To select the appropriate sample, the Raosoft Sample Size Calculator was used as follows:

Table 3.1: Sample Calculation

Population size	76
Margin of error	7%
Confidence level	95%
Response distribution	50%
Sample size	55

Source: Raosoft (2004) and tabulated by the author

As shown in Table 3.1, the population size of the farmers was 76. A margin of error of 7% was tolerated in this study. In addition, a 95% confidence interval, which is the amount of uncertainty a researcher can tolerate (Raosoft 2004), was also implemented in the sample calculation. Last, a response distribution – which balances/centralises the skewness of the responses – was set at 50%. Using the figures presented in Table 3.1, the following formulae were used to come up with the sample size:

$$x = Z(^{c}/_{100})^{2}r(100-r)$$

$$n = {}^{N\,x}/_{((N-1)E2\,+\,x)}$$

$$E = \mathrm{Sqrt}[{}^{(N\,-\,n)x}/_{n(N-1)}]$$

Where n = sample size, E = margin of error, N is the population size, r is the fraction of responses, and $Z(^{c}/_{100})$ is the critical value for the confidence level *c*. A sample size of 55

smallholder maize farmers was then determined to be appropriate to come up with representative research findings.

3.7 Research instrument

This study used survey questionnaires for quantitative data collection. The use of questionnaires permitted respondents to participate in their own time; thus, questionnaires ensure greater consistency in data collection (Creswell 2013). In addition, the questionnaires were easy to understand as the pilot study (discussed in the following section) was completed and the answers were already predetermined so that the respondents were directed from start to finish. The predetermined questions excluded the open-ended ones, which required the respondents to provide more detail.

The questionnaire used in this study, attached as Appendix B, had four sections, namely Section A, Section B, Section C and Section D. Section A comprised of general information that was relevant to the research study such as the gender of the participants, their age groups, population group membership, marital status, number of years in the maize production industry and their size of land. Section B was made up of open-ended questions about the farmers' perceptions of the prevailing drought. Section C consisted of five-point Likert scale questions that ranged from 'strongly disagree' to 'strongly agree'. These questions pertain to the perception of the smallholder maize farmers on the impact of the prevailing drought on farming. Section D consisted of five-point Likert scale questions on the strategies applied to mitigate the challenges faced by smallholder maize farmers to cope with drought. A cover letter, attached as Appendix A, was designed to accompany the questionnaires. The cover letter consisted of information about the research being done, the researcher's details as well as contact details in terms of further questions

3.8 Pilot study

A pilot study was carried out to assess if the questionnaire was suitable for this research and if it was well understood by the respondents. According to Esser and Vliegenthart (2017) and Etikan and Bala (2017), a pilot study is a method by which a research instrument is checked on a few components of the study population to allow adjustments to any questions that might need consideration in the questionnaire. Pilot testing is carried out to correct errors in the research instrument and to assess the time it takes to complete it until data collection begins.

Pilot testing of the instrument used in this analysis was conducted on ten respondents. These respondents were omitted from the list of respondents for final data collection to minimise bias. Any major mistakes, such as spelling errors, ambiguous sentences and lengthy questions, have been found and corrected. It was also found that the original questionnaire was longer since it took more than 20 minutes to be completed. The required changes were made before the final questionnaire for data collection was released. Pilot testing also allowed the data collection agent to verify the potential of the questionnaire to yield accurate and consistent results. Finally, this phase was important in this analysis because it determined the quality of the primary data.

3.9 Data analysis

Data analysis is the ultimate step of finding answers to study questions. This process is described by Patten and Newhart (2017) as the methods used to structure and organise raw data to extract valuable information from it. Several steps have been taken in this study to analyse the results. When the completed questionnaires were obtained from the respondents, they were subject to cleaning, checking, editing, elimination, data coding and, finally, analysis (Queirós et al. 2017; Van de Ven and Poole 2017). Data cleaning is the method of separating all missing and spoiled questionnaires from the remainder of the completed questionnaires. Data editing is the method of reviewing questionnaires to ensure that they follow the pre-determined requirements for gathering the necessary data. In data coding, replies are transformed into electronic copies using the Microsoft Excel Spreadsheet (Meister 2018).

Based on the quantitative methods used in this report, the Statistical Package for Social Sciences version 25 (SPSS 25) was used for the analysis of research results. The data was then descriptively evaluated. Descriptive statistics is a research tool that investigates the distribution score for each variable and evaluates the relationship between the calculated variables (Cypress 2018). Results were presented in the form of bar graphs such that they can be easily understood and related to the empirical literature. Bar graphs have been developed on the Microsoft Excel Spreadsheet.

3.10 Reliability and validity of the instrument

3.10.1 Validity of the instrument

In this study, validity testing was done using content validity. Through content validity, the content of the measurement instrument was valid enough to capture different variables

about the perception of smallholder maize farmers on the impact of drought in Buffalo City Metro. The instrument was adapted from previous studies done in this research field, and this ensured that all the important facets were captured during primary research. The validity of the questionnaire survey was enhanced by the fact that it was pilot tested beforehand. Besides those who received the pilot questionnaire, the participants who made part of primary data collection were also knowledgeable in the field of smallholder farming and on how drought impacts their operations. Their feedback on the questionnaire thus added to the validity of the measuring instrument.

3.10.2 Reliability of the instrument

In this research, reliability was ensured by enquiring about the same aspects related to the perception of different smallholder maize farmers on the impacts of drought. In addition, comparisons were made between the responses about the same aspects among the different participating groups from the farming community. To further improve the reliability of the results, the research sought to improve the response rate to the questionnaires. Therefore, numerous reminders for completion and return of the questionnaires were sent. This was done because a low survey participation rate could have a definite impact on the value of the information obtained and its perceived usefulness for this investigation. Finally, author's critical self-reflection regarding the processes of data analysis and interpretation contributed to ensuring reliability in this study.

3.11 Limitations of the study

The key drawback of this research was carried out with insufficient resources. As a result, this research picked a small region within the Eastern Cape Province. This would mean that the results would be difficult to generalise to large populations, as they may not be fully representative. In this light, it was clearly specified that the research is conducted in Buffalo City Municipality and the findings can be generalised in this region only. A larger sample would be used, provided there are sufficient funds.

3.12 Delimitations

This research was performed in the Eastern Cape Region under the limits of Keyser's Beach. This is a location situated 35 kilometres from East London. This research involved only smallholder maize farmers in this area who engage in maize farming, mainly subsistence agriculture.

3.13 Ethical considerations

This research was driven by the ethical considerations of the University of the Free State attached as Appendix C. The research was; therefore, done in strict accordance with the institution's academic ethics policies and guidelines. Concerning the collection of data, the research adhered strictly to the participants' voluntary participation. The safety of data usage as well as the principles of anonymity. Efforts were also be made to ensure that research engagement was based on the concept of informed consent and that researcher during the data collection period was not exposed to socio-political, psychological, or physical harm. Besides, participants were also told that the data they provided would only be used for academic purposes.

3.14 Conclusion

This chapter provided a summary of the research philosophy used in this study, namely mixed-methods. The chapter also outlined the research strategies put in place and the discussion of the study population followed by the sampling methods chosen, that is, purposive sampling. This section was accompanied by an outline of the research instrument used and it explained how the questionnaire for this review was built. This was followed by details on the pilot tests, as well as the management and compilation of questionnaires. A description of the data collection was then presented, accompanied by details on the validity and reliability of the survey questionnaire. The chapter then pointed out the shortcomings of the analysis and ended with an overview of the ethical issues observed in this study. The following chapter discusses the results of the research, discussion and explanation of findings.

CHAPTER 4: RESEARCH RESULTS AND ANALYSIS

4.1 Introduction

The previous chapter described and explained the methodological approach used in this study to provide answers to research questions and to satisfy the research objectives. The chapter focused on different approaches that are enshrined under mixed-method as it is the one that was applied in this study. This chapter presents the findings obtained from primary research to answer the following research questions:

i. What are the perceptions of smallholder maize farmers on the prevailing drought and the choice of the adaptation strategies implemented in Buffalo City Metropolitan Municipality?
ii. What are the perceptions of the smallholder maize farmers in Buffalo City Metropolitan Municipality on the impacts of the prevailing drought on their agricultural activities?
iii. What strategies can be applied to mitigate the challenges faced by smallholder maize farmers in Buffalo City Metropolitan Municipality because of drought?

The chapter first presents the smallholder maize farmers' response rate followed by their demographic details. This is then followed by an analysis of the findings on the perceptions of smallholder maize farmers on the prevailing drought. This section is preceded by the impacts of the drought on the participants and the various coping mechanisms they apply. Data was mostly analysed using descriptive statistics and the vulnerability index was used to determine the extent to which farmers are impacted by drought.

4.2 Response rate

First, it was important to determine the response rate of this study. This is presented in Table 4.1.

Table 4.2: Response rate

Calculated sample size	Number of respondents	Response rate
55	50	91%

As Figure 4.1 shows, the goal was to collect data from 55 smallholder maize farmers. However, 50 farmers returned the questionnaires on time while the remaining 5 did not respond. Overall, a response rate of approximately 91% was obtained. This response rate

was deemed appropriate for analysis, as it was higher than the 50% threshold (see Taherdoost 2016). In this light, Taherdoost (2016) holds that the survey response rate of 50 % or more is deemed excellent as it is likely motivated by a high degree of commitment to complete the survey or a close relationship between research participants.

4.3 Respondents' demographic profile

The demographic profile of the respondents is analysed and discussed in the next sections. The section classified into four categories namely:

- Distribution of the smallholder maize farmers by gender, age groups and marital status;
- Distribution of the smallholder maize farmers by population groups and educational level;
- Distribution of smallholder maize farmers by land size and level of experience, and
- The extent to which smallholder maize farmers relied on maize farming for livelihoods.

4.3.1 Distribution of the smallholder maize farmers by gender, age groups and marital status

Table 4.2 shows the demographic details of the smallholder maize farmers who participated in this study based on their gender, age groups and marital status.

Table 4.3: Distribution of the smallholder maize farmers by gender, age groups and marital status

Variables	Male Frequency (percentage)	Female Frequency (percentage)	Total Frequency (percentage)
Gender	20 (40%)	30 (60%)	50 (100%)
Marital Status			
Single	2 (4%)	5 (10%)	7 (14%)
Married	12 (24%)	15 (30%)	27 (54%)
Divorced	3 (6%)	4 (8%)	7 (14%)
Widowed	2 (4%)	5 (10%)	7 (14%)
Co-habiting	1 (2%)	1 (2%)	2 (4%)
Age groups			
18-20 years	-	-	-
21-25 years	-	2 (4%)	2 (4%)
26-30 years	2 (4%)	3 (6%)	5 (10%)
31-35 years	3 (6%)	4 (8%)	7 (14%)
36-40 years	3 (6%)	5 (10%)	8 (16%)
41-45 years	4 (8%)	5 (10%)	9 (18%)
46-50 years	5 (10%)	6 (12%)	11 (22%)
51-55 years	3 (6%)	5 (10%)	8 (16%)

Table 4.2 indicates that out of all the respondents, 60% were female and the remaining 40% were male. The dominance of female participants in this study area shows the state of affairs of the majority of rural communities in South Africa and other neighbouring countries. This is particularly true since men normally migrate to urban areas for economic opportunities leaving women and children behind (Posel 2004). As a result, these results show that the viewpoints or overall conclusions of this research are to a lesser degree likely to be distorted or biased towards female respondents since they were slightly more than their male counterparts were. Other studies conducted were also dominantly populated by female participants due to more or less similar reasons (Ngaka 2012; Ntombela et al. 2017).

The results derived from primary research show that the respondents were fairly distributed from the early 20s to the middle 50s. The least respondent (4%) were aged between 21-25

years while the majority (22%) were in the age group 46-50 years. Table 4.2 also shows that 10% of the smallholder maize farmers were in the 26-30 years age category, followed by 14% who were aged between 31-35 years. A reasonably high number of participants aged between 36-40 years were also present and these represented 16%. Eighteen-percent (18%) of the overall participants were aged 41-45 while the remaining 16% were in the 51-55 years category. Overall, these age dynamics indicate that all of the sample participants were above the age limit required to partake in a study. In addition, given that age plays an important role in the answers given, the results obtained are highly likely to be accurate and consistent. Previous studies conducted in the agricultural field were also characterised by farmers who were fairly distributed between the 20s to the 50s years of which the majority were in their 20s and 30s (Mdungela et al. 2017). This situation is seen by Mrema et al. (2018) as a major feature that characterise the majority of farming communities in sub-Saharan Africa.

In addition, Table 4.2 shows the marital status of the respondents. The majority of the smallholder maize farmers, 54%, were married at the time of data collection while 14% were single. Furthermore, 4% indicated that they were co-habiting while 14% were widowed. The remaining 14% were divorced. A close analysis of the marital status variable shows that most of the female participants were single, married, divorced and widowed compared to their male counterparts. However, although the marital status variable did not have a direct relationship with the research findings, it was necessary to obtain such information as it can infer the implications of drought on smallholder maize farmers.

4.3.2 Distribution of the smallholder maize farmers by population groups and highest educational level

Table 4.3 shows the demographic details of the smallholder maize farmers based on their population groups and the highest levels of education.

Table 4.4: Distribution of the smallholder maize farmers by population groups and highest educational level

Variables	Male Frequency (percentage)	Female Frequency (percentage)	Total Frequency (percentage)
Population group			
Black, African	16 (32%)	24 (48%)	40 (80%)
White	1 (2%)	2 (4%)	3 (6%)
Coloured	3 (6%)	4 (8%)	7 (14%)
Educational level			
No formal education	-	2 (4%)	2 (4%)
Primary education	2 (4%)	5 (10%)	7 (14%)
Secondary education	13 (26%)	20 (40%)	33 (66%)
Tertiary education	5 (10%)	3 (6%)	8 (16%)
Agricultural related formal education	3 (6%)	3 (6%)	6 (12%)
Agricultural related informal education	17 (34%)	27 (54%)	44 (88%)

As shown in Table 4.3, the smallholder maize farmers who participated in this study were dominated by the black (African) population group. This black population group constituted 80% of the participants. This group was followed by the coloured population group, which constituted 14% of the respondents. The remaining 6% were white smallholder maize farmers. Similar to the preceding sections, the majority of these participating smallholder maize farmers were made up of women. Overall, these findings can be generalised to the entire group of smallholder maize farmers in Keyser's Beach as they high likely represent the population composition of this region. Importantly, the overall findings are likely to be skewed towards black women, as they were the majority of the participating groups.

