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Vulnerability and adaptation of rural households livelihoods to climate change in the Eastern Cape, South Africa: perspectives on the asset-based adaptation framework

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VULNERABILITY AND ADAPTATION OF RURAL HOUSEHOLDS LIVELIHOODS TO CLIMATE CHANGE IN THE EASTERN CAPE, SOUTH AFRICA : PERSPECTIVES ON THE ASSET-BASED ADAPTATION FRAMEWORK



BY

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Thesis

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DOCTOR OF PHILOSOPHY

In

Department Of Geography and Environmental Studies

SUPERVISOR: PROF MULALA DANNY SIMATELE

SEPTEMBER 2019

DECLARATION

I, Laura Novienyo Abla Amoah with student number (1272442), hereby declare that the thesis for Doctor of Philosophy is my own work and it has not previously been submitted for assessment or completion of any postgraduate qualification to another University or for another qualification.



…… ……..

Laura Novienyo Abla Amoah

DEDICATION

I would like to dedicate this thesis to my husband Dr. Felix Amoah and children, Austin, Hans, Antonio and Antoinette.

ACKNOWLEDGEMENTS

I am most thankful to Almighty God for allowing me to reach this milestone of my academic career. Furthermore, I would like to thank the following personalities and entities for their invaluable contribution to this study.

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To my late father Mr. Victor Dotse who was an anchor in my studies until his passing this year, my mother, Mrs. Veronica Dotse, and siblings, for their support and encouragement.

ABSTRACT

The purpose of this study was to investigate how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security. Fieldwork data were obtained from three different rural communities namely, Mgugwana, Manaleni, and Ndayini. These communities are located in Port Saint John's Local Municipality in the Eastern Cape, South Africa. Primary data were obtained using semi-structured questionnaires, interviews, observations, and focus group discussions. Data obtained from closed-ended questions were analysed using basic statistics and organised in frequency tables and graphs. The open-ended and focused group interviews were transcribed and similar themes were identified and reported. Several responses from the open-ended questions were also reported verbatim.

The findings suggest that climate change significantly affect food security in all three rural communities. Prolonged drought occurs during the summer season and this impact negatively on their agricultural production. The findings also reveal that farmers have knowledge of, and have implemented different adaptation and coping strategies during extreme weather conditions. However, farmers were not able to adequately produce food in their farms to ensure food security. Lack of irrigation facilities and persistent drought emerged as contributing factors to food insecurity in the area. Factors such as soil infertility, low crop production, hunger, school dropout, unemployment, death of livestock, high crime rates, damage to roads and bridges, destruction of homes and houses, and poor health were the effects of climate change on rural household livelihood assets.

Based on the above findings it is recommended that government should renew its political will to direct policy formulation and implementation to assist rural communities and rural farmers to mitigate the impact of climate change. The policies should focus on education, reformed adaptation, and coping strategies. The government should also establish and capacitate institutions (such as the South African Weather Services, Department of Agriculture, Forestry and

Fisheries) to provide relief and early warning information to rural communities of potential extreme weather conditions. The government should also invest in the building of dams and provision of irrigation facilities to rural farmers especially those living in the three communities involved in the study. The local municipality should establish programs or projects (e.g. supply of seedlings) to encourage and support rural gardening and rural agriculture especially for the rural poor. It is also recommended that the local municipality should liaise with the national government to provide financial assistance to rural farmers to acquire farm implements that can assist them to reduce the effect of climate change. Finally, the government in partnership with private donor institutions should formulate a long-term policy focusing on post-climate crises management for rural poor communities. The proposed framework in this study can serve as an important guide.

Finally, both theoretical and practical contributions are achieved. The study has contributed to advancing the scholarly knowledge of rural households' adaptation strategies to CC using the assets-based framework. Practically, the recommendations and proposed framework will contribute to empowering the society specifically those in rural communities to be resilient in the event of extreme climate change.

Keywords: Adaptation strategies, asset-based framework, climate change, coping strategies, food security, Port Saint John's, South Africa.

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LIST OF ABBREVIATIONS

CC - Climate Change

CRF – Community Resilience Framework

DEA –Department of Environmental Affairs

EC - Eastern Cape

FAO - Food and Agriculture Organization

IPCC –Intergovernmental Panel on Climate Change

OR Tambo – Oliver Reginald Tambo

PSJ – Port Saint Johns

UK – United Kingdom

UNCTAD-United Nations Conference on Trade and Development

WMO-World Meteorological Organization

CHAPTER ONE

THE FRAME OF REFERENCE

1.1 INTRODUCTION

Climate change is described as a global challenge that affects households, communities and the broader economy negatively. Climate change is a worldwide phenomenon because it affects all countries and can be described as the biggest environmental concern. Climate change has also become a major problem to society because of its potential adverse impacts. Over the past decades, there has been increasing concerns regarding changes in climate that are threatening to transform the livelihoods of the vulnerable population segments. Evidence suggests that the earth's climate has warmed on average by about 0.7^0C over the past 100 years with decades of the 1990s and 2000s being the warmest (Rajasree, 2010). Unganai (2009) defines climate change as changes that occur through an increase in frequency and intensity of extreme weather events including storm, flood, drought and irregular rain over time and irregular climate signal. For the current study, climate change is defined as an extreme weather event such as severe drought, flooding, cyclones experienced over a given period time.

In South Africa, climate change has resulted in many of the natural disasters and contributed significantly to food and water insecurity. Heavy dependence on climate-sensitive economic sectors, particular sustainable livelihood, makes South Africa vulnerable to climate change (Unganai, 2009). The effect of climate change on livelihoods directly affect communities through reduced income and employment and have a knock-on effect on both the rural economies and food-security (Unganai, 2009). Rural households are more vulnerable because they lack the means of adaptation. As a natural, human, financial, physical, and social resources are limited, these scarce resources must be targeted at the most vulnerable communities. This is the premise that the asset-based framework is built. The asset-based framework

examines the household ability to accumulate sufficient assets to build capacity to address climate change effects (Moser, 2006).

The National Climate Change Response Policy (White Paper) has mentioned that the unique environmental and socio-economic conditions of South Africa have made it more vulnerable to climate change effects (Department of Environmental Affairs (DEA), 2013). South Africa is a developing country that relies heavily on exploiting mineral resources such as coal, which is one of the main sources of Greenhouse gas emissions. South Africa has large coal deposits and considers coal as a relatively cheaper source of energy (Statistics South Africa, 2018). The country depends on coal as its main source of electricity supply. Coal was used to generate 85,7% of South Africa's electricity supply in 2016, followed by nuclear power (5,2%) and natural gas (3,2%) (Statistics South Africa, 2018). In 2016, the mining of coal contributed 1,8% total value to Gross Domestic Product (GDP), a figure higher than the gold contribution of 1,3% (Statistics South Africa, 2018). The over-dependency on coal as a source of electricity increases the country's vulnerability to climate change. South Africa also suffers from high levels of poverty, which exposes the people to several socio-economic situations to climate change impacts, particularly the livelihood sources of poor communities (DEA, 2013). According to Statistics South Africa (2017) in 2015, 30, 4 million (55, 5% of the population) people in South Africa live in poverty. Thus the effect of climate change will affect a substantial number of poor people in the country.

Climate change also affects agriculture in several ways, one of which is its direct impact on food production. It brings an additional burden to the national challenge of increasing agricultural production to keep pace with the rising population while keeping high standards of environmental protection. Negative effects on agricultural yields will be increased by more frequent extreme weather events (CEC, 2009). Adaptation reduces the negative impact of climate change (Kurukulasuriya & Mendelson, 2006). In a study conducted in Southwest Nigeria, Adebayo, Dauda, Rikko, George, Fashola, Atungwu, et al. (2011) showed that farmers' productivity is

affected by climate change and adapting to climate change by the farmers especially through innovative agricultural practices and farming systems has been recognized as the main coping strategies. It is believed that proactive adaptation strategies will help farmers improve their personal productivity and efficiency in food crop production and raise their returns in farming.

Based on the foregoing discussions associated with climate change, this study envisages evaluating the impact that climate change has on rural livelihoods and their adaptation response to climate change using an asset-based framework in three rural communities in Eastern Cape, South Africa. As the first study in these rural communities on the impact of climate change, the study will contribute to a better understanding of the complex effects of climate change on rural communities. Such understanding will not only highlight the magnitude of the challenge but also improve policy targeting and community-based monitoring.

1.2 STATEMENT OF THE PROBLEM

In terms of climate change, livelihood and food security studies, Bohle, Downing and Watts (1994) argue that "it may be most important to assess present vulnerability to infer lessons for coping with future challenges of global climate change". This study focuses on three rural communities located in the Eastern Cape of South Africa. The communities include Mgugwana, Manaleni, and Ndayini rural area. These communities fall under Post Saint John's (PSJ) Local District Municipality but can be found en-route between PSJ and Lusikisiki. These settlements experience repeated adverse weather conditions, ranging from severe droughts to extreme precipitation, severe flooding, and soil erosion which negatively impacts on the lives of the poor (Port Saint John's Municipality, 2018; Singh, 2019). The extreme weather events has not only affected the few infrastructures within the area (Siqathule, 2019) but has also adversely impacted food production, availability, and distribution, as well as consumption. These communities depend heavily on rainfall for agriculture, especially cereal (maize) crop production, which represent the basic crop

production consumed in the study area (Port Saint John's Municipality, 2018; Port Saint John's Municipality, 2015). Most households in these rural areas face severe poverty (Port Saint John's Municipality, 2018). At the household or individual level, the poverty and food insecurity situation is more a result of the rural poor's lack of the means of production (i.e. the stock of assets), and their inability to secure decent wage employment and incomes to purchase food (Port Saint John's Municipality, 2018). These different circumstances have subjected a significantly large proportion of the rural poor to different vulnerabilities, among which include sub-standard housing, poor roads, poor sanitation, and poor waste management and service provision (Port Saint John's Municipality, 2018; Port Saint John's Municipality, 2015). Climate change, for example, have resulted in reductions in crop yields and agricultural productivity in the municipality including the three settlements. For the majority of the rural poor, climate change have resulted to increased food and energy prices, and the continued diminishing of their livelihood assets (Port Saint John's Municipality, 2018).

1.3 AIMS AND OBJECTIVES

In view of the above observations, the core aim of this study is grounded on **how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security**. In order to achieve this aim, the following objectives were formulated for the study.

i. Discuss ways in which changes in weather patterns are negatively impacting the livelihoods of the rural poor.
ii. Discuss how the rural poor adapt their assets to build their resilience against food insecurity.
iii. Develop a framework for social and other types of risk management in rural areas, with a focus on rural areas in South Africa. The framework will be grounded in the literature on risk, its management, and the relationship to desired outcomes of reduced vulnerability and broad-based growth.

1.4 RESEARCH QUESTIONS

Based on the objectives, the following research questions were formulated.

i. To what extent are the rural poor affected by climate change?
ii. How do rural households adapt to climate change?
iii. How does climate change render the poor more vulnerable?
iv. What are the household livelihood assets and risk factors associated with climate change in the chosen study area?

1.5 OVERVIEW OF THE LITERATURE

Climate change has become a global challenge and many researchers have concluded that "warming of the climate system is unequivocal" and a "settled fact" (Romm, 2018:2). There cannot be any contestation of this fact. Globally, the entire population of the world is vulnerable to climate change although the impact may vary from region to region (Tol, 2005). Many people are affected in diverse ways to the extent that some people suffer mental health (Cunsolo & Ellis, 2018). Because climate change is directly or indirectly linked to human activities, an increase in the world's population will further impact negatively on the climate. Samset, Sand, Smith, Bauer, Forster, Fuglestvedt, Osprey and Schleussner (2018) establish that regions with high population growth experience higher changes in temperature, precipitation, and extreme weather conditions. To mitigate the impact of CC many people have adopted different ways and strategies to ensure that there is adequate food security, water, and shelter (Kulkarmi & Leary, 2007).

The understanding of vulnerability should not be limited to absolute damage or disaster. Vulnerability does not also suggest that a community is experiencing severe effects (Archer, Engelbrecht & Landman 2010). Vulnerability is linked to a system (Brooks, Adger & Kelly 2005) such as population growth, an economic factor or a natural system that prevent a person or group of people to cope (Füssel 2006).

Vulnerability is also associated with the Pressure and Release (PAR) model (Blaikie, Cannon, Davis & Wisner, 1994).

The PAR model emphasizes the inequitable distribution of impacts and is a useful entry point for understanding the complex nature of climate change risk and its application in the context of development (Cannon, 1994). Pressure and release are influenced by natural and human or political ecology which leads to vulnerability (Adger, 2006). In sub– Saharan Africa, Unganai (2009) argues that the financial cost of the impacts may be low, but the relative cost for the individuals will be higher, as they often have no capacity to cope with the risk and recover from incurred damages or losses. Over the last few decades, efforts have been made to undertake climate change adaptation research by means of impact assessment research (Burton, Huq, Lim, Pilifosova & Schipper, 2002). The IPCC proposed an impact assessment approach to adaptation, but many researchers have expressed reservations about the validity of its findings. The critics argued that the impact assessment approach to determining adaptation measures was based on the impacts of climate change rather than on the vulnerability of the communities in question (Burton, 2002). Since this criticism of the impact assessment approach, many researchers have begun to highlight the importance of vulnerability studies for the development of adaptation measures. It is necessary also to emphasise once again that vulnerability does not imply a complete lack of resilience or capacity to adapt to changes.

Gbetibouo and Ringler (2011) carried out a study on the level of vulnerability to climate change in South Africa's farming sector by developing a nationwide provincial level vulnerability profile. In the study, particular attention was given to the socio-economic and institutional factors that threatens farmers' response to and cope with climate hazards. In the study, vulnerability is conceptualized as a function of three factors: exposure, sensitivity, and adaptive capacity. Exposure can be described as the direct danger (stressor) together with nature and extent of changes in a region's climate variables (temperature, precipitation, and extreme weather events). In their findings, they conclude that coastal provinces exhibit high exposure

to extreme events of cyclones whilst the Western Cape is more exposed to drought. The most sensitive provinces are the Eastern Cape, KwaZulu Natal, and the Limpopo and this is mainly due to their high proportion of smallholder subsistence farmers in the provinces and high dependency on agricultural livelihoods. Inappropriate land uses in these provinces have severely degraded land and reduced production capacity (Archer, Engelbrecht, & Landman, 2010).

KwaZulu Natal, Limpopo is also predicted to suffer the largest impacts of climate change. They have the largest exposure and the highest sensitivity. Indicators of adaptive capacity differ considerably across the nine provinces. The Western Cape Province has the best resources to deal with CC due to combined effects of well-developed infrastructure, high literacy rates and income levels, low unemployment levels and HIV prevalence, and relatively high capital wealth (Archer et al., 2010).

In addition to the above-mentioned points, the emergence of clear evidence of climate change and its ecological and socio-economic implications, institutions at all levels have faced difficulties in establishing effective intervention. The political challenge represented by addressing climate change notwithstanding, scientific uncertainties regarding the characteristics and impacts of future climate change also contribute to delaying action. These uncertainties relate to questions about the magnitude, frequency and other characteristics of climatic processes expected to be affected, as well as to questions regarding the impacts of the changes (Schipper, 2004).

An assessment shows that with appropriate actions it is possible to reverse the degradation of many ecosystem services over the next 50 years, but the changes in policy and practice required are substantial and need political commitment for investment(Schipper, 2004). The options involve changes in institutional and environmental governance framework, for instance by properly designing institutions to deal with the management of resources, property rights, access rights, user rights, pollution control, application of polluter and user pays principles among others. Integrating ecosystem management goals within other sectors and broader

development planning frameworks will help to develop a climate resilient economy (Schipper, 2004).

Dixon, Smith and Guill (2003) argue that livelihood is sustainable when households can cope and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future whilst not undermining the natural resource base. Regarding the growing climate change-based threats to rural livelihoods, Chagutah (2010) and Ayers (2011) warn that in the absence of an immediate intervention of appropriate measures involving every nation and citizen of the world, the gains so far recorded towards sustainable development and the achievement of the millennium development goals (MDGs) would be reversed.

In an attempt to draw lessons on vulnerability and adaptation strategies used by rural households to respond to climate change, this study adopted the asset–based adaptation framework to explore how three rural communities in the Eastern Cape Province of South Africa adapt to climate change. The strength of this framework, as opposed to other frameworks, is that it incorporates the notion that all individuals or households possess some sort of assets (natural, human, physical, social, and financial). A stock of these assets will empower a person to create wealth and ensure sustainable livelihood to mitigate the impact of CC. From this perspective, the role of government will be to formulate policy on investment opportunities for the community to create more wealth (Chagutah 2010; Brown, Chanakira, Chatiza, Dhliwayo, Dodman, Masiiwa, Muchdenyika, Mugabe, & Zvigadza, 2012). Strategic policy formulation and investment at all levels will support participatory and inclusive decision-making processes to ensure that adaptation strategies address the needs of the rural poor. It is argued that a strengthened community through policies on investment opportunities utilising available assets will help rural dwellers and rural poor people to negotiate to get more, rather than less, from the local and national level (Ayers, 2011). To strengthen the institutional framework in climate change adaptation strategies, Ayers (2011) suggests the need to introduce the concept and practice of climate governance, which is largely linked to policy-making

across a variety of sectors and stakeholders. Currently, no study could be located in the Eastern Cape of South Africa focusing on the asset-based framework to explore how rural households are affected and how they respond to climate change. The use of the asset-based framework will therefore enhance policy-making and implementation at the Municipality level where the three study sites are located.

1.6 SIGNIFICANCE OF THE STUDY

Climate variability results in decrease rainfall patterns which lead to drying of rivers and water stress thus contributing to declining agricultural productivity. The declining levels of agricultural productivity are due to continuous climate variability. Women constitute the largest percentage of the world's poorest people and are most affected by the effects of climate variability (Lefton, 2013). Majority of women are smallholder farmers and they constitute 70% compared to 35% men (FAO, 1998). These women spend much of their time on agricultural activities which makes them highly vulnerable to the effects of climate change than their male counterparts.

Barraclough (2005) agree that a linkage exists between climate change and the impact on vulnerable populations to build resilience to long term recurrence of climate hazards. Given the growing evidence of climate change in different regions of the world including sub-Saharan Africa (Archer, et al., 2010), a useful starting point in the analysis of climate change and its impact on environmental and livelihood vulnerability cannot be overlooked. Livelihood vulnerability will be employed as the key term to assess the climate change impacts at the rural level. Moyo, Mvumi, Kunzekweguta, Mazvimavi, Craufurd and Dorward (2012) agree in their studies that climate change is exposing world communities, particularly subsistent farmers to new and unfamiliar conditions. Whilst some farmers may be in a position to take advantage of these changes, many are facing increased vulnerability, particularly in the developing world (Ziervogel & Calder, 2003; Thornton, Jones, Ericksen and Challinor, 2006; Archer et al., 2010). According to Ayers (2011), climate change impacts are projected to undermine prospects for

sustainable development in many nations and parts of the world. Sustainable development is increasingly understood to encompass economic, environmental and social sustainability. Key concepts are quality of life and survivability.

Vulnerability interlinks the physical environment, natural hazards, and risk with socio-economic factors such as development, culture, and religion (Simatele & Simatele, 2015). Although some studies on climate change have been carried on in South Africa, little is known within the context of the study area for this study. Additionally, applying the asset-based framework approach, a broader perspective and understanding was uncovered in rural households. The conceptual framework emanated from the study offer insight for policymakers in their planning for the rural households affected by climate change.

1.7 METHODOLOGICAL CONSIDERATIONS

A detailed research methodology is provided in Chapter 4 of the study. As pointed out, the study focuses on three rural communities of PSJ Local Municipality in the Eastern Cape of South Africa. These communities are Mgugwana, Manaleni, and Ndayini locations. The target population for the study involved all subsistence individual or household farmers who have lived in the areas for at least a minimum of two years. The critical realism ideology was followed which was based on the combination of both qualitative and quantitative research approaches. The systematic sampling approach was used to recruit the participants for the study. A semi-structured questionnaire was used to obtain data from individual participants. This allowed for both open-ended and closed-ended questions to be used. Further data collection techniques in the form of focus group interviews and participants observations were utilised to obtain in-depth information about the research problem. Prior to data collection, the questionnaire was reviewed by a subject expert, fellow researchers and pilot tested with six potential participants from the study sites (two from each study site). The information obtained from the reviewers and participants helped restructure the questionnaire for the final data collection.

All the closed-ended questions were collated in numbers and presented in frequency tables and graphs. The open-ended questions and focus group discussions were analysed by transcribing and identified themes from the answers provided. In most cases, answers provided in the open-ended questions were also reported verbatim.

1.8 ETHICAL CONSIDERATIONS

Good ethical practices are matters of importance in every research practice. Iphofen and Tolich (2018) point out that the heart of ethics is an attempt to balance the risk of harm against the potential for benefits that can accrue to individuals, groups, communities, organisations, and societies from research participation. Ethics in research is a moral obligation of what is deemed proper and practices that will not hurt, infringe or invade the privacy of participants (Drew, Hardman & Hosp, 2008:79). Before the data collection was embarked upon, the interview guide, questionnaire, and the research methodology were scrutinised by the ethics committee of the University of Witwatersrand. Ethical approval was issued on 20th October 2017 and the protocol number is H17/10/01 (see Appendix A). The ethics committee established that the study would not violate any ethical issue pertaining to humans. During the entire data collection process also, the following ethical practices were adhered to.

1.8.1 Informed consent

An important ethical issue in research involving human intervention is to ensure that potential participants understand what they are being asked to do and that they are informed of any potential negative consequences of such participation (Polonsky & Waller, 2015). Before the interview with individuals or groups, an informed consent letter structured on the University's letterhead was read and explained to the potential participants. The letter informed all the participants what the research project was about and the desired outcomes. The letter also contained an assurance that all the information provided was for academic purposes. The contact details of the supervisor and myself were also provided in the letter. An opportunity was given

to all participants to seek clarity on information contained in the letter. Those who agreed to participate in the interview were asked to sign the information sheet and handover the signed copy to the researcher. All participants were made aware of the project and agreed to participate in the research.

1.8.2 Voluntary participation

Voluntary participation was the second ethical consideration observed in the study. Blaikie (2010) cautions that research participants cannot be required to be involved, and, if they agree, they must know that they have the right to withdraw at any time. Throughout the data collection process, participants were assured of their right to opt out of the interview at any time should they feel to do so. No participant was forced, coerced or deceived to remain in the interview. This right was also specified in the informed consent letter handed out to the participants prior to the interview.

1.8.3 Confidentiality

Another important ethical consideration followed in the study was confidentiality. By definition, confidentiality refers to the right to privacy, and functions as a precautionary principle (Punch, 2014). One of the requirements of informed consent is to inform those in the study whether the research is anonymous, confidential, or neither. Research is anonymous when the researcher is not able to identify the participants in the study. Violating confidentiality can cause harm to members and becomes a serious ethical breach. It is important to withhold this sensitive information (Bailey, 2007). All information obtained during the interviews were treated as confidential for academic purposes. Those who participated were assured that no individual will be identified by name in the report, no personal information was requested from the participants and only summative and thematic results were reported.

1.9 THESIS OUTLINE

This study comprised of seven chapters. Each chapter is related to a part of the research process. A number of equally important contents such as the introduction to the study, statement of the problem, aims and objectives, research questions, an overview of the literature, the significance of the study, methodological considerations and ethical considerations were highlighted in **Chapter one** of the study. **Chapter two** will present a theoretical perspective of the study. **Chapter three** will present a detailed description of the study area. **Chapter four** will describe the research methodology used for the study. This will comprise the methods that will be employed in collecting the data for the research. In **chapters five**, the results of the study will be presented and analysed. **Chapter six** will consist of a discussion and interpretation of the findings. The final chapter, **Chapter seven,** will include conclusions and recommendations arising from the findings.

CHAPTER TWO

THEORETICAL OVERVIEW OF CLIMATE CHANGE AND VULNERABILITY

2.1 INTRODUCTION

Chapter 1 of this study provided insight into the background, the aims and objectives driving the study. As highlighted, climate change has become a subject of global concern due to its impact on the society especially the rural poor. It is acknowledged that academic literature on rural livelihoods and vulnerability to climatic change covers a wide variety of issues hence this chapter is dedicated to the literature review, giving a note to all theoretical considerations. The focus of this chapter is, therefore, to give both conceptual and theoretical clarity in a way that is relevant to this particular study. Thus, this chapter will explore the extant literature on climate change and its impact thereof. Particular attention will be narrowed to a South African context which forms the focus area of the current study.

Apart from the introductory section of this chapter, the chapter has an additional nine sections: Firstly, this chapter will explore the concept of climate change and contextualise it in a manner that will be understood in the present study. Next, the concept of vulnerability will be unpacked given note to South Africa's vulnerability to climate change. Thereafter, the concept of rural livelihood as well as the composition of rural livelihood assets will be explored. The next sections of the chapter will detail a discussion on adaptation strategies and asset-based adaptation strategies to build long-term resilience. This will be followed by a discussion on the impacts of climate change on food security and rural livelihood. Prior to the concluding remarks, South Africa's vulnerability to climate change will be discussed. Lastly, concluding remarks for the chapter will be provided.

2.2 CLIMATE CHANGE (CC)

The earth's climate varies from place to place (Rumsey & King, 2013). Increases in global average air and ocean temperatures, widespread melting of ice, and rising global mean sea levels are common phenomena in the 21st century (Rumsey & King, 2013). The earth's average surface temperature has risen by over 0.7^0C mainly due to the influence of human activities and industrialisation (Rumsey & King, 2013). According to the World Meteorological Organization (WMO, 2016), the climate is the "weather average, of measurement of the mean and variability of relevant quantities of certain variables (such as temperature, precipitation or wind) over a period of time, ranging from months to thousands or millions of years". Weather in this context refers to the "condition of the atmosphere over a short period of time" (WMO, 2016). Weather can be examined by the amount of humidity, coldness of the atmosphere, or the quantity of rainfall over a given period of time. Therefore, the climate can be described as the weather condition experienced over a given time.

CC is relatively a complex concept. The earth's atmosphere acts as a transparent, protective covering the planet, letting in sunlight and retaining heat. Without this 'atmosphere', the sun's heat would strike the earth and rebound into space, leading to temperatures on earth that would be approximately 30^0C colder (Rumsey & King, 2013). This is often referred to as 'greenhouse effect'. Over the past two decades, CC has been a matter of concern as it impacts on sustainable livelihoods, food security and economic development, especially in developing countries (Kibassa, 2013; Lema & Majule, 2009). Connolly-Boutin and Smit (2016) describe CC as an 'emerging stressor' resulting from extreme weather conditions. It is mostly driven by natural or human influences leading to changes in the likelihood of occurrence or strength of extreme weather and climate events or both (Cubasch et al., 2013). Human influence is characterised by factors such as population growth, economic activity, lifestyle, energy use, land use patterns, technology and climate policy (IPCC, 2014a). These factors contribute to the emissions of greenhouse gases to the atmosphere that eventually leads to climate change.

According to the contribution of Working Group II to the Fifth Assessment Report of the IPCC (2014b), the continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. The report cautions that future climate events will be dominated by heat waves, droughts, floods, cyclones, wildfires and climate-related extreme impacts that can cause significant vulnerability and exposure of some ecosystems (IPCC, 2014a).

In South Africa, CC does not only result in higher temperatures but also in floods and persistent droughts (Turpie & Visser, 2013). Climate change for South Africa up to 2050 and beyond under high emission scenarios include very significant warming, as high as 5-8^{0}C, over the South African interior by the end of the 21st century (LTAS, 2013). A general pattern of risk of drier conditions to the west and south of the country and risk of wetter conditions over the east of the country is projected. Many of the projected changes of climatic conditions are high, raising many uncertainties such as extreme warmer or too much rainfall (e.g. flooding) (LTAS, 2013). These negative weather events, together with the country's already stressed water resources, are expected to affect the rural livelihood and the economy at large (Turpie & Visser, 2013). Although CC and its effects affect both the wealthy and the poor, available scientific evidence suggests that the rural poor are the most hit. The prevailing projections of climate CC events require an assessment of how vulnerable the rural poor are exposed to CC and their adaptive strategies.

2.3 VULNERABILITY

The concept of vulnerability has been examined in various fields of disciplines such as in the social sciences, economics, anthropology, psychology, and engineering. These disciplines draw opinions from various theories (Singh, Deshpande & Basu, 2016). However, a consensus on its interpretation has not been reached (Adger, 2006). The human geography and human ecology are the only disciplines, in

particular, that have attributed the concept of vulnerability to environmental change (Adger, 2006). Füssel (2006) describes vulnerability using four fundamental dimensions and scenarios of a vulnerable situation (see Figure 2.1). These four dimensions are systems, an attribute of concern, hazard, and temporal reference. The *systems approach* are sometimes also referred to in some research as social systems (Dumenu & Obeng, 2016). The systems approach comprises of factors such as human environmental factors, population growth, an economic sector, a geographical region, or a natural system that places a person or group of people in a difficult situation making it impossible to cope (Füssel, 2006). For example, a community characterised by high population growth, high unemployment, and with no access to arable land for agricultural production can be categorised as systems affecting these groups of people which exposes them to a vulnerable situation.