In addition, Table 4.3 shows information relating to the participants' highest level of educational qualification. Four-percent (4%) of the participants noted that they did not have any formal education while 14% had primary education as their highest educational qualifications. The majority (66%) of the smallholder maize farmers had secondary education while the remaining 16% had tertiary qualifications. A comparison of the male

and female respondents shows interesting dynamics that the women were more educated than their male counterparts were.

Furthermore, the respondents were asked to indicate whether they had formal or informal education related to farming. Interestingly, the majority of these participants had informal education on agriculture. These were 88% of the participants. The remainder, 12%, had agricultural-related formal education. These findings are important in this study because they provide the basis that the participants were literate enough (either formally or informally) in agriculture; hence the findings are likely to be valid and reliable. As a result, while there was a significant number of respondents who had low educational qualifications, their formal and informal education in agricultural production makes the findings reliable as they were provided by the people who are knowledgeable in this sector.

The demographic details presented pertaining to the population groups in the farming communities as well as their level of education tallies with other studies conducted in line with the effects of drought among farmers. In a study conducted by Nash et al. (2019), it was found that the majority of black people in South Africa rely on agricultural production, hence their continuous reliance on land. In addition, Mfitumukiza et al. (2017) emphasise the over-reliance of the marginalised rural communities in Africa on natural resources to the extent that their ownership of land tends to be high. Other studies also highlight that the majority of the people in the marginalised communities who financially depend on agricultural production have at least informal farming practices (Hannaford 2018). Due to the indigenous knowledge systems, the farmers tend to gain experience from their seniors and later on pass it to their children for the benefit of their communities (Kamara et al. 2019).

4.3.3 Distribution of smallholder maize farmers by land size and level of experience

Table 4.4 shows the smallholder maize farmers' land size and their level of experience dynamics in maize farming within the study area.

Table 4.5: Distribution of smallholder maize farmers by land size and level of experience

Variables	Male Frequency (percentage)	Female Frequency (percentage)	Total Frequency (percentage)
Land size			
0-1 hectares	3 (6%)	6 (12%)	9 (18%)
1-2 hectares	2 (4%)	10 (20%)	12 (24%)
2-3 hectares	9 (18%)	8 (16%)	17 (34%)
3-4 hectares	4 (8%)	4 (8%)	8 (16%)
4-5 hectares	2 (4%)	2 (4%)	4 (8%)
Years of experience			
Less than 2 years	-	-	-
2-5 years	5 (10%)	3 (6%)	8 (16%)
5-8 years	8 (16%)	12 (24%)	20 (40%)
8-10 years	3 (6%)	8 (16%)	11 (22%)
10-15 years	3 (6%)	4 (8%)	7 (14%)
15-20 years	1 (2%)	3 (6%)	4 (8%)

Table 4.4 shows that more than one-third of the smallholder maize farmers who participated in this study had a land size of 2-3 hectares. These constituted 34% of the sample of smallholder maize farmers. A significant number (24%) had land ownership of between 1-2 hectares while 18% owned land up to 1 hectare in size. Sixteen-percent (16%) had 3-4 hectares while only 8% of the participants had land of up to 5 hectares. The land ownership dynamics show an interesting trend in the sense that the majority of the landholders were females compared to men. Such a scenario in which the majority of the women own land is similar to the preceding demographics which showed that many rural households in South Africa are women-headed (Kamara et al., 2019). This is mostly due to the migration patterns among the male population groups as they seek employment opportunities. The land tenure dynamics, to a certain extent, indicate that the findings obtained through primary research are likely biased towards women.

The participants, as shown in Table 4.4, were also asked to indicate their high levels of experience in maize farming. Importantly, the smallholders indicated that they had farming experience ranging from 2 years to 20 years, the majority of which were in this sector for a period of 5 to 8 years. These were 40% smallholder maize farmers who participated in this study. A significant number (22%) indicated that they had 8-10 years of experience while

14% were maize farmers for 10-15 years. An additional 8% noted that they had been farmers for the past 15-20 years. Both women and men had their level of experience in the farming sector fairly distributed from 5 years up to 20 years. Overall, these experience levels are important in this study because they provide the basis and justification on which reliable and valid information on the implications of the prevailing drought in Buffalo City Metropolitan Municipality is provided.

The findings presented on the size of land ownership and level of experience in maize farming represents an important facet in the field of agriculture. Similar to the findings presented on indigenous knowledge systems, Kamara et al. (2019) also indicate that farmers gain knowledge in the farming system through the indigenous knowledge that is passed from one person to the next or from one generation to another. In this light, Kamara et al. (2019) note that it becomes fairly difficult to really account for the level of experience that farmers have on farming a particular crop because their experience is longitudinal and can prolong for a long period of time. The issue of sizes of land owned is also explained by Nash et al. (2019) and Mfitumukiza et al. (2017) who indicate that the size of land owned among land holders tend to vary. In some cases, other participants have small pieces of land while others have large pieces of land.

4.3.4 The extent to which smallholder maize farmers rely on maize farming for their livelihood

As part of the demographic profile of the smallholder maize farmers, a question was posed as to what extent they rely on maize farming for their livelihoods. The findings obtained are presented in Figure 4.1.

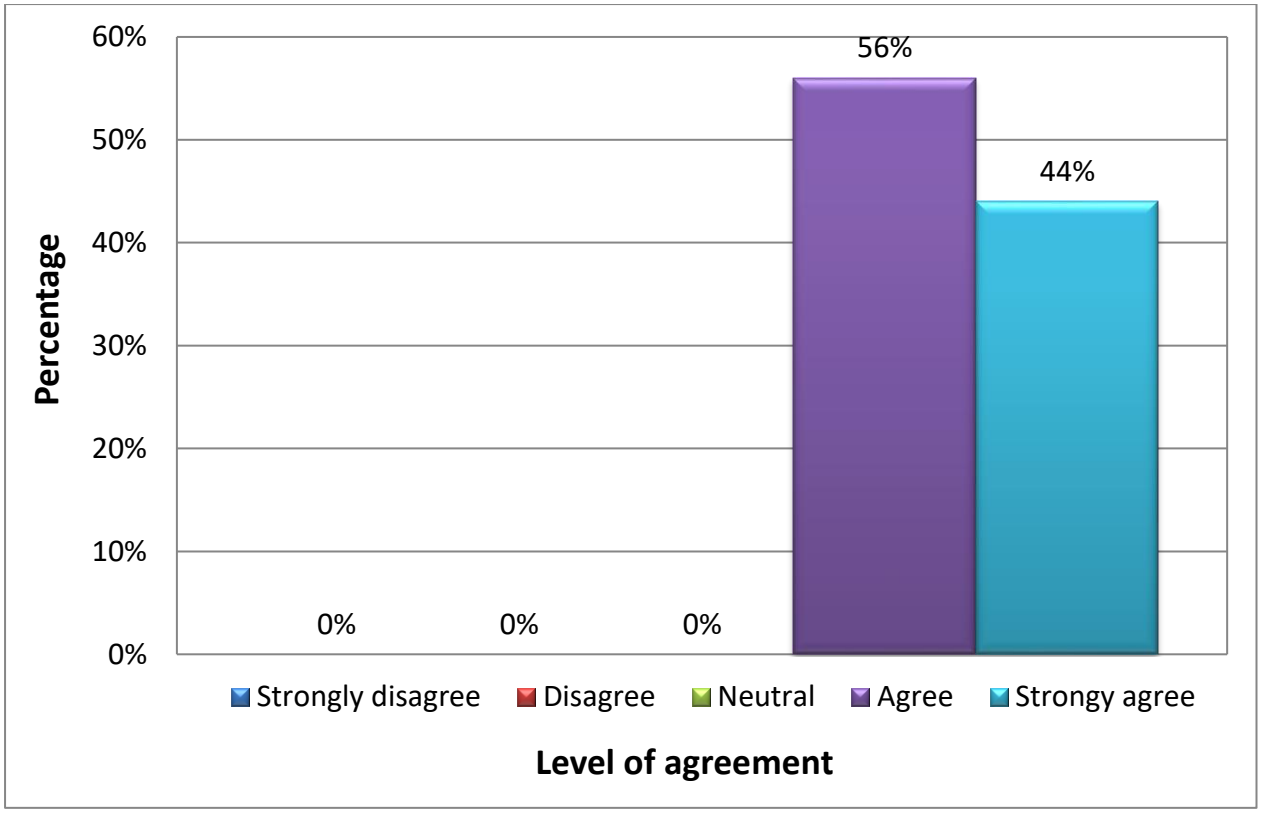

Figure 4.4: The extent to which smallholder maize farmers rely on maize farming for their livelihood

Figure 4.1 shows that largely, the smallholder maize farmers who participated in this study heavily relied on maize farming for their livelihoods. Fifty-six percent (56%) of these smallholder maize farmers agreed while the remaining 44% strongly agreed that their livelihoods depended on agriculture. These findings are particularly important in this study because they explicitly highlight the extent to which drought impacts these farmers. For instance, understanding the dynamics of drought from someone who has lived realities with it and whose livelihood is affected by it is likely to be more detailed than someone who does not have epistemic knowledge about such.

4.4 Smallholder maize farmers' perceptions of the prevailing drought

This section presents the findings obtained from primary research on the perceptions of smallholder maize farmers on the prevailing drought in Keyser's Beach, Buffalo City Metropolitan Municipality. Three questions were posed to understand the perceptions of these farmers on droughts. These questions were as follows:

- What do you understand by drought?
- Is drought a form of disaster that can be anticipated from its onset?

- Does drought occur more frequently than expected?

Some of the questions were open-ended, for example; the first question. The remaining two questions were closed-ended which meant that the participants had to provide further details on the answers they provided.

4.4.1 Smallholder maize farmers' perceptions of the meaning of drought

As indicated, the first question attempted to understand the perception of the smallholder maize farmers on the meanings of drought. The smallholder maize farmers were asked to indicate their understanding of drought based on three options, namely drought is a natural disaster, drought is a man-made disaster, and it is both a natural and man-made disaster. The findings are presented in Figure 4.2.

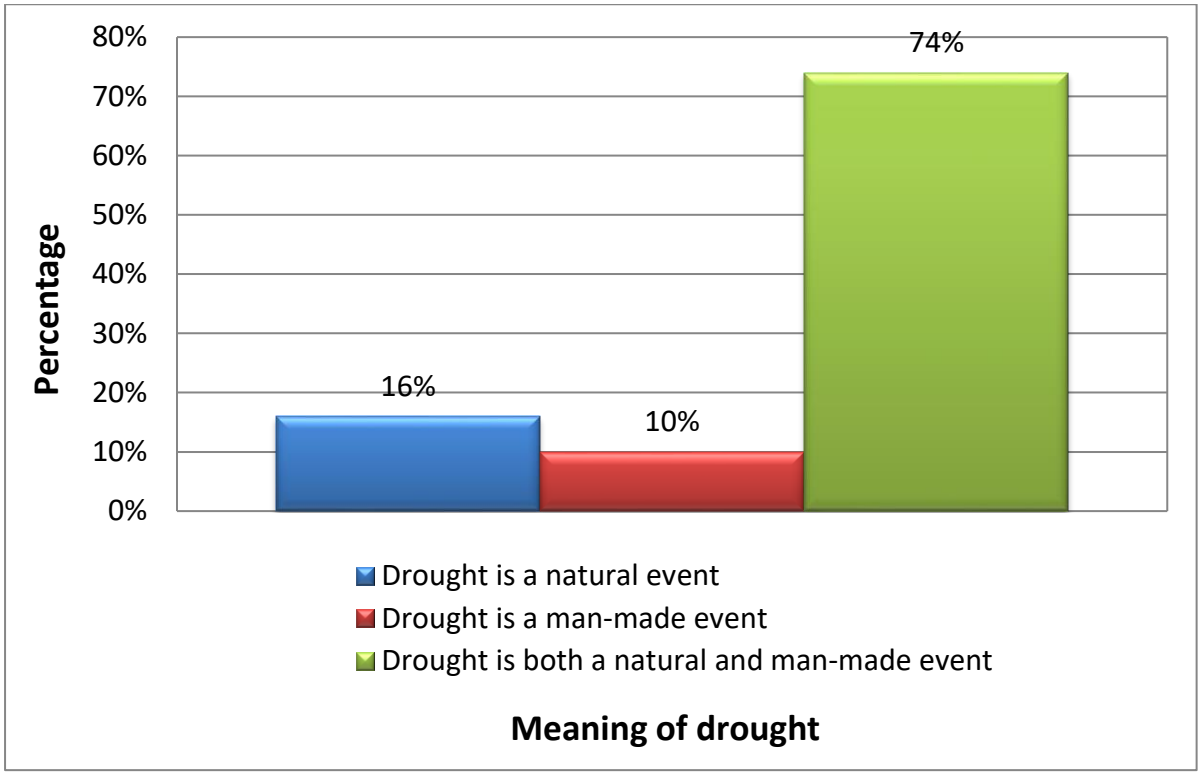

Figure 4.5: Smallholder maize farmers' perceptions of the meaning of drought

As presented in figure 4.2, the majority of the smallholder maize farmers from Keyser's Beach who participated in this study believed that drought is a combination of both man-made and natural events. These participants constituted 74% of the total respondents. Some of the smallholder maize farmers believed that drought is a natural event and these were 16% of the participants. The remaining 10% indicated that drought is a man-made event. These findings show that the smallholder maize farmers largely had knowledge

about drought and how it comes into existence. While some participants associated drought as either natural or man-made event, the majority of the farmers were aware that this comes because of both human and natural events.

The findings presented can be linked to literature on the perception of farmers on drought. As mentioned in Chapter 2, Slette et al. (2019) posit that drought is viewed in different based on its types, characteristics and people's susceptibility. Importantly, Van Loon et al. (2016) also describe drought based on two concepts, namely conceptual and operation. These explain how drought begins and its implications, respectively. In this light, farmers tend to interpret drought differently in the sense that some see it as a natural cause, others see it as a man-made cause while others believed that it was both a natural and man-made event.

4.4.2 Smallholder maize farmers' anticipation of the occurrence of drought

The smallholder maize farmers were also asked to indicate their understanding of whether the occurrence of drought can be anticipated from their onset or not. In addition, these participants were asked to provide reasons for their answers. The findings obtained are presented in the following section.

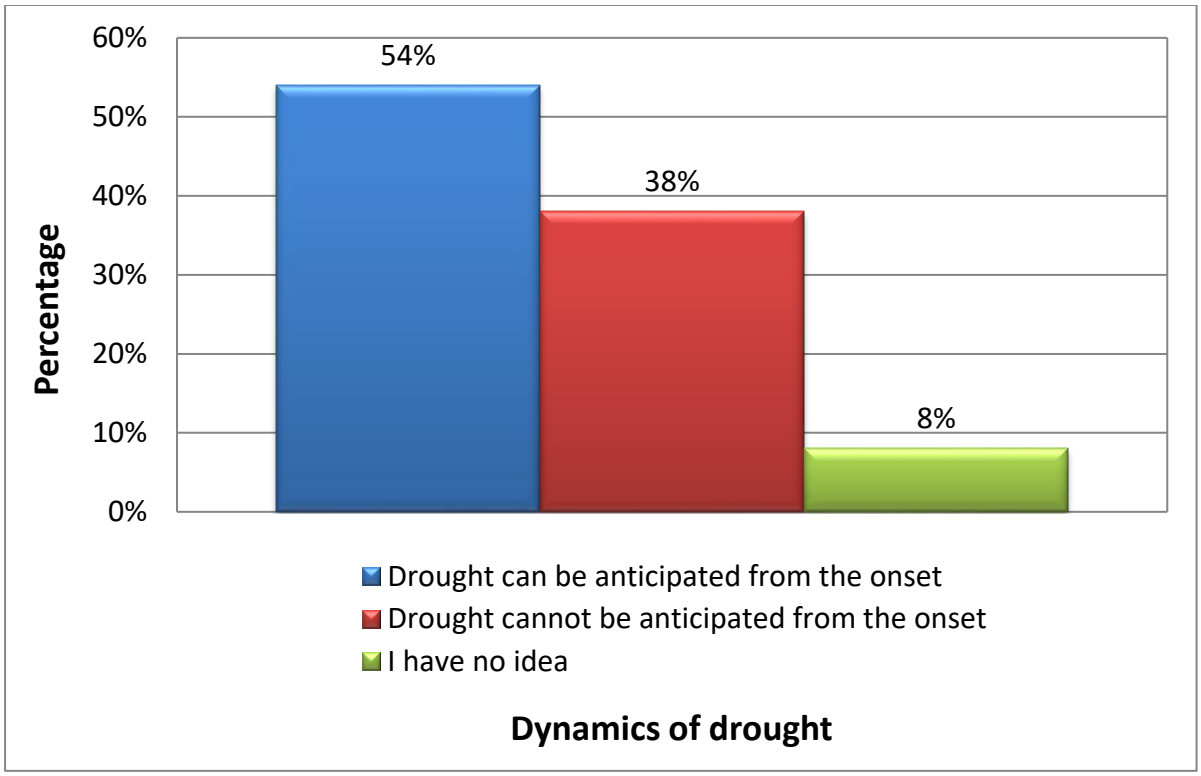

Figure 4.6: Smallholder maize farmers' anticipation of the occurrence of drought

Based on the findings presented in Figure 4.3, the majority of the smallholder maize farmers believed that drought could be anticipated from its onset. These represented 54% of the smallholder maize farmers who participated in the study. In addition, a significant number (38%) of respondents were convinced that drought could not be anticipated from its onset. The remaining 8% indicated that they did not have any idea about the occurrence of drought. To understand these different perceptions, a sample of the participants was asked to provide further details to their claims. These participants were chosen because they believed that drought occur naturally. When some of the smallholder maize farmers who believed that drought cannot be anticipated from its onset were asked to provide reasons, and they had the following to say:

> *…..drought is a natural thing so no person will have an understanding of how it happens. If it happens, it is only natural that can explain better that there is drought* (Respondent 1).

> *…..at times, when we anticipate that there is drought, we get surprised because the opposite happens. It is not surprising that when we expect the drought to happen there will be bumper harvests* (Respondent 14).

> *…..these days, the climate is really difficult to predict. At times you may think that there is no drought but you will be surprised that rain comes over a short period and then it dries out* (Respondent 25).

> *…..since drought is a natural disaster, predicting it becomes so difficult to the extent that it is not predictable just like any other natural event* (Smallholder farmer 36).

> *…..in certain circumstances, other regions within Buffalo City Metropolitan Municipality receive adequate rainfall while we don't. In other cases, we receive much rainfall and other regions don't. So coming up with a correct prediction on who will receive adequate rainfall is impossible* (Smallholder farmer 50).

Overall, the smallholder maize farmers believed that predicting drought from its onset is impossible because of various reasons. Most of their arguments were based on the premise that drought is a natural phenomenon and no one is an expert when it comes to predicting how natural events occur. These farmers also argued that at times when there is

a correct prediction of drought, the opposite happens and the farmers tend to experience bumper harvests.

The smallholder maize farmers who believed that it was easy to anticipate drought from its onset were also asked to elaborate their answers. A sample of their responses was obtained from primary research and it is presented below:

> …..*these days we are living in the world of technology and it is fairly easy to tell whether there is going to be drought or not* (Respondent 5).
>
> …..*from the interactions we do with some of the large-scale commercial farmers in the province, we know that the periods of drought are going to continue for many years to come* (Respondent 11).
>
> …..*we have access to meteorological information which is always given to us. In this way, we receive informed information about the drought in this province and the country as a whole* (Respondent 19).
>
> …..*everyone is aware of the world we are living in where natural disasters are at their peak. It is for this reason that we also know that drought is going to be with us for a long period* (Respondent 27).
>
> …..*there is climate change these days. Climate change is something that happens over a long period. We are not even surprised by the drought we have been facing for a long time and we know this is not the last to experience them* (Respondent 39).
>
> …..*the weather fluctuations we are experiencing like at times it is cold in summer and hot in winter make it easy for us to anticipate that the impossible can happen any time we least expect. This is one of the reasons why it has become so easy to anticipate the drought even before its onset* (Respondent 47).

Overall, these findings clearly show the extent of differing perceptions on the drought within this one region. The smallholder maize farmers who believed that drought can be predicted from its onset based their arguments on climate change and climate variability dynamics. Then, the farmers who held that drought could not be anticipated from its onset based their arguments on different factors, which include the unpredictability of natural events.

The findings presented can also be explained by the existing literature on the issue of climate change and how climate change has led to the unpredictability of weather and climate (Coles and Eslamian 2017). In this study, Coles and Eslamian (2017) note that the world climate is rapidly changing to the extent that it becomes difficult to predict the weather conditions because of various factors. Gizaw and Gan (2017) also highlight the unpredictability of weather and climate in the present day using the examples of the occurrence of El Nino. In their remark, they note that the weather conditions can no longer be predicted to the extent that some places are having drought while others are receiving more than adequate rainfall required for agricultural production. In the same light, studies conducted by Hannaford (2018) indicate that it is also becoming difficult for farmers to be resilience to drought because its occurrence is no longer known. Thus, farmers' resilience to drought tends to shift towards mechanisms to cope with changing climates.

4.4.3 Smallholder maize farmers' perceptions of the frequency of drought in the future

Finally, the smallholder maize farmers were asked to provide their opinions on whether drought will occur frequently than expected in the future. The findings are presented in Figure 4.4.

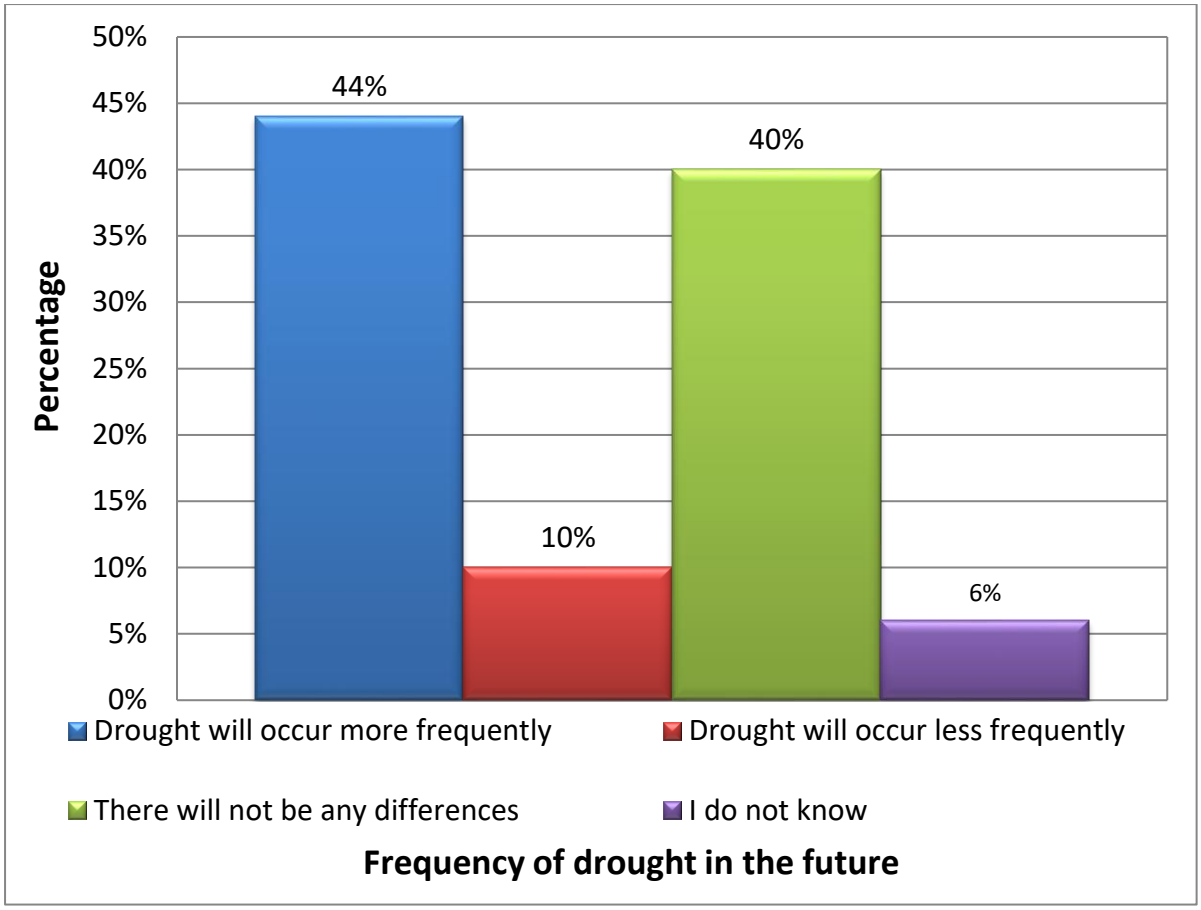

Figure 4.7: Smallholder maize farmers' perceptions of the frequency of drought in the future

As presented in Figure 4.4, the majority (44%) of the smallholder maize farmers believed that drought would occur more frequently in the future than anticipated. Interestingly, 40% of the participants were held that there would not be any difference with the present drought experiences. Other participants, 10%, believed that drought would occur less frequently in the future while the remaining 6% did not have any idea. These findings are important in this study because they present important dynamics on the smallholder maize farmers' perspectives about the drought in Keyser's Beach. Importantly, the reason the majority of the participants believed that drought will occur frequently, or that there will not be any difference is probably because this region has been affected by drought over the past 15 years. Farmers have become resilient to the drought through the impacts tend to vary across the region.

Similar to the findings presented to back-up the issues of unpredictability of drought, Khanal et al. (2018) also note that the droughts have been frequently occurring due to changing climate. This is in line with a study conducted by Kom (2020) which concluded that droughts in the contemporary times are not dominantly caused by lack of rainfall, but at

times it is due to lots of rainfall that fall when they are least expected. Such rains do not come when farmers expect them, and this has been the case with the Eastern Cape Province, South Africa (Mahlabela et al. 2020)

4.5 Perception of smallholder maize farmers on the impact of the prevailing drought.

Data was also collected on the perception of smallholder maize farmers on the impact of the prevailing drought. Five-point Likert scale questions ranging from strongly agree to strongly disagree was used to gather data. Data was then descriptively analysed and categorised into the following classes, which are then presented and discussed:

- Impact on surface and groundwater bodies;
- Impact on unemployment and household income;
- Impact on maize prices and supplies;
- Impact on people's health and extreme challenges such as hopelessness and social losses, and
- Impact on population migration and water conflicts among farmers.

4.5.1 Impact on surface and groundwater bodies and soil quality

Presented in Figure 4.5 are the impacts of drought on surface and groundwater bodies as well as on the soil quality.

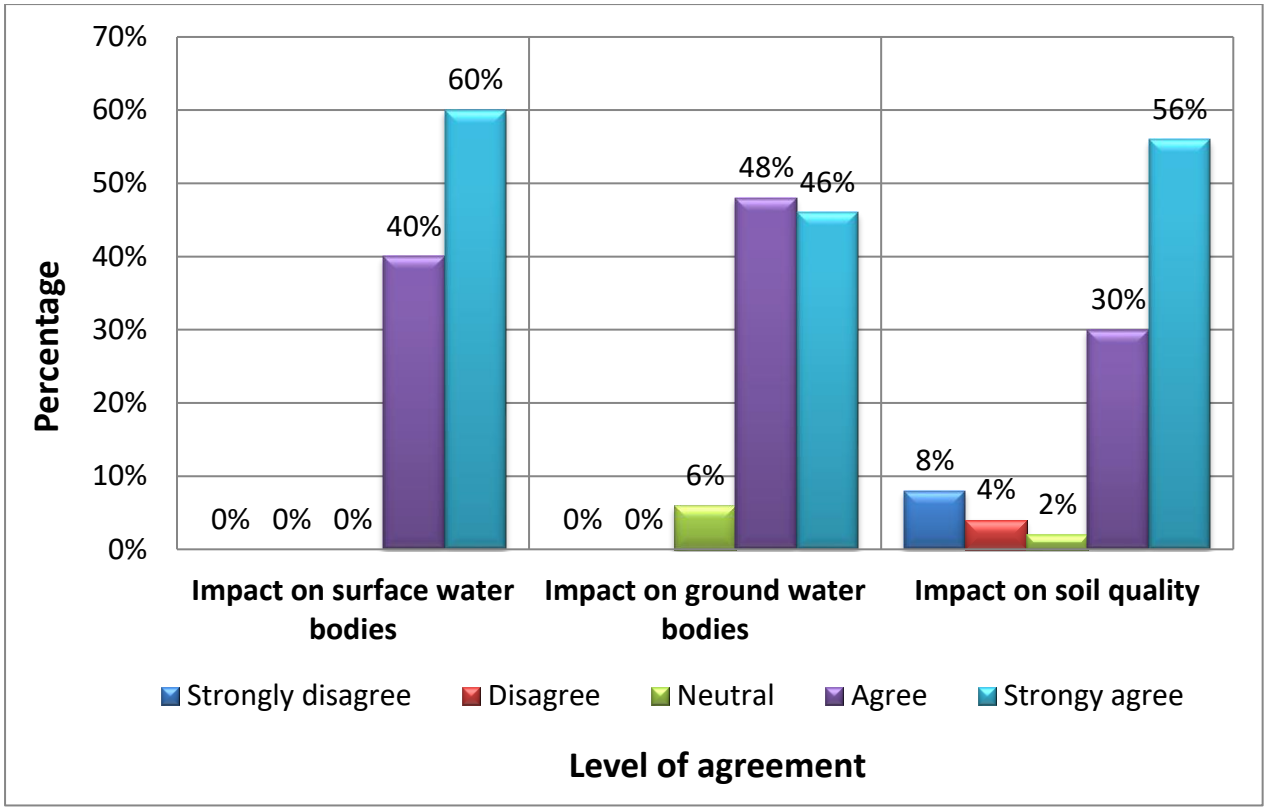

Figure 4.8: Impact of drought on surface and groundwater bodies and soil quality

Figure 4.5 shows that largely the prevailing drought is heavily impacting the surface water bodies, groundwater bodies and the soil quality within Keyser's Beach in Buffalo City. Data provided by the smallholder maize farmers who participated in the survey shows that 60% strongly agreed that groundwater levels were affected by the prevailing drought. These participants were seconded by 40% who agreed that the drought had led to this cause. Overall, the study concludes that surface water bodies within the study area are negatively affected by drought.