The second dimension, which is captioned as an a*ttribute of concern*, refers to a vulnerable system that is/are threatened by exposure to a hazard (Füssel, 2006). An example of an *attribute of concern* includes potential threats of CC to human lives and health, income and cultural identity of a community, and the threat posed to biodiversity (Füssel, 2006). The third dimension of vulnerability is a *hazard*. A hazard is one of the commonest disasters that renders many people vulnerable. A hazard can be weather events such as storms, floods, droughts, or heatwaves (Geiger, Frieler & Bresch, 2018). Hazards are often threatened and cause damage to properties, results in famine, and put individuals and household disillusioned. The fourth dimension of vulnerability is a *temporal reference*. According to Füssel (2006), temporal reference of vulnerability results when an individual or a person, or collective group of people can specify a temporal reference when the risk to a system drastically changed their state of affairs. In other words, the time of interest or occurrence is crucial in defining a vulnerable situation. In the light of the above, Füssel (2006:157) used these four dimensions to define a vulnerable situation as a "vulnerability of a system's attribute(s) of concern to a hazard (in temporal reference), whereby the temporal reference can alternatively be stated as the first qualifier".

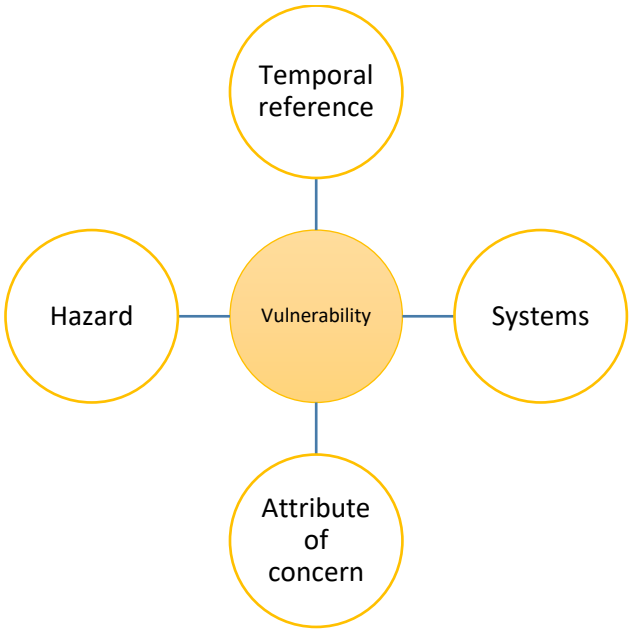


Figure 2.1: Dimensions of vulnerability

Source: Adapted from Füssel (2006:157)

From another perspective, Adger (2006) believes that there are two main antecedents or 'traditions of research' that can be used to describe the concept of vulnerability (see Figure 2.2). These antecedents or traditions of research include the analysis of vulnerability as lack of entitlements and analysis of vulnerability to hazards. Hazards overlap in the area of human ecology (or political ecology), natural hazards, and 'pressure and release' model. 'Pressure and release' spans the space between natural hazards and human/political ecology approaches.

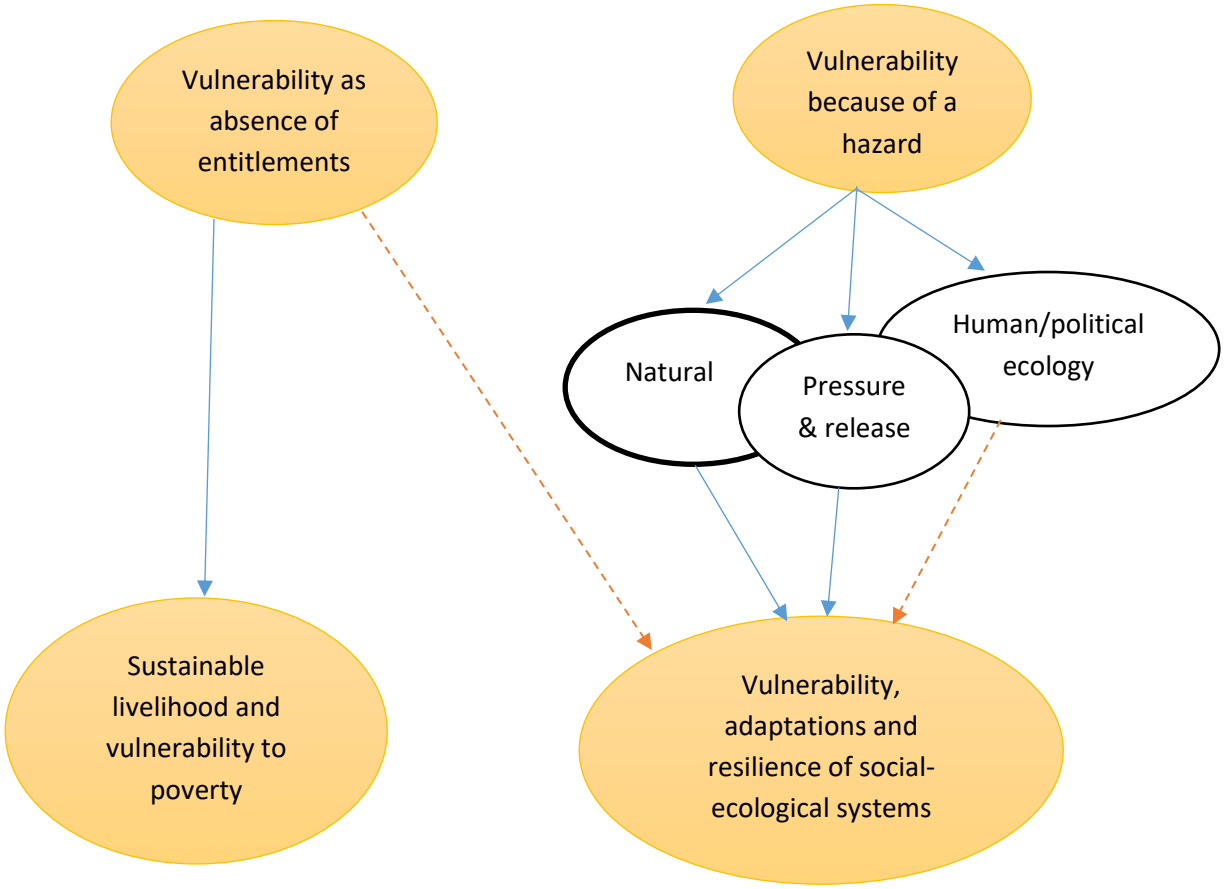


Figure 2.2: Antecedents and traditions of research on vulnerability
Source: Adapted from Adger (2006:271)

Entitlements refer to the actual or potential resources available to individuals based on their own production, assets or reciprocal arrangements. Entitlements are sources of welfare or income that are realised. They are "the set of alternatives commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces" (Sen, 1984:497). Entitlements are the belongings of an individual or the household. Vulnerability thus results when the person has lost either all or part of the belongings. The vulnerability of a person or household can also be viewed when a person has insufficient real income and wealth, and when there is a breakdown in other previously held endowments. When people

have no entitlements, this directly affects sustainable livelihoods and causes poverty. Absence of entitlements contributes significantly to famine (no food or shortages of food).

The second antecedent or tradition of research used to describe vulnerability is *hazards*. As mentioned earlier on, Adger (2006) also categorised hazards into three spheres namely natural, human/political ecology, and pressure and release. A natural hazard is the probability of anything not propelled by human but from a natural occurrence to cause harm to an individual or the community. Natural hazards include disasters such as flood and drought. Almost every natural hazards have a significant impact on society. Natural hazards also render the human population vulnerable based on where they live, their access to natural resources, and the extent to which they have to cope with available resources.

The human/political ecology forms the second component of hazard. This tradition of research states that the poor and the marginalised people in society are the most vulnerable to natural disasters. Most poor people often reside at a riskier location in urban settlements due to financial constraints. This makes them vulnerable in times of disasters such as floods, diseases and other chronic illnesses (Adger, 2006). Fordharm (2003) points out that women are the most vulnerable to environmental hazards as they carry the burden of work in ensuring that the home return to normalcy after a disaster. The third aspect of hazard displayed in Figure 2.2 is 'Pressure and Release'. Blaikie, Cannon, Davis, and Wisner (1994) conceive the model on 'Pressure and Release' and emphasise that physical or biological hazards represent one pressure and that a further pressure comes from the cumulative progression of vulnerability, from the root causes of a vulnerability within a human ecology framework. 'Pressure and release' as a component of hazard have a direct influence on vulnerability (Adger 2006).

Otto, Reckien, Reyer, Marcus, Masson, Jones, Norton, and Serdeczny (2017) also define vulnerability from a social angle stating that vulnerability is sensitive, causes

harm, and affects an individual or a society's ability to adapt. Factors such as wealth, social status, and gender influence vulnerability and exposes people to climate-related risks (Otto, Reckien, Reyer, Marcus, Le Masson, Jones, Norton & Serdeczny, 2017). Accordingly, Otto, et al. (2017) argue that the definition of vulnerability is not just the physical exposure of people, assets, species or ecosystem in places and settings that could be negatively affected, but also the society's ability to respond. Prior to Otto et al. (2017) argument, Cutter and Finch (2008) also viewed vulnerability from a social perspective and described social vulnerability as a measure of both the sensitivity of a population to natural hazards and its ability to respond to and recover from the impacts of hazards.

Füssel (2006) also conceives social vulnerability as the lack of capability of individuals, groups or communities to cope with and adapt to any external stress placed on their livelihoods and well-being. Figure 2.3 summarises the conceptualisation of social vulnerability. It follows that climate hazards interact with other stressors and exposure, which positively influences social vulnerability. Social vulnerability is therefore characterised and influenced by factors such as age, gender, race/ethnicity, the health status and disability of the individual, and access to physical and non-physical resources. These factors threaten human and socio-economic well-being such as food security, health, safety, and displacement and migration (Otto et al., 2017). It is emphasised that certain social vulnerability is not a permanent situation because the vulnerability of particular social individuals or communities might change over time when there is an environmental change or a change in social conditions (Cutter & Finch, 2008). For example, flood or drought may cause a severe impact on the social well-being of a community or an individual. Once this disaster (post-disaster) subsides, the community or the social condition of the individual might change thereafter.

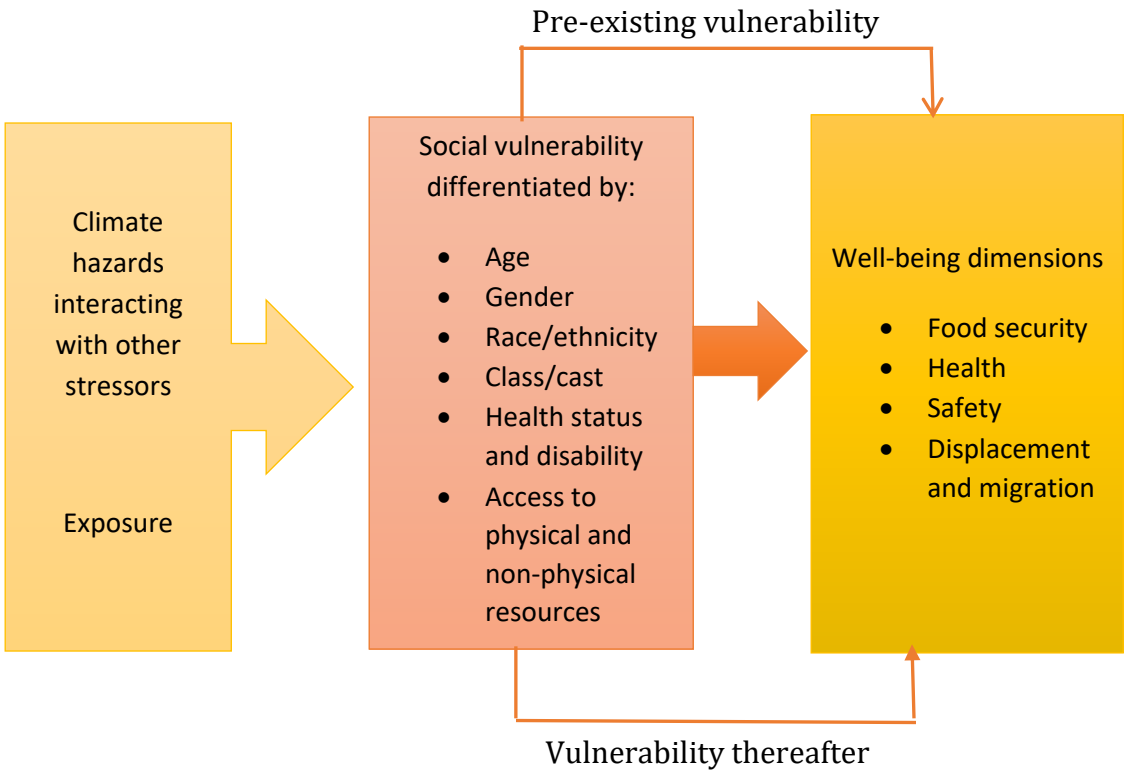


Figure 2.3: Conceptualization of social vulnerability
Source: Adapted from Otto et al. (2017)

Besides the conceptual groundings of the term vulnerability, other researchers have also offered varied interpretations. According to Coppola (2011:176), vulnerability is a "measure of the propensity of an object, area, individual, group, community, country, or other entity to incur the consequences of a hazard". Kaushik and Sharma (2015) refer to vulnerability as a "concept which involves a combination of exposure and sensitivity to weather changes, and adaptive capacity enabled by a combination of natural, social and human capital". Dumenu and Obeng (2016:209) view vulnerability as the "degree to which a system is susceptible to or unable to cope with adverse effects of climate change, including climate variability and extremes".

Coppola (2011) and Dumenu and Obeng (2016) contend that the most notable dimensions of vulnerability are physical, economic, and social impacts. The physical component of vulnerability relates to exposures which include natural hazards and

environmental stressors. The economic component refers to the impact of CC to household income distribution and effect on assets and wealth creation (Coppola, 2011; Dumenu & Obeng, 2016). The social component of vulnerability emphasises on the capacity of existing systems to deal with socio-economic factors. Examples of social factors are linked to ethnicity, gender, poverty and source of livelihood (Dumenu & Obeng, 2016). Grounded by Dumenu and Obeng (2016), Table 2.1 provides further information on social vulnerability factors, indicators, description of indicators and potential impact on vulnerability.

Table 2.1: Social vulnerability factors, indicators, descriptions, and impact on vulnerability

Major vulnerability factor	Indicators	Description of indicators	Impact on vulnerability
Demographic	Size of the household	Depends on the total number of persons living together as a family, they share resources and responsibilities such as food and financial	A substantial number of household will experience severe economic hardship which will tighten the issue of vulnerability
	Illiteracy	Includes the number of household who have no formal education. An illiterate person is someone who cannot read and write in any formal language	Illiteracy will affect employable skills in non-climate sensitive sectors. These groups of people will depend more on climate sensitive occupations (e.g. farming) and have minimal access to information regarding adaptable strategies. This in turn will increase their vulnerability
Economic	Diversified sources of income	These are households with the least number of economically active members and who are involved on secondary jobs	Diversified income sources will provide welfare resistance against shocks and lessen the impact of vulnerability
Physical	Climate sensitive occupations	This represents the number of households engaged in agriculture as a source of income	Households engaged in agriculture as their main occupations are prone to climate change. Changes to the climatic conditions affect production and impact on livelihood
Social	Access to climate change information	This represents the number of household who would have received prior information on climate change such as awareness, impacts, adaptations and mitigation, warning, drought and flood in the past five years	Available information to the public on climate change will minimize the impact. However, little or no access to information on climate change will increase vulnerability

Source: Adapted from Dumenu and Obeng (2016)

Based on the foregoing discussions, vulnerability in the context of the current study can be conceptualised (see Figure 2.4) as emerging from a number of factors such as hazards, social, systems, entitlements, resilience, and adaptation strategies which hampers a person's ability to cope with CC events.

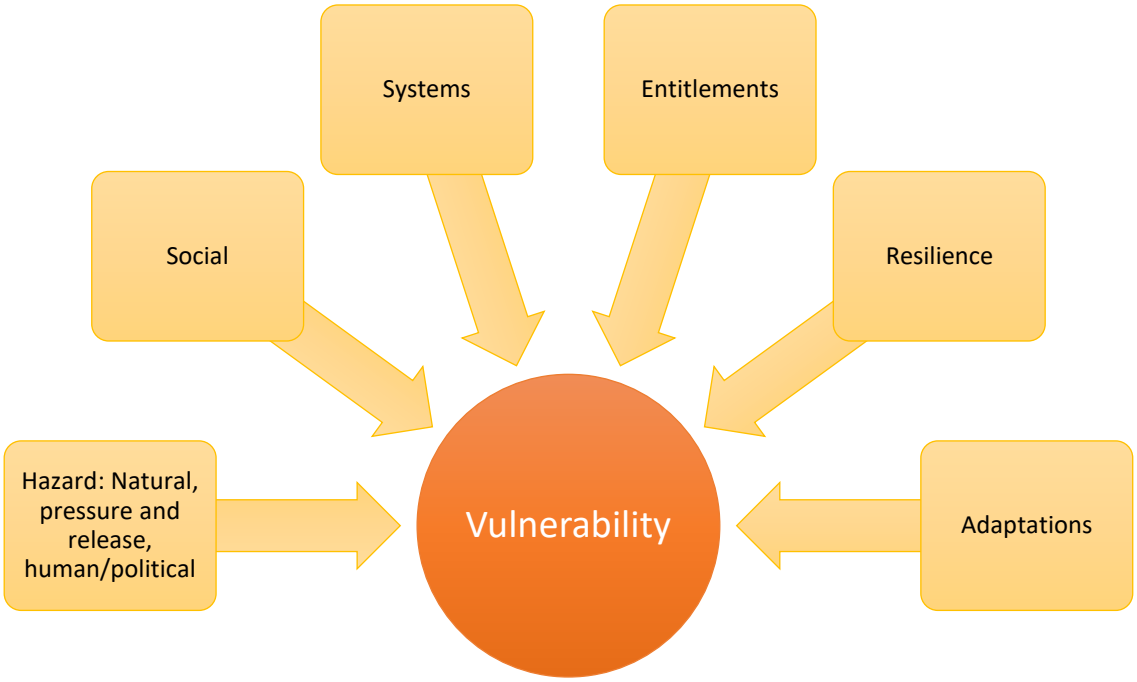


Figure 2.4: Conceptualisation of vulnerability

Source: Researcher's own construction based on Otto, et al. (2017), Adger (2006), Füssel (2006)

2.4 RURAL LIVELIHOODS

The interpretation of the term *rural livelihood* differ significantly based on the discipline investigated. Fundamentally, rural livelihoods describe the means by which the poor in rural areas are able to secure a better life. However, there is disagreement as to what constitutes a rural livelihood. Chambers and Conway (1992) describe a rural livelihood by providing certain conditions required for such a livelihood to be sustainable as follows:

> *"A rural livelihood comprises the capabilities, assets ... and activities required for a means of living. A livelihood is sustainable [when it] can cope*

with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and [when it can] contribute net benefits to other livelihoods at the local and global levels and in the short and long term".

The Department for International Development (1999) define livelihood as the assets, capabilities, and activities required to achieve a living. They further asserted that livelihood is deemed sustainable when people are able to effectively adapt their assets and emerge as victors to shocks, trend and seasonality both now and in the future in a manner that does not destroy the natural useful resource base. Ellis (2000) defines a rural livelihood as a combination of household resources and activities undertaken by a household to make a living or develop a sustainable livelihood for survival. Smith (2001) asserts that rural livelihoods are not only multifaceted in nature but also differ temporally and spatially. This is especially true in the Southern African context.

Based on the definitions provided above, it can be argued that rural livelihood refers to whether a person or group of people can cope with and recover from shocks and stressors while at the same time conserving resources for the future. Therefore, sustainable rural livelihoods are built on a combination of factors such as migration from one place to another to lessen population pressure on the land; effective subsistent agricultural methods employed by the household to supply food; access to land; and access to the skills and to viable non-agricultural employment opportunities that would ensure the survival of the household over the long term period (Bebbington, 1999).

Rural livelihoods which is the focus of this study can be influenced by the spatial setting and social and economic (e.g. capital) conditions prevailing within PSJ Local Municipality (Eriksen et al., 2005). Rural households in general and in particular at Mgugwana, Manaleni, and Ndayini should perform certain activities and adopt particular strategies to generate a livelihood. A household uses its livelihood capital to perform activities to generate income, garner social support, and gather resources to sustain itself. These activities include subsistence agriculture (involving but not limited to the growing of basic foodstuffs such as maize, cabbage, carrot), the collection of natural resources, livestock rearing and

herding, hunting, carrying out shoe repairs, sewing and weaving, informal employment functions, small- and micro-scale enterprises (e.g. hawking), and construction work. Working for a wage, sending remittances to the rural areas (from migrants and non-agricultural labourers such as miners), obtaining government pensions, as well as benefiting from social reciprocity and support from kinship networks are some of the means by which the lives of the rural population can be sustained (Chambers & Conway, 1992; Smith, 2001; de Sherbinin et al., 2008).

The choice of livelihood activities is influenced by many internal household factors (e.g. status in the community) and external/societal factors (e.g. social, economic, cultural, and political factors) collectively known as societal factors (de Sherbinin et al., 2008). CC renders several people especially in African countries vulnerable and undermines efforts to grow their economies.

2.5 COMPOSITION OF LIVELIHOOD ASSETS

Before commencing on the composition of livelihood assets, it important to discuss what an asset is from both industry perspective and livelihood assets. According to Folger (2018), an asset is anything of value or a resource of value that can be changed into money. From a business point of view, an asset generates revenue or benefit in some way from owning or using a particular asset. Assets add value to a company's equity and worthiness (Erkins, 2015). From a household perspective, personal assets include cash, property or land, personal property (e.g. household furnishings, jewellery, vehicles, and investments) (Folger, 2018).

In the context of climate change, an important factor that determines how people can adapt and become resilient to climatic change and variability have been attributed to their assets (Moser & Dani, 2008; Moser & Satterthwaite, 2008). Moser and Dani (2008) define assets as the resource endowments and capabilities possessed by the people to sustain their livelihoods and to enhance their welfare. Assets can either be 'tangible or intangible' (Moser, Sparr & Pickett, 2007). Tangible assets of the poor refers to capital endowments such as natural,

physical, human, and financial resources, whereas intangible assets may include factors such as inspirational, psychological, social, civic, and political assets, which to a large extent are increasingly becoming embedded in the human rights discourse (Moser, 2008). The degree to which the poor have access to both tangible and intangible assets determines the extent to which they will be vulnerable to either internal or external stresses such as climate change (Simatele & Simatele, 2015). From the above definitions, a common theme that emerges is that assets refer to the stock of wealth that can enhance the livelihood of the household (Sherraden, 2015). Assets also empower people to take action to overcome challenges such as extreme weather events (Bebbington, 1999).

Advocates of asset accumulation and targeting argue that a focus on *income* accumulation for the poor is inadequate since it is only meant to maintain consumption but a focus on *assets* accumulation can change attitude about how a person perceive and interact in the world (Sherraden, 2015). With assets, individuals will be able to develop long-term goals and pursue activities that will enhance not only their wellbeing but also the wellbeing of the entire household. In other words, an asset-based approach moves beyond what low-income earners lack and instead draws on the resources present within low-income people and their communities (Benenson & Stagg, 2016). Thus, the essence of the asset based approach is to investigate how low-income earners utilise their limited resources to create a sustainable livelihood. Since the context of this study is on rural livelihood's ability to cope with climate change and variability using the asset-based framework, it is important to explore the composition of livelihood assets.

Based on the research works by Bebbington (1999); Connolly-Boutin and Smit (2016); Moser (2011); Moser and Satterthwaite (2008); Siegel and Alwang (1999), there are five essential livelihood assets namely natural, physical, social, financial and human assets (see Figure 2.5). These assets could serve as the foundation for understanding how human beings respond to climate change. These assets are discussed in the following sections.

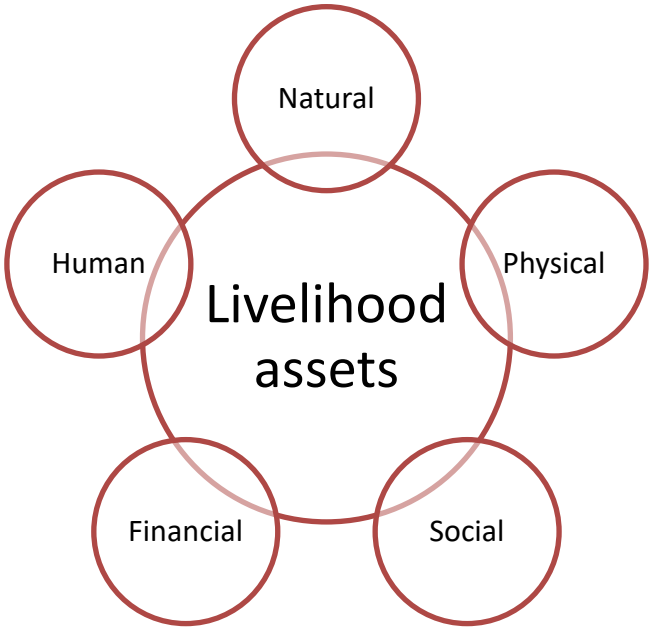


Figure 2.5: Composition of livelihood assets

Source: Researcher's own construction based on Bebbington (1999); Connolly-Boutin and Smit (2016); Moser (2011); Moser and Satterthwaite (2008); Siegel and Alwang (1999)

2.5.1 Natural assets

Natural assets are basically free gifts by nature and comprise the atmosphere, land, minerals, forests, water, and wetlands (Siegel & Alwang, 1999). Usually, these gifts are own by the household. For the rural poor, land is a valuable asset because it provides access to basic needs such as food and shelter, and provides privileges to social capital, infrastructure, and political and institutional assets (Siegel & Alwang, 1999). Natural assets can be depleted (e.g. soil fertility losses, over-harvesting of woodlands and water sources), which subsequently affects their returns-generating potential. But the land has the potential to be resilient if investments are undertaken. In practice, however, poor households often forego investments in the protection, maintenance, and enhancement of their natural assets, because they are consumption and investment poor (Siegel & Alwang, 1999). In addition, in order to smooth consumption, vulnerable households often resort to poor environmentally coping strategies which affect the natural assets (e.g. mining or overharvesting of land, forests, water, wildlife). Thus, there are

externality issues associated with natural assets, at the household, community, and extra-community levels (Siegel & Alwang, 1999).

From the foregoing discussions, it is evident that available land provides the means to obtain food and most rural households rely on this asset for their livelihood. Prior researchers have found that extreme weather conditions negatively affect natural assets and subsequently the livelihood of many communities. For example, Khayyati and Aazami (2016) analyse the effects of drought on rural livelihood in Iran. The authors investigated the relationship between drought and livelihood outcomes. Livelihood assets were used as the mediating variable. The authors actioned a cross-sectional data based on 11 years average comparison of drought severity and agricultural value added during 2002 to the end of 2012. The results suggest that severe droughts have reduced the agricultural value added and have decelerated its growth in the years when the country has experienced moderate droughts. Evidence was found for partial mediation of livelihood assets on the relationship between drought and agricultural value added. The worst drought occurred in 2008 and this affected 30 provinces. The affected provinces suffered a decline in agricultural produce and value (decrease from 136.4 thousand billion Rials in 2007 to 105 thousand billion Rials in 2008). According to Khayyati and Aazami (2016), since agriculture is the primary source of income and subsistence for many rural households, damage to natural asset diminishes the level of production and income which adversely impact on household food security.

Ebhuoma and Simatele (2017) investigated on climate variability, asset adaptation and food security nexus in the Delta State of Nigeria. Their study assessed the impact that the 2012 flood disaster had on people residing in coastal communities. The flood was caused by heavy rainfall. Their study noted that small-scale farming was the primary economic occupation of the communities of which most of the farmers were women. The men often engage in fishing, whiles others helped their wives in their fields of land to produce food. This indicates that a person's possession of natural assets (land and water) influences access to a sustainable livelihood (e.g. food). The empirical evidence from their study

revealed that the flood-affected 30 of the country's 36 states resulting in the destruction of nearly 600000 houses and displaced over 7 million people. The after effect of the flood lead to severe hunger of those households who primarily depend on agriculture for their livelihood. Most households resorted to begging from neighbours for food as their monthly income deteriorated. Some household heads had to eat once daily. Children had little access to food. Their findings thus suggest that extreme weather condition (e.g. heavy rainfall) negatively impact on food production and affect the livelihood of the household.