In addition, Figure 4.5 also shows that groundwater bodies are in turn impacted by drought. This is shown by a fair distribution of the respondents who agreed with this question. As presented, 46% strongly agreed while 48% agreed that groundwater bodies were negatively affected. The remaining 6% of the smallholder maize farmers chose to be neutral in this regard for reasons not clear in this study. Importantly, these findings validate those presented which show the impact of drought on water storage. In this light, it can be concluded that groundwater bodies in Keyser's Beach are affected by the on-going drought.

A significant number of smallholder maize farmers associated drought with poor soil quality. Fifty-six percent (56%) of the participants strongly agreed that the drought had had an

impact on the soil quality while 30% agreed. However, other smallholder maize farmers were in disagreement although their representativeness was insignificant compared to those who agreed. These were the 8% who strongly disagreed and 4% who disagreed while the remaining 2% were neutral. Overall, the study concludes that the drought had had a severe effect on the soil quality within the study area.

The results discussed are consistent with current research on the environmental effects of drought in different areas. Studies by Zeleke (2017) concluded that perpetual drought negatively affects different parties (including farmers – both smallholder and large-scale farmers) in the sense that it results in disruption to water supplies and soil quality. The drought will eventually have consequences for plant and animal ecosystems, woodland and wildlife ecosystems, ecosystem sustainability and environment biodiversity (Van Loon et al. 2016). Some of the consequences are short-term while others last until the end of the drought period. Those environmental impacts that continue for a long period can even become permanent if they are not well managed. For example, due to the destruction of groundwater and surface water bodies, wetlands, lakes and trees, wildlife habitat can be permanently be degraded unless they are rehabilitated. Degrading the quality of the environment, including increased soil erosion, could contribute to a more lasting loss of biological productivity (Spinoni et al. 2019).

4.5.2 Impact on unemployment and household income

Figure 4.6 shows the impact of the prevailing drought on unemployment and subsequently, household income among smallholder maize farmers.

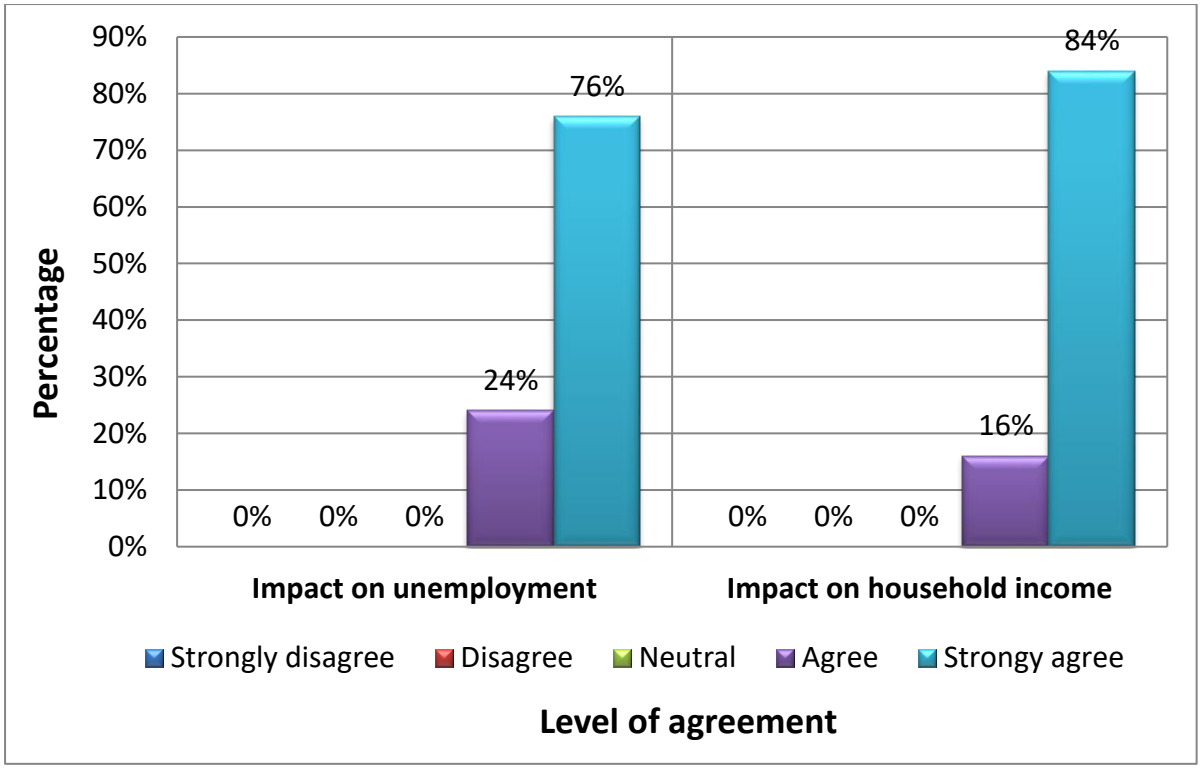

Figure 4.9: Impact of drought on unemployment and household income

As Figure 4.6 shows, the prevailing drought has negatively affected the smallholder maize farmers in Keyser's Beach, Buffalo City Metropolitan Municipality, as shown by the unemployment and household income dynamics. Regarding employment, the smallholder maize farmers believed that the drought has led to an increase in unemployment. This is evidenced by 76% of the respondents who strongly agreed and 24% who agreed that the drought had led to unemployment. This is probably because the agricultural intensity has been negatively affected to the extent that production levels have lowered; hence, the employment levels tend to be lowered.

Furthermore, the study also found that smallholder maize farmers' household incomes are also affected by a prevailing drought. As Figure 4.6 shows, 16% of the smallholder maize farmers indicated that their incomes were heavily affected. These respondents were seconded by an overwhelming number (84%) who strongly agreed. These findings are probably because drought is currently affecting production, employment, demand and supply of maize production and other market forces to the extent that the incomes of the farmers are negatively affected. Overall, Figure 4.6 explicitly shows that smallholder maize farmers in Keyser's Beach are severely impacted by the drought and this is seen through reduced employment and household income levels.

The aforementioned results are also confirmed in the literature relating drought to socio-economic dynamics such as unemployment and declining household incomes. According to Stagge et al. (2017), the most immediate consequence of drought is the lack or decline of farmers' revenue. Reduced farm income has an impact as retailers and other service providers face reduced market operations, resulting in loss of jobs, heightened credit risk for financial institutions, capital shortfalls and, eventually, a lack of tax revenue for local, state and federal governments (Ngaka 2012; Ojo and Baiyegunhi 2020). The costs of food, electricity and other goods are increasing, as stocks are limited. For example, where there is a local shortage of such commodities, certain goods must be shipped from outside the drought-ridden regions to supply the drought-affected areas. Reduced water supplies weaken the navigability of waterways and result in higher shipping costs since goods must be shipped by other means. Overall, all these deteriorating economic dynamics will lead to an increase in the rate of unemployment (Muyambo et al. 2017).

4.5.3 Impact on maize prices and supplies

Figure 4.7 presents the findings obtained from the study on the impact of drought on maize supplies and subsequently the prices.

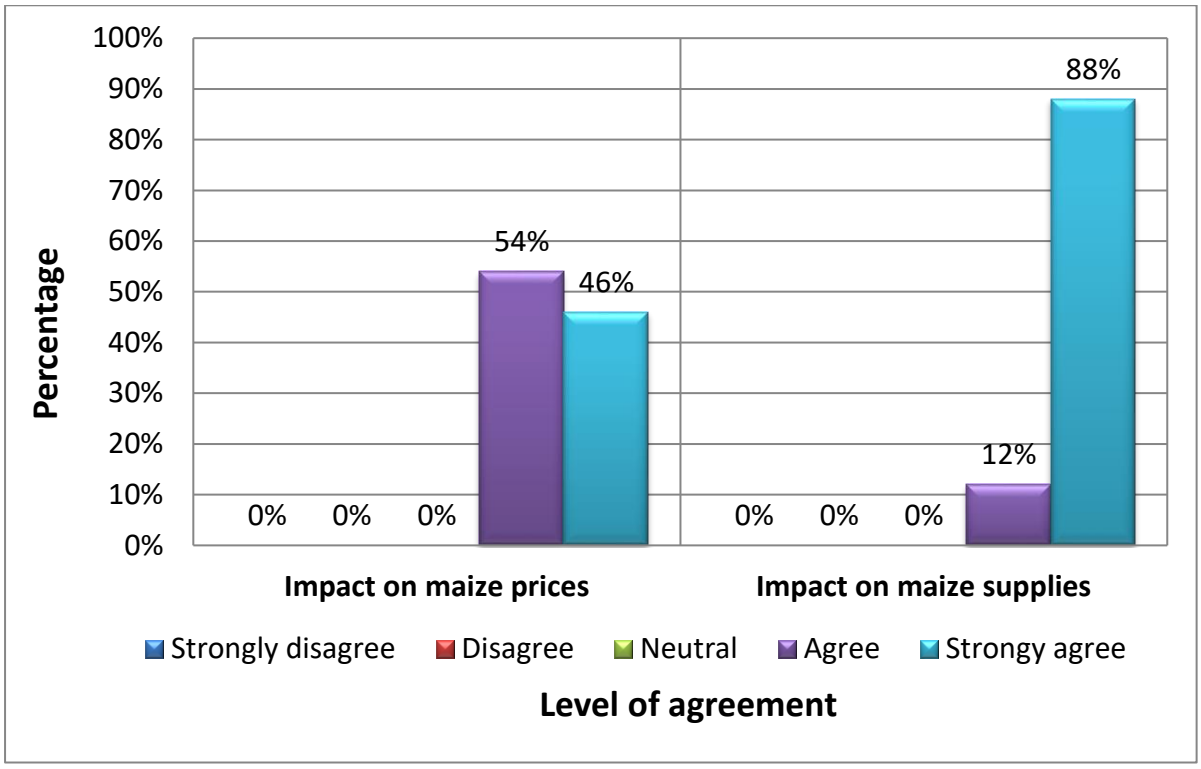

Figure 4.10: Impact of drought on maize prices and supplies

Figure 4.7 shows findings obtained from primary research about the impact of drought in Keyser's Beach on the supplies of maize production. The smallholder maize farmers who participated in this study agreed that drought had hurt the supply of maize. Figure 4.7 shows that 88% of the smallholder maize farmers held that the maize supplies were affected followed by 12% who agreed with this question. However, a negative impact had also been experienced on the prices of the maize production because of the drought. As Figure 4.7 shows, 54% of the smallholder maize farmers agreed that the prices were affected by the prevailing drought while the remaining 46% strongly agreed. Overall, the study clearly shows that the smallholder maize farmers who participated in this study believed that both supplies and prices of maize produce were negatively impacted by the drought in Keyser's Beach, Buffalo City Metropolitan Municipality.

The findings of this study can also be interpreted from the existing evidence on the effect of drought on markets and the production of goods. According to Mahlalela et al. (2020), maize is a very important staple food for low-income people and is thus badly impaired by market imprevisibility during droughts. For low-income families, starvation and poverty arise during times of rising prices, so they cannot afford higher food prices (Lai et al. 2019). The unpredictability of price increases will occur mainly from two causes (Khanal et al. 2018; Kuwayama et al. 2019). The first is due to the unpredictability of environmental conditions, such as the weather, which has led to a decrease in overall crop yields, hence increasing prices. The second is due to the difference between planting decisions and crop harvesting (Khanal et al. 2018; Kuwayama et al. 2019). Government interference to limit price volatility is also common in developed and developing countries, leading to the natural uncertainty of agricultural markets (Hannaford 2018).

4.5.4 Impact on people's health and extreme challenges such as hopelessness and social losses

Furthermore, an inquiry was done on the extent to which drought in Keyser's Beach, Buffalo City Metropolitan Municipality has an impact on the people's health as well as on other extreme social challenges, which include hopelessness and a sense of loss. The findings obtained from primary research are presented in Figure 4.8.

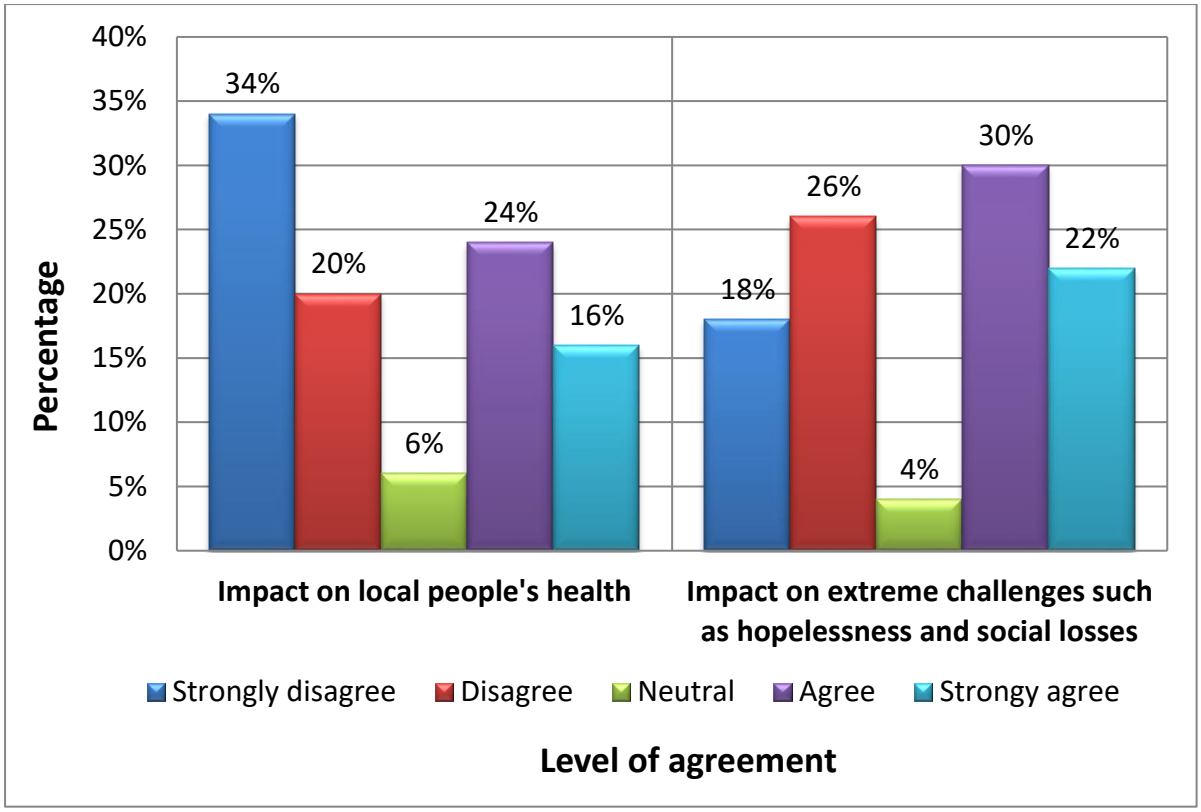

Figure 4.11: Impact of drought on people's health and extreme challenges such as hopelessness and social losses

As Figure 4.8 shows, there was a mixed bag of findings on the impact of drought in Keyser's Beach on local people's health and other extreme social challenges. Some of the smallholder maize farmers believed that drought harms these variables while others had different views. For instance, the majority (34%) of the participants strongly disagreed that the drought had severe implications on people's health. These parties were seconded by 20% who also disagreed. Overall, a cumulative frequency of 54% of smallholder maize farmers were in disagreement that people's health is affected by drought. On the contrary, 24% of the smallholder maize farmers opposed and agreed that people's health was negatively affected. These farmers were seconded by 16% of their counterparts who strongly agreed. The remaining 6% neither agreed nor disagreed but chose to be neutral. Thus, these findings lead to the conclusion that the drought in Keyser's Beach affects people's health but not to the full extent as others are not affected.

Regarding the impact of drought on other challenges such as subjecting local communities to a situation where they become hopeless and left experiencing a sense of loss, the study also found that there were mixed reactions from the participants. For instance, the majority (30%) of the smallholder maize farmers agreed that local people faced extreme challenges

because of the drought. These were followed by 22% who strongly agreed. However, 26% of the respondents disagreed and they were followed by 18% who strongly disagreed. The remaining 4% of the smallholder maize farmers were neutral. In this light, the study concludes that some parties are affected by drought to the extent that they feel helpless and suffer from a sense of loss while others do not have this experience. Overall, the study found that the drought in Keyser's Beach affects people's health and their social status to a certain extent.

Studies conducted in drought prone regions clearly show that droughts have severe social implications on the people affected (Mdungela et al. 2017). In extreme circumstances, farmers get depressed, stressed and they face other social challenges. To a greater extent, Rapholo and Makia (2020) indicate that droughts have huge impacts in the sense that they can even lead to conflicts among community members especially when they have to share scarce water sources. In addition, the study by Botai et al. (2017) concluded that the health of people and livestock tends to be affected due to the reduction in the quality and quantity of water sources.

4.5.5 Impact on population migration and water conflicts among farmers

The study also investigated the extent to which drought in Keyser's Beach led smallholder maize farmers migrating to other places. An inquiry was also done on whether the drought had led to any conflicts related to water access and usage among the farmers. The findings obtained are presented in Figure 4.9.

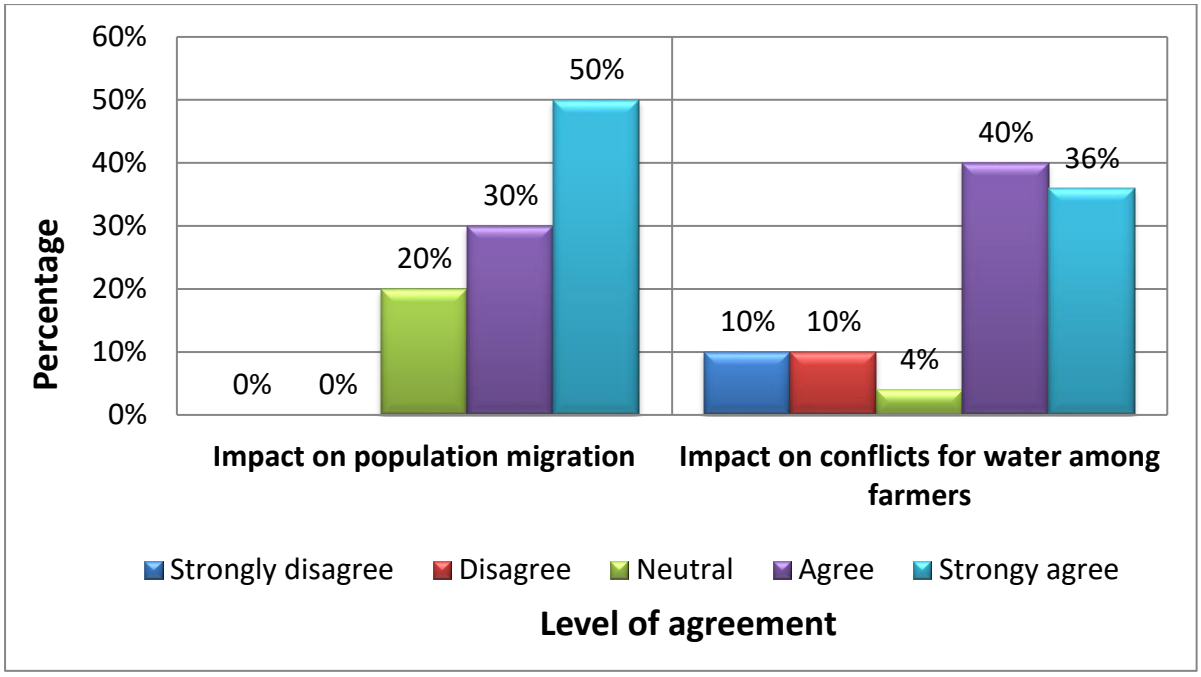

Figure 4.12: Impact of drought on population migration and water conflicts among farmers

Figure 4.9 shows that the drought in Keyser's Beach has had severe consequences as shown by the increase in population migration and conflicts over the water among farmers. First, in terms of the implication of the drought on the movement of people, primary research concluded that smallholder maize farmers are migrating from one place to the next to ease the impact of drought. Figure 4.9 shows that although 20% of the smallholders were neutral, the majority (50%) strongly agreed that the drought was increasingly resulting in migration of people. These respondents were validated by 30% who also agreed with their counterparts. In all, based on the number of responses that agreed, a conclusion can be made that the drought in Keyser's Beach has caused continuous migration of people from this place to several others.

Concerning drought as one of the sources of conflict over water among the smallholder maize farmers in Keyser's Beach, mixed findings were obtained even though the responses were mostly skewed on the agreement side. Forty-percent (40%) agreed with this claim while 36% strongly agreed. A significant number (10%) strongly disagreed followed by an equal number of respondents (10%) who disagreed that the drought led to conflict over water among farmers. Only 4% of the participants chose to be neutral. These findings are important in this study because they explicitly present drought-related challenges faced by the smallholder maize farmers in Keyser's Beach, namely migration and conflicts, due to drought. However, the fact that a cumulative 20% disagreed that the drought was leading to conflicts for water and distrust among smallholder maize farmers implies that to some

extent drought is not severe throughout the study area. Overall, the study found to a greater extent drought in Keyser's Beach is leading to increasing conflicts for water usage. In addition, it is leading to the migration of smallholder maize farmers from Keyser's Beach to others that offer better opportunities.

The findings presented can also be interpreted from the existing evidence on the effect of drought on people's health and other extreme challenges. Eslamian et al. (2017) hold that drought can result in different impacts such as a decline in the quality of public health and the general well-being of people. Consequently, there is deterioration of the quality of life of various stakeholders. Botai et al. (2016) add that drought can negatively affect farmers in the sense that they will start to have conflicts over water sources and other natural resources. Conflicts over the use of resources can also lead to inequities in the distribution of disaster management resources such as food parcels to the public (Martey et al. 2020).

In addition, a significant problem in many countries is that of population migration, which is often encouraged by a greater supply of food and water elsewhere (Stagge et al. 2017). Those that migrate usually migrate to urban areas, or areas outside the drought regions. Migration may even be to adjacent countries. The migrants hardly ever return home, even when the drought is less intense, which results in the deprivation of valuable human resources in rural areas (Jin et al. 2016). The drought migrants put more pressure on the social infrastructure of the urban areas, leading to increased poverty and social unrest.

4.6 Smallholder maize farmers' adaptation strategies to drought

Following the impacts of drought analysed this far, the following section presents the findings obtained from primary research on the adaptation strategies implemented by smallholder maize farmers. Data was also collected through the five-point Likert scale questions running from strongly agree to strongly disagree. The findings obtained are categorised into the following classes:

- Storing produce for human and livestock consumption;
- Saving money and doing nothing;
- Human migration, changing cropping calendar and shifting to less water consuming maize crops, and
- Selling livestock and resorting to alternative sources of income.

4.6.1 Storing produce for human and livestock consumption

As part of the adaptation strategies, the smallholder maize farmers were asked the extent to which they stored their harvest for their consumption as well as for stock feeds. The findings obtained are presented in the following figure:

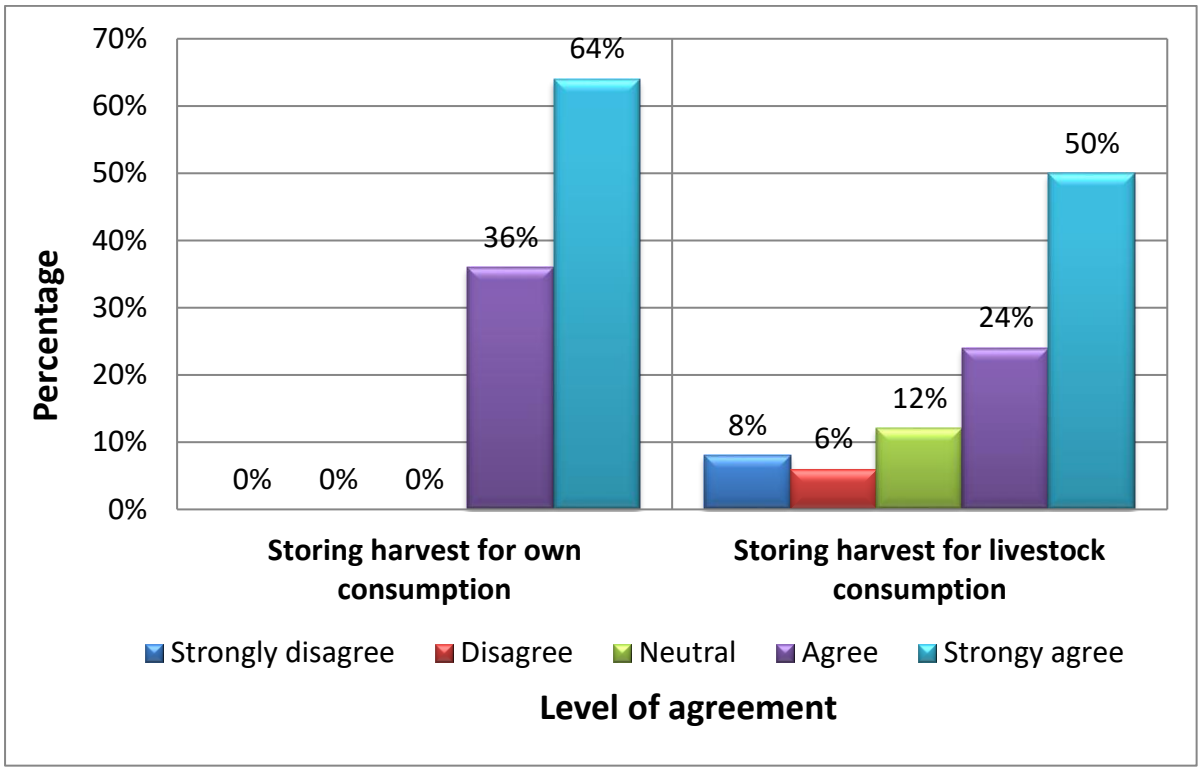

Figure 4.13: Mitigating drought through storing produce for human and livestock consumption

Figure 4.10 shows that the majority of the smallholder maize farmers agreed that they stored harvest for their consumption and their livestock. In terms of storing maize produce for their consumption, a significant number (64%) of the farmers strongly agreed while 36% of their counterparts agreed. These findings are particularly true in most farming communities, as it is a norm that farmers store their harvest even during times when there is no drought. However, there were mixed findings from the smallholder maize farmers with regard to storing produce for livestock consumption. Nonetheless, the majority of the smallholder maize farmers agreed.

As Figure 4.10 depicts, 50% of the smallholder maize farmers strongly agreed that they stored their harvest for livestock consumption. These participants were in addition to 24% who agreed with their counterparts. Other farmers, however, indicated that they did not keep their products for livestock consumption. These were 8% who strongly disagreed and

6% who disagreed while the remaining 12% chose to be neutral. While it is not clear why these smallholder maize farmers did not store maize produce for livestock consumption, one of the reasons could be that they did not own livestock. It could also be because the farmers did not have enough produce to store for livestock consumption. Overall, the findings obtained clearly show that all smallholder maize farmers keep the harvest for their consumption and largely for their livestock production.

To explain the findings presented, studies conducted in the field of drought resilience have also established the preservation of goods for potential use as one of the most successful ways to deal with drought (see Muyambo et al. 2017 and Nash et al. 2019). For example, Rapholo and Makia (2020) consider that drought primarily affects crops and livestock production; thus, farmers tend not to sell their crops and instead store them to cope with predicted droughts. In other studies, Krüger (2018) submits that other farmers store crop residues to satisfy feed demand during predicted droughts, while others reduce their costs and save money.