Another research result also suggest that variations in rainfall patterns results in loss of cropland which is a knock on natural assets possession (Niang, et al. 2014; Kotir 2011). Crop yields in most sub-Saharan Africa are estimated to fall by at least 10-20% by 2050 (Kotir, 2011; Thornton, et al. 2011). Arid and semiarid regions of the continent are expected to expand (Kotir, 2011). In West Africa, predictions are that rainfall will be more variable and less uncertain, which will reduce the length of the growing season. By 2050, crop yields could drop by 20-50% in most countries in West Africa due to climate variations (Sarr, 2012). Shisanya and Mafongoya (2016) examine the methods of and adaptation to climate change used by smallholder farmers and their impacts on household food security. Their study focused on rural farmers in uMzinyathi District of Kwazulu-Natal, South Africa. The findings from their study indicate that 95% of the household interviewed knew that the climate is changing and expected severe impacts on their crop production systems. The authors also found that "the people of uMzinyathi fear the effects of climate change on their food security because of past experiences which include rampant floods, shorter rainy seasons and decline in soil fertility". Alam, Alam, Mushtaq, and Clarke (2017) highlight that loss of land to river-bank erosion in Bangladesh lead to loss of farmland and development opportunities which resulted in insufficient food. Similarly, previous empirical studies have found that drought decreases crop production (Benitez & Domecq, 2014; Antwi-Agyei, Dougill, Fraser & Stringer, 2012; Simelton, Fraser, Termansen, Benton, Gosling, South, Arnell, Challinor, Dougill, & Forster, 2012).

Extreme weather events do not only affect the rural poor and their natural assets but also the global business landscape. In the context of agriculture, food, and beverage sector, the impacts of climate change have the potential to change growing conditions and seasons, especially a decrease in crop yields. Disruptions in the supply chain may affect production processes that depend on natural assets such as biodiversity and groundwater (Whelan & Fink, 2016). A disaster such as flood or drought affects production processes or commodity price fluctuation. For example, Bunge, an agribusiness firm, reported a $56 million quarterly loss in its sugar and bioenergy segments due to drought in 2010. Flooding in 2011 in Thailand, harmed 160 companies in the textile industry and halted nearly a quarter of the country's garment production, increasing global prices by 28% (Whelan & Fink, 2016).

2.5.2 Physical assets

The second composition of livelihood asset is physical assets. Physical assets consist of equipment, infrastructures such as road networks and other productive assets owned by individuals, households, communities or the country itself (Siegel & Alwang, 1999). According to Cao, Xu, Xie, Liu, and Liu (2016), physical assets are the measure of basic production materials such as housing and durable consumer items. Physical assets can also broadly be classified as productive assets (e.g. tools and equipment, livestock), household assets (e.g. housing, household utensils and furnishings, clothing, radio, bicycle, jewellery) and stocks (e.g. stored food) (Siegel & Alwang, 1999). Livestock, such as cattle, can be used as work animals and for transport, and also serve as stocks that can be liquidated. Bicycles and radios are important sources of transportation and communication and can also be used for non-productive purposes. Housing generates imputed income and can generate actual income when space is rented or provides a site for household businesses. Housing and household goods are also crucial in determining household size and composition, which is a major determinant of household income-generating potential and risk management strategies. Kumar, Geneleti, and Nagendra (2016) acknowledge that ownership of physical assets is an important part of building people's resilience.

Possession of stock in the form of livestock and food assist in asset diversification and risk management (Siegel & Alwang, 1999). These assets have the advantage of being fairly liquid and can be consumed or sold to earn income. Livestock can be a good store of value, and can be used for agricultural production and transport, and have other economic and social value. In 2010, statistics indicated the following South African livestock population: 13.6 million beef cattle, 1.4 million dairy cattle, 24.6 million sheep, 7.0 million goats, 3 million game species (farmed), 1.1 million pigs, 113 million broilers, 31.8 million layers and 1.6 million ostriches (DAFF 2018). Further evidence indicates that at the end of August 2016, the total number of cattle in South Africa was estimated at 15.57 million, comprising various developed dairy and beef cattle breeds (DAFF 2018). At the end of August 2016, estimated total number of sheep stood at 23.71 million with the largest numbers of sheep farmed in the Eastern Cape (29%), followed by the Northern Cape (25%), Free State (20%), and Western Cape (12%) (DAFF 2018). These livestock productions serve as huge physical assets and food stocks to the population especially the rural households.

According to the Department of Agriculture, Forestry, and Fisheries (2018), disaster management such as drought, floods and disease outbreaks are not easily undertaken due to lack of a formal identification system. Extreme weather conditions such as floods, droughts, and heat waves can significantly impact on poor people's assets especially their physical assets in terms of livestock possessions, housing, labour productivity, infrastructure and social networks (IPCC, 2014; Merrey et al., 2003). Food stock is low-return assets that are vulnerable to depreciation (storage losses of 10-30% are reported), therefore, actions to improve storage conditions are needed (Siegel & Alwang, 1999). Also, sales of clothing and household furnishings are only undertaken under times of extreme stress. Physical assets also involve infrastructural facilities (e.g. road network to veterinary institutions including artificial insemination centres, medical institutions, and electricity) in rural settlements. Better infrastructure can enhance the capacity to withstand the risk from any climatic shocks (Maiti et al., 2017).

Ebhuoma and Simatele (2017) identify the use of bicycles and motorbikes as physical assets that the less vulnerable rural households used to commute to their farms. They found that most of the rural households surveyed owned bicycles and motorbikes which they use to transport harvested cassava tubers from the farm to the grinding unit. Bicycles and motorbikes also assisted in conveying of firewood from the point of purchase or where the tree was felled to their various houses. On the contrary, the most vulnerable household especially those who did not have these physical assets walked on foot to their various farmlands, carry the harvested cassava tubers on their heads or through the use of wheelbarrow to the grinding unit. Households also collected firewood and carried them on their head to the point of purchase or where the tree was felled to their various houses. Lack of available physical assets delays production activities of farmers.

Physical assets such as road networks connecting farms to market centres may determine how a community can respond to hazards as well as aid in rapid response to receiving relief or external help to affected communities (Epule, Bryant, Akkari & Daouda, 2015; Sivakumar, Das & Brunini, 2005). Wang, Qu, Yang, Nichol, Dimitriu, Clarke and Bowden (2019) conducted a study on how the United Kingdom (UK) road system be adapted to the impact posed by CC. In their findings, the authors established that flooding has been the major occurrence affecting many people. Flooding damaged infrastructure, destroyed roads, and washed away bridges (Wang, et al., 2019). Physical assets in the form of technological (e.g. tractors and machines) and non-technological (e.g. shovels, spade) implements are also key agricultural capital (Asfaw, Pallante & Palma, 2018). Non-technological assets are linked to traditional agriculture which is often utilised by the rural household (Asfaw et al., 2018). Available technological and non-technological assets can also enhance the ability of farmers to maximize food production which, will in turn, assist the rural household to overcome hunger and poverty.

2.5.3 Social assets

This refers to the norms, rules, obligations, mutuality, and trust embedded in social relations, social structures, and societies' institutions. The IPCC, as part of its mission, has explored potential options for adapting to the negative impact of climate change. One of these avenues is to increase the adaptive capacity of smallholder farmers, especially in developing countries (IPCC, 2008). Research shows that individuals and communities, throughout history, have been able to adapt to climate change through collective ways (Adger, 2003). Thus, social relationships, networking, exchange of information as well as 'social learning' have been found to contribute greatly to environmental management and building adaptive capacity (Adger, 2003; Moser et al., 2010). This asset, popularly known as social capital, has not reached consensus in terms of its definition and measurement. For example, Putnam (1995:664) defines social capital as "features of social life – networks, norms, and trust – that enable participants to act together more effectively to pursue shared objectives". Moreover, social capital, according to Moser et al. (2010) is an intangible asset and that it is an embodiment of rules, norms, obligations, reciprocity, and trust which are embedded in social relations, structures, and institutional arrangements. The term network has been distinguished from the association. For example, Bayat (2015:33) notes that "networks are distributed groups of people that communicate with one another and work together as a unit or system for a joint purpose. Networks are more characteristic of individuals and small groups while associations are broader than networks". Thus, despite the debates around the definition of social capital, there are several elements that have been found to relate to adaptive capacity. These include social trust, reciprocity and interpersonal relationship (Pelling & High, 2005).

Pretty (2003) identifies that in the event of droughts, households that are socially connected rely on their friends and families for assistance in the areas such as obtaining shelter, food, and clothing. In some coastal parts of East Africa such as the cities of Mombasa in Kenya and Dar es Salaam in Tanzania, social capital or networks has been utilised to build adaptive capacity against extreme weather events. Kithiia (2010) reports that the urban poor resides in areas of these cities

that are subject to the highest level of risk. National and city governments in East Africa, as in many other low-income countries, do not possess sufficient resources to build appropriate infrastructure to mitigate climate change impacts, or to otherwise reduce the vulnerability of its population (Kithiia & Lyth, 2011). The collective group actions in Dar es Salaam and Mombasa demonstrate the presence and the capabilities of social capital to conserve the natural resource and in building adaptive capacity. The latter is often termed "soft engineering" methods of building adaptation (Kithiia, 2010). The soft engineering method, according to Kithiia and Lyth (2011) can be achieved through the protection of urban wildscapes, green infrastructure, and provision of spaces (i.e. heterogeneous structures which facilitate the survival of some wild species and or support biodiversity in the urban habitat). In the realm of risk management, studies have shown that the poor strategize by using networks. According to Bayat (2015), the poor can maximize social and economic outcomes in diverse ways with and even without the government intervention. Poor service delivery has been a common problem in most developing countries and that poor communities strive to manage and maintain local resources by collaboration and engaging with state institutions to facilitate service provision. From the perspective of the individual, it can be argued that farmers should strive to maximise production, reduce vulnerability, and minimise the impact of climate change. Where there is a farmer-based organisation (which is a common practice in most farming communities), leadership can engage with state institutions (e.g. District Chief Executive or Extension officer) for assistance (e.g. training, accessed to government fertilizer subsidy and tractor for mechanisation) and thus establish networks. This mechanism does not only lead to the flow of information with regards to farming practices but also behavioural change through appropriate climate change adaptation strategy.

2.5.4 Financial assets

Financial assets represent another livelihood asset. This refers to monetary resources accessible and effortlessly available to individuals, which includes loan, access to credits and savings in a bank or any other financial institutions (Siegel & Alwang, 1999). Cao, et al. (2016) refer to financial assets as disposal capital

reserves obtained through formal and informal channels. Financial assets also involve rural household access to available banking services (Maiti, 2017). Better financial status of an individual can serve as a backbone while planning a good adaptive strategy to deal with climate change or variability (Maiti, 2017). Savings is crucial and an important component of financial strength. An ability to build the habit of savings can minimise the severity of the impact of climate change (Maiti, 2017).

The physical establishment of financial institutions and policy reforms that guarantee positive real interest rates, deposit insurance, and, in general, increased confidence in financial institutions (Maiti 2017). In some case, special savings institutions, and legal protection is needed to encourage savings by females. Livestock ownership is an example of informal insurance. Livestock, however, is not a perfect means of reducing risk. Holdings of livestock are not fully liquid and ownership of livestock fulfills a number of non-insurance objectives.

Fafchamps, et al. (1998) show that livestock transactions play a little role in the sustainability of household's financial wellbeing. This assertion deviates from certain countries such as in West Africa and in India where livestock sales are almost exclusively used to smooth consumption. In a study conducted in Burkina Faso and other evidence from West Africa showed that in extreme weather events livestock sales are found to assist household consumption (Swinton, 1988).

Rosenzweig and Wolpin (1993) argue that investments in bullocks in South India help increase productivity and smooth consumption. Accumulation of cattle is impeded by weather shocks when there are borrowing constraints. Farmers sell productive assets to meet consumption needs (Alemayehu & Bewket, 2017). A person's possession of financial assets in the form of savings, pensions, or access to credit facilities enhances a community's resilience to contain the shocks related to droughts (Pretty, 2003).

2.5.5 Human assets

Human assets refer to population density, the degree of education, skills, health status and nutrition of individuals (Maiti, 2017; Siegel & Alwang, 1999). Maiti (2017) indicates that "formal education empowers rural masses in enhancing knowledge and awareness of the potential impact of climate change and climate-resilient agriculture". Labour is carefully related to human capital investments. Health and wellbeing statuses of humans influence either positively or negatively on their ability to work, whilst talent and level of education is vital because it influences individuals employability (Alam et al., 2017). Health and wellbeing of the rural household are antecedents of progressive and productive farming activities for sustainable food security (Alam et al., 2017). The idea that investments in human capital are necessary for promoting broad-based economic growth is well accepted by most governments and policymakers (Cao et al., 2016; Siegel & Alwang, 1999).

Cao, et al. (2016) argue that since peasants (rural farmers) forms the backbone of their families, their ages and level of education plays a greater role in the implementation and improvement of family livelihood strategies, which directly affect family vulnerability levels. It thus suggests that investments in human capital from infant and child feeding to education represent informal household savings and an investment in the economy as a whole. Apart from the benefit of expected household well-being, investments in human capital are a means of managing health and other risks. Siegel and Alwang (1999) outline a number of reasons why it is important to invest in human capital. First, higher levels of human capital (especially management skills) reduce transaction costs associated with reallocation of the asset portfolio. They also lead to higher returns on existing assets. Second, investments in human capital can reduce the susceptibility to risk. Better-nourished and better-educated children are less likely to become ill; higher-skilled workers are less likely to lose their jobs. Third, investments in human capital can change risk preferences and subjective appraisals of risk. Fourth, investments in human capital can be viewed as a form of precautionary savings that can help smooth consumption. Thus, household investments in human capital increase the flexibility with which labour can be

used, enhance the ability to assess and manage risk and increase returns to other assets.

Good health and good nutrition create synergisms that help to raise the productivity of all assets. Investments in human capital also increase well-being. Education and health are clear examples of goods that provide benefits that are external to the household. Because all society benefits from having well-educated and healthy citizens, there is a clear role for public interventions in education (i.e. there is an economic efficiency argument in favour of subsidized education). The level of education plays a huge impact on the household's ability to understand climate change-related information (Epule, Ford, Lwasa & Lepage, 2017; Scoones, 1998). In a community where poverty is high, evidence of literacy rates are usually low, and vulnerability to droughts becomes very high (Epule et al. 2017). Low levels of education translate into reduced earning capacity, minimal ability to understand early weather warnings and changes in planting dates (Epule et al., 2017). Besides the level of education which influence household ability to withstand climatic shocks, Alam (2016) points that good health is also vital because it enables people to pursue different farm and nonfarm activities efficiently and helps them to achieve their livelihood aspirations. Furthermore, it was found that farmers' physical health status influences their ability to farm and non-farm activities (Alam, 2016). If a farmer falls sick mainly due to inadequate calorie intake and lack of proper health facilities, they will no longer be able to perform their farming jobs and ultimately become vulnerable and a burden to the family and society (Alam, 2016).

The above sentiments thus suggest that human capital investments are directly linked to a household's ability to manage risk. Human capital can be an effective form of precautionary savings that can be used for consumption smoothing. Skipping meals and changing labour allocations are widely used practices of risk management. This implies that households hold an "excess" stock of human capital. In this context, good management of human capital can assist households to be resilient to CC. The work burden for women increases with stress as they are often expected to seek additional work, yet their duties at home are not lessened (Siegel & Alwang 1999). Risk thus imposes an inordinate burden on

women and children. Risk management efforts can have subtle effects on the balance between risk management and equity. Some efforts might shift the burden of risk management and improve equity within vulnerable households. Investments in female education, for example, raise their productivity and can increase their participation and empowerment in risk management practices (Siegel & Alwang, 1999).

There are a number of research studies that have found that climate variability and extreme weather events impact negatively on the human assets, in particular, the rural household. Alam, et al. (2017) found that households affected by extreme weather events (in their case, it was flooding) displayed higher vulnerability to health-related problems affecting both people and livestock. In addition, the number of chronically ill people were more for those areas affected by the flooding. Furthermore, accessibility to routine government services such as hospitals became a hindrance due to damaged road networks (Alam et al., 2017).

2.6 ADAPTATION STRATEGIES

Often conditions like "coping with," "resilience" and "adaptation" are being used interchangeably, though they imply severally, success, recovery, and improvement once damage, whether it be an abrupt loss, as with disastrous drought, or continuous loss, or such as a progressive drop in drinking water convenience. CC adaptation cannot be branded as a couple of mounted activities designed to alleviate a particular group of conditions. Instead, weather change adaptation may be a basic effect interlocked toward creating and guarding decisions that change communities to answer environmental and cultural conditions.

Adaptations can be categorised as either groundwork actions or adaptation actions (Ford et al., 2015). A groundwork actions are the immediate steps necessary to inform and prepare for adaptation. They are not physical or tangible changes in policy or delivery of government services that improve resilience. A groundwork action may include an assessment of impact and vulnerability,

research on adaptation options, conceptual tools, stakeholder and networking opportunities, and recommendations for adaptation action. Groundwork actions are important as it serves as a step to full adaptation and assists in government planning (Lesnikowski et al., 2011).

Adaptation actions, on the other hand, are solid changes made to intentionally minimise vulnerability or adaptive capacity to climate change (Ford et al., 2015). Adaptive actions include initiatives such as changes made to built environments, the delivery of government services, organisational mandates, or regulations in response to predetermined impacts of climate change (Ford et al., 2015). It is important to limit the impact of climate change and vulnerability through sustainable adaptation ways. Stock, Birkenholtz and Garg (2019) argue that all farmers especially those within the global south are vulnerable to CC. The authors recommended that adaptation programs should be decentralised to community-level institutions. This practice will enhance the efficiency to address CC risks more proactively. Strong knowledge by the community on adaptation strategies is of utmost importance to prepare for both long-term and short term CC risks (Clarke, McNamara, Clissold & Nunn, 2019). Encouraging innovation is important to minimise community vulnerability and escalate resilience in the long-term (Clarke, et al., 2019). Cafer, Green and Goreham (2019) grounded a community resilience framework (CRF) (see Figure 2.6).

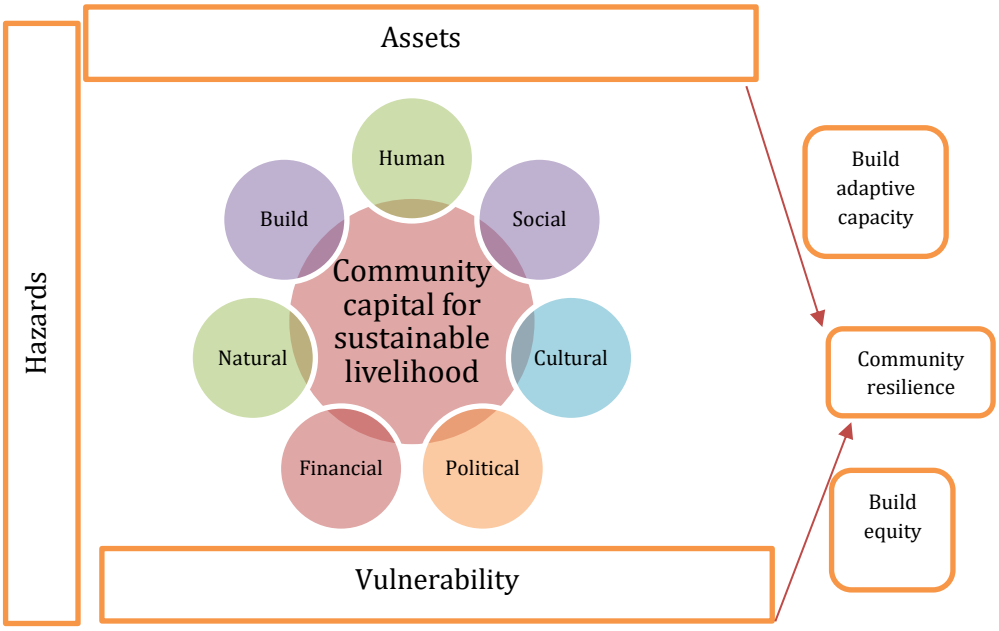


Figure 2.6: Community resilience framework (CRF)

Source: Adapted from Cafer, Green and Goreham (2019)

Cafer, et al. (2019) explains that "a system's vulnerability to hazards is inversely related to its resilience or the number of assets per hazard that are strengthened. Systems may assess their points of vulnerability by evaluating the strength of assets relative to each asset". Therefore, to optimise community resilience there is the need to firstly build adaptive capacity through the assets possessed by a person or a household. Secondly, it is vital to building equity to minimise exposure to vulnerability (Cafer, et al., 2019). It is therefore argued that incorporating the fundamental ideas of the CRF into the current study will add value and strengthen the research findings.

2.7 ASSET-BASED ADAPTATION STRATEGIES TO BUILD LONG-TERM RESILIENCE

Adaptation strategies have increasingly received more attention over the past decade and are well organised in the literature. Moser and Satterthwaite (2008) argue that asset adaptation refers to the measures or steps adopted by individuals or households in preparation for, or in response to, actual or expected changes in weather conditions. The aim of undertaking these actions is to

minimise adverse impacts or to take advantage of the opportunities presented by these changes (Frayne et al., 2012). This is because climatic risks have been observed to present some opportunities (Scheraga & Grambsch, 1998). The above claim is based on two premises; first, it has been observed that the vast majority of assets owned by individuals and households, particularly the poor, are susceptible to multiple stresses, shocks, trends and/or seasonality (Frayne et al., 2012). Thus, there is a need for the poor to adopt various strategies in order to minimise the adverse effects of climate variability and change and associated risks on their livelihood assets. This is because the more assets people have or have easy access to, the better equipped they will be to continue in food production and vice versa in the aftermath of an extreme weather event (Prowse & Scott, 1998).

The second premise is the fact that the poor are not passive victims to the impacts of climate variability and change. They are actively and consistently trying to seek various ways in which they will be able to protect and modify their assets against climate variability and change (Frayne et al., 2012). It is, however, important to note that there are major ways in which individual's and households employ asset-based adaptation strategies to minimise the impacts of climate variability and change on their livelihoods.

This is arguably the most effective means of preventing extreme weather events. But for the poor, it can be the most difficult to implement due to the limited resources at their disposal (Moser, 2011). Insuring farmlands, for example, could be a means whereby households can protect their food, which is crucial for the attainment of the livelihood they pursue, against the extremities of weather conditions. However, this act can have adverse implications for the financial capital of the rural poor because the premiums could be extremely high. Other asset-based adaptation strategies employed by households to build long term resilience include renting or purchasing farmland in a region less prone to extreme weather events (Moser, 2011). In the following sections, a holistic analysis of pre-disaster and post-disaster strategies to minimise climate variability will be assessed.

2.7.1 Pre-disaster strategies to minimise destruction to productive assets

Prior to any anticipated extreme weather event, adopting a strategic plan can help reduce the loss of productive assets (Moser, 2011). To facilitate asset-based adaptation by protecting and limiting damage to livelihood assets, social capital, for example, can be relevant. To illustrate, there is a tendency for social capital to facilitate the dissemination of climate information in a timely manner within communities that are expected to be affected by an extreme weather condition (Moser, 2011; Moser & Stein, 2011). This could enable the poor to adopt strategies such as early planting, planting crops on the elevated ground (if the farmland where they usually cultivate on is highly prone to flooding) and early harvesting. Within this context, IKS has been observed to play an important role in reducing the possible loss of the farm produce and other productive assets of the rural poor (Nkomwa et al., 2014; Roncoli et al., 2002).

Roncoli et al. (2002), for example, argue that prior to the 1997 food shortages in Burkina Faso, the resource-constrained farmers, through the use of their IKS, were made aware of a looming crisis six months before the official forecast was disseminated. In a related vein, Fabiyi and Oloukoi (2013) argued that the appearance of the full moon in some rural coastal communities in Ondo and Delta States of Nigeria was an indication that coastal flooding is inevitable to occur. As a result, the farmers started preparing to harvest their farm produce. These findings show that, while local farmers lack a thorough understanding of the processes that lead to the change in climatic conditions they are experiencing, they possess ample knowledge of climate conditions in their local environment (Pareek & Trivedi, 2011). This is, arguably, because their livelihoods are overwhelmingly tied to the natural environment and therefore, they have come to rely on various local indicators to predict future weather events and prepare accordingly.

2.7.2 Asset-based adaptation post-disaster strategies

Prior researchers have found an association linking vulnerability to droughts and its impacts on socio-economic development. Assets, whether natural, physical,

social, financial, and human aspects significantly impacts on the ability of a community to cope with climate change-related problems (Alemayehu & Bewket, 2017; Ebhuoma & Simatele, 2017; Epule et al., 2017; Epule et al., 2014; Gbetibouo, Ringler & Hassan, 2010; Mabiru & Banda, 2012). Several authors have also offered valuable recommendations on adaptation strategies that farmers can employ post extreme weather events or climate change. Pinto et al. (2012) classify post-adaptation strategies in Ghana into four options. Firstly, dealing with risk and uncertainty (e.g. indigenous knowledge, weather, and climate information services and early warning, crop insurance, raising of awareness and access to information). Secondly, farming practices and technology (e.g. drought-resistant varieties, soil conservation and erosion control, crop diversification, and specialisation, irrigation). Thirdly, off-farm practices and strategies (e.g. improve post-harvest, food storage practices, migration, empower communities, and females). Fourthly, national development policy (e.g. agricultural intensification and land use policy, access to and governance of water, institutional reforms).

Alemayehu and Bewket (2017) studied about smallholder farmers' coping and adaptation strategies to climate change and variability in the central highlands of Ethiopia. Their research involved 200 farm holders in three districts, three focus group discussions and three informant interviews in each district. The authors identified various local farming adaptation strategies used by farmers. These strategies were grouped into four main categories. The first category was land management (social and water conservation, tree planting, irrigation and fertilizer, and manure (dung) application). The second adaptation strategy found was crop management (changing planting dates, crop diversification and the use of drought-tolerant and fast –maturing crops and improved seeds). The third adaptation strategy identified was livelihood diversification and adjustment (off-farm income, seasonal migration, change in consumption pattern, taking credit, land renting, and remittance). The fourth adaptation strategy was livestock management (decreasing the population of livestock, the use of cross-bred livestock and diversification). Their findings also revealed that selling of livestock was the most widely coping strategy, followed by changing consumption pattern.

Changing crop planting dates emerged the most preferred adaption option. Only a few surveyed farmers (10%) utilised irrigation as an adaptation strategy.

Epule, Ford, Lwasa, and Lepage (2017) recommends that because maize yields in the north of Uganda are more vulnerable to droughts, all stakeholders must find better ways of making maize production more resilient to the severity and continuous drought. Agroforestry, irrigation, agro ecology-based organic nutrient inputs, research, training and innovation, and information diffusion were proposed as key adaptation strategies (Epule et al., 2017). Furthermore, Bawakyillenuo, Yaro, and Teye (2016) explored the adaptation strategies to climate change and climate variability in selected villages in the rural northern savannah zone of Ghana. The villages were selected from the Savelugu Nanton, West Mamprusi and Kassena Nankana East Districts. Their findings corroborate with the results of many studies regarding the adaptation strategies used by the rural household. Intensification of irrigation, integration of livestock production, changes in tillage practices, fertilizer and other inputs application on farms, shift from agriculture to non-farm jobs, seasonal migration and purchase of drought insurance for maize were the valuable adaptations strategies utilised by the rural farmers (Bawakyillenuo et al. 2016).

In the aftermath of any disaster, individuals and households usually embark on rescue missions with a goal to recover those assets that have been affected by the disaster. Subsistence farmers, for example, will go out and attempt to harvest crops that did not rot away in the aftermath of a flood (Frayne et al., 2012). Human and social capitals, for example, could play an immense role in enabling the poor to bounce back into food production. This is because friends, relatives and some governmental and NGOs can provide financial assistance and/or offer to lend them parcels of land and seedlings, so that they can engage almost immediately in food production, thereby ensuring that they continue to obtain the livelihoods that they always seek for (Frayne et al., 2012). It is, however, necessary to mention that there are growing concerns that future climate-related events will affect household's ability to utilise IKS to predict weather events accurately due to the unprecedented rate at which extreme weather conditions

are expected to occur globally (IPCC, 2014b; Kalanda-Joshua et al., 2011; Roncoli et al., 2002; Shepherd et al., 2013). Consequently, only by planned adaptation strategies will the rural poor be able to protect and adapt their assets, and in so doing, continue more effectively in food production (Fankhauser et al. 1999).

The use of technology can also improve the effective management of asset adaptation and reduce the severity of climatic risks agricultural practices of the rural poor (Hansen et al., 2011; Shisanya & Mafongoya, 2016). Extreme weather conditions such as drought can severely affect agricultural practices of the rural poor. However, farmers who have irrigation facilities can use these implements to draw water in order to solve the negative effect of climate change or variability on their crops. Irrigation is the artificial application of water to the soil through various systems of tubes, pumps, and sprays (Schultz & De Wrachien, 2002).