4.6.2 Saving money and doing nothing

Some of the adaptation strategies implemented by smallholder maize farmers to cope with the prevailing drought are through saving money and/or by simply doing nothing. The findings presented in Figure 4.11 shows the responses obtained from the smallholder maize farmers who participated in this study.

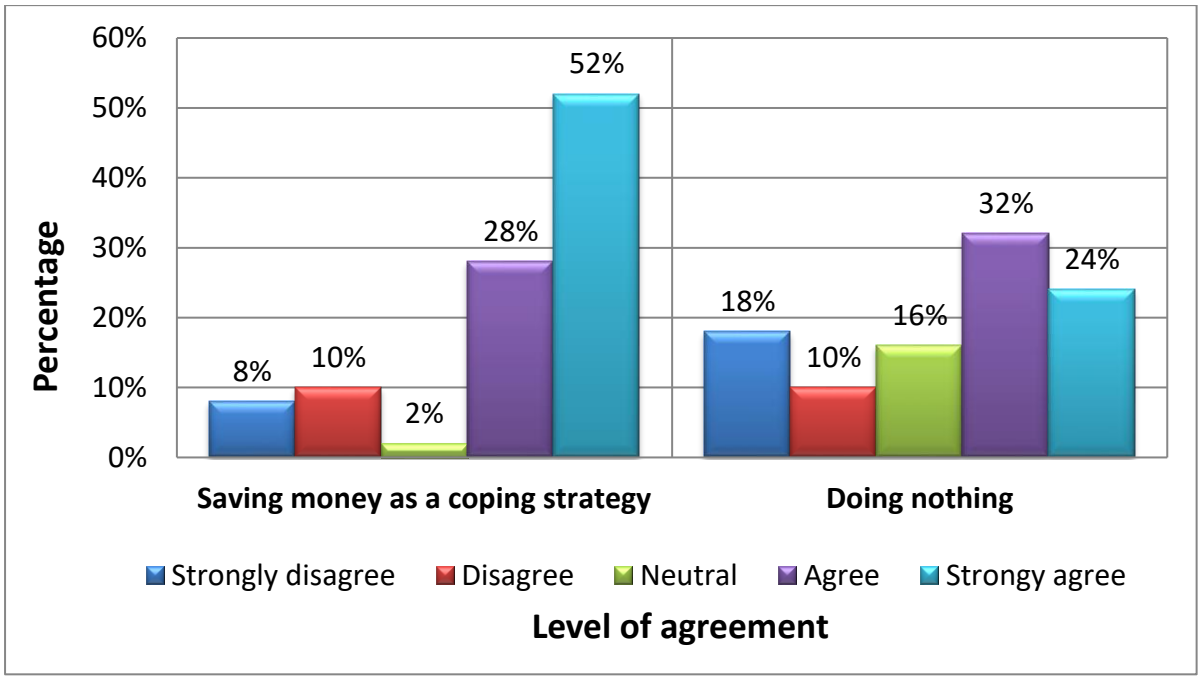

Figure 4.14: Mitigating drought by saving money and/or doing nothing

Figure 4.11 shows a high level of agreement where a significant number of smallholder maize farmers save money as a coping mechanism during drought. This is depicted by the majority (52%) of the farmers who strongly agreed that saving money was one of their coping strategies for the prevailing drought. An additional 28% of the farmers also agreed with their counterparts. However, 8% of the smallholder maize farmers strongly disagreed while 10% disagreed that they saved money during these trying times. The remaining 2% of the farmers neither agreed nor disagreed but instead chose to be neutral. While the reasons these smallholder maize farmers did not save money were not established in this study, one of the reasons could be that they operated at a subsistence level and barely made extra income to save. Overall, based on the number of participants who agreed, it could be concluded that saving money is one of the strategies implemented by smallholder maize farmers in Keyser's Beach in times of drought.

Furthermore, there were mixed findings about smallholder maize farmers 'doing nothing' during times of drought. The majority of these farmers agreed while some disagreed. Among those that agreed, the majority (32%) agreed and an additional 24% of their counterparts strongly agreed. However, a significant number (18%) of these farmers strongly disagreed that they just did nothing. These were also seconded by 10% who disagreed. Sixteen-percent (16%) of the remaining smallholder maize farmers were neutral. These findings show mixed perceptions of the smallholder maize farmers and it is clear that while most of them, as shown by a cumulative 56%, simply did nothing during the prevailing drought, others disagreed that they did not do anything. Some of the reasons these farmers did not do anything could be that they saved money or implemented other drought coping measures already discussed or to be analysed later in this chapter.

4.6.3 Human migration, changing cropping calendar and shifting to less water consuming maize crops

Furthermore, primary data unveiled the extent to which smallholder maize farmers migrate, change cropping calendar and shift to less water consuming crops during drought. The data collected is presented in Figure 4.12.

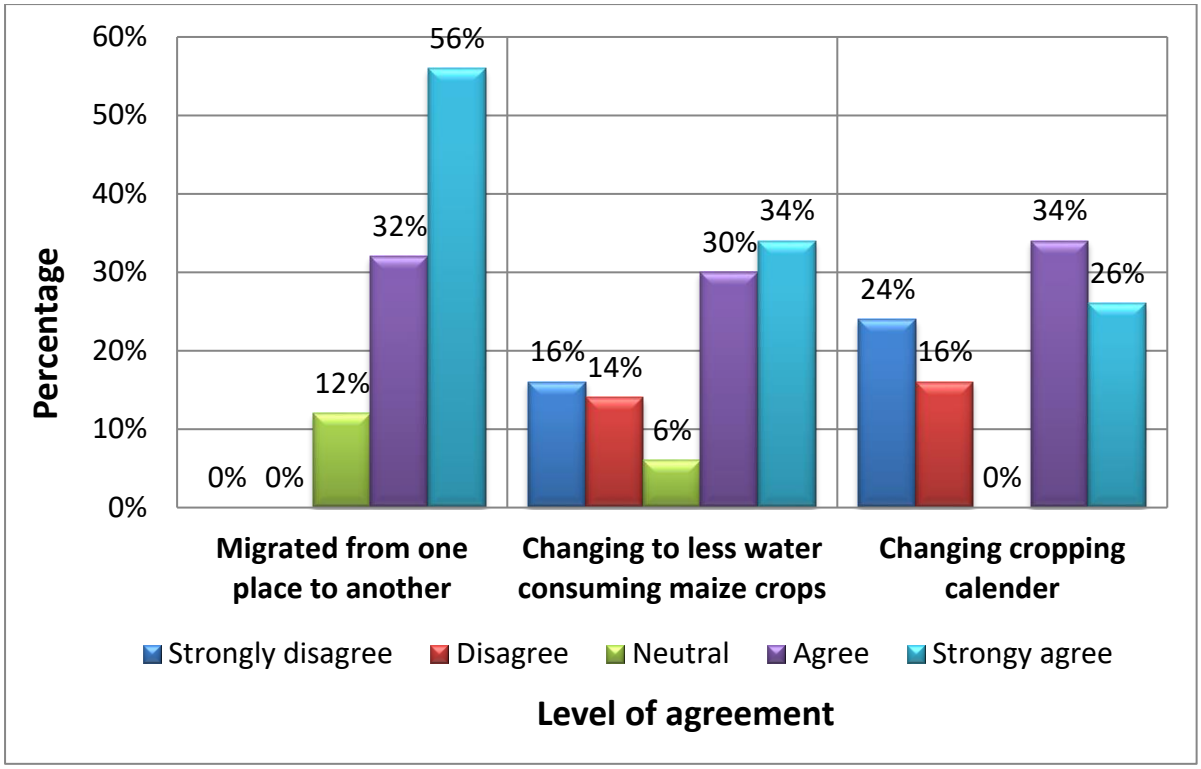

Figure 4.15: Mitigating drought through human migration, changing cropping calendar and shifting to less water consuming maize crops

Figure 4.12 shows different, mixed and multi-faceted responses from smallholder maize farmers on the choice of migrating, crop shifting and calendar changes to cope with the prevailing drought. First, the smallholder maize farmers in Keyser's Beach showed high levels of agreement on migration as one of the drought coping mechanisms. In this light, a significant number (56%) strongly agreed that migration was one of the solutions while 32% of their counterparts agreed. Twelve-percent (12%) of these farmers were neutral. These drought coping mechanism dynamics are more or less similar to the prior findings presented in Figure 4.9, which concluded that the drought in Keyser's Beach has had a significant impact on the migration of farmers from one place to another. Such an instance is the norm in the majority of places prone to drought, as people tend to shift to other places in search of economic opportunities.

In addition, Figure 4.12 also shows mixed responses regarding the shifting of smallholder maize farmers from planting maize crops that require a lot of water to the ones that have less water consumption. Out of the total smallholder maize farmers, 34% strongly agreed that they were shifting to maize crops that required less water consumption. These were seconded by 30% of the smallholder maize farmers who also agreed. In this case, these farmers are shifting from their traditional crops to drought resistant ones. Some of the

farmers, however, disagreed that they had adopted the crop shifting policy. For instance, 16% strongly disagreed and an additional 14% of their counterparts disagreed. The remaining 6% of the smallholder maize farmers chose to be neutral. Overall, while a cumulative 64% of the participants indicated that they had shifted to drought-resistant crops, the interplay of those participants who disagreed should not be overlooked because they form a significant percentage (16% plus 14%) of the participants.

Furthermore, Figure 4.12 shows that there were mixed perceptions regarding the changing of the cropping calendar as a drought coping mechanism among farmers. While the majority of the smallholder maize farmers agreed, an equal number of participants were in disagreement that they changed their cropping calendar. For instance, while 34% of the smallholder maize farmers indicated that they had changed their cropping calendars, a significant number (24%) strongly disagreed with that drought coping mechanism. However, 26% of the smallholder maize farmers strongly agreed that changing the cropping calendar was one of the strategies for them while 16% disagreed. In the end, a cumulative 60% of the smallholder maize farmers believed that they have changed their cropping calendar while 40% disagreed. These findings show interesting perceptions that farmers operating in one region – Keyser's Beach – have regarding drought and how to cope with it.

In support of the results presented, Ayanlade et al. (2018) conducted a study and concluded that farmers are exploring a range of alternatives, such as migration for jobs, sale of livestock and non-agricultural income to minimise drought impacts. In a separate study, Botai et al. (2016) note that some farmers have irrigation facilities and sow crops on schedule despite uneven weather and climatic conditions, and even fewer prefer crops that need less water to cope with drought. However, Botai et al. (2016) note that other farmers tend to be well-positioned to cope with any predicted drought by storing harvested grain and saving money relative to those in medium and heavily irrigated areas. Some smallholder maize farmers tend to sell their cattle and pursue new sources of revenue to deal with drought (Drysdale et al. 2020).

4.6.4 Selling livestock and resorting to alternative sources of income

Lastly, an inquiry was made on the extent to which the smallholder maize farmers in Keyser's Beach sell their livestock or resort to other sources of income as a solution to the prevailing drought. Data obtained from primary research is presented in Figure 4.13.

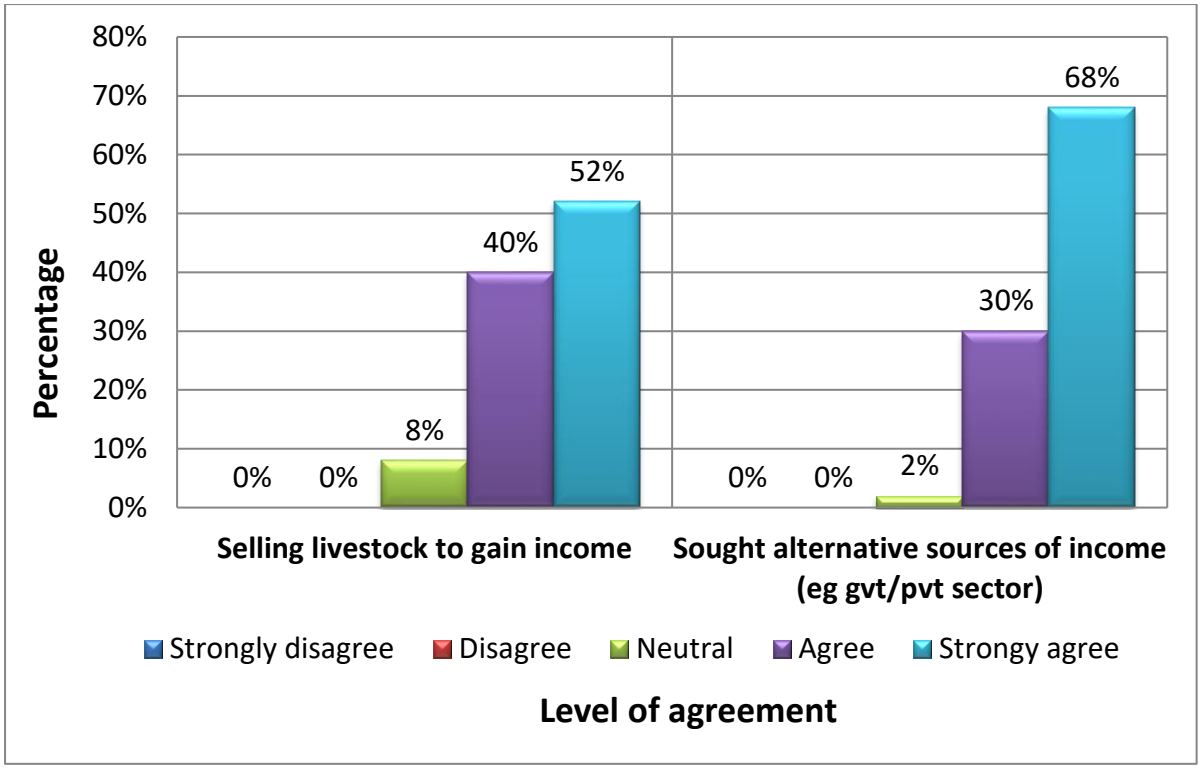

Figure 4.16: Mitigating drought by selling livestock and resorting to alternative sources of income

Figure 4.13 shows that, largely, the smallholder maize farmers who participated in this study sold their livestock and sought alternative sources of income to cope with the prevailing drought. For instance, 52% of the farmers strongly agreed that selling livestock enabled them to gain income during the time of drought and these were seconded by an additional 40% who agreed. Some 8% were neutral about the issue of selling livestock. While the reasons they chose to be neutral were not established in this study, one of the factors could be that they did not own livestock because if they did own any and did not sell, they would have chosen any of the disagreement scales.

In terms of trying other income-generating initiatives, 68% of the smallholder maize farmers indicated that they tended to look for alternative sources of income, for example, from the government and the private sector. These smallholder maize farmers were seconded by 30% of their counterparts who agreed while an insignificant number (2%) chose to be neutral. These findings show important dynamics that are common in many drought-hit places as smallholder maize farmers tend to shift from traditionally depending on agriculture to the adoption of other income-generating initiatives.

Finally, the findings presented on the ways in which smallholder maize farmers resort to the prevailing drought resonate with studies in the field of natural disasters and resilience. (Eee Blamey et al. 2018; Graw et al. 2017.) The importance of having livestock, especially in the farming communities, is to sell when there is need so that the farmer could have a financial base. Graw et al. (2017) talk about subsistence farming where the smallholder farmers tend to sell the surplus they have from their produce to have money to sustain themselves. Blamey et al. (2018) note that farmers tend to sell their farm produce to realise the advantages they have through farming.

4.8 Smallholder maize farmers' vulnerability to drought – analysis using Sustainable Livelihood Framework

To analyse the farmers' vulnerability to drought, the vulnerability indicators were used. The creation and use of metrics to assess social circumstances has a long tradition and it started during the 1830s when social statistics were used to improve public health conditions in Europe and the USA. This was well before the development of environmental indicators (Cobb and Rixford, 1998). This section discusses how vulnerable smallholder maize farmers are to drought.

The reader should note that this study used the Sustainable Livelihood Framework as the underpinning theory. As a result, an understanding of the level of vulnerability of the smallholder maize farmers to drought was calculated based on their level of access to various capitals such as human capital, natural capital, social capital, financial capital and physical capital. The human capital index, in this case, refers to the sum of different demographic particulars that formed part of this research, namely participants' gender, age groups, education, population groups, land ownership and level of experience in the maize farming industry.

The financial metrics refer to smallholder maize farmers' access to financial resources such as important information, capital and alternative sources of funds, employment and other aspects that have a relationship with the economic activities on a farm. The social capital index, in turn, refers to the different social infrastructure that the farmers have. These also include land ownership, their interaction with other farmers, their important networks in the farming community and other dimensions that increase their vulnerability to drought. Natural capital refers to the natural resources in the possession of the farmers, for example; their land tenure systems and availability of water systems for irrigation.

To understand the extent to which smallholder maize farmers are vulnerable to drought, equal weights were applied to the capitals identified. According Cutter et al. (2003), there is no scientific rationalisation for applying different weights to suggest different degrees of importance to individual variables that lead to vulnerability. A scale ranging from a minimum of one to a maximum of five was applied to each of the capitals as presented in table 4.5.

Table 4.6: Smallholder maize farmers' vulnerability to drought

Vulnerability index/metrics	Minimum Score	Maximum Score	Mean Score	Standard Deviation
Natural capital	1.000	5.000	4.101	1.202
Human capital	1.000	5.000	2.251	1.195
Social capital	1.000	5.000	2.331	1.235
Financial capital	1.000	5.000	4.512	1.056
Physical capital	1.000	5.000	3.901	1.116
Total vulnerability metrics	5.000	25.000	17.096	

First, the standard deviations calculated for each of the vulnerability scores presented were within the acceptable limits. The standard deviations of less than 1.250 as indicated show how elements were 1 point dispersed around the average, or mean scores of the metrics presented in Table 4.5. In terms of smallholder maize farmers' vulnerability to drought, Table 4.5 shows that financial capital had the highest index (4.512) while human capital had the lowest index (2.251). These vulnerability scores imply that the higher the index, the higher farmers are vulnerable to drought. Thus, the findings presented show that due to drought, smallholder maize farmers tend to be highly affected in their financial capitals. In this case, their income levels, financial stability and revenues tend to be affected greatly.

In a nutshell, the smallholder maize farmers were asked to rate the extent to which they are vulnerable to the current drought based on the five capitals. These capitals were rated on a scale of one (1) to five (5), where one (1) represented least vulnerable and five (5) being highly vulnerable. In order to come up with the overall vulnerability for each capital, the ratings of the responses were multiplied by each rating and then the ratings for all the responses were then added and divided 100 as shown in the following table. These became the mean scores of the vulnerability index.

Table 4.7: Smallholder maize farmers' vulnerability index calculator

Variable	Least Vulnerable (1)	(2)	(3)	(4)	Highly Vulnerable (5)	Mean (x)
Natural capital (includes land, soil quality, water quality, accessibility to water sources, etc.)	0%	0%	10%	42%	48%	$\frac{\sum x}{n}$ =4.101 *Where n = 100*
Human capital (age, experience, education, gender, population group, etc.)	40%	20%	10%	30%	0%	$\frac{\sum x}{n}$ =2.251 *Where n = 100*
Social capital (sense of belonging to different groups, socialisation).	30%	30%	20%	20%	0%	$\frac{\sum x}{n}$ =2.331 *Where n = 100*
Financial capital (access to funds, sources of income, loans, etc.)	0%	0%	6%	44%	50%	$\frac{\sum x}{n}$ =4.512 *Where n = 100*
Physical capital (farm machinery, assets, farmhouses and barns,	12%	22%	40%	12%	8%	$\frac{\sum x}{n}$ =3.90 *Where n = 100*

This was then followed by their natural capitals, which include the land, ground and surface water sources as well as the quality of soils. This was preceded by the implications on the physical capitals, which include severe implications on the physical resources such as farm material, farm assets, houses and other resources. The results presented show that the smallholder maize farmers were less vulnerable to human capital and social capital as shown by mean scores of 2.251 and 2.331, respectively. These findings are presented in the vulnerability spider diagram presented in Figure 4.14.

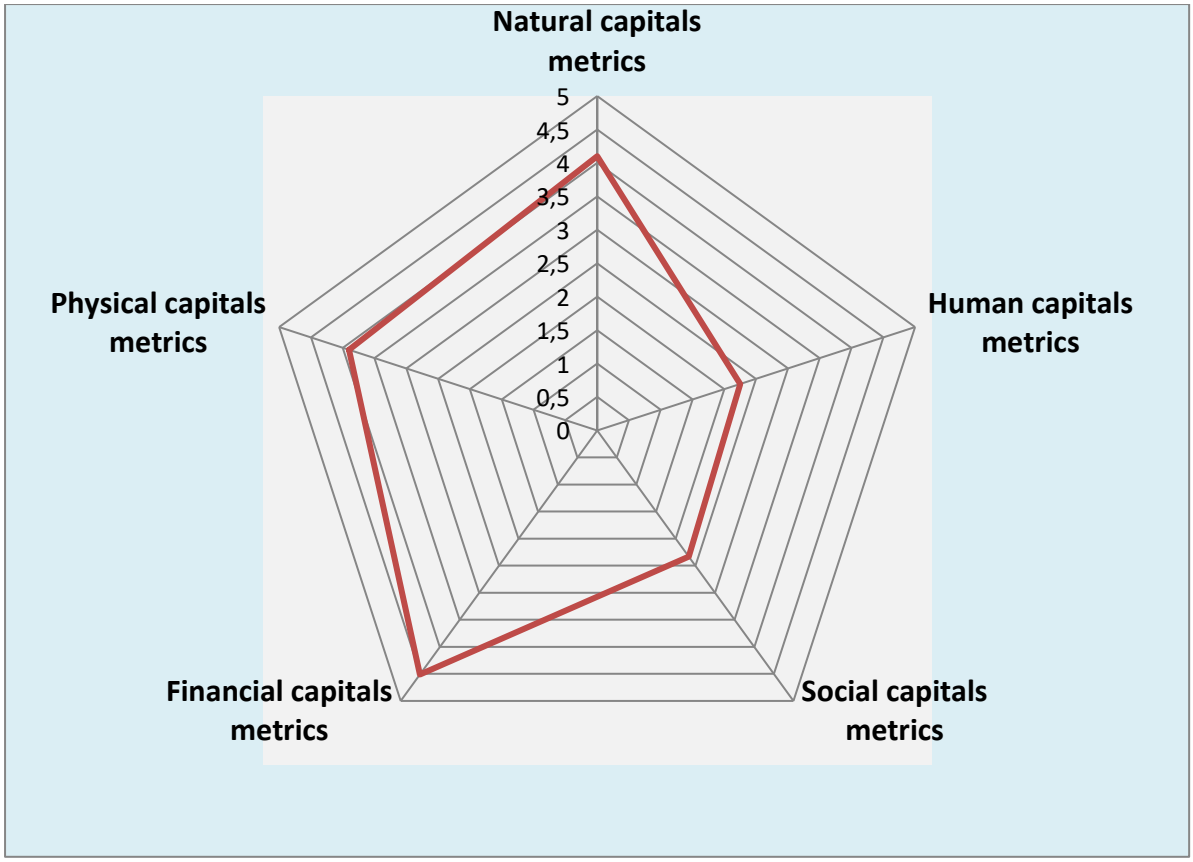

Figure 4.17: Smallholder maize farmers' vulnerability to drought

The total vulnerability was then calculated by summing up the mean scores of each of the five capitals. In this case, a total vulnerability of 17.096 out of 25 was obtained. The metrics were then assessed against the selected smallholder maize farmers' gender profiles, namely their gender, population group membership, marital status, educational qualifications and level of experience. The findings are presented in the Table 4.7.

Table 4.8: Smallholder maize farmers' total vulnerability against the demographic profile

Demographic Profile		Total vulnerability
Gender	Male	14.012
	Female	17.236
Population group membership	Black	17.355
	White	12.100
	Coloured	13.025
Marital status	Married	12.065
	Single	15.465
	Co-habiting	12.066

	Widowed	17.289
	Divorced	17.566
Years of experience	Less than 2 years	17.687
	2-5 years	16.563
	5-8 years	15.224
	8-10 years	12.855
	10-15 years	12.395
	15-20 years	12.034

When the level of smallholder vulnerability was measured against the smallholder maize farmers' gender, it was found that the females were more vulnerable compared to their male counterparts. This could probably be because men tend migrating from one point to another as a coping mechanism to drought. In addition, the study found that the black population group was also more vulnerable to drought followed by coloured farmers and then the white farmers. Reasons for this could be that the black smallholder maize farmers formed the majority of the participants in this study while other population groups had insignificant representativeness. In terms of levels of vulnerability measured against marital status, the study concludes that the widowed and divorced were more vulnerable. Co-habiting and married couples were less vulnerable probably because these partners can join efforts together and face the impact of drought collectively. In addition, the experience of smallholder maize farmers in maize production was also found to have a significant impact on the vulnerability of the participants. The study found that the least experienced smallholder maize farmers were more vulnerable to drought than the highly experienced.

4.9 Conceptualisation of the Sustainable Livelihood Framework in the Study

Upon completion of data analysis, the study came to the conclusion that the smallholder farmers in Keyser's Beach, Buffalo City Municipality are vulnerable to drought in different ways. The study found that their vulnerability varies based on different factors. For instance, the study found that there is high vulnerability with regard to the natural resources available to farmers. These include the impact the drought has on their land, soil quality, water quality and how the extent to which they access other natural resources. This kind of vulnerability is also explained by the sustainable livelihood framework in the sense that it identifies a variety of natural shocks that have an impact on development (Ashley and Carney, 1999; Mensah, 2011). The study also came to the conclusion that the smallholder farmers are also left vulnerable due to their lack of financial resources. In this light, they find difficulties to withstand the impacts of drought or adapt other strategies that enable them to face the consequences of drought.

While the study came to the conclusion that the farmers have varying vulnerability as a result of the drought they face, it has also been found that there are different capitals which play a significant role in their adaptation. These capitals, namely; natural capital, human capital, social capital, financial capital and physical capital have been found to have an influence on the farmers during drought. For instance, the study found that human capital dimensions such as the age of the smallholder farmers and their level of experience plays essential roles on the adaptation of farmers to drought. This is especially true in the sense that the experience of individuals provides them with various ideas on how to navigate around a problem if they are faced with one. On the other hand, the financial capital dimensions such as how much the smallholder farmers have, the level of financial assistance available from institutional stakeholders, the farmers revenue when they sell their produce and other financial resources have all been found to have a huge implication on the adaptation of farmers to drought. The sustainable livelihood framework specifically associates the capital assets with the important role they play to the livelihoods of individuals and have been placed at the centre of this framework (Serrat, 2008; Ashley and Carney, 1999). In a nutshell, the capitals identified above form part of the resources upon which people in pursuit of their livelihoods (Ashley and Carney, 1999).

Additionally, the smallholder farmers also indicated that they have various other adaptation strategies that they apply even though they are not always successful as they expect. The adaptation strategies identified in this regard can be tallied with the transforming structures and processes in the sustainable livelihood framework. According to Ashley and Carney (1999), transforming structures and processes play a vital role in shaping livelihood assets and outcomes. The transforming structures in this regard may include the community in general and the social support it provides in the adaptation strategies of the smallholder farmers to drought. The study, in fact, found that due to their social capital, they are least vulnerable to drought. The social capital such as community groups, cooperatives and other social groups enable them to easily adapt to different impacts of drought.

4.10 Conclusion

In conclusion, the study found that smallholder maize farmers in Keyser's Beach had different perceptions of the prevailing drought. Importantly, the study found that the smallholder maize farmers were aware that drought is a result of natural and human causes and can either be predicted or not anticipated from its onset. The study established that drought has severe implications on the smallholder maize farmers' soil quality, water supplies, income, employment, savings and productivity. The vulnerability index also shed

light on the fact that female smallholder maize farmers tended to be more vulnerable than their male counterparts did. In addition, the study found that the demographic details such as farmers' gender, level of experience and marital status significantly impacted their vulnerability to drought. The chapter also indicated that the smallholder maize farmers tended to adopt different mechanisms to deal with drought and these include storing produce, selling livestock, changing cropping calendars, adopting drought-resistant crops, migrating and looking for other sources of funding. The following chapter provides conclusions and recommendations of the study.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The previous chapter presented and analysed data. It also focused on discussion and interpretation of the findings of the study. The data was collected through the questionnaire survey and in-depth interviews. Chapter 4 provided the basis on which the current chapter proceeds. This chapter provides conclusions of the study and articulates recommendations on drought among smallholder farmers. First, the chapter provides a summary of the demographic details of the participants and the research findings. This is then followed by an outline of the recommendations. Lastly, the chapter gives suggestions for further studies.

5.2 Summary of the demographic details of the participants

The study used a sample of 55 smallholder maize farmers. Out of these farmers, 50 successfully participated in the research, which led to a response rate of 91%. Out of these, 60% were female and the remaining 40% were male. The farmers were also distributed among the single, married, divorced, widowed, and those who were cohabiting. The smallholder farmers were also distributed across different age groups, ranging from 21 years to 55 years. The majority of the smallholder maize farmers who formed this study were black, and these were followed by coloured and the least were whites. In terms of their educational qualifications, all participants had basic education as well as informal education in agriculture. These participants also indicated that they had farming experience ranging from two to 20 years. They also indicated that they owned land ranging from one to five hectares.