It has also been argued that anticipated extreme weather events should be conveyed to vulnerable groups by personalising or tailoring the message. Individuals need to be able to effectively understand how the predicted extreme weather will affect their livelihood. This will enable them to adopt proactive behaviours that will aid in mitigating the impacts of the anticipated extreme weather event (Lorenzoni & Pidgeon, 2006; Pelletier & Sharp, 2008). According to Spence and Pidgeon (2010), "personal relevance impacts on the ways in which information is processed". Meyerowitz and Chaiken (1987) argue that proactive behaviours will only be adopted when the consequences of inaction have been successfully communicated. Nonetheless, studies have shown that being a past victim of extreme weather condition influences the adoption of proactive actions (Siegrist & Gutscher, 2006). In this regard, Shisanya and Mafongoya (2016) found that after extreme weather events the main adaptation strategies by farmers include growing of different crop varieties, planting different fields at different times, an application of organic fertilizers, leaving some of their fields fallow, minimum tillage, planting trees alongside, cropping on valley bottoms and mixed cropping.

In a different survey conducted by the FAO (2006), climate change adaptation strategies were classified into traditional strategies, government supported

strategies, alternative and innovative automatic adaptation strategies, and technology-driven strategies. Thus, recognition of local knowledge seems to be one of the means of enhancing awareness and adaptation of climate change. Following the classification of Pinto et al. (2012) and FAO (2010), recommended indigenous adaptation strategies to mitigate climate variability, the literature unveils and classifies different indigenous adaptation strategies used by smallholder farmers such as, for example, re-sowing and changing the timing of farm operations (Kuwornu et al., 2013). The FAO (2010) categorised indigenous adaptation practices into three, namely, income coping strategies, cutback strategies, and agricultural coping strategies.

2.8 IMPACTS OF CLIMATE CHANGE ON FOOD SECURITY AND RURAL LIVELIHOOD

Under all the emission scenarios, the surface temperature is expected to rise which implies that changes in precipitation will occur (IPCC, 2014). CC will increase the existing pressures on water resources from poor management, degradation, and competing uses. Irrigation alone will not be sufficient to adapt to CC, and can indirectly drive vulnerability if water resources are not well managed. Yields of key cereal crops such as maize are most likely to decline due to temperature rise and decreasing water availability, with significant implications for commercial investment, small-scale farmers, and food security. The most significant impacts of temperature rise on agriculture were largely the effects on water availability and pests and diseases, including the possible expansion of pest and disease ranges and significant impacts on soil moisture and fertility (FAO 2010). Agriculture is a sector severely affected by climate change causing adverse risks on crop production and food insecurity to the African continent (IPCC, 2014).

Food security is a "situation in which all people at all times have physical and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 2006). The IPCC (2014) confirmed that CC undermines food security which will negatively impact on the world's increasing food demand. The global population rose to 6.9 billion

in 2010, with the greatest proportion emanating from developing countries (FAO, 2009). Magdoff and Tokar (2010) found that decreased food production is evident in less developed countries due to CC. The relative impacts of CC on food security may differ across regions. For instance, most vulnerable countries in Africa's food insecurity are due to factors such as extensive reliance on rainfall for crop production, high intra- and inter-seasonal variability, recurrent droughts, and floods that affect both crops and livestock, and persistent poverty that limits the capacity to adapt (Boko et al., 2007).

Livelihoods of the majority populations especially in Africa is dependent on agriculture, so even minor variability at some times of the year can represent a shock to income or food availability only because food security and weather are so tightly linked for smallholder and subsistence farmers (IPCC, 2014). Food systems might be affected by climate change in several ways ranging from direct effects on crop production such as changes in rainfall leading to drought or flooding, or warmer or cooler temperatures leading to changes in the length of growing season, as well as changes in markets, food prices and supply chain infrastructure (IPCC, 2014).

CC impacts negatively on *poor households*. The poor and food-insecure generally have a narrow economic resource base with few options for expanding their incomes, either on-or off-farm. They often lack access to adequate resources such as land, improved technology, credit, extension advice and training and how to market (mostly women farmers) (FAO, 2006). While women may find themselves with additional work and no greater food security, men are normally benefiting from productivity-enhancing technological innovations. Similarly, men migration to the city or to work on large farms results in an extra burden on the women who remain on the farms (Premanandh, 2011). Additionally, low levels of education and skills, make the off-farm employment seasonal and low paid, and hence they end up on purchasing a small portion of food which is sometimes not enough to feed the whole household.

Furthermore, CC significantly impacts on s*carce water resources.* The world's water resources are limited relative to human demand due to population growth, industrial expansion, and irrigated agriculture, exceeding supply in developed and developing countries (FAO, 2008). There is no creation of new water on the planet and the hydrological cycle is the only means to recycle available volume of water through a well-coordinated system between the earth and the atmosphere (FAO, 2008). The volume of available and accessible water remains roughly the same and it is predicted that the situation will worsen in the future due to the growing population (FAO, 2008). Water is the key to food security as crops and livestock need water to grow, and general agriculture requires large quantities of water for irrigation and of good quality for various production processes (UNCTAD, 2011). Hence water scarcity might impact agricultural production as well as food security.

Extreme weather events may also occur due to CC. The IPCC (2012) report defines an extreme event as "the occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable". While the high latitudes and the equatorial Pacific are likely to experience an increase in annual mean precipitation, the mid-latitude and subtropical dry regions mean precipitation will likely decrease, and in many mid-latitudes wet regions, mean precipitation will likely increase. Over most of the mid-latitude land and over wet tropical regions, masses extreme precipitation events will very likely become more intense and more frequent. Based on these predictions, it is certain that there will be more frequent hot and fewer cold temperature extremes over most land areas on daily and seasonal timescales, as global mean surface temperature increases. It is very likely that heat waves will occur with a higher frequency and longer duration (IPCC 2012). Occasional cold winter extremes will continue to occur (IPCC 2014).

Extreme weather events such as droughts and floods are likely to be frequent which can cause significant impacts to the agriculture sector, economy, and food security. Droughts and floods are highly uncertain, and there are serious implications for widespread crop failure, costly damage to infrastructure, and

degradation to soil and land. The ocean will continue to warm and acidify, and global mean sea level to rise (IPCC, 2014).

2.9 SOUTH AFRICA'S VULNERABILITY TO CLIMATE CHANGE

South Africa is one of the countries in Africa severely affected by climate change. Increased daily maximum temperatures in summer and autumn; increased incidents of flood and drought, and enhanced temperature causing air-pollution problems are examples of persistent CC confronting the country (Strydom & King, 2013). The poor are the least able to organise resources to adapt to such dramatic changes and thus climate change is difficult but necessary to tackle. This section of the chapter will explore South Africa's vulnerability to CC in three key sectors of the economy namely agriculture, water, and health.

2.9.1 Agriculture

Agriculture is one of the most important sectors in several African countries, averaging 24% of GDP for the continent (Byerlee, Garcia, Giertz, Palmade & Palmade, 2013). Majority of Africa's population continue to derive at least part of their livelihoods from agriculture (Murphy & Carmody, 2015). Projections indicate that agriculture and agribusiness will reach US$1 trillion industry in Sub Saharan Africa by 2030 (Byerlee et al., 2013). In South Africa, agriculture, forestry, and fisheries contributed significantly to the country's GDP growth rate of 3.1% in the fourth quarter of 2017 resulting in additional 39000 jobs (Department of Agriculture, forestry and Fisheries, 2018). Despite the huge economic successes contributed by the sector to many countries including South Africa, there are continuous challenges especially, the adverse impact of CC on agriculture.

Several authors have conducted an impact assessment of CC in the agricultural sector and have focused on staple crops and key commodities, such as maize and plantation forestry, using a range of crop modeling approaches (Ziervogel et al., 2014). One common approach incorporates process based mechanistic modelings such as Decision Support System for Agrotechnology Transfer (DSSAT) and Agricultural Production Systems Simulator (APSIM) (Johns et al.,

2003). Another common approach uses climate envelope distribution modeling to estimate changes in crop or plantation forestry suitability (Bradley et al., 2012). The latter approach uses observed empirical relationships between abiotic variables such as climate, and current distribution or crop presence points to estimate suitable areas under future climate. Other studies have investigated the economics of CC impacts on crops (Blignaut, Ueckermann & Aronson, 2009; Benhin, 2006), yield and soil nitrogen level interactions (Walker & Schulze, 2008), changes in pest and disease distribution (Schulze 2010), and the impact of climate change on the livestock sector (Archer van Garderen, 2011; Hoffman & Vogel, 2008).

Ziervogel, et al (2014) found that climate change negatively affects key cereal crops, including maize for the summer rainfall region, and wheat for the winter rainfall region. Impacts on key agricultural pest species were found to be a serious concern, with a number of key pests and pathogens projected to increase (Ziervogel, et al. 2014). Diseases and pests that threaten the maize crop were projected to be greater problems as the temperature rises. Maize production, contributing approximately 70% of South Africa's total grain production, is predicted to also fall by up to 20% over the next 50 years as a result of the hotter and drier conditions, even as a growing population increases food demand. Similar evidence indicates that climate-related event reduces crop yield and absolute crop failure and causes a high incidence of pest and diseases (Elum, Modise & Marr, 2017).

Rangelands are landform whose natural vegetation is dominated by grasses and shrubs are not usually used for growing annual crops (such as corn) but for grazing (Hoffman & Vogel 2008). As patterns of precipitation shift with warmer temperatures, the productivity of the rangelands will decline, having a negative impact on the cattle-ranging industry. Moreover, the animal disease will spread, causing additional losses. Drier grasslands will lead to rangeland fires of increased intensity (Archer van Garderen, 2011; Hoffman & Vogel, 2008).

2.9.2 Water

South Africa is a water-stressed country, and has been classified as a 'semi-arid' in receiving just over half the world's average annual rainfall and, even without CC, demand is more than supply due to the country's population growth and increased industrialisation. Because water is already a limiting factor for economic growth in most of the provinces in South Africa, CC has serious implications for socio-economic development in the provinces. Water Hydrological models using downscaled climate projections have been the primary means of assessing sectoral impacts (Perks & Schulze, 1999; Schulze, 2005; Schulze et al., 2010). The hydrological system is dynamic, and changes in climate may result in unanticipated hydrological responses, possibly beyond the ranges for which the models' ability to represent processes has been tested (Warburton, Schulze & Jewitt, 2010). Preliminary projections under the wide range of scenarios generated by the MIT hybrid approach (LTAS, 2013) for runoff range from a 20% decrease to a 60% increase by as early as 2050, while under a constrained emissions scenario projections of runoff range from a 5% decrease to a 20% increase (LTAS, 2013).

Spatially, the eastern seaboard and central interior of the country are likely to experience increases while much of the Northern and Western Cape are likely to experience decreases in runoff (Ziervogel et al., 2014). Studies on the impact of climate change on water resources have begun to look beyond changes in streamflow to changes in the timing of flows and the partitioning of streamflow into baseflows and stormflows, reservoir yields, and extreme hydrological events (Stuart-Hill & Schulze, 2012). Many provinces in South Africa suffers continued periods of drought or simply lower rainfall than required (LTAS, 2013). This occurrence is also evident in the current study site. A warmer climate will alter the intensity and seasonality of rainfall, leading to increasing water shortages, increased desertification, and, at times, flooding. While some regions may receive more surface water flow, water scarcity, increased demand for water and water quality deterioration are very likely to be increasing problems in the future. LTAS (2013) report on CC effects confirms that future climates situations will be characterised by higher frequencies of flooding and drought events. Complexities

of the hydrological cycle, influences of land use and management and the linkages to society, health, and the economy indicate far higher levels of complexity in the water resources sector than in other sectors (Ziervogel et al., 2014).

The influence of CC on water quality is an emerging research field in South Africa, with assessments limited to water temperature (Schulze, 2010). In certain provinces of South Africa, such as the Western Cape, available water is limited, causing serious crises. In some catchments of the province, water deficit already exist when the ecological reserve is factored into the water allocation, meaning that too much water is already being abstracted from the system if the integrity of the ecosystems that depend on this water is to be maintained. Adaptations that will be required are much greater efficiency in use, especially in agriculture, which implies investment in technology and know-how to improve efficiencies, investment in alternative sources are required. The arid and semi-arid regions, covering more than half of South Africa, are particularly sensitive to changes in precipitation. Desertification, which is already a problem in South Africa, will be exacerbated as the climate changes. A critical interaction that has not been explored is between changes in water quality and quantity and the combined impacts, such changes might have an impact on various types of water use, e.g., irrigation, domestic consumption, or aquatic ecosystems support (Ziervogel et al., 2014).

2.9.3 Health

A country's development is wholly or partly dependent on the quality of the health of its citizens. It is based on this notion that measures need to be taken to address key factors that can potentially affect the health standards of the people. Studies investigating the impact of climate variability and change on the health of the people are rising and all evidence point to greater health risks. In the context of South Africa, the potential impacts of CC are relevant to a range of key health risks, including heat stress, along with high precipitation and drought have been shown to affect morbidity and mortality (Thompson, Matamale & kharidza, 2012). Many studies have also investigated on climate-sensitive health outcomes including diarrhea, respiratory, cardiovascular health, and vector-borne

infectious diseases such as malaria (Myers & Rother, 2013; Myers et al., 2011). LTAS indicates climate change's potential impact on vector-borne disease (DEA, 2013), although the incidence of vector-borne infectious diseases, principally malaria, in the South African context, has declined over recent years. Modeling predicts no overall increase in malaria incidence for sub-Saharan Africa but a shift from west to south and east are driven by climate CC impacts (Peterson, 2009; Byass, 2009). Evidence also suggests that areas prone to malaria are predicted to be more than double in the next 50 years, putting over 7 million South Africans at risk. Predicted flooding and temperature increases also create a habitat for infectious diseases such as bilharzia, thus also exposing a greater proportion of the population to this disease (Strydom & King, 2013).

Mathee, Oba, and Rose (2010) document that there is decreased productivity among workers who are exposed to high temperatures. Further key health risks seen as potentially impacted by CC include: food insecurity; hunger and malnutrition; natural disasters; air pollution; communicable diseases, specifically HIV/AIDS; non-communicable disease; high injury burden; mental health; and occupational health (see, for example, LTAS's detail on heat stress risks for agricultural workers).

2.10 GAPS IN KNOWLEDGE

As noticed in the literature, CC has been a global challenge and continues to affect many nations, communities, households, and individuals. The literature also revealed that a substantial amount of empirical evidence exists on the impact of CC from a global perspective. It is argued that whiles there is research on the impact of CC and vulnerability globally, little empirical data exist on how the rural poor are vulnerable to CC in South Africa. The Eastern Cape is one of the poorest provinces in South Africa. However, no empirical research could be located focusing on the three study sites selected for the current study. Furthermore, literature also suggests that the stock of assets enhances an individual's ability to remain resilient in extreme CC events (Sherraden, 2015). The asset-based framework has been extensively used to examine how households and individuals utilise their available assets to address the impact of climate change

(Simatele & Simatele 2015). No studies could be located in the Eastern Cape Province of South Africa that has applied this framework to explore the vulnerability and adaptation of rural households' livelihood to climate change. It is envisaged that the current study will close this void and enhance the applicability and reliability of the framework in a South African context. Thus, the findings from this study will contribute to the scholarly advancement of knowledge on the use of the asset-based framework.

2.11 CONCLUDING REMARKS

This chapter highlights the theoretical overview of climate change and vulnerability, as well as perspectives on livelihood assets and adaptation strategies pre and post extreme weather events. Five livelihood assets namely natural, physical, social, financial, and human were identified in the literature and explored in the context of climate change and climate variability. Prior literature indicates that lack of these assets affects household ability and resilience to respond and adapt to climate shocks. Furthermore, the literature emphasises that knowledge of pre and post-disaster adaptation strategies can facilitate and avert household vulnerability. It is argued that the household's level of education current knowledge of climate forecast can enhance their ability to prepare for any climate shocks. In the aftermath of a disaster, several adaptation strategies have also been offered. These include but not limited to the selling of livestock, changing planting dates, crop diversification, land management, application of fertilizer and manure, and application of technology such as irrigation techniques.

CHAPTER THREE

THE STUDY AREA

3.1 INTRODUCTION

The aim of this chapter is to share light on the geographical and socio-economic characteristics of the three study areas that this study focused on. This chapter will also foster a better understanding of the study sites in which the fieldwork was undertaken. The chapter is demarcated into a number of sections. The first section provides a brief overview of the history of South Africa, socio-economic and physical characteristics of the country. Next, a brief history and composition of the Eastern Cape Province of South Africa are presented. This is important since the study area is located in this province. Thereafter, Port Saint John's (PSJ) Municipality, a town in the Eastern Cape Province will also be explored. Thereafter, the three study sites including the farming activities of the area are presented. The last section is the concluding remarks.

3.2 SOUTH AFRICA: A PROFILE THE COUNTRY

South Africa is a country located at the Southern tip of the African continent (Indexmundi, 2018). It shares borders with five countries namely Namibia, Botswana, Zimbabwe, Mozambique, and Swaziland, while the Mountain Kingdom of Lesotho is landlocked by South African territory in the south-east (South African Government, 2018). Adjacent to the country is bodies of water, Indian and Atlantic oceans. The country has a total land area of 1 219 602 square kilometers and stretches latitudinal from 22 to 35 degrees South and longitudinally from 17 to 33 degrees East (South African Government, 2018). The interior land consists mostly of flat plateau-rising from approximately 1000 meters to 2100 meters above sea level.

The country has approximately 12.6% of land size that is suitable for agricultural cultivation. South Africa is a water stress country with only 30% of the country receiving over 500mm of rainfall per year (Pringle 2013). The country also has huge deposits of minerals such as gold, coal, platinum, and diamonds (Minerals

Council South Africa, 2018). In 2017, the mining sector contributed R312 billion to the country's GDP and a total of 464 667 people were employed by the sector (Minerals Council South Africa, 2018). Demographically, South Africa's population is estimated to be 57.7 million with the elderly population accounting for 8.1% (Statistics South Africa, 2018). The location of South Africa in Southern Africa is displayed in Figure 3.1.



Figure 3.1: Location of South Africa in Southern Africa

Source: Adapted from Google Map (20/12/2018)

In 1994 the country obtained independence from colonial rule making it one of the youngest countries on the African continent to gain political independence. The country has nine provinces with an average population density of 46.09 square kilometres in 2016 (Trading Economics, 2018). The population density varies widely. On average, Northern Cape has the biggest land mass but the lowest population density of 3 people living per square kilometre. Gauteng has the smallest land mass out of all the provinces but the highest population of 650 people per square kilometre (South African Market Insight, 2018).

3.3 A BRIEF HISTORY

Historically, the indigenous South Africans were Africans (Ross, 2008). In 1652, Jan van Riebeck, an European, first arrived at the Cape. The seventeenth century was the golden age of the Dutch Republic, its merchants was the most successful in Europe pioneered by the greatest trading operation of the Dutch East Indian Company (Saul & Bond, 2014). Van Riebeck's arrival at the Cape of South Africa was motivated to establish a route station at the Cape for provisioning the Dutch ships sailing to and from the far more lucrative East Indies (Saul & Bond, 2014). This mission was later changed to allow white settlement by 'free burghers' in order to grow and supply agricultural produce. From this practice, a white settler-based colony began to grow in South Africa. New farmers found better opportunities in herding sheep and cattle over large tracts of land (Saul & Bond, 2014).

Between the periods of 1806-1910, the country became under the control of the British colony and by the end of the eighteenth century, farmers of European descent had conquered most of the territory to the west of the Fish River and to the south of the Gariep (Ross, 2008). The Afrikaners (origins of Dutch) assumed governance of the country from 1941-1994. During this period, the country was characterised by racial oppression springing from the dictates of racial ideology (Ross, 2008). Due to racial segregation and oppression, several political formations emerged especially among the African population to resist European authoritarian rule (Ross, 2008). The various black political groupings came together to form the so-called Congress Alliance in 1955 at Kliptown to adopt a foundational document which was referred to being the historic Freedom Charter. The premise of the Freedom Charter was 'South Africa belongs to all who live in it, black or white' and demanded a democratic nation, 'one-person, one vote' (Ross, 2008).

The Struggle for freedom continued unabated between 1960-1990, and in 1994, the African National Congress (ANC) led by Nelson Rolihlahla Mandela obtained political power–formal democracy of the country which embraced all racial populations (Ross, 2008; Saul & Bond, 2014). Since 1994, the country has

successfully held four democratic elections. The next section is aimed at providing a brief history of the socio-economic characteristics of the country during pre-and-post-colonial dispensation.

3.4 SOCIO-ECONOMIC CHARACTERISTICS OF SOUTH AFRICA

As specified in Chapter 1, the current study aims to find out **how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security**. To reach a valid and reliable conclusion, it is important to explore the socio-economic characteristics within South Africa. This information will assist to make inferences from the study sites selected for the study. The economic situation and trend in South Africa have been unequal in the past 20 years. The poverty headcount ratio in 2010 was 16.5% and rose to 18.9% in 2014 (The World Bank 2019). Poverty in South Africa increased again in 2015 (Statistics South Africa, 2017). There are over half of the South African population (55.5%) who were poor in 2015 (Statistics South Africa, 2017). In terms of provinces, more than 50% of the adult population in the four provinces were poor. These provinces include Limpopo (67,5%), followed by Eastern Cape (67.3%), Kwazulu-Natal (60.7%) and North West (59.6%) (Statistics South Africa, 2019). Gauteng (29,3%) and Western Cape (33.2%) had the lowest population of adults living in poverty (Statistics South Africa,2019).

In 2015, South Africa placed the value of food poverty line at R441 and the proportion of population below this poverty line stood at 25,2% which translated to 13,8 million of people living below the food poverty line (Wilkinson, 2018). The most vulnerable groups of the population were women, black people children, and people with no education. More women than men have lived in poverty since 2006 (Wilkinson, 2018). Nine out of ten poor people in South Africa (93%) were black people (Wilkinson, 2018). White South Africans have the lowest levels of poverty (1% of the population) (Wilkinson, 2018). In 2015, 66,8% of children lived in poverty. 79,2% of South African adults with no education lived in poverty (Wilkinson, 2018).

According to the General Household Survey (GHS) conducted by Statistics South Africa (2019), significant progress has been made in service delivery over the years. Access to drinking water (89, 0%) was common in 2018, followed by access to electricity (84,7%), and improved sanitation (83,0%) (Statistics South Africa, 2019). Furthermore, while South Africa generates 60 percent of Africa's total electricity, 70 percent of black South African households have no access to electricity (Tarp & Brixen, 2014).

The South African government through its National Development Plan (NDP) identified agricultural productivity and rural development as an engine to job creation, economic growth, poverty reduction, and reducing food security and have made significant strides in this sector (South African Market Insight 2019). In 2002, 13,5 million South Africans experienced hunger and this number dropped drastically in 2017. Households that experienced hunger also decreased from 2,7 million to 1,7 million households within the same period (South African Market Insight 2019).

In 2011, about 2,9 million (19,9%) reported that they were involved in agricultural activities and 2016, this declined to 2,3 million households (13,8%)(South African Market Insight 2019). The decrease in households' agricultural activities ws evident in all provinces. Generally, 7,5% of South Africans engaged in agricultural activities as a source of food. Within the Eastern Cape, only 6,5% of households are involved in agriculture (South African Market Insight 2019).

Moreover, increased drought has impacted severely on the agricultural sector of the country with adverse effects felt on food security. It is against this background that the study aims to find out how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security. Since the study area was located in the rural areas of the Eastern Cape- a province in South Africa, it is important to also offer a brief history of the province.

3.5 EASTERN CAPE PROVINCE OF SOUTH AFRICA

The aim of this section is to provide a brief discussion of Eastern Cape Province where the study was conducted. The intention is to provide a brief history of the province, discuss the geography and climatic characteristic of the area. The geography and climatic conditions are important as the impacts on farming activities. Since the climatic and geographical conditions also have an influence on human population, demographic and socio-economic characteristics of the area will also be investigated.

3.5.1 Brief history of Eastern Cape Province

The early history of Eastern Cape Province was characterised by a different period of human way of living. Documented history characterised the early period as the Stone Age period where people have lived in the Eastern Cape for at least 100000 years. During this period, people lived in caves and ate mainly shellfish, seals and other seafood, as well as antelopes and plants. Nearly 10000 years ago hunter-gatherers people moved into the province, mostly origins of the San people. These group of people moved from place to place hunting animals and collecting plants for food. The San people lived along the coast such as Matjies river rock shelter near Keurbooms River and the Nelson Mandela Bay cave near Plettenberg Bay (Cadman, 2007).

Between 1000 and 2000 years ago, the Khoikhoi people who herded cattle, sheep and goats also arrived in the Eastern Cape. They hunted animals for food and gathered wild plants. The Khoikhoi people lived in small huts made out of sticks and thatching grass. About 1500 years ago, Xhosa people whose ancestral origins came from central Africa slowly moved to South Africa and settled in Eastern Cape. The Xhosas lived in small villages, grew crops such as millet, and herded cattle. At the passage of time, the Xhosas and Khoikhoi people dominated the province. During the 17th century, white settlers moved into the Eastern Cape in search of land for farming. This motive was resisted by the original occupants of the land which resulted in protracted wars between the British (backed by the Boer farmers) and the Xhosas. These wars over land were termed 'Frontier Wars'. Nine frontier wars were fought in the Eastern Cape and in 1820 about 4000

British settlers arrived in the Eastern Cape to make the Cape Colony stronger (Cadman, 2007).

In 1858 about 4000-5000 German settlers also arrived in the Eastern Cape. This intensified the war over land with the Xhosas and between 1887-1889, most Xhosas had lost their land. The history of the Eastern Cape also has its reference to the Anglo-Boer war (1899-1902) between the British and Boers. Part of the war was fought in the Eastern Cape. Most of the world's famous leaders such as Nelson Rolihlahla Mandela and Thabo Mbeki were born in the Eastern Cape. In the 1960s, two biggest 'homelands' namely Transkei and Ciskei were formed. Many people in the Eastern Cape opposed apartheid, and large numbers of people were sent to jail for protesting against the colonial rulers or for their beliefs (Cadman, 2007).

3.5.2 Geography and climate of Eastern Cape Province

The province covers a land area of 168966 square kilometres, representing 13.8% of the total area of South Africa. The population density is approximately 39 people per square kilometre. The majority population group is black Africans, with isiXhosa as the most spoken language (Statistics South Africa 2014). The province is characterised by rocky, mountains, and grasslands which impede agricultural production. East of approximately longitude 250E, soils have formed under wet summer and dry winter conditions. Eastern Cape receives precipitation during the year and the soil contains grey sandy and sandy loam soils. Most of the soil in the province are not characterised by high fertility (Hall, Nel, Mabin, Vigne, Gordon & Thompson, 2018). Within the Lusikisiki area, Bühmann, Beukes and Turner (2006) found that 80% of soils require K fertilisation for adequate crop yields.

Climatically, South Africa has four weather seasons (South African Weather Services, 2018b) namely:

i. Autumn: This falls between the months of March to May. During this period the weather is foggy with little or no rainfall.

ii. Winter: This falls between the months of June to August. Winter season is mostly cool to cold. Within the Eastern Cape Province, the temperature seldom drops below 10^0C during daytime (Cadman, 2007).

iii. Spring: This falls between the months of September to November. Spring season is the period where the country experiences intermittent rainfall. However, the rainfall during this season is not enough to address the country's water shortfall.

iv. Summer: This falls between the months December to February. Summers are warm to hot and the temperature during this period range between 23 and 27^0C. During the summer period, both day-time and night-time temperatures rise significantly. The summer period is the period where the province experiences some form of rainfall. The province receives between approximately 630mm to 650mm of rain during the year.

South Africa experienced severe droughts in certain areas of the province. From December 2016 to November 2018, a prolonged drought occurred in most parts of the country including the Eastern Cape (South African Weather Service, 2018a). Majority of farming activities in the Eastern Cape are subsistence in nature, where production is intended for household consumption with little aim of selling for profit. Rural households engage in the cultivation of vegetables grown in home gardens. The success of these gardens largely depends on rainfall and hand watering. Vegetables produced include cabbages, spinach, carrots, onions, green pepper, tomatoes, potatoes, beans, peas, sugar beet. Limited fruit production occurs in the province, with tomatoes becoming the common vegetable cultivated. The PSJ local Municipality land is suitable for a banana plantation. However, the majority of rural households in and around PSJ spanning to Lusikisiki engage in growing cereal crops (such as maize) for their own consumption. Because most of the farming practices rely on rainfall, any adverse climatic changes severely affect food security, especially among rural households.

3.5.3 Demographic characteristics of Eastern Cape Province

Brief demographic characteristics and composition of the Eastern Cape Province are provided in Tables 2.1 to 2.4. In terms of the population, there is a constant

increase in the number of people living in the Province from 1996 (6147244), 2001 (6278651), 2011 (6562053). In 2011, the total population in the province was 12.7% representing the fourth highest number of people in the entire country. Majority of the population who are unemployed were black Africans (547454, see Table 2.2). The total number of females exceeds the number of males in the province (see Table 2.3). Regarding the dwelling type, a huge number of the population live in informal dwelling. It has to be noted that there are a large proportion of households whose dwelling type are informal (7.7%) and traditional (28.2%). More than 77% of the Eastern Cape population use isiXhosa as their first language and the languages least spoken were Siswati and Tsonga (Statistics South Africa, 2014).

Table 3.1: Population distribution by Province based on 1996, 2001 and 2011 Census

	Census 1996		Census 2001		Census 2011	
Province	**Number**	**%**	**Number**	**%**	**Number**	**%**
Western Cape	3956875	9,8	4524335	10,1	5822734	11,3
Eastern Cape	6147244	15,1	6278651	14,0	6562053	12,7
Northern Cape	1011864	2,5	991919	2,2	1145861	2,2
Free State	2633504	6,5	2706775	6,0	2745590	5,3
KwaZulu-Natal	8572302	21,1	9584129	21,4	10267300	19,8
North West	2727223	6,7	2984098	6,7	3509953	6,8
Gauteng	7834125	19,3	9388854	21,0	12272263	23,7
Mpumalanga	3123869	7,7	3365554	7,5	4039939	7,8
Limpopo	4576566	11,3	4995462	11,1	5404868	10,4
South Africa	40583573	100,0	44819778	100,0	51770560	100,0

Source: Adapted from Statistics South Africa (2014)

Table 3.2: Age distribution of persons 15-64 years by labour market status and population group of Eastern Cape, Census 2011

	Africans		Coloured		Indian or Asian		White	
Labour Market Status	Number	%	Number	%	Number	%	Number	%
Employed	740675	22,1	136616	38,4	10736	53,9	130417	62,5
Unemployed	547454	16,3	56811	16,0	1385	6,9	8862	4,2
Not Economically Active	2063531	61,6	162434	45,6	7811	39,2	69554	33,3
Total	3351660	100,0	355862	100,0	19932	100,0	208833	100,0

Source: Adapted from Statistics South Africa (2014)

Table 3.3: Population distribution by five-year age groups and sex of Eastern Cape, Census 2011

Age group	Male	Female	Total
0-4	387956	379261	767217
5-9	361487	354506	715993
10-14	352824	331459	684283
15-19	374534	365980	740514
20-24	300394	307979	608373
25-29	236394	253912	490306
30-34	182662	205925	388587
35-39	161535	197869	359404
40-44	139451	187885	327336
45-49	127867	180741	308608
50-54	120201	170604	290805
55-59	101945	140460	242405
60-64	82810	113820	196630
65-69	56894	83576	140470
70-74	47471	78479	125950
75-79	26770	54466	81236
80-84	16788	36939	53727
85+	11717	28494	40211
Total	3089700	3472355	6562055

Source :Adapted from Statistics South Africa (2014)

Table 3.4: Percentage distribution of households by type of dwelling in Eastern Cape, Census (2011)

	Formal dwelling	Informal dwelling	Traditional dwelling	Other
Eastern Cape	63,2	7,7	28,2	0,9

Source: Adapted from Statistics South Africa (2014)

3.5.4 Eastern Cape Province: Locating the study sites

Choosing the study site is an important but challenging aspect of any fieldwork study especially those in social sciences. As stated in Chapter 1, this study intends to evaluate the impact that climate change has on rural livelihoods and their adaptation response to climate variability using an asset-based framework in rural communities in Eastern Cape, South Africa. To be able to achieve this goal, it was purposely decided to focus on three rural communities within PSJ Local Municipality. In order to select the rural communities for the study, a complete list of all the rural communities was obtained from the municipality (see Appendix D). These communities had been grouped under various wards. The lottery technique was then consulted and this resulted in Mgugwana, Manaleni, and Ndayini locations selected for the study. The three communities can be located along the road from PSJ to Lusikisiki (see Cartography map of the marked study area in Figure 3.2). Although the lottery technique was used in selecting the study site, these communities have unique common characteristics such as poverty, disease, high unemployment, and the fact that no research could be found that investigated the livelihood of these communities and their adaptations thereof in relation to climate variability and how they utilise their available assets to cope. The latter might potentially assist the government and policymakers to be able to assist the communities where necessary. Since the study sites are located under PSJ Local Municipality, a brief description of the district will be provided. Thereafter, a brief discussion of the three study sites will be offered.

3.5.4.1 PSJ Local Municipality

PSJ Local Municipality is located in the OR Tambo District of the Eastern Cape Province and has a total land area of approximately 1239 square kilometre (8800

hectares). The municipality share borders with Inquza Hill Local Municipality to the north, Nyandeni Local Municipality to the west and King Sabatha Dalindyebo Local Municipality to the south. The municipality comprises of one urban area and approximately 130 rural areas. The total population is approximately 165000 people consisting mainly of Black Africans (99%), White, coloured, Indian/Asian (1%), women (55%), male (45%). The municipality is characterised by a moderate, humid, and sub-tropical coastal climate. Summer temperatures vary from an average maximum of about 25^0C to an average maximum of 20^0C, whilst winter the maximum and minimum are 21^0C and 8^0C respectively. The annual rainfall varies between 1100 and 1400ml and occurs mostly between October and March. Extreme weather conditions are uncommon. The municipality also has mountainous terrain with hills, cliffs, beaches, and sand dunes. The slopes are as deep as 1:3 or steeper. The sandy area is underlain by sedimentary rock (Port Saint John's Municipality, 2011).

Settlement patterns remain influenced by the vegetation and topography of the land. High-density areas are limited to developed areas while the highest population remains in the rural villages. The estimated employment figure is as low as 4%. Education and skills levels remain low and have poorly resourced schools and poor access to educational facilities such as road and transport. HIV/AIDS pandemic remains high and poverty is huge and a critical issue (Port Saint John's Municipality, 2011).

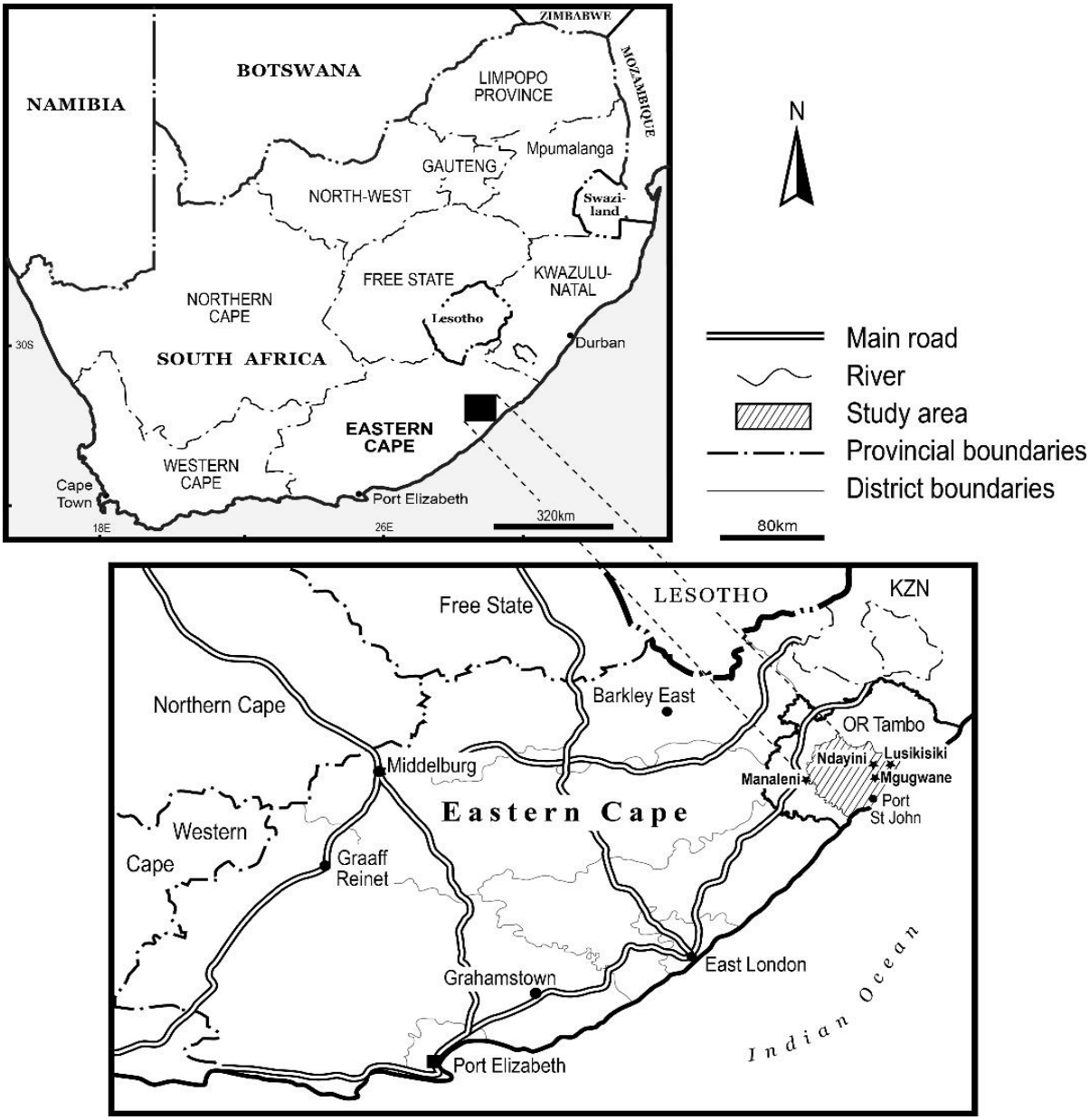


Figure 3.2: Location of study sites in Eastern Cape Province

Source: Cartographic Unit, University of Witwatersrand (2018)

3.5.4.2 Mgugwana location

Mgugwana location is a rural location under PSJ Local Municipality. It has a land area of approximately 1.45 square kilometres and a population of 750 people (Census 2011a). The area has a total of 147 households. They have more females (422) than males (328) and all the population is Black Africans (Census 2011a). Most of their house dwelling are informal and traditional buildings. Major

shopping malls are located in the peri-urban area of PSJ or Lusikisiki. Over 50% of the population depends on government social welfare for a living. Poverty, illiteracy, crime, and HIV/AIDS and other diseases (e.g. tuberculosis) are high in the location (Census 2011a).

Most of the households possess some form of assets such as a plot of land (approximately 40 to 200 square meters), cattle, donkeys, and house. Besides the government welfare support, they engage in subsistence farming within their backyard or on a designated piece of land. They often use their cattle and donkeys to plough the land for planting their crops. Maize, cabbage, potatoes, carrots, and spinach are the main crops cultivated by the household (Port Saint John's Municipality, 2011). Although they possess little assets, they are passive and seldom utilize these assets to adapt to extreme climate change. Landowners and subsistence farmers cultivate the plots while it awaits rain or government support (in the form of irrigation facilities or fertilizer). Their adaptation strategies are constrained by lack of money and adequate knowledge, thereby causing many of their subsistence farms destroyed.

Mgugwana location has a high migration of their youthful population who often travel to major cities such as Durban and Johannesburg in search of job opportunities. Most of them find employment in the mining industries and other peasant jobs. Climate change and variability have become an 'enemy of progress' and a contributor to poverty in the area. It is against this background that Mgugwana location as a whole is suitable to conduct this study.

3.5.4.3 Manaleni location

The second rural location selected for the current study is Manaleni location. It is a small farming community just after Ndayini location around Ntafufu administrative area of PSJ local municipality. It is about 18 kilometers from the main R61 tarred road leading to both Lusikisiki and PSJ. The area has a land size of 1.12 square kilometres and a total population of 253 people living in 55 households (Census, 2011b). There are fewer males (94) compared to the female population of 159. Approximately 99.60% are Africans with isiXhosa as their first language (Census, 2011b). Many people in the location are unemployed and so

depend on a government grant for a living. The community is one of the poorest locations in the municipality with a high poverty and crime prevalence. Food security outlook assessments show that the location is severely affected by climate change and the food security situation is poor. Rainfall in the location is low which negatively impact on their subsistence farming activities. The soil fertility in the location is also very poor and characterised by rocks. The location has no commercial farms. The main economic activities include subsistence agriculture, animal farming and petty trading involving predominantly women who trade in PSJ and Lusikisiki (Port Saint John's Municipality, 2011). The community has one primary and one secondary school.

3.5.4.4 Ndayini location

The third study site of this study is Ndayini location. The location is among 130 locations under PSJ Local Municipality. It is believed that the location was established about 160 years ago. From this location, one has to travel 6 kilometers of gravel road before joining the R61 tarred road to either Lusikisiki or PSJ for shopping and other social services. The area has a land size of 2.15 square kilometres and is home to approximately 279 people (Census, 2011c). The area is mountainous terrain with valleys which is prone to erosion. One can visibly observe gulley erosion due to stormwater runoff (Port Saint John's Municipality, 2011).

The community depends on rainwater and one river which runs through the area for household water and for agricultural usage (see Figure 3.3). Compared to Mgugwana and Manaleni locations, the area has 48 households. Males (143) are more than females (136). Over 99.64% of the population are Black Africans with isiXhosa as their first language (Census, 2011c). Most households engage in some form of subsistence farming on their backyard or piece of land (Port Saint John's Municipality, 2011). Maize farming is common in the area, however, it is often cultivated during raining season (Port Saint John's Municipality, 2011). The soil fertility of the area is also poor. There is a high rate of unemployment which has left the local people in adverse poverty. The community has only one primary

school but with no clinic. There is a high rate of crime and teenage pregnancy leading to high dropout of teen girls from school.

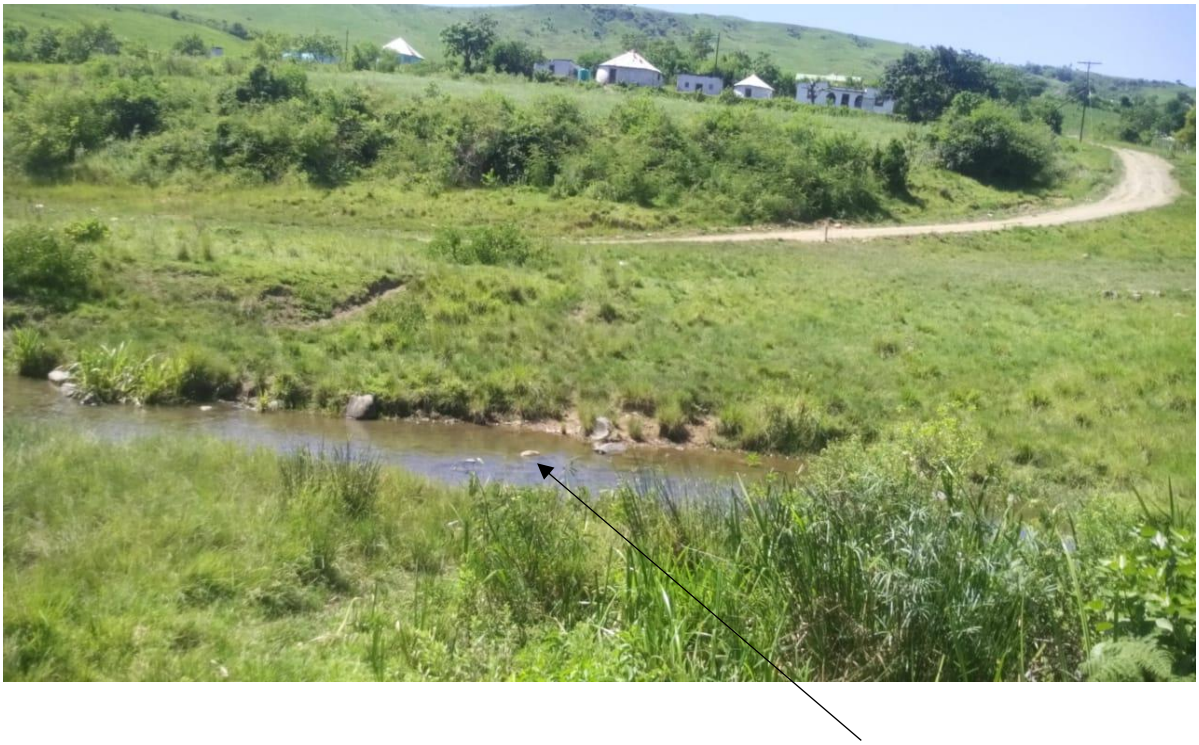


Figure 3.3: Small running water for the area

Source: Picture was taken by the researcher from fieldwork (2018)

3.6 CONCLUDING REMARKS

As stated earlier on, the aim of this chapter is to present the study sites selected for the study. The three study sites were chosen using the purposive sampling method because the focus of the study is on rural locations adaptations to climate change. As highlighted South Africa is a young democratic country with a history stemming from the apartheid regime. The Eastern Cape Province where the study sites were grounded also suffered from the apartheid colonial rule, which led to many of the population without land. The imbalances of the past especially social exclusions of black Africans contributed to poverty and other associated diseases (e.g. HIV/AIDS and tuberculosis). In the current democratic dispensation, many black Africans possess some form of assets (e.g. land) but are passive about adaptation strategies to cope with extreme weather conditions. The three study sites selected for the current study are areas of concern. There is increased

poverty due to high illiteracy and households' inability to adapt to climate change. Agriculture whether commercial or subsistence can contribute to reduction in poverty among rural households. Therefore, studies into vulnerability and adaptation of rural households' livelihoods to climate change in the Eastern Cape, South Africa is important as it will serve as an instrument to guide rural dwellers to improve on food security.

CHAPTER FOUR

METHODOLOGICAL ISSUES AND CONSIDERATIONS

4.1 INTRODUCTION

The theory on climate change, food security, asset portfolio and adaptation strategies to climate change were discussed in chapter 2. Five livelihood assets namely natural, physical, social, financial, and human assets were identified as important resources that enable rural households to remain resilience in the event of climate shocks. Lack of or insufficient possession of these assets exposes the rural population to a more vulnerable situation. It was also found that rural households adapt to extreme weather events using various strategies. Some of the strategies include selling of livestock, changing planting dates, and crop diversification. In Chapter 3, a detailed description of the study site was provided.

This chapter is devoted to methodological discussions and explores the different methods and steps that were implemented in the study. The methodology is important because it considers and explains the logic behind research methods and techniques. A carefully planned research methodology will serve as a guide to the researcher and outlines relevant attributes of the research procedure and methods followed in the study (Takhar-Lail & Ghorbani, 2015).

In view of this, the chapter is divided into the following order. The chapter commences with a recap of the research aim and objectives. It is important that this aim and objectives are stated because they have implications on the nature of the research philosophy and the methodology that was adopted for this study. Thereafter, the manner in which research is conceived of in terms of the research philosophy subscribed to are provided. Next, the research design process followed in the current study is discussed. The study population and sampling will also be described. Other components of the chapter include data collection tools, pretesting the questionnaire, data analysis, validity and reliability, ethical consideration, and methodological reflections. The chapter ends with a conclusion synthesizing the entire chapter.

4.2. RECAPPING THE RESEARCH AIM AND OBJECTIVES

In chapter one of this study, the aim, objectives and research questions for this study were stated. However, in order to ensure that the research methodology and considerations are aligned, it is important to recap the aims and objectives stated for the study. The primary aim of this study is to find out how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security. To be able to achieve this aim, a number of objectives were formulated for the study. The first objective was to discuss ways in which changes in weather patterns are negatively impacting the livelihoods of the rural poor. The second objective was to discuss how the rural poor adapt their assets to build their resilience against food insecurity. The last objective was to develop a framework for social and other types of risk management in rural areas, with a focus on rural areas in South Africa. The framework will be grounded in the literature on risk, its management, and the relationship to desired outcomes of reduced vulnerability and broad-based growth.

Four research questions were put forward to assist in addressing the objectives. These questions are:

i. To what extent are the rural poor affected by climate change?
ii. How do rural households adapt to climate change?
iii. How does climate change render the poor more vulnerable?
iv. What are the household livelihood assets and risk factors associated with climate change in the chosen study area?

4.3 RESEARCH PHILOSOPHY

A research philosophy describes the assumptions, values, and beliefs about the nature of reality, knowledge, and methods for obtaining knowledge (van der Walt & van Rensburg, 2010). The basic philosophical assumptions guides and directs the thinking and action of the researcher (Mertens, 2010). The research philosophy addresses the nature of knowledge and explores how to generate, understand, and use the knowledge that is deemed to be acceptable and valid (Mertens, 2010). Maree and van der Westhuizen (2010) argues that “research is

about understanding the world, and one's understanding is informed by how you view the world, what you view understanding to be and what you see as the purpose of understanding". Three main research traditions namely positivism, interpretivism, and critical realism have been documented (du Plooy-Cilliers, Davis & Bezuidenhout, 2014).

Positivists advocate for the application of natural sciences methods to study certain phenomena. They believe that science could enlighten people and, in the process, make the world a better place to live in. Thinkers of this tradition believe that only an objective, observable and verifiable facts should be considered when attempts are made to understand and explain natural and social phenomena. Positivists believe that knowledge is the results of empirical observation only, through the testing of hypotheses against the real world. They contend that reality can be observed and measured and that the duty of the researcher is to discover the law that governs reality. They are not interested in examining the unobservable internal motivations of an individual's behaviour. Thus positivists place emphasis on objective and value-free research, where theories are tested by using hypotheses. The quantitative research strategy drives this tradition. Therefore, they aim at recording facts in terms of quantities or numbers using statistical techniques (du Plooy-Cilliers, et al., 2014).

The second tradition which guides the thinking of researchers is interpretivism. Unlike the positivist's approach, interpretive aim to understand human behaviour. They argue that facts are not objective and natural, especially in the social sciences. Instead what is factual depends on the context and people's interpretation of information. They believe that reality is a social construction and that it is dependent on the meanings that people ascribe to their own experiences and interactions with others. They tell stories, describe and interpret how people living in a particular context conduct their lives. They rely on detailed descriptions and direct quotes from participants. They depend on qualitative research using methods such as focus groups, in-depth interviews, ethnography and narrative inquiry (du Plooy-Cilliers, et al., 2014). The qualitative research is an approach for exploring and understanding the meaning individuals or groups

ascribe to a social or human problem. It also involves emerging questions and procedures, data analysis inductively building from discussions to general themes and making interpretations of the meaning of the data (Creswell, 2014).

Critical realism constitutes the third tradition of guiding researchers. The aim of this tradition is to expose myths, to transform society and free people from all forms of oppression, and to empower people to build a better world for themselves in the process. They do not see knowledge as permanent, but something that should be considered within the historical and social context. They believe that certain aspects of reality are seen as real and exist independently of human interpretations. Because critical realists' emphasis on change, they maintain that theory should be practical and include a plan for change. They argue that no single method can provide definite results about any given object of research and advocate for mixed-method research. This involves the combination of quantitative and qualitative research (du Plooy-Cilliers, et al., 2014).

4.3.1 Selecting the tradition for the current study

The aim of this section is not to engage or be involved in the current debates surrounding the strengths or relevance of each of the traditions guiding researchers. However, it has to be pointed out that the choice of any of the traditions should be able to address the purpose and objectives formulated for the research. Therefore, considering the preceding arguments about the traditions, the overall concern is that the selected tradition should be suitable to the purpose, objectives, and research questions formulated for the current study, and should be rigorous in its operationalization. Overall, the critical realism ideology was considered suitable for the study. This allowed for the application of the mixed method (both quantitative and qualitative methods) in collecting and analysing the data in the study. Furthermore, the use of both qualitative and quantitative methods became necessary to identify both internal (necessary) and external (contingent) relations (Zachariadis, Scott & Barrett, 2013). The interplay between methods not only helped to ensure completeness and complementarity in the study but also advanced the research strategy by enabling to build on the

results from different methods and develop a systematic process of inquiry (Zachariadis, et al. 2013). Finally, the decision to combine both qualitative and quantitative research techniques was made to provide a more complete understanding of the research problem (Creswell, 2014) and to compensate for the limitations of the other methods and thus provide a diversity of ideas or responses(Creswell, 2014; Zachariadis, et al. 2013). The written report has a flexible structure (Creswell, 2014) offered respondents the opportunity to tell their stories, capture those stories as they emerged and also record some of the facts in the form of numbers or quantities.

4.4 RESEARCH DESIGN

Research design can be viewed as the architecture or masterplan for the entire research. It represents advance planning of the methods to be adopted for collecting the relevant data (Kothari, 2004). The plan also covers important aspects such as target population, programmes or tools, samples, measurements, adopted to address the aim and objectives of the study (Maree, 2013).

4.4.1 Target population

A distinction between the population and target population is of vital importance in research. The population comprises the total objects or individuals, or a set of a well- defined class of people. The population also serves as the basis of the research. The defined target population, on the other hand, is the population which is actually studied (Jha, 2014). The target population for the study involved all subsistence individual or household farmers who reside at Mgugwana, Manaleni, and Ndayini locations of Port Saint John's Municipality. These farmers should have lived in the location for a minimum of two years and embarked in some form of farming in the location over this period. The nature of their farms could range from small backyard or compound farms to a large scale subsistence farm. Both males and females were involved in the study but only those aged over 19 to 65 years were interviewed. Individual or household farmers were purposefully targeted because these respondents would be able to provide the needed data to achieve the objectives of the current study.

4.5 APPROACHING THE INTERVIEWEES: DATA COLLECTION METHODS

Another important component of the research plan is how the data collection process was executed. The data collection method consists of specific procedures, tools, and techniques used to gather and analyse data. In an effort to strengthen the research findings for the study, questionnaires, interviews, and participants observations were used. The procedures adopted in this process are discussed below.

4.5.1 Semi-structured questionnaires

The current study utilised a semi-structured questionnaire to obtain the required data. A semi-structured questionnaire combines some structured questions to obtain basic information with others that permit more flexible answers to convey ideas or perceptions in an open-ended manner (Desai & Potter, 2006). In this study, semi-structured questionnaires were handed over to individual household farmers from the three study sites to be completed. Where necessary the researcher assisted participants who could not read nor write to complete the interview questionnaire. The questions were simple, clear and easy to understand. It had both open-and closed-ended question. Open-ended questions were included to enable participants to express their personal experiences regarding climate change, food security, adaptation strategies, and their impact on the community. Closed-ended questions provided some choice of answers for participants to select.

The questionnaire was divided into four sections. The first section collected information on basic demographic and socio-economic characteristics of respondents. This information include the gender, age, education level, size of the family, occupation, source of income, and rationale for farming. In most of the studies related to the rural locations, it has been documented that capturing the demographic information of the respondents enables the research to categorise respondents and draw comparisons between the different categories (Van Heerden, 2011). The second section of the questionnaire sought information about respondent's socio-economic issues, social capital, and livelihoods. In the third section of the questionnaire, information on respondent's existing

adaptation strategies to climate change and motivating factors were established. The last section of the questionnaire obtained data on respondent's experience with adaptation strategies to climate change influenced by food insecurity. In the last section, most of the questions were open-ended questions. All the questions were developed by the researcher based on literature.

4.5.2 Focus group interviews

Interviews constituted the second form of data collection method used in the study. Interviews are a uniquely sensitive and powerful method for capturing the experiences of the subjects in the study (Kvale, 2007). Interviews also allow the subjects to convey to others their situation from their own perspective and in their own words (Kvale, 2007). Questionnaires with individual respondents alone can provide a 'snapshot' rather than a rich, in-depth picture of an area of concern and respondents may give answers that they think are socially desirable even if they are not fully accurate (Patten, 2017). Because of the likelihood of these reasons, this study also collected some information through group interviews which were organised by two focus groups in each of the three locations. The groups were relatively small and consisted of an average number of between 6 to 12 participants. The groups comprised of both adult female and male participants aged between 19 and 65 years. All the members of each focus group were purposefully selected farmers from the locations. Permission was sought from them if they want to be part of the focus group.

The group interview was conducted in a quiet atmosphere prepared by the researcher within the study area. The aim of the group interviews was to obtain qualitative data and participants were given the opportunity to set the ground rules for the session so that all members will feel comfortable, involved and not offended during the discussions. The group discussions were used to gather information on respondents' assets and how climate change impacts on their available assets within the study area. As stated earlier on, the group interview comprised a relatively small number of participants between 6 to 12 members of which 50% were men and the other 50% were women. Two separate discussions were held. In the first round of the discussion, the women had their separate

discussion and the men also had their separate discussions. The rationale of the separate discussions was to eliminate the potential possibility where men are assumed to be the head of the household in most rural communities and are only expected to talk during meetings. This would have compromised the intended objective of the group interview. In the second round of discussions, both sexes were brought together in one compound to express their opinions on the issue at hand in the area. Unstructured questions were asked throughout the discussions to allow members of the group to share their opinions, ideas and reactions on climate change and its impact on their available assets. During the group interview, all participants were constantly informed that their inputs are valuable and they can disagree with each other if it was necessary. The researcher compiled detailed notes that emerged during the discussions. An effort was made to create a tolerant environment in the focus group that would give confidence to participants to share perceptions, points of view, experiences, wishes and concerns without forcing the participants to reach an agreement.