To have an understanding of the perception of smallholder farmers on drought, a question was asked to understand how reliant their livelihoods were on maize farming. The question was asked on a five-point Likert scale that had the following scales: strongly disagree, disagree, neutral, agree, and strongly agree. The study found that all the participants agreed that their livelihoods depended on agriculture. Most of these participants agreed while a few strongly agreed.

5.3 Summary of findings

This section provides a summary of the research findings for this study. The chapter specifically presents these findings based on each research objective.

5.3.1 Summary of research objective one

The first objective of this study was to ascertain the perceptions of smallholder maize farmers on the prevailing drought and their choice of the adaptation strategies implemented in Buffalo City Metropolitan Municipality. The majority of the participants believed that drought is both a natural and a man-made event. This was followed by a significant number of smallholder farmers who held that drought is a natural event while the remaining few believed that it is a man-made event. In terms of the occurrence of drought, the majority of the smallholder farmers believed that droughts could be anticipated from their onset while a significant number noted that droughts could not be anticipated at all. The remaining participants noted that they did not have any idea about the drought occurrence patterns.

Due to the different perceptions highlighted, the participants expressed different views about droughts and how they manifested. Some participants linked droughts to climate change in terms of unpredictability while others noted that no matter how difficult it was to predict a drought, they always got information from other stakeholders. When asked how frequently they anticipated droughts to occur in the future, the majority were of the view that droughts will occur frequently in the future whereas a significant number of participants indicated that there would not be any changes to the current drought occurrence pattern. Some believed that droughts would be occurring less frequently and others did not have any idea. Overall, the study concludes that smallholder maize farmers have mixed opinions about drought, its occurrence, frequency and impacts on their agricultural activities.

5.3.2 Summary of research objective two

The second research objective was to establish the perceptions of the smallholder maize farmers in Keyser's Beach, Buffalo City Metropolitan Municipality on the impacts of the prevailing drought on their agricultural activities. First, primary data revealed that drought in Buffalo City Metropolitan Municipality has severe impacts on surface and groundwater bodies as well as on soil quality. The majority of the smallholder maize farmers that participated in this study indicated that surface water bodies within the study area were negatively affected by drought. In the same light, groundwater bodies in Keyser's Beach

are affected by the on-going drought. Concisely, it was found that these implications on water sources lead to severe implications on the soil quality within the study area.

In addition, the study found that the prevailing drought in Buffalo City Metropolitan Municipality in general and Keyser's Beach in particular, has negative impacts on employment and household income. Regarding employment, the smallholder maize farmers believed that drought had led to an increase in unemployment. This is because the production levels are continuously becoming lower because of reduced capacity in order to cope with drought. This has compromised the household income levels since there is insufficient produce for sale compared to output during normal times. Overall, the smallholder maize farmers' household incomes are greatly affected by the prevailing drought, as there is little to no output to sell. This is in addition to the severe implication that has resulted in the alteration of the market forces such as the prices and supplies of maize crops and hence its performance on the market.

The study also found that the existing drought in the Buffalo City Metropolitan Municipality has severe impacts on smallholder maize farmers' social lives. For instance, a significant number of participants indicated that drought leads to hopelessness among the different smallholder maize farmers. Some also indicated that people's health and the health of their livestock were severely affected by drought. It should, however, be noted that these social impacts are, largely, experienced but not to the full extent since others are not affected. Similarly, the study established that some parties were affected by drought to the extent that farmers felt helpless and suffered from a sense of loss while others did not experience such. In brief, the study found that drought in Keyser's Beach affects smallholder maize farmers' health and their social status to a certain extent.

Other social implications of drought as established in this study are that it leads to population migration, especially among male farmers. Farmers often migrate to urban areas in order to seek economic opportunities. This is mainly driven by the fact that maize farming can no longer sustain employment among the local communities. It was also found that drought leads to conflicts among smallholder maize farmers in relation to water sources. This is because there exist insufficient water supplies for all the stakeholders to benefit. However, mixed findings were obtained because some of the participants did not end up conflicting with others in terms of water sources.

5.3.3 Summary of research objective three

The last research was to provide strategies that can be applied to mitigate the challenges faced by smallholder maize farmers in Buffalo City Metropolitan Municipality because of drought. The smallholder maize farmers were asked to provide information on how they navigated the challenges emanating from the drought. The study established that smallholder maize farmers made use of different ways, which include storing the produce for their consumption and their livestock. On the other hand, there were mixed findings from the smallholder maize farmers with regard to storing produce for livestock consumption. Some indicated that they did not store produce. However, the majority of the smallholder maize farmers agreed, which implies that storing the maize produce is one of the drought adaptation strategies.

As another strategy, the smallholder maize farmers in Keyser's Beach indicated that saving money is one of the strategies they used in times of drought. The study also found that other smallholder farmers did not make use of this strategy. Other participants also indicated that they sold their livestock to gain income, while others looked for funding from sources other than farming. In addition, the study obtained mixed findings on smallholder maize farmers 'doing nothing' during times of drought. The majority of these farmers agreed while some disagreed that they do nothing to respond to drought. Thus, doing nothing can be seen as one of the ways smallholder maize farmers were coping with drought.

In addition, the study also found that the farmers tended to migrate from one place to the next as a way of coping with the severe impacts of drought. Furthermore, they tended to change the cropping calendar to reduce the impact of the drought through maximising on the little window of rain received. Lastly, the smallholder farmers indicated that they made use of the most common practice of shifting to less water consuming maize crops to maximise during the dry times.

5.4 Recommendations

From the findings presented, the following recommendations are be provided to smallholder maize farmers in Buffalo City Metropolitan Municipality currently affected by drought:

- Smallholder maize farmers have to understand the idea of drought and understand that it is caused by multiple factors, which include human activities and natural

conditions. This understanding will enable the farmers to devise strategies that are relevant to particular causes.

- Smallholder maize farmers also need to understand the magnitude of the drought they face in terms of severity and implications. An understanding of the potential impact of drought helps them to anticipate the amount of effort needed to cope with the drought.
- The smallholder farmers are also encouraged to be always abreast with information pertaining to weather and climate. This information is available to the farmers through different media, including meteorological platforms, televisions, radios, and other mainstream media in the Buffalo City Metropolitan Municipality.
- In the event of drought, the smallholder maize farmers are also encouraged to practice crop shifting. In this light, instead of the farmers sticking to their traditional maize crops, they are encouraged to change to and adapt drought resistant crops.
- Smallholder maize farmers are also encouraged to practice sustainable agricultural activities such as water harvesting, greenhouse farming, and drip irrigation, among other measures. These help in the conservation of the environment and continuous fight against drought.
- There is also need to shift from the current agricultural activities that are heavily affected by drought to those that are resistant to drought. For example, in order to maintain the status quo of agricultural production in Buffalo City Metropolitan Municipality, farmers may shift from maize production to livestock production. This implies that farming continues but with a different focus.
- Smallholder maize farmers also need to operate under the guidance of large commercial farmers in the region. The fact that drought has been prevailing in this region for many years, yet the commercial farmers continue to prosper shows that the small-scale farmers have more to learn from the commercial farmers. It is recommended that the commercial farmers guide the small-holder farmers on the ways to easily adapt to drought in their farming activities.

5.5 Suggestions for further studies

This study focussed on smallholder maize farmers' perceptions of drought. In order to have a broad understanding of this subject matter, a similar study may be conducted with the commercial farmers. This will provide a different view of how drought is currently impacting farmers. In addition, research can also be conducted on how smallholder farmers in places other than Buffalo City Metropolitan Municipality view drought and how it affects them. This

provides a basis on which comparisons may be done on the underlying perceptions that smallholder farmers in different regions have on drought.

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APPENDIX A: COVER LETTER

Dear Respondent

RE: PERCEPTION AND ADAPTATION STRATEGIES OF SMALLHOLDER MAIZE FARMERS TO DROUGHT IN BUFFALO CITY METROPOLITAN MUNICIPALITY, EASTERN CAPE, SOUTH AFRICA.

I am a student at the University of the Free State studying towards a Master's degree in Disaster Management. I am conducting a study with the title indicated above. I am kindly asking you to participate in this study as part of the requirements for me to complete my degree. It is envisaged that the following results will be achieved upon completion of this study:

Aim – This research is mainly conducted to ascertain the perception of smallholder maize farmers in Buffalo City Metropolitan Municipality of the on-going drought and their preference of the adaptation strategies used.

Objectives – This study is conducted to fulfil the following objectives:

i. To ascertain the perceptions of smallholder maize farmers on the prevailing drought and the choice of the adaptation strategies implemented in Buffalo City Metropolitan Municipality;

ii. To establish the perceptions of the smallholder maize farmers in Buffalo City Metropolitan Municipality on the impacts of the prevailing drought on their agricultural activities and

iii. To provide strategies that can be applied to mitigate the challenges faced by smallholder maize farmers in Buffalo City Metropolitan Municipality due to drought.

Ethical Considerations – Please note the following:

i. Participation in this study is completely voluntary and you will not be forced in any ways to participate when you are not willing;

ii. Should you feel that you want to withdraw from the study, you are completely free to do so and it is your own choice;

iii. Please note that if you decide to participate in this study, you will remain anonymous.

iv. You are not allowed, in any way, to provide your personal details such as your name, address and contact details during the interviews.

v. I will use voice recorders to record the information you provide and the data will be stored for this study and similar future studies I will conduct.

Could you please sign below as acknowledgement that you have understood what is expected of you as the participant and the accompanying ethical considerations.

Sign_____ Data_____/_____/_____

Thank you for agreeing to participate in this study.

Yours Sincerely

Jotham Kumalo

Cell: +27 (0) 78 202 2586

Email: j.kumalo@icloud.com / jothamk@buffalocity.gov.za

APPENDIX B: QUESTIONNAIRE

SECTION A: PARTICIPANTS' DEMOGRAPHIC PARTICULARS

1. What is your gender?

Male		Female	

2. What is your age group?

18-20 years		21-25 years	
26-30 years		31-35 years	
36-40 years		41-45 years	
46-50 years		51-55 years	
56-60 years		61-65 years	
Above 65 years			

3. What population group do you belong to?

Black		Coloured	
White		Indian	
Other			

4. What is your marital status?

Married		Single	
Co-habiting		Widowed	
Divorced			

5. Indicate your highest level of educational qualification

No formal education	
Primary education	
Secondary education	
Tertiary education	

6. Indicate whichever qualification is relevant in your case

Agriculture related formal education	
Agriculture related informal education	

7. How long have you been practicing maize farming in this area?

Less than 2 years		2-5 years	
5-8 years		8-10 years	
10-15 years		15-20 years	
More than 20 years			

8. Please indicate the number of employees that are responsible for maize farming

_____

9. Please indicate the size of land you use for maize production

0-1 hectare		1-2 hectares	
2-3 hectares		3-4 hectares	
4-5 hectares			

10. To what extent do you rely on maize farming for your livelihood?

Strongly disagree		Disagree	
Neutral		Agree	
Strongly agree			

SECTON B: SMALLHOLDER MAIZE FARMERS' PERCEPTIONS ON THE PREVAILING DROUGHT

1. What do you understand by drought?

Researcher probes:

i. Are they natural disasters?

ii. Are they man-made disasters?

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

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

Researcher probes:

i. If yes, please explain why you say so

ii. If no, please expand why drought are not anticipated from their onset

3. Do you think drought will occur in future more frequent than expected?

Researcher probes:

i. Participants should explain why they say yes or no. For those who say yes, how have the past drought affected them? They should also provide the years they have been affected by drought.

SECTION C: PERCEPTIONS OF THE SMALLHOLDER MAIZE FARMERS ON THE IMPACTS OF THE PREVAILING DROUGHT

1. As a small-scale maize farmer, how have the prevailing drought impacted you?

Please use the following scale to answer the questions below:

1 = Insignificant; 2 = Minor; 3 = Moderate; 4 = Major; 5 = Severe

i	Impact on surface water bodies	1	2	3	4	5
ii	Impact on ground water levels	1	2	3	4	5
iii	Impact on the quality of the soil	1	2	3	4	5
iv	Impact on local people's health	1	2	3	4	5
v	Impact on unemployment	1	2	3	4	5
vi	Impact on household income	1	2	3	4	5

vii	Impact on market prices of the produce	1	2	3	4	5
viii	Impact on food (maize supplies) security	1	2	3	4	5
ix	Impact on conflicts for water among farmers	1	2	3	4	5
x	Impact on population migration	1	2	3	4	5
xi	Impact on extreme challenges such as hopelessness and sense of loss	1	2	3	4	5

2. Please indicate the extent to which drought make you vulnerable to the following capitals. Use a scale of 1 to 5 with 1 being least vulnerable to 5 being highly vulnerable.

Vulnerability index/metrics	1	2	3	4	5
Natural capital (includes land, soil quality, water quality, accessibility to water sources, etc.)	1	2	3	4	5
Human capital (age, experience, education, gender, population group, etc.)	1	2	3	4	5
Social capital (sense of belonging to different groups, socialisation).	1	2	3	4	5
Financial capital (access to funds, sources of income, loans, etc.)	1	2	3	4	5
Physical capital (farm machinery, assets, farmhouses and barns, etc.)	1	2	3	4	5

SECTION D: STRATEGIES APPLIED TO MITIGATE THE CHALLENGES FACED BY SMALLHOLDER MAIZE FARMERS AS A RESULT OF DROUGHT

1. As a smallholder maize farmer, what strategies have you been implementing to address the challenges resulting from drought?

Please use the following scale to answer the questions below:

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

i	I have been doing nothing	1	2	3	4	5
ii	I have been storing crop harvest for own consumption	1	2	3	4	5
iii	I have been storing crop residues for livestock	1	2	3	4	5
iv	I have been saving money	1	2	3	4	5
v	I have migrated from one place to another as a coping mechanism	1	2	3	4	5
vi	I have been selling livestock to gain income	1	2	3	4	5
vii	I have sought alternative sources of income from the government/private sector (*choose whichever is relevant and rate*)	1	2	3	4	5
viii	I have tried to implement less water consuming maize crops	1	2	3	4	5
ix	I have tried to change the crop calendar/cropping dates	1	2	3	4	5

2. What other strategies have you applied to mitigate the challenges you face due to prevailing drought?

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APPENDIX C: CONSENT FORM