Using interviews in research has a number of advantages. These advantages include: the privilege of a researcher to work directly with the respondent; the opportunity to probe or ask further questions during the course of the interview; and, also, interviews are usually easier for participants especially if the researcher requires their perception or opinion on a certain issue. Group interviews permitted access to shared social meanings and how these are enacted. It also assisted the researcher to observe the interaction between the participants in a more 'naturalistic' setting, resembling in some ways the kinds of interaction people might have in their everyday lives. Another benefit gained from the group interviews was that sensitive issues were discussed within the group setting (Krueger & Casey, 2015). The researcher took written notes during all interview processes.

4.5.3 Participants observation

This involves recording the behavioural patterns of people, objects and events (DeWalt & DeWalt, 2011). To achieve this the researcher would have to learn what life is like for an insider while remaining, inevitably, an outsider. Thus the

researcher intentionally engages with the respondents, develop relationships and learn from the everyday life activities of the respondents. It also involves sitting back and watch how activities unfold within the study area. Participants observation can help uncover valuable factors for a thorough understanding of the research problem. The added strength of participants observation is that as the observer is actually involved in the event, insights into the internal perspectives of the setting can be achieved (Flick, 2011).

One approach used in the study to observe the respondents activities was transecting walks. This involved making unplanned visits to the study sites, walking around the farming sites and talking to rural farmers (see Figure 4.1 and Figure 4.2). In some days, I also participated in assisting farmers to weed, tilled the land, plant, and harvest some of their produce (see Figure 4.3). Maximum effort was made to ensure that the researcher remained neutral during the participatory observations. This process yielded rich information for the study. Another observational approach employed was to sit back and watch events and make notes of activities of the rural dwellers regarding their farming practices.



Figure 4.1: Researcher (in braids) and a farmer in a cabbage farm
Source: The picture was taken during fieldwork (2018)



Figure 4.2: Researcher interacting with a rural farmer in a cabbage farm

Source: The picture was taken during the fieldwork (2018)



Figure 4.3: A portion of an area prepared by the researcher and rural farmer for planting

Source: The picture was taken by the researcher during the fieldwork (2018)

4.6 STUDY SAMPLE AND SAMPLING PROCEDURE

In chapter three of the study, it was pointed out that three rural study sites namely Mgugwana, Manaleni, and Ndayini locations located in the Port Saint John's Local Municipality were selected for the study. Based on the 2011 census data, it was documented that a total of 1281 (750+252+279) respectively reside within the selected areas. Thus the primary data were based on these three locations. Considering logistical constraints, it was purposefully decided that a 5% margin of error for a sample size will be suitable for each location. Using the Raosoft sample size calculator, this resulted in a total of 296 samples at 95% confidence. However, the sample size was increased to 385 to enhance the reliability of the findings. A proportional ratio was used to establish the new sample size per study site. However, the selection of individuals and households were all drawn using the systematic sampling technique.

Table 4.1: Sample size

	Mgugwana	Manaleni	Ndayini	Total
Population	750	252	279	**1281**
5% margin of error sample size				**296**
The sample size was increased to enhance the reliability of findings	225	76	84	**385**

Source: Own construction

Probability sampling was selected due to two main reasons. Firstly, the sample is more likely to be representative of the population and to reflect its variations. Thus, each member of the population has an equal chance of being selected for inclusion in the sample (Quinlan, 2011). Secondly, probability sampling has the potential of minimising bias in the selection of the sample for the purposes of making generalisations and inferences (van der Walt & van Rensburg, 2010). It has to be acknowledged that there are different probability sampling (e.g. stratified and simple random) techniques available for use. However, for the purposes of this study, the systematic technique was deemed appropriate to select the target population. Quinlan (2011) explains that systematic sampling involves selecting items at regular intervals from the sample frame. Systematic sampling technique facilitated the selection of the respondents in the selected

locations for the study. The procedure followed to select the respondents from each of the three study sites are highlighted below.

A. Mgugwana location

As highlighted in chapter 3, Mgugwana location has a population size of approximately 750 people. As indicated in Table 4.1, a sample size of 225 respondents from this location will be suitable for the study. In order to recruit the respondents for the interview, the following equation was used to determine the interval ratio.

$$\mathbf{K} = \frac{N}{n} = \left\{\frac{\text{size of population}}{\text{size of sample}}\right\}. \text{ Thus } \mathbf{K} = \frac{750}{225} = 3.$$

Where **K** is the interval ratio, **K**=3

Using the above calculations, it was decided that every third house at Mgugwana location was selected for the interview. The first respondent was selected from the first house found in the location. Thereafter, every ninth house counted from the first house was approached for the interview. The process was followed sequentially until the 225 respondents were attained.

B. Manaleni location

The second location selected for the study was Manaleni location. Based on the 2011 census, the location has a total population of 253 people. As pointed out in Table 4.1, it was decided that a sample size of 76 respondents from this location will be suitable for the study. In order to obtain these respondents, the following equation was used to determine the interval ratio.

$$\mathbf{K} = \frac{N}{n} = \left\{\frac{\text{size of population}}{\text{size of sample}}\right\}. \text{ Thus } \mathbf{K} = \frac{250}{76} = 3.$$

Where **K** is the interval ratio, **K**=3

From the above calculation, it was decided that every third house at Manaleni location will be included in the study. The first respondent was selected from the first house found in the location. Thereafter, every third house counted from the first house was approached for the interview. The process was followed sequentially until the 76 respondents were attained.

C. Ndayini location

Compared to Mgugwana and Manaleni locations, Ndayini location is home to approximately 279 people. As displayed in Table 4.1, 84 respondents from this location will be suitable for the study. In order to obtain these respondents, the following equation was used to determine the interval ratio.

$$\mathbf{K} = \frac{N}{n} = \left\{\frac{\text{size of population}}{\text{size of sample}}\right\}. \text{ Thus } \mathbf{K} = \frac{279}{84} = 3.$$

Where **K** is the interval ratio, **K**=3

From the calculation above, it was decided that every third house at Ndayini location will be included in the study. The first respondent was selected from the first house found in the location. Thereafter, every fourth house counted from the first house was approached for the interview. The process was followed sequentially until the 84 respondents were attained.

4.7 PRETESTING THE QUESTIONNAIRE AND INTERVIEW GUIDE

It is very rare that a questionnaire or interview guide can be absolutely perfect in just one attempt. Even after a self-evaluation, the questionnaire and interview guide may have some problems or errors. A pretest allows the researcher to try out the questionnaire with an external group to isolate problem areas. Therefore, it is recommended that prior to the 'full-blown' of the final data collection, the draft questionnaire or the interview guide be pretested. Pretest involves

administering a questionnaire or interview guide to a limited number of potential respondents to identify inherent problems and point out design flaws (Neelankavil, 2007). Pretesting helps to identify ambiguity in questions, problems of redundancy, question-sequencing issues, use of incorrect or difficult words, unanswerable questions, problems in skip patterns, and an estimate of the time it takes to complete the questionnaire (Neelankavil, 2007). The feedback received from the pretest led to some adjustments in the initial questionnaire.

The initial questionnaire was first given to two Ph.D. students from the University of Witwatersrand who were in their final year of graduation and also specialising in similar fields of study. I asked them to review the questionnaire, the content and its application thereof in a South African rural context. Valuable input was received from them. The suggested changes were incorporated. Thereafter, a subject expert in the field of climate change, food security and vulnerability from a South African University was approached to review the content and statements of the questionnaire. The suggestion received involved reducing the number of statements to minimise the time in completing the questionnaire, rewording and merging of some statements. The suggested changes were also incorporated in the questionnaire.

Six respondents (two from each study site) were purposefully selected for the pilot study. The pilot study took place in the month of August 2018. A number of valuable contributions and suggestions were received from the respondents during the pilot study. The first concern that emerged was related to the literacy level of the respondents. The respondents were unable to complete the questionnaires on their own and had to be assisted during the process. They suggested that a community member who can read and communicate in their local dialect can be assisted in the final data collection. This was not a major problem since the researcher is fluent and understand the Xhosa language. However, their suggestion was implemented in the final data collection. The second concern was about the time spent to complete each questionnaire. It took more than 30 minutes on a single questionnaire per an individual respondent. An effort was made to merge some questions in order to shorten the timeframe.

Respondents also complained about the nature of some of the questions asked. They identified that some of the questions were not relevant to their environment. These questions were eliminated from the final questions. Finally, respondents found two questions to be problematic or not clear. I tried to explain those questions to them and they also gave their input on how those questions could be restructured to meet their level of understanding.

4.8. DATA ANALYSIS

As stated in section 4.3.1 of this chapter, the critical realism tradition was followed in the current study. This allowed for the use of both qualitative and quantitative method of data analyses. The analysis of data involves organising the collected data in a way to answer the research question and objectives of the study (Houser, 2008). To ensure the quality of data analysis and interpretation, the raw data was firstly inspected and cleaned (Aaker & McLoughlin, 2007). The questionnaires received from respondents were carefully checked for illegible answers, possible errors (example double marking for the same question) and incomplete answers. After the questionnaires had been inspected, all the closed-ended questions and answers provided were organised in frequency tables and graphs. This provided the researcher with the necessary data through which conclusions, meanings, and implications could be drawn to answer the research question.

The open-ended and focus group aspects of the questions were analysed qualitatively. These involved transcribing and identification of themes from the answers provided. Similar answers provided during the focus group interview were grouped and reported as a theme. In most cases, answers provided in the open-ended questions were also reported verbatim.

4.9 VALIDITY AND RELIABILITY OF THE MEASURING INSTRUMENT

According to Robbins (2009), both reliability and validity are important and are fundamental characteristics of any measurement procedure. In addition, the issues of reliability and validity have ethical implications, making it an important

principle in research (Goodwin, 2010). Valid research generates reliable data that is derived from professionally conducted practices, and by the standard of scientific methods (Cooper & Schindler, 2007). According to Bryman and Bell (2015), validity refers to the issue of whether or not an indicator (or set of indicators) devised to gauge a concept really measures that concept. In other words, validity is the extent to which the instrument measures what it is supposed to measure. Taylor (2013) opines that validation is a process by which theoretical statements are tested. As already mentioned in Section 4.6, reviewers and experts were engaged to help ensure content and face validity of the interview guide and questionnaire. Their suggestions offered valuable contributions to improving the overall measuring instrument. In addition, the pre-test of the questionnaire with potential participants from the study sites provided an opportunity to receive feedback from respondents regarding the readability, ease of interpretation of the questions, and general improvement of the questionnaire.

In contrast to validity, *reliability* is defined as the extent to which the results of the study are consistent over time, and to which an accurate representation of the population is included in the study (Robbins, 2009). Robbins (2009) posits that a measure is reliable when it is repeatedly consistent or dependable, generating accurate information at an aggregate level. Goodwin (2010) emphasises that reliability is necessary because it enables one to have some confidence that the measure taken is close to the true measure.

The first reliability procedure followed was to appoint a second person who was not involved in the research process to independently code the data. This allowed the researcher to develop an interobserver reliability (Thyer, 2010). The independent coder served like a copy editor who checked the logic and assignment of meanings to the text. I also involved a Ph.D. student to confirm part of the coding and also check the observation in the field. The second reliability procedure was to stay close to the empirical data and provide accurate descriptive, verbatim accounts and subjective meanings of the participants. As suggested by Thyer (2010), I strived to condense the narrative data at any point

during the collection of the field note taking or the preparation of the data for coding. Exact quotes from research participants and detailed, rich descriptions of that which is being researched were captured and reported. Equivalence of responses to various forms of the same questions also provided a useful reliability check (Thyer, 2010). The use of detailed exploration of participants' perspectives guides socially desirable responses to questions in ways that helped the researcher to examine internal consistency.

4.10 METHODOLOGICAL REFLECTIONS

As evidenced in several research works, there are rare cases where researchers do not encounter problems during the research process. Some of the problems often highlighted include neglect from respondents, logistical constraints, communication barriers, accessibility to the research sites, religious and political difficulties. These factors often affect the researcher in several ways. The aim of this section is to highlight a handful of the problems experienced during the data collection process and how those problems were addressed.

4.10.1 Immediate benefits

The most difficult problem experienced was what I have termed 'immediate benefit' demands from the respondents. In all the three study sites, respondents were of the opinion that I worked with one of the government departments and I will be in a position to address some of the problems faced in their communities. People from the study sites expected me to assist them with irrigational equipment, fertiliser, and seeds in their farms. According to the respondents, they have communicated these challenges to the local government for so many years but these have yielded no positive help. Some of the respondents decided not to be part of the interviews because I will not be able to assist them with some of the requests made to the government. One respondent commented that:

……"*I am not going to talk to anyone because nobody can help with my situation*"

This implies that problems within the community have been persistent for so many years. Little or no assistance has been received in the past. Confidence in

the government or other non-governmental organisations is low. In order to overcome this problem, I emphasised to the respondents that I was a registered Ph.D. student and the research was only for academic purposes. I also emphasised to them that published findings from the study will also assist the community because the government and other non-governmental organisations may read those articles and offer assistance to the community. The declaration of this information to the respondents helped to overcome potential neglect and avoid answers linked to questions such as what can I do to assist them with their problems or what did I bring to assist them in their farms.

4.10.2 High crime zones

As highlighted in Chapter 3, the three sites are characterised by poverty and high illiteracy. Unemployment is another major problem affecting the areas. As in many communities where these problems are common, crime rates are high. The three study sites are among the high crime areas in the municipality. As a person who does not reside in the area, this was a major problem. The fear of being robbed, raped or even stabbed was a serious concern. In order to overcome this challenge, a female high school teacher who was a resident of the area was approached to lead me to the various homes and farmers of the community. I had to make prior appointments with this person before visiting the sites. Where she was not available, I was unable to carry out the planned data collection which impacted on the progress of the study. I offered a small token of money to this person and she was motivated to travel with me to the three sites without further excuses. In all the places visited, we were cautious and avoided late hour interviews.

4.10.3 Varying timeframes of respondents

The researcher experienced a problem of varying time constraints. Since some women households are engaged in petty trading in Lusikisiki and PSJ, it was difficult getting them on time for the interviews. Moreover, most of the farmers in the area had different time schedules when they can be available for the interview. To overcome this, all interviews were held in afternoons of the day. Because of the distance from the researcher's place of residence and the high cost

of accommodation (example guesthouses) in Port Saint Johns and Lusikisiki, often a maximum of ten interviews could be done in a day. Scheduled and unscheduled visits to homes and farmyards for participant's observations and interview also helped the progress of the study.

4.11 CONCLUDING REMARKS

This chapter discussed the research methodology followed in the study. The critical realism paradigm was employed which allowed for the opportunity to combine both qualitative and quantitative approaches in collecting and analysing the data. Systematic sampling techniques were utilised to identify respondents from various houses of the study sites that needed to be interviewed. Semi-structured questionnaires, interviews, and participants observations were combined to source the necessary data. The obtained data were analysed using basic numerical summations and further presented in graphs. Also, direct transcribing and identification of themes were used to analyse the focus group and open-ended questions. Maximum effort was made to ensure that data was collected and analysed in a manner that was ethical. Although some methodological problems such as expected immediate benefits from the respondents, the high crime rate of the study sites, varying time constraints were encountered, the researcher was able to proceed and complete the data collection process. The following chapter will present the empirical results and the interpretation thereof.

CHAPTER FIVE

THE EMPIRICAL FINDINGS

5.1 INTRODUCTION

The methodological issues and considerations for the study were discussed in Chapter 4. The aim of this chapter is to present the empirical findings of the study. The empirical findings are organised to address the research questions formulated for the study in section 1.4. The first aspect of this chapter will recap the scope of the study. Thereafter, the empirical findings are presented in six sections. The first section will provide evidence on the vulnerability and poverty situation in the three study sites. This is followed by an assessment of the impact of climate change on food security. Thereafter, evidence relating to the extent to which the rural poor are affected by climate change are also presented. Next, information on rural household's adaptation strategies to climate change is also provided. The fifth section of the empirical findings will constitute how climate change renders the poor vulnerable. The final section will present evidence on household's livelihood assets and risk factors associated with climate change.

5.2 RECAPITULATING THE SCOPE OF THE STUDY

As highlighted in chapter 3, the study focused on three rural locations in PSJ local municipality. These locations were Mgugwana, Manaleni, and Ndayini. The aim of the study was to find out how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security. In order to achieve the aim, individuals and household farmers who have lived in the three study sites for a minimum of two years were approached for the data collection. Both qualitative and quantitative research approaches were utilised to obtain data from the target population. The data was collected using unstructured interviews, focused group discussions, and participants' observations. As explained in Chapter 4, a total of 385 respondents from the three study sites were recruited of which 225 were from Mgugwana, 76 from Manaleni, and 84 were recruited from Ndayini location. In addition, two focus group interviews were

held in each of the three study sites on different days. The focus group interviews had 6-12 members.

5.3 RESEARCH FINDINGS AND INTERPRETATIONS

This section presents the research findings of the study. As mentioned earlier on, the findings of the study are presented to engage with the research questions formulated in section 1.4 of the study.

5.3.1 Vulnerability and poverty assessments

One of the questions that the researcher was interested in was to establish the extent to which vulnerability and poverty is an issue in the study areas. In view of this, a number of questions were asked one of which includes the respondent's main sources of income. The data obtained are presented in Table 5.1. It emerged that a large proportion of the respondents (Mgugwana 74.7%, Manaleni 67.1%, Ndayini 75.0%) earn income from piece jobs, government social grants, and peasant farming.

Table 5.1: Main sources of income in household

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Formal employment	16	7.1	8	10.5	6	7.1
Own business	41	18.2	17	22.4	15	17.9
Other (piece jobs, government social grant, small farming)	168	74.7	51	67.1	63	75.0
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

Further investigation on how many respondents receive remittances or social welfare grant from the government was conducted. The evidence gathered are displayed in Table 5.2. The data shows that 82.7% of the respondents from Mgugwana, 76.3% from Manaleni, and 82.1% from Ndayini receive government remittances or social grants. In light of this response, it seems to suggest that a large proportion of households from the three study site rely heavily on government social grants for their livelihood. The high dependency on

government social grants further suggests the poverty situation prevailing in the study sites.

Table 5.2: Household recipients of government remittances

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Recipients of remittances	186	82.7	58	76.3	69	82.1
Not receiving remittances	39	17.3	18	23.7	15	17.9
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

Those who receive government remittances or social grant were requested to indicate how much they earn. The response received is presented in Table 5.3 below. It emerged that in Mgugwana and Manaleni a large number of the respondents earn between R501 to R1000 per month (approximately $34.76-$69.38). In Ndayini, a large proportion of the respondents (46.4%) earn between R1001 and R1500 per month (approximately $70.59-$105.81). The general picture presented in Table 5.3 suggests that the income received from government social grant is very little to cater for the entire household. This could result in hunger, adverse poverty, and increased vulnerability in most rural households in PSJ. In South Africa, the upper boundary poverty line is R1183 (in April 2018 prices) per person per month (Statistics South Africa, 2018). Upper boundary poverty line refers to "the food poverty line plus the average amount derived from non-food items of households whose food consumption is equal to the food poverty line" (Statistics South Africa, 2018). Therefore, in terms of the upper boundary poverty line, the data in Table 5.3 suggest that most people from the three study sites are poor.

Table 5.3: Income bracket of household's

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
<R500	29	15.6	18	31.0	13	18.8
R501-R1000	101	54.3	27	46.6	17	24.6
R1001-R1500	42	22.6	8	13.8	32	46.4
>R1500	14	7.5	5	8.6	7	10.2
Total	186	100	58	100	69	100

Source: Fieldwork based data (2018)

Respondents were also requested to indicate whether they produce their crops for food consumption, cash, or both. From Table 5.4, it can be seen that a large number of the respondents from the three locations produce their crops for own food consumption. At Ndayini for instance, 78.6% of the respondents produce their crops for own food consumption. The information obtained suggests that most rural households in the study area are subsistence farmers who cultivate the land to feed themselves and their families.

Table 5.4: Reasons for producing crops

	Mgugwana		Manaleni		Ndayini	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**
Food	157	69.8	51	67.1	66	78.6
Cash	38	16.9	16	21.1	12	14.3
Both	30	13.3	9	11.8	6	7.1
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

Apart from the evidence presented above, the researcher also sought to understand how the respondents understand poverty and vulnerability and their causes thereof.

A male respondent aged 58 years from Manaleni stated:

> *Most of us in this location are poor because we don't have any job. We are unemployed. We depend on government social pension for our livelihood. Because we are not working we don't have access to loans or credits. We cannot buy properties that we have dreamt of when we were young.*

Another male respondent aged 48 years from Mgugwana also pointed:

> *Farming is our major occupation in this community. We depend on rainfall but in the past 10 years, our farm production has been worse. Drought and heatwaves have impacted negatively on our farms and we cannot produce enough food for our families. The land or soil quality is very poor which affect our production. Poverty has rendered us vulnerable. Donor agencies such as NGO's do not come to our aid in times of difficulties. We lack*

incentives such as irrigation equipment to enhance our agricultural production. Our poverty situation also prevents us from taking insurances to cover our assets.

From the above evidence, it is apparent that poverty is a serious concern in the three study sites. Respondents are also of the view that they are vulnerable because their livelihood is dependent on the availability of rainfall which can improve their agricultural production.

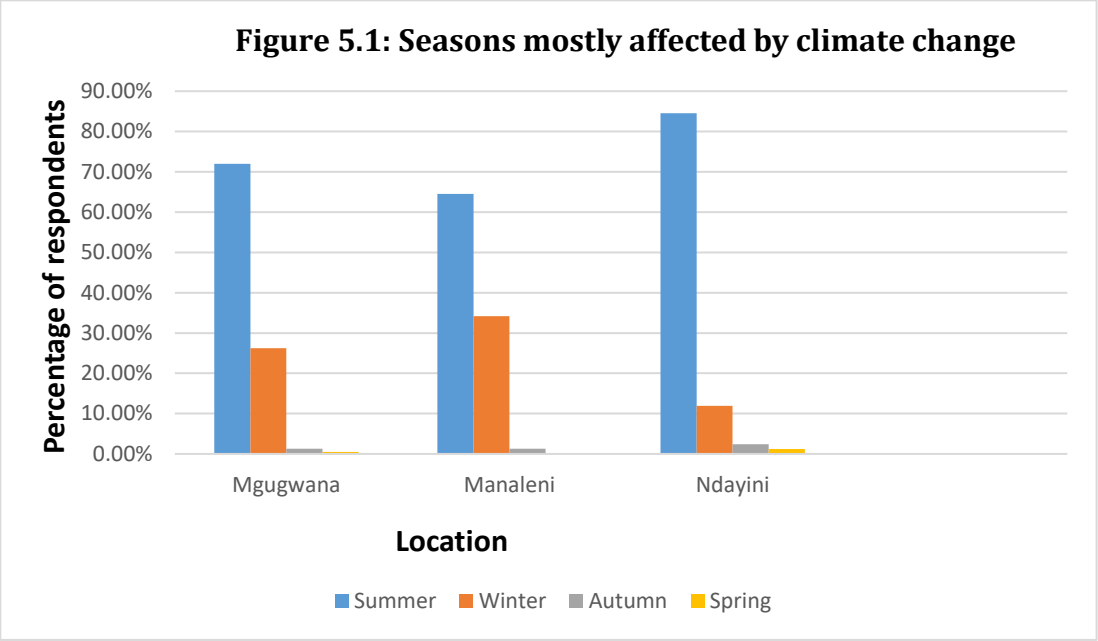
5.3.2 Impact of climate change on food security

It was also important to understand the impact of climate change on the three study sites. In view of this, the researcher asked questions that required the research respondents to state what kind of weather patterns they have experienced over the past 10-15 years. The data received are presented in Table 5.5 and in Figure 5.1 below. It was evident that a large proportion of the respondents from the three study sites (Mgugwana 72.0%, Manaleni 64.5%, Ndayini 84.5%) view the summer season as the period where climate change becomes a serious problem to the household.

Table 5.5: Seasons that climate change becomes a severe problem

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Summer	162	72.0	49	64.5	71	84.5
Winter	59	26.2	26	34.2	10	11.9
Autumn	3	1.3	1	1.3	2	2.4
Spring	1	0.5	0	0	1	1.2
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)



Source: Fieldwork based data (2018)

Furthermore, the research respondents were asked how they have experienced climate change in their farms. The information obtained is captured in Table 5.6. It is obvious that majority of the respondents (91.6% of the respondents from Mgugwana, 90.8% from Manaleni, and 96.4% from Ndayini) consider drought as a major weather event observed in the area.

Table 5.6: Type of climate change affecting the rural households

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Floods	19	8.4	7	9.2	3	3.6
Drought and heatwave	206	91.6	69	90.8	81	96.4
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

Respondents were also asked whether climate change influence food security in the area. The responses obtained are displayed in Table 5.7 below.

Table 5.7: Influence of climate change on food security

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Yes, climate change influence food security	209	92.9	74	97.4	81	96.4
No, climate change does not influence food security	16	7.1	2	2.6	3	3.6
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

It emerged from Table 5.7 that 92.9% of respondents from Mgugwana, 97.4% from Manaleni, and 96.4% from Ndayini were of the view that climate change has an influence on food security in their respective locations. The large representation of the respondents thus suggests that climate change has an impact on food security in the rural locations of PSJ local Municipality.

Furthermore, respondents were requested about their experience of climate change since they embarked on farming in the past 15 years. The data received are displayed in Table 5.8.

Table 5.8: Experience with climate change on farming in the past 10-15 years

	Mgugwana		Manaleni		Ndayini	
	Yes	No	Yes	No	Yes	No
More heavy rains	86 (38.2%)	139 (61.8)	48 (63.2%)	28 (36.8%)	52 (61.9%)	32 (38.1%)
Getting rain later than normal	187 (83.1%)	38 (16.9%)	59 (77.6%)	17 (22.4%)	66 (78.6%)	18 (21.4%)
Planting date change applying to most crops	133 (59.1%)	92 (40.9%)	39 (51.3%)	37 (48.7%)	48 (57.1%)	36 (42.9%)
Temperature of the area increasing	173 (76.9%)	52 (23.1%)	55 (72.4%)	21 (27.6%)	64 (76.2%)	20 (23.8%)
Temperature of the area decreasing	76 (33.8%)	149 (66.2%)	22 (28.9%)	54 (71.1%)	33 (39.3%)	51 (60.7%)
Decrease in recurrence of floods	123 (54.7%)	102 (45.3%)	61 (80.3%)	15 (19.7%)	59 (70.2%)	25 (29.8%)
Increase in recurrence of droughts	209 (92.9%)	16 (7.1%)	64 (84.2%)	12 (15.8%)	71 (84.5%)	13 (15.5%)
Increase in number of pests or rodents compared to previous years	126 (56.0%)	99 (44.0%)	43 (56.6%)	33 (43.4%)	52 (61.9%)	32 (38.1%)
Other	18 (8.0%)	207 (92.0%)	6 (7.9%)	70 (92.1%)	14 (16.7%)	70 (83.3%)

Source: Fieldwork based data (2018)

A closer examination of the data presented in Table 5.8 revealed that large proportion of the respondents from Mgugwana (92.9%), Manaleni (84.2%), and Ndayini (84.5%) experience increase recurrence of drought. It was also found from the three study sites that planting date changed for most crops cultivated by the respondents. For instance, at Mgugwana (59.1%), Manaleni (51.3%), and Ndayini (57.1%) respondents agreed that their planting date for most of their crops changed due to climate change. Increase in a number of pests or rodents also emerged as a major problem to farmers during extreme weather conditions. Furthermore, majority of the respondents from all the study sites were of the view that there has been a decrease in recurrence of floods. There were mixed indications on the issue of more heavy rains. Majority of the respondents from Mgugwana (61.8%) disagreed that there has been more heavy rainfall over the past 15 years. However, at Manaleni (63.2%) and Ndayini (61.9%) respondents agreed that there has been more heavy rainfall over the past 15 years.

The evidence gathered also shows that majority of the respondents from the three study sites were unanimous that temperature in the locations is increasing instead of a decrease in temperature. A large number of the respondents from Mgugwana (83.1%), Manaleni (77.6%), Ndayini (78.6%) were also of the view that they obtain rain later than normal.

The evidence presented above suggest that respondents have experienced prolonged drought on their farms over the past 15 years and that the temperature in the location continuous to rise. Increase in insects and pest are major concerns for farmers in the study sites. The evidence also suggest that respondents receive rainfall later than normal and that this might have caused their planting dates for most of their crops to change. The above data point to the view that climate change influence food security in PSJ.

The impact of climate change on food security was also vividly described by participants in the focus group interview. One of the participants, a female aged 54 years and resides at Ndayini stated:

Our biggest problem as peasant farmers in this area over the years has been continuous dryness, heatwaves, and less rainfall. As you can see, we depend on rainfall in our farms. Our farm production depends on rainfall. Most of our crops wither, damaged (dry) due to severe sunshine or high temperature (humidity). We sometimes do not get anything from what we planted, absolutely nothing to harvest from these crops. We do not have irrigation facilities which we can use to get water from the river. Hunger is a common problem here. Because of drought in our community, farming is no longer attractive, especially to the youth.

To build on this observation, another female farmer aged 46 years and a single parent of two children highlighted:

We farm but we do not get anything from farming because of drought. Our food production has reduced drastically due to high temperature. In some days I have to beg my neighbours for food before I and my children can eat.

A male farmer from Mgugwana aged 49 years also indicated that:

Last year two of my cattle's died because of dryness of the grass and hunger. Our livestock is severely impacted by high temperatures. They do not get greener pastures to feed on, loose weight and sometimes die.

Another male farmer aged 52 years from Manaleni recalled and shared this:

In 2014, there was a heavy rainfall continuously for more than three days. Our crops were affected because the water settled on the land resulting in most of our crops getting rotten.

The evidence presented above suggests that climate change impacts on food security, especially in the three study sites.

5.3.3 Extent at which the rural poor are affected by climate change

The first research question aimed at finding out the extent to which the rural poor are impacted by climate change. To address this question respondents were

asked to indicate what extent does climate change affect food production on the local people's livelihood. The evidence obtained is displayed in Table 5.9 below. It is apparent from the evidence that a large proportion of the respondents (Mgugwana 90.7%, Manaleni 72.4%, Ndayini 89.3%) consider climate change as highly affecting their food production.

Table 5.9: Extent at which climate change affect food production

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Least affecting	1	0.4	0	0	0	0
Affecting	20	8.9	21	27.6	9	10.7
Highly affecting	204	90.7	55	72.4	75	89.3
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

5.3.4 Rural household's adaptation strategies

The second research question was how the rural household in the study area adapt to climate change. In order to obtain data for this, a number of questions focusing on adaptation strategies were posed to the respondents. Firstly, the researcher asked whether participants have changed any of their farming practices in order to adjust to climate change. The response obtained is captured in Table 5.10.

Table 5.10: Changed farming practices in order to adjust to climate change

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Yes, changed farming practices	192	85.3	71	93.4	66	78.6
No, never changed farming practices	33	14.7	5	6.6	18	21.4
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

The evidence gathered from the three study sites revealed that majority of the respondents from Mgugwana (85.3%), Manaleni (93.4%), and Ndayini (78.6%) have changed their farming practices during extreme weather conditions. The findings expressed suggest that climate change influence farming practices. Lack

of knowledge of alternative farming practices will negatively influence food security.

The next question requested respondents to specify the changes made in responding to climate change and the reasons for their decision. The answers obtained from the respondents are provided in Tables 5.11. From Mgugwana it emerged that respondents have applied a variety of changes to their farming practices. A large number of respondents indicated that they have introduced new crop varieties (60.4%), shifted to higher yielding crop varieties (56.9%), shifted to shorter cycle crop varieties (52.9%), and in some cases stopped cultivating some crop varieties (74.2%). Key motivating factors for their decisions include drought, rainfall variety, less rainfall, and increased temperature.

From Manaleni location, the data shows that large representation of respondents have also introduced new crop varieties (69.7%), shifted to a shorter cycle of crop varieties (81.6%), and stopped cultivating some crop varieties during extreme climate change (53.9%). Possible motivating factors highlighted include drought, rainfall variety, less rainfall, and increased temperature. The data obtained from Ndayini also indicates that a large proportion of the respondents had introduced new crops (70.2%), shifted to a shorter cycle of crop varieties (57.1%), and stop cultivating some crop varieties (85.7%). Possible reasons for their decisions include drought, rainfall variability, and less rainfall.

The sentiments shared by the respondents from the three study sites seem to suggest a common trend of adaptation practices by the farmers during extreme weather conditions. In all the three locations, farmers introduced new crop varieties, shifted to shorter cycle crop varieties, and in some cases stopped cultivating some crop varieties. The evidence displayed in Table 5.11 further indicates that respondents have experience increased drought, less rainfall and increased the temperature in all study sites. Furthermore, respondents have been proactive in their farming practices by engaging in different forms of strategies that can assist them to minimise the severity of the impacts of climate change. It was a major concern however, to observe that majority of the respondents do not

have mechanisms in place to intensify irrigation activities in their farms. The over-reliance on rainfall can affect food security.

Table 5.11: Changes made in responding to climate change

		Mgugwana	Manaleni	Ndayini	Possible motivating factors																	
Adaptation strategies	Response				**Drought**			**Rainfall variability**			**Less rainfall**			**Pest invasion**			**Heavy rain/flooding**			**Increased temperature**		
					Mgugwana	Manaleni	Ndayini	Mgugwana	Manaleni	Ndayini	Mgugwana	Manaleni	Ndayini	Mgugwana	Manaleni	Ndayini	Mgugwana	Manaleni	Ndayini	Mgugwana	Manaleni	Ndayini
	Yes n, (%)	136 (60.4)	53 (69.7)	59 (70.2)	103 (45.8)	37 (48.7)	52 (61.9)				19 (8.4)	12 (15.8)	7 (8.3)							14 (6.2)	4 (5.3)	
Introduce new crop varieties	No n, (%)	89 (39.6)	23 (30.3)	25 (29.8)		23 (30.3)	15 (17.9)	89 (39.6)														10 (11.9)
	Yes n, (%)	128 (56.9)	34 (44.7)	19 (22.6)	111 (49.3)	28 (36.8)					17 (7.6)	6 (7.9)	19 (22.6)									
Shift to higher yielding crop varieties	No n, (%)	97 (43.1)	42 (55.3)	65 (77.4)		7 (9.2)	65 (77.4)				97 (43.1)										35 (46.1)	
	Yes n, (%)	119 (52.9)	62 (81.6)	48 (57.1)	119 (52.9)	41 (53.9)	31 (36.9)	109 (48.4)	21 (27.6)	17 (20.2)												
Shift to shorter cycle crop varieties	No n, (%)	106 (47.1)	14 (18.4)	36 (42.9)		14 (18.4)	36 (42.9)															43 (51.2)
	Yes n, (%)	88 (39.1)	16 (21.1)	27 (32.1)	88 (39.1)					27 (32.1)		16 (21.1)										
Shift to drought resistant crop varieties	No n, (%)	137 (60.9)	60 (78.9)	57 (67.9)	137 (60.9)	59 (77.6)	2 (2.4)						12 (14.3)								1 (1.3)	
	Yes n, (%)	167 (74.2)	41 (53.9)	72 (85.7)	167 (74.2)	41 (53.9)	55 (65.5)						17 (20.2)									
Stop cultivating some crop varieties	No n, (%)	58 (25.8)	35 (46.1)	12 (14.3)				58 (25.8)	35 (46.1)	12 (14.3)												
	Yes n, (%)	59 (26.2)	29 (38.2)	23 (27.4)	44 (19.6)		23 (27.4)				15 (6.7)										21 (27.6)	
Intensify irrigation	No n, (%)	166 (73.8)	47 (61.8)	61 (72.6)		47 (61.8)	61 (72.6)							124 (55.1)						42 (18.7)		
	Yes n, (%)	3 (1.3)	1 (1.3)	0 (0)	3 (1.3)				1 (1.3)													
Others	No n, (%)	222 (98.7)	75 (98.7)	84 (100)	222 (98.7)	75 (98.7)				68 (81.0)										20 (8.9)		16 (19.0)

Source: Fieldwork based data (2018)

The researcher further asked respondents to indicate which coping strategies they have adopted in their households. The evidence obtained and captured in Table 5.12 revealed an occurrence of common coping strategies in the three locations. Households have relied on less preferred and less expensive foods, have borrowed food, or relied on help from friends or relatives, purchased food on credit, consumed seed stock held for next season, sold assets to gain income for buying food, limited portion size at mealtime, reduced number of meals eaten in a day, and relied on government grants.

Table 5.12: Coping strategies adopted by household

Strategy	Specify						
	Mgugwana		Manaleni		Ndayini		How
	Yes	No	Yes	No	Yes	No	
Dietary Change Coping Strategies							
Rely on less preferred and less expensive foods?	199 (88.4 %)	26 (11.6 %)	64 (84. 2%)	12 (15. 8%)	61 (72.6 %)	23 (27.4%)	
Increase Short -Term Household Food Availability							
Borrow food, or rely on help from a friend or relative	147 (65.3 %)	78 (34.7 %)	41 (53. 9%)	35 (46. 1%)	55 (65.5 %)	29 (34.5%)	
Purchase food on credit?	133 (59.1 %)	92 (40.9 %)	39 (51. 3%)	37 (48. 7%)	53 (63.1 %)	31 (36.9%)	
Gather wild food, hunt, or harvest immature crops?	43 (19.1 %)	182 (80.9 %)	22 (28. 9%)	54 (71. 1%)	37 (44.1 %)	47 (55.9%)	
Consume seed stock held for next season?	145 (64.4 %)	80 (35.6 %)	36 (47. 4%)	40 (52. 6%)	22 (26.2 %)	62 (73.8%)	
Sale of assets to gain income for buying food?	156 (70.7 %)	69 (30.7 %)	53 (69. 7%)	23 (30. 3%)	46 (54.8 %)	38 (45.2%)	Sale of cattle, sheep and goats
Decrease Numbers of People							
Send children to eat with neighbours?	61 (27.1 %)	164 (72.9 %)	21 (27. 6%)	55 (72. 4%)	15 (17.9 %)	69 (82.1%)	
Send household members to beg?	24 (10.7 %)	201 (89.3 %)	19 (25. 0%)	57 (75. 0%)	8 (9.5%)	76 (90.5%)	
Rationing Strategies							
Limit portion size at mealtimes?	129 (57.3 %)	96 (42.7 %)	44 (57. 9%)	32 (42. 1%)	27 (32.1 %)	57 (67.9%)	
Restrict consumption by adults in order for small children to eat?	47 (20.9 %)	178 (79.1 %)	26 (34. 2%)	50 (65. 8%)	13 (15.5 %)	71 (84.5%)	
Reserve more food for certain members/groups in the household.	38 (16.9 %)	187 (83.1 %)	29 (38. 2%)	47 (61. 8%)	31 (36.9 %)	53 (63.1%)	
Ration the money you have and buy prepared food?	76 (33.8 %)	149 (66.2 %)	16 (21. 1%)	60 (78. 9%)	26 (31.0 %)	58 (69.0%)	
Reduce number of meals eaten in a day?	174 (77.3 %)	51 (22.7 %)	57 (75. 0%)	19 (25. 0%)	57 (67.9 %)	27 (32.1%)	
Skip entire days without eating?	53 (23.6 %)	172 (76.4 %)	6 (7.9 %)	70 (92. 1%)	11 (13.1 %)	73 (86.9%)	
Economic reasons							
Shift to crops that command good market prices	28 (12.4 %)	197 (87.6 %)	13 (17. 1%)	63 (82. 9%)	9 (10.7 %)	75 (89.3%)	
Diversify household income sources	89 (39.6 %)	136 (60.4 %)	18 (23. 7%)	58 (76. 3%)	16 (19.1 %)	68 (80.9%)	
In case of total failure of coping strategy							
Total dependence on external food aid?	1(0.4 %)	224 (9 9.6%)	3 (3.9 %)	73 (96. 1%)	2 (2.4%)	82 (97.6%)	
Government grants	163 (72.4 %)	62 (27.6 %)	53 (69. 7%)	23 (30. 3%)	61 (72.6 %)	23 (27.4%)	Receives government grants

Source: Fieldwork based data (2018)

Scrutiny of Table 5.12 revealed a picture of the three most coping and adaptation strategies practiced by households from the three study sites. This data is displayed in Table 5.13. It was obvious that 88.4% of the respondents from Mgugwana, 84.2% from Manaleni, and 72.6% of the respondents from Ndayini prioritise relying on less preferred or less expensive foods. The second coping strategy observed was reducing the number of meals eaten in a day (77.3% from Mgugwana, 75.0% from Manaleni, and 67.9% from Ndayini). Thirdly, 72.4% of respondents from Mgugwana, 69.7% from Manaleni, and 72.6% of the respondents from Ndayini rely on government grants as a coping strategy.

Table 5.13: Three commonly used coping and adaptation strategies

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Rely on less preferred or less expensive foods	199	88.4	64	84.2	61	72.6
Reduce number of meals eaten in a day	174	77.3	57	75.0	57	67.9
Government grants	163	72.4	53	69.7	61	72.6

Source: Fieldwork based data (2018)

The respondents were further requested to indicate whether the adaptation strategies to climate change implemented in their farms/household have assisted them. The evidence obtained is presented in Table 5.14. The evidence captured shows that a large representation of the respondents from Manaleni (72.4%) and Ndayini (72.6) agrees that the adaptation strategies adopted have assisted them. However, the sentiment was different at Magugwana (54.7%) where several respondents disagreed that the adaptation strategies assisted them. From the data captured in Table 5.14, it is apparent that knowledge of adaptation strategies can help limit the effect of climate change in farms and households.

Table 5.14: Helpfulness of the application of the adaptation strategies to climate change and variability by farmers

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Yes, the adaptation strategies helped	102	45.3	55	72.4	61	72.6
No, it never helped	123	54.7	21	27.6	23	27.4
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

In another question, respondents were asked whether the adaptation strategies to climate change influenced their agricultural production. The data received is presented in Table 5.15. It emerged that 59.6% of the respondents from Mgugwana (59.6%) and 66.7% of the respondents from Ndayini disagreed that their adaptation strategies had an impact on their agricultural production. It is also evident that over 50% of respondents from Manaleni agreed that the adaption strategies improved their agricultural production. In light of the data presented in Table 5.15, it suggests that most respondents did not realise any improvement from the adaptation strategies implemented.

Table 5.15. Adaptation strategies and impacts on agricultural production

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Yes, it improved my farm produce	91	40.4	47	61.8	28	33.3
No, it did not improve my farm produce	134	59.6	29	38.2	56	66.7
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

Table 5.16 captured the respondent's perceptions on whether the adaptation strategies helped to achieve food security. The response received revealed that most respondents from Mgugwana (52.0%) and Manaleni (51.3%) disagreed that the adaptation strategy helped to attain food security. Furthermore, at Ndayini, 57.1% of respondents said the adaptation strategies did not help them to attain food security. The views reflected further suggest that most respondents felt that the adaptation strategies never helped to attain food security.

Table 5.16: Adaptation strategies helped to attain food security

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Yes, the adaptation strategies helped to attain food security	108	48.0	37	48.7	36	42.9
No, the adaptation strategies did not help to attain food security	117	52.0	39	51.3	48	57.1
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

The researcher also asked respondents' about their capacity to adapt to climate change. Variety of questions were asked. The first questions as shown in Table 5.17 sought to find out whether the adaption strategies to climate change adopted were cost-effective. The evidence shows that 63.6% of respondents from Mgugwana, 64.5% respondents from Manaleni, and 60.7% respondents from Ndayini view the adaptation strategies as not cost effective. The evidence suggests that the adaptation strategies utilised by the rural community were not cost effective.

Table 5.17: Cost effectiveness of adaptation strategies

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Yes, it is cost effective	82	36.4	27	35.5	33	39.3
No, it is not cost effective	143	63.6	49	64.5	51	60.7
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

5.3.5 How climate change render the poor more vulnerable

The third research question was about how climate change renders the poor more vulnerable. This question was discussed with participants in the focus group interview. Key common responses that emerged are summarised below.

(i) Respondents indicated that their crops die
(ii) Low farm productivity and poor farm yield
(iii) Leads to hunger in many households
(iv) Cannot afford to buy basic stuff and cause us to be poor

(v) Increases illness and diseases, making us be vulnerable.

5.3.6 Risk factors associated with climate change

The fourth research question was dedicated to risk factors associated with climate change in the chosen study area. Specifically, the focus was on risks associated with household assets. Six household assets were investigated and the findings are presented below.

5.3.6.1 Views by respondents regarding risks associated with agricultural production

Respondent's agricultural activities were investigated. Firstly, participants were asked whether they have cultivated the land in the last/previous year. As displayed in Table 5.18, in Mgugwana 99.1% of the respondents had cultivated the land in the previous year, in Manaleni 96.1% and all the respondents from Ndayini had also performed some agricultural activity in the previous year. The general sentiment suggests that a large proportion of the community members were actively involved in agricultural activities over the past years.

Table 5.18: Cultivated the land last year

	Mgugwana		Manaleni		Ndayini	
	Freq	%	Freq	%	Freq	%
Respondents who farmed	223	99.1	73	96.1	84	100
Respondents who did not farm	2	0.9	3	3.9	0	0
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

The major agricultural production was also determined. The findings are presented in Table 5.19. It emerged that a large proportion of the respondents (89.3% from Mgugwana, 90.8% from Manaleni, 90.5% from Ndayini) were involved in crop farming. Livestock farming seems to be a secondary activity that the community is engaged in. The evidence gathered suggest that households in the three study sites rely on crop farming.

Table 5.19: Major agricultural production respondents depended on

	Mgugwana		Manaleni		Ndayini	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**
A. Crop farming	201	89.3	69	90.8	76	90.5
B. Livestock keeping	19	8.5	7	9.2	8	9.5
C. Agro-pastoralists	5	2.2	0	0	0	0
D. Other (specify)	0	0	0	0	0	0
Total	225	100	76	100	84	100

Source: Fieldwork based data (2018)

The researcher embarked on a fieldwork observation with three farmers to see the nature and type of crop production that has been cultivated in the three study sites. Evidence gathered can be seen in Figure 5.2 to Figure 5.5.



Figure 5.2: A farmer on a piece of cultivated land (maize and pumpkin)

Source: The picture was taken by the researcher during the fieldwork (2018)



Figure 5.3: A cultivated land (maize and pumpkin)

Source: The picture was taken by the researcher during the fieldwork (2018)



Figure 5.4: A cultivated land (maize)

Source: The picture was taken by the researcher during the fieldwork (2018)



Figure 5.5: A cabbage farm

Source: The picture was taken by the researcher during the fieldwork (2018)

The fieldwork observation revealed that most rural households engaged in mixed cropping. Maize and cabbage plantation dominates the farming activities of the area.

From the focus group discussions with respondents in the three study sites, a number of reasons were greatly attributed as risk factors to agricultural production.

A farmer from Ndayini stated that:

> *Our crop production is very low due to poor soil quality. The little food that we obtain from our gardens and farms for food is not sufficient for our household. The situation is getting worse every year. Hunger is a common trend affecting most households in the community*.

Another view was expressed by a male farmer from Mgugwana:

> *In this community, our cattle's are our biggest assets although we have other animals. Due to severe heatwaves and drought, the grass has become dry,*

the river also runs dry. The cattle's do not get enough pastures to feed on and water from the river to drink. The situation has affected many farmers in the community and some cattle's have died. The number of cattle's that we possess has reduced every year over the past 10 years.

In Ndayini again, another female farmer also said:

I and my husband have no formal jobs. We rely on our farm for our food and little pension from the government. We grow cabbages, potatoes, spinach, and mealies. We sometimes sell some of the mealies produced to support the income received from the government. When our children go out to play and they are hungry, they run and come back to their mothers to ask for food. They do not go to their father. Drought has severely affected our food production in the past 5 years. We either produce less or sometimes we have absolutely no crop yield. Hunger is a common occurrence in my home as sometimes we only have one meal per day. In some days, I have to beg our neighbours or go to the shops and look for vegetables that are disposed of by the shop owners to feed the family. Extreme heatwaves and drought have rendered us poor.

In light of the above responses, it can be argued that farmers in the selected study sites experience continuous low farm produce, have lost assets such as cattle's through hunger, begged for food or slept without food. Climate change has also caused low crop yield also influence poverty. Respondents sometimes collect disposed food by shops in nearby towns to feed their families.

5.3.6.2 Views of respondents regarding risk associated with natural assets

The views of the respondents regarding risks associated with households natural assets were also investigated through the focus group interview. The opinions expressed by the respondents are captured below.

A household male farmer from Manaleni vividly described the natural assets possessed and how climate change has affected him:

I own a piece of the plot (land) in the community. That is where I have built my home for myself and the family. On the same plot is where we plant crops

and keep our cattle. Due to the heat and no rainfall, the land is no more fertile and we cannot harvest enough food to feed on. We have only one river (Ntafufu river) also where we get water from. The heatwaves or drought causes the river to be dry. This affects our source of water for drinking.

Another view that was expressed by a participant from Mgugwana is that:

In the past, we used to get fish from the river but now this is no more. Our river is getting dry every year as a result of drought.

A third participant from Ndayini shared this:

In 2014, there was a heavy rainfall for almost three days. The roof of my house was destroyed. I also experienced severe soil erosion in my farm which destroyed almost all my crops.

Closer scrutiny of the views expressed by the participants from the three study sites indicates that households perceive land and the river as their major natural assets. It was also evident that soil infertility, soil erosion, and loss of fish in the river, destruction of roof and housing are risks factors affecting natural assets in the rural locations.

5.3.6.3 Views of respondents regarding the risks associated with physical assets

Respondent's views about how climate change affects their physical assets were also sought. The evidence obtained is presented below.

A male farmer from Mgugwana location who participated in the focus group interview described how heavy rain in 2014 damaged their road and bridge.

Since our road is not tarred, our road was severely damaged. The rain destroyed our road leaving big potholes. Cars were unable to come or leave our locations. The river was also full and caused damage to the bridge that connects us to Lusikisiki and PSJ. The situation was very bad. The government has to involve military engineers to reconstruct the bridge for us.

The researcher took a walk with two of the participants to observe the river and the reconstructed bridge that was destroyed by the heavy rain. The evidence is presented in Figure 5.6 below.

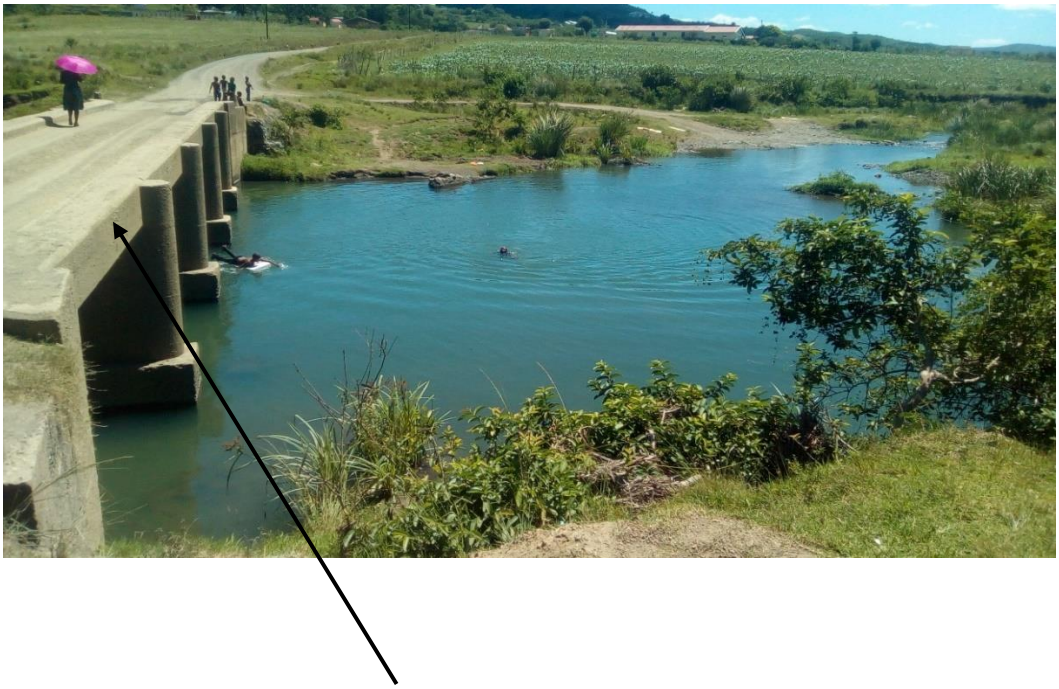


Figure 5.6. The reconstructed bridge connecting Mgugwana to Lusikisiki and PSJ

Source: The picture was taken by the researcher during the fieldwork (2018)

A male farmer aged 56 years from Manaleni described the equipment that he has been using for ploughing the land.

> *Over the years we use animals (cattle and donkeys) in this location for ploughing our land for farming. We tie our equipment around the body of the animals and use them to prepare the land. Some years back (approximately 20 years ago), the animals were healthy because they had greener pastures to feed on and we had plenty of those animals in our homes. Due to drought in recent years, most of our animals have died due to hunger and dried grass. The few ones left are also not healthy to use them for ploughing the land. We fear they may also die when we use them. In fact, climate change has affected our lives and the way we live in this rural location.*

Based on the foregoing evidence presented above, it is obvious that climate change affects rural household infrastructure (road, bridge) and traditional animal-drawn physical asset used for ploughing the land for farming.

5.3.6.4 Views of respondents regarding risks associated with human assets

The risk associated with the human assets of the three study sites were also investigated. Firstly, the education level of the respondents who participated in the study was scrutinized. The results obtained are presented in Table 5.20 below.

Table 5.20: Education level of respondents

	Mgugwana		Manaleni		Ndayini		
	Freq	%	Freq	%	Freq	%	Total
Primary school	145	64.4	46	60.5	48	57.1	239
Secondary school	49	21.8	17	22.4	23	27.4	89
College/ University	8	3.6	2	2.6	1	1.2	11
No education	23	10.2	11	14.5	12	14.3	46

Source: Fieldwork based data (2018)

In Table 5.20, it can be seen that a large proportion of the respondents had attained only primary school education (Mgugwana 64.4%, Manaleni 60.5%, Ndayini 57.1%). Furthermore, 10.2% of respondents from Mgugwana, 14.5% from Manaleni, and 14.3% from Ndayini had no formal education. When looked at these figures as a whole, a large number of respondents with primary education and those with no formal education is a matter of concern. This will have huge implications on their resilience to climate change.

The focus group interview also revealed a gloomy picture of how human assets are affected by climate change.

A male participant from Mgugwana said:

> *I have three male children, all are unemployed. They started a cabbage farm last year but they did not get any good yield from the farm. The soil was so dry and because they did not have money, they could not purchase machinery to irrigate the farm. They absolutely lost everything.*

A female respondent from Ndayini also indicated:

> *I have two children who were supposed to be in the classroom studying today. But due to several reasons, they have dropped out. There are several instances where they had to go to school without eating any food. This affected their health as they continuously suffer from illness and hunger. Sometimes, we eat only one meal for the entire day. Drought in the area has affected us as we cannot get food from our farms. I have failed to eliminate hunger in my home.*

Another male respondent from Mgugwana pointed out:

> *There is a high crime rate in this community because most of our youth are unemployed. The poor soil quality and severity of drought in the area also do not attract them to engage in farming.*

From the above interview responses, it is obvious that climate change poses a risk to the human assets of rural households. The evidence suggests that illness, school dropout, hunger, high crime rates, and unemployment are risks factors affecting the human assets of the three study sites.

5.3.6.5 Views of respondents regarding risks associated with social assets

From the discussions with the focus group interview, respondents highlighted how climate change influences their social assets. The views provided are reported below:

A female respondent from Ndayini claimed:

> *We have community associations where we put together money every month. In the last month of the year, we use the money to buy foodstuffs and share amongst ourselves.*

Another female respondent from Manaleni also claimed:

> *In the community, we help each other. If I am in need of food, I can go to my neighbour and if he or she has some, the person can assist me.*

A male participant from Mgugwana shared:

> *In situations of extreme weather conditions such as heavy storm which results in the destruction of homes and roofs, we assist each other to rebuild homes.*

A key feature in the response provided above is the social connections that rural households have to address risks associated with climate change.

5.3.6.6 Views of respondents regarding risks associated with financial assets

Respondents were also asked about risks associated with their financial assets. The views expressed by the respondents from the focus group discussions are captured below.

A male farmer from Manaleni said:

> *We don't have money and skills. We rely on rainfall for our farms and gardens. When there is no rainfall, it becomes very difficult for us because we have no other means of farming. The only river here is our source of water for consumption. As you can see, it is far from our gardens and farms and it is impossible to carry water always from the river to irrigate our farms. Things would have been better if we have money to acquire irrigation equipment.*

Another male participant from Mgugwana also claimed:

> *I do not have any savings account, no money in a bank account that when there is a problem I can go and withdraw. I rely on a government pension to survive.*

The concerns of the respondents suggest that lack of money, skills, over-reliance on rainfall, and lack of irrigation facilities are financial risks that the rural households have experienced.

5.4 CONCLUDING REMARKS

The empirical findings have revealed that CC becomes a serious problem to the three rural areas during the summer season. Drought was found as a major climatic condition facing the rural poor. The results also show that a significant number of respondents confirmed that CC severely affect food security. It was also clear from the responses that the participants have knowledge of adaptation and coping strategies, however, these strategies have not yielded enough positive results to ensure food security. The result also shows that households livelihood assets are affected by CC.

CHAPTER 6

DATA ANALYSIS AND DISCUSSION

6.1 INTRODUCTION

The focus of this chapter is to present the analysis and discussions on how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security. This chapter is primarily building on the empirical findings in Chapter 5. Specifically, the discussions will revolve around the objectives formulated for the study. The chapter is broadly divided into five sections with the introduction being the first one. The next section will be devoted to a discussion on ways in which changes in weather patterns are negatively impacting the livelihoods of the rural poor. In the third section of the chapter, a discussion on how the rural poor adapt their assets to build resilience against food insecurity will be provided. The fourth section will discuss the asset-based framework and how climate change influences the livelihood assets of the rural poor. The final section of the chapter will provide the concluding remarks for the chapter.

6.2 CHANGES IN WEATHER PATTERNS AND IMPACT ON LIVELIHOODS OF THE RURAL POOR AT MGUGWANA, MANALENI, AND NDAYINI

Before discussing the impact of changes in weather patterns on the livelihoods of the rural poor, it would be necessary to share the evidence gathered on the poverty situation of the communities where the study was conducted. The empirical chapter from the three study sites confirmed certain common characteristics among the respondents that suggest that the people in the community were poor. A large number of the respondents in all the three communities had no formal employment, they rely on piece jobs, they embark on small farming and depend heavily on government grants or social welfare as their main source of income. It was further discovered that respondents earn very small income primarily from government social grants (See Table 5.2 and Table

5.3). The focus group interview also confirmed that the community is a poverty striking community where most people are unemployed and vulnerable.

The findings largely corroborate with the poverty statistics in South Africa (Statistics South Africa, 2017). Poverty is a major concern in South Africa and seem to be evident in most rural communities of the country. The evidence in this study suggests that people living in rural communities of Port Saint Johns' Municipal area are still confronted with challenges such as low income, unemployment, and over-dependence on government social grants. The income received or earned by the communities which range between R501 to R1500 per month (approximately $34.76-$105.81) are absolutely very little to enable them to buy seedlings, plough the land and cultivate a meaningful farm that will ensure food security. Poverty is a social problem which affects the livelihood of the households in areas such as health, education, and standard of living. The poverty situation among the communities can affect households' capacity to build resilience in order to mitigate the impact of climate change.

The field survey data presented in the empirical chapter highlights that climate change becomes a serious problem for the rural poor during the summer season (see table 5.5). Summer is a period where most South African farmers prepare the land and plant their crops or seeds. It is also a period where farmers expect rainfall to grow their farm produce. Farmers in all three study sites indicated that drought and heatwaves are climatic challenges affecting their farm produce (see Table 5.6). Given the empirical findings in Table 5.5 and Table 5.6, it can be argued that respondents from the three study sites have knowledge that summer is the season that farmers in the rural locations experience severe drought and heatwaves which adversely impact on their farm produce and their livelihoods. It is important therefore to sensitise rural dwellers and farmers in around PSJ to consistently prepare and build capacity during the summer season to address the impact of the continuous drought and heatwaves that have engulfed the rural poor.

In fact, a significant number of respondents (93%) of respondents from Mgugwana, 97% from Manaleni, and 96% from Ndayini) confirmed that climate

change has an influence on food security in the community (see Table 5.7). The findings confirm the assertion made by Turpie and Visser (2013) that unfavourable weather events such as heat waves and drought affect the rural poor. Similarly, the findings are in line with the IPCC (2014) report which cautions that future climate events will be dominated by heat waves, droughts, floods, cyclones, wildfires and climate-related extreme impacts that can cause significant vulnerability and exposure to some ecosystems.

Drought emerged as a major climate change event experienced in the three study sites. The situation has caused many farmers to change their planting dates for most of their crops. Although changing planting dates can be a short term remedy to adapt to climate change, it has to be mentioned that prolonged delays in planting dates due to drought can affect food security. Whiles farmers are waiting for rainfall before planting, the likelihood of available food to depend on will be a huge challenge. Pests or rodents in farms were also found in the current study as a major problem affecting farmers during climate change and in particular when there is drought. During the focus group interview, respondents raised a number of concerns as the impact of climate change on the community. These challenges are summarised in Figure 6.1.

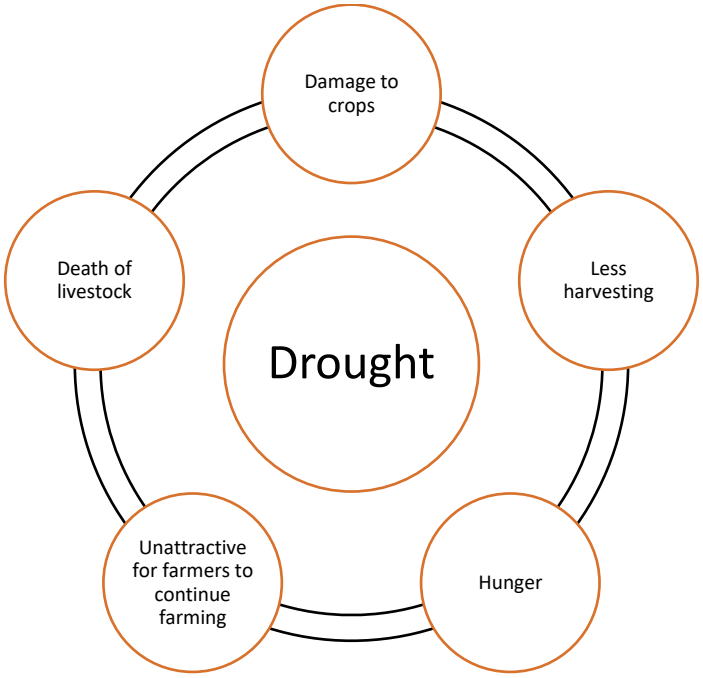


Figure 6.1: Impact of climate change on the livelihood of the rural poor

Source: Fieldwork based data (2018)

Death of livestock, damage to crops, less food to harvest, hunger, and loss of hope to farm are some of the effects of drought on the rural poor. In view of the above observations, it can be argued that changes in weather patterns affect food security in rural poor communities. The above findings are in line with several other previous studies which also found that climate change negatively impacts on food security (Magdoff & Tokar, 2009; Boko, 2007; IPCC, 2014). It is important to state further that, respondents from the three study sites have the knowledge and are aware of the changes in weather patterns and the season that this weather becomes problematic to the community. This prior knowledge, if utilised positively, can assist the community to build strategies before the occurrence of a climate event. The findings can influence policy direction focusing on empowering rural dwellers and providing them with early warning signs and notification such as news on heavy rainfall indicators. It is thus important to put interventions in place to assist rural farmers to minimise the impact of extreme weather events. The findings thus address the first objective formulated for the study.

6.3 ADAPTATION STRATEGIES OF THE RURAL PEOPLE AT MGUGWANA, MANALENI, AND NDAYINI TO BUILD RESILIENCE AGAINST FOOD INSECURITY

From the responses expressed by the respondents in the empirical study, it emerged that rural households embark on different adaptation strategies in order to address the impact of climate change. A significant number of respondents from the three study sites confirmed that they have changed their farming practices during extreme weather conditions. Basic knowledge of alternative farming practices is necessary for rural communities to overcome extreme weather conditions. It is therefore argued that this knowledge should be enhanced to equip farmers with several different alternative farming practices that can assist to build resilience against food security.

As found in the empirical study (see Table 5.11), farmers in all the three study sites have also introduced new crop varieties, changed to shorter cycle crop varieties, and stopped cultivating some crop varieties. These practice are an indication that rural farmers from the study sites strive to incorporate different adaptation strategies to build resilience for climate change. The responses revealed that these adaptation strategies were implemented due to drought, rainfall variety, less rainfall, and increased temperature. The findings in the current study corroborate with Alemayehu and Bewket (2017) and Shisanya and Mafongoya (2016) study which found that adaptation strategies used by smallholder farmers to manage their crops include changing planting dates, crop diversification and the use of drought-tolerant and fast –maturing crops and improved seeds. However, these adaptation strategies may be considered as a temporal solution for many households, therefore it is argued that rural communities should be assisted to develop structures and infrastructure that will contribute to long term solutions to manage extreme weather events.

Whiles several authors such as Schultz and De Wrachien (2002), Bawakyillenuo et al. (2016), and Epule et al. (2017) have recommended irrigational practices as a strategy to manage drought-related issues in rural households, it was a major concern for the researcher to establish that a large number of the respondents from the three study sites did not have any mechanism in place for irrigation

activities in their farms. This shows the communities overreliance on rainfall for their farm produce. In view of these findings, it can argue that food security can become a huge challenge for the communities in seasons where drought extends over a longer period of time. It is thus important to build proactive measures to increase the capacity of the rural communities to acquire irrigational facilities for their farms. More acquisition of irrigation equipment through government support and other non-profit organisations can help reduce the challenge and impact of drought in the area.

Furtherance to the investigation in the study was the coping strategies adopted by households during extreme weather conditions. The empirical evidence displayed in Table 5.12 is summarised in Figure 6.2. Firstly, all the three communities where the study took place confirmed that they had relied on less preferred and expensive foods to cope with climate change. Although dietary change can assist rural households to reduce the burden of the impact of climate change, caution has to be exercised to avoid a trade-off between less expensive foods and nutritious foods. Children, in particular, require healthy and nutritious foods to grow. Once this is compromised, health-related diseases such as malnutrition (e.g. Kwashiorkor) can affect the livelihood of the rural poor.

It is also apparent from the interview that in order to ensure short term food availability (see Table 5.12), households from the three study sites borrowed food, or relied on help from friends or relatives, purchased food on credit, consumed seed meant for future season planting, and sold assets such as cattle, sheep, and goats in order to obtain income to buy food. Considering the low households income bracket as indicated in Table 5.3 and the fact that a large number of respondents depend on government social grant for their livelihood, obtaining food on credit will increase the hardship on households, thereby intensify poverty and vulnerability of rural households. In addition, consuming seed meant for future season planting will greatly compromise the availability of seedling to plant in the next season. As observed in the empirical chapter, most households have little income to live on, therefore when the seedlings meant for future planting are consumed, households will have little or no means of money to buy seedlings to plant in their farms. This can also negatively impact on food

security in the area. Having established the poverty situation in the communities, instead of consuming the seedlings, one would have to explore other alternatives to build capacity to cope with climate change.

It is also not an exaggeration to find that respondents have utilised two different rationing strategies to cope with extreme weather effects (see Table 5.12). A large number of respondents from the three study sites limit the portion size of food eaten at mealtimes and reduced the number of meals eaten in a day. Although the two coping strategies may be a short term solution, from a health perspective, these practices may lead to weight loss for most children and expose households to several illness or diseases. This is likely to put more burden on the health system in the municipality.

In the event of total failure of coping strategies, it was found that a large proportion of the respondents relied on government social grants for their livelihood (see Table 5.12). From the empirical chapter, government support grant was identified in the three communities as their basic relief mechanism to cope with climate change and other economic challenges.

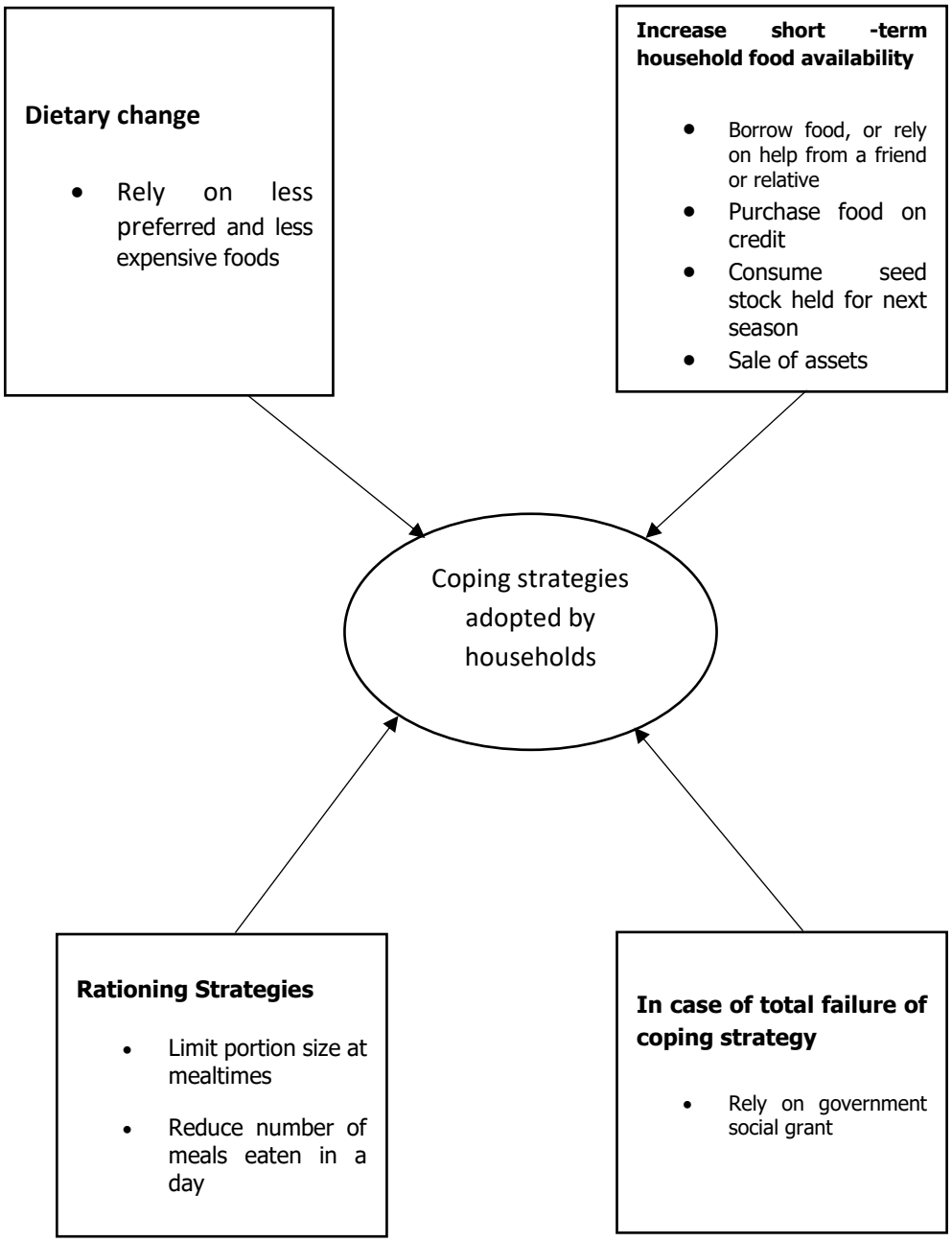


Figure 6.2: Coping strategies adopted by households

Source: Fieldwork based data (2018)

In the context of the current study, the coping strategies adopted by the households corresponds with the findings by Alemayehu and Bewket (2017). Further scrutiny based on the respondents rating of the various coping strategies revealed that the most preferred coping strategy is relying on less preferred or less expensive foods. This is followed by reducing the number of meals eaten in a day. Thirdly, respondents rely on government social grants. In contrast, when

comparing the ratings with other studies, Alemayehu and Bewket (2017) study which was conducted in the central highlands of Ethiopia with 200 small farm holders, however, found that selling of livestock was the most widely coping strategy, followed by changing consumption pattern.

It was worrying to also observe that most of the respondents interviewed from the three locations did not appreciate the fact that the adaptation strategies implemented have helped them to improve food security. In fact, majority of the respondents from Mgugwana, and Ndayini disagreed that the adaptation strategies that they have embarked on have contributed to improving their agricultural production. Furthermore, respondents from all the three locations disagreed that the adaptation strategies helped them to attain food security (see Table 5.16). These findings above could be attributed to the continuous drought that farmers face in the area. An adaptation strategy does not necessarily change the conditions of extreme weather events. It is simply a short term remedy for farmers to deal with the impact of CC at that particular time and season. Food security is a critical area of concern for governments across the globe. Agricultural production serves as a foundation for sustainable economic development. Therefore, the impact of climate change on agriculture as observed in the current study should be considered as a strategic focus area. Based on the findings above, it can be argued that because the adaptation strategies had not helped the communities, food insecurity, vulnerability, and poverty of the rural poor will persist unless government institutions are deployed to assist the local communities to deal with climate change related impacts. The findings presented above addresses objective two of the current study which is to discuss how the rural poor adapt their assets to build their resilience against food insecurity.

6.4 IMPACT OF CLIMATE CHANGE ON RURAL HOUSEHOLD ASSETS

The empirical chapter established the risk factors associated with the household's livelihood assets in the three study areas. The aim of this section is to analyse and discuss the risk factors associated with rural household livelihood assets in the event of extreme weather conditions. Household agricultural

production, natural, physical, human, social, and financial assets served as the basis of the asset-based framework and investigation. The findings are summarised in Figure 6.3 and discussed below.

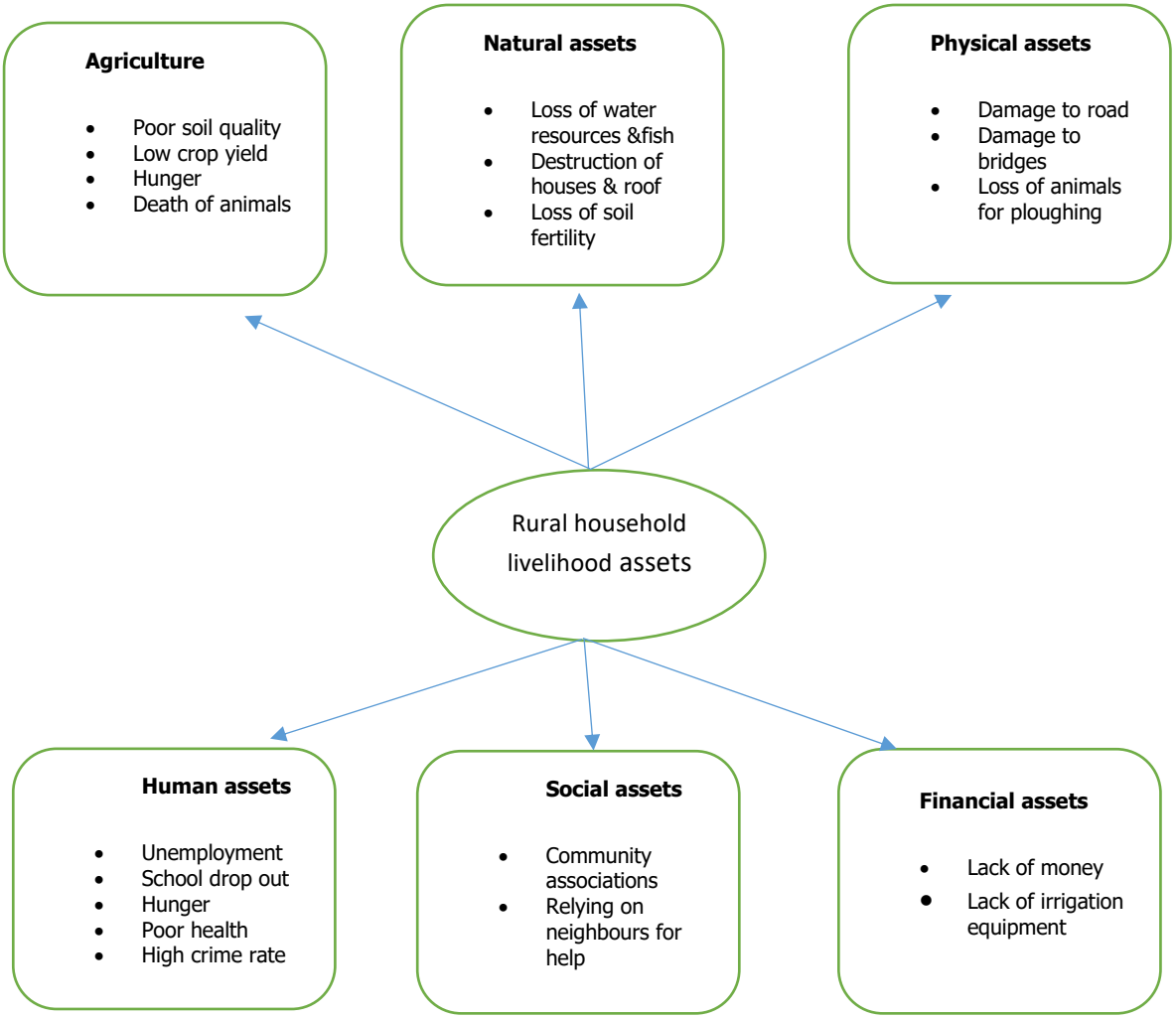


Figure 6.3: Risk factors associated with rural household livelihood assets

Source: Fieldwork based data (2018)

As reported in Figure 6.3, rural households in the three study sites are exposed to several risks factors which in turn affect their livelihood assets. In terms of household agricultural production, respondents claimed that climate change has impacted on the quality of soil in their farms. Soil quality refers to the richness of the soil to promote crop growth in a safe and healthy manner. Rural households depend on the richness of the soil to grow their farm crops. The effect of climate change on the soil quality will thus affect the quantity of crop production in the

study area. Since household income brackets are so little, there will be little or no income to acquire fertilizers to nourish the soil for planting.

The above evidence is a direct confirmation of the work established by Hall et al. (2018) who noted that most of the soil in the Eastern Cape Province lacked high soil fertility. Bühmann, et al.'s (2006) study which focused on Lusikisikisi, an area not far from the study sites also confirmed that 80% of soils within the area will require K fertilisation for adequate crop yield. The climatic condition of the area and the associated climate change risks require that rural household especially those within the study area are assisted with fertilisers to grow their crop yields. Soil run-off through heavy wing or heavy rainfall also renders plants or crops to die. It can be argued that poor soil quality can cause food insecurity. The findings are also consistent with prior research findings by Walker and Schulze (2008), Ziervogel, et al. (2014), Elum, Modise and Marr (2017) who established that climate change reduces crop yield due to dryness of the soil.

Furthermore, the responses indicate that climate change has exposed the community to hunger due to the dryness of the soil. The above findings are in line with the study conducted by Ebhuoma and Simatele (2017) on climate variability, asset adaptation and food security nexus in the Delta State of Nigeria. The authors found that the after effect of extreme weather conditions lead to severe hunger of households who depend solely on agricultural production for their livelihood. Although viewed from a general standpoint, South Africa has not reached the extent where famine and hunger is a serious concern, the findings in this study has proved otherwise. This revelation suggests that there are rural communities experiencing hunger and famine due to climate change effects on their farms. It is thus important for the South African government to conduct a holistic investigation into the livelihood of rural communities. This will assist in policy formulation and strategies to help the rural poor in times of extreme weather conditions.

Livestock, on the other hand, is also affected by climate change. Most people voiced out that most of their livestock died due to unavailability of water in the river where they normally get their water from as it gets dried up because of

climate change. Livestock such as cattle, sheep, chicken, pork, and goats are used especially by rural communities as a source of food and a basic income when they are sold. Cattle, in particular, is seen as a major asset to the rural poor. Cattle are used for customary marriage rights and for other traditional celebrations. A loss in the number of livestock assets can affect household livelihood. The findings also relate positively to the findings by Archer van Garderen (2011) and Hoffman and Vogel (2008) who in their study established that climate change affects livestock production.

According to Siegel and Alwang (1999), natural assets are free gifts of nature. For the rural poor, natural assets include land, minerals, forests, water, and wetlands. The land is also a very strategic asset for rural households because it provides access to basic needs such as food and shelter, and provides privileges to social capital, infrastructure, and political and institutional assets (Siegel & Alwang, 1999). From the responses obtained from Mgugwana, Manaleni, and Ndayini, households have been exposed to risk such as dryness of the river where they obtain their main source of water. They also claimed that they can no longer obtain fish from the river. The respondents also emphasised that their houses and roof were destroyed due to extreme weather conditions. In view of the above findings, it can be argued that the destruction of natural resources due to climate change adds to the burden of the rural poor and their capacity to deal with food security. The findings link up positively with theory. For instance, Alam, et al. (2017) found that loss of land to river-bank erosion in Bangladesh leads to loss of farmland and development opportunities which result in insufficient food. Several other previous empirical studies have also established that drought decreases crop production (Benitez & Domecq, 2014; Antwi-Agyei et al. 2012; Simelton et al. 2012) and these are in line with the findings of this study.

The third livelihood asset investigated in this study was physical assets. As discussed in chapter 2, physical assets consist of equipment, infrastructures such as road networks and other productive assets owned by individuals, households, communities or the country itself (Siegel & Alwang, 1999). Infact, Kumar, et al. (2016) emphasised that possession of physical assets is an important part of building people's resilience. The empirical responses from this study revealed

that in 2014, the road and bridge utilised by the communities were severely damaged by heavy rainfall. With respect to the road and bridge, most households cannot sell their food crops in the neighbouring locations due to the road not being in good condition. Furthermore, household mobility to other city centres is affected when the road or bridge is damaged.

Households also voiced their concern that they did not have the money nor qualify for loans to buy farm implements such as tractors to plough the land. They use their cattle and donkeys on their farms for ploughing. However, most of these animals are undernourished due to the grass on which they feed on becoming dry. Most farms are left unattended because of the incapability of the undernourished animals used for ploughing. With that said most community members go hungry due to the fact that there is no other means or equipment that they use to farm.

In view of the above findings, it is plausible to argue that climate change affects the physical assets and capacity of the rural poor to farm and produce food for the household. This failure by the local authority or municipality to assist households in the form of farm implements can worsen the vulnerability and poverty situation of the rural poor. The findings in the current study correspond with the findings by IPCC (2014) and Merrey, et al. (2003) that extreme weather conditions such as floods, droughts, and heat waves can significantly impact on poor people's assets especially their physical assets in terms of livestock possessions, housing, labour productivity, infrastructure, and social networks. The findings are also closely linked to prior research findings by Epule, et al. (2015), Sivakumar, et al. (2005) where they argue that physical assets such as roads networks connecting farms to market centres may determine how a community can respond to hazards as well as aid in rapid response to receiving relief or external help to affected communities.

Another livelihood asset investigated in this study is the human asset. Maiti (2017), Siegel and Alwang (1999) describe human assets in terms of population density and growth, the degree of education, skills, health status and nutrition of individuals. Maiti (2017) argues that formal education empowers rural

households to acquire knowledge and awareness of the possible impact of climate change and climate-resilient agriculture. The empirical study revealed that a large proportion of the households interviewed from the three locations had only completed primary school education (see Table 5.20). Some respondents also had no formal education (see Table 5.20). Cao, et al. (2016) argue that subsistence rural farmers form the pillars of their families, their ages and level of education have a significant impact in the implementation and improvement of family livelihood strategies, which directly affect family vulnerability levels. Based on the empirical study regarding the participants' level of education, the general picture formed was that a large proportion of households are less educated. Thus the level of education in the three rural communities can influence their knowledge and capability to be resilient in extreme weather conditions.

The focus group interview yielded additional risk factors associated with human assets. Unemployment, school drop-out, hunger, the poor health status of the community, and the high crime rate were captured from the participants. Alam et al. (2017) are of the view that health and wellbeing of people affect their ability to work. Poor health status which is evidenced in the current study can hinder the workforce and ability of the community to farm and build resilience to climate change. Epule et al. (2017) contend that in a community where poverty is high, evidence of literacy rates are usually low, and vulnerability to droughts becomes very high. High school drop-out due to the effect of drought as claimed by the participants can impact negatively on the household ability to be resilient to climate change. Unemployment, hunger, and high crime rates are closely linked to each other. Therefore, continued drought or extreme weather events can worsen the situation in rural areas.

Social assets is another livelihood assets that need to be mentioned. In the literature chapter (see chapter 2), social assets refer to social relationships, networking, exchange of information as well as 'social learning' (Adger, 2003; Moser et al. 2010). These characteristics assist community member in environmental management and building adaptive capacity (Adger, 2003; Moser et al. 2010). If anything to conclude by, the findings of this study show that

households have formed community associations that assist each other. Furthermore, it was established that households rely on neighbours for help. Social networks can be used as support mechanisms to support each other in the communities in dealing with the extreme weather condition. The current study confirms Pretty's (2003) assertion that in the event of droughts, households that are socially connected rely on their friends and families for help in the areas of obtaining shelter, food, and clothing. In view of the above findings, it is important to encourage rural households to form community groups or associations that they can utilise to assist each other in different ways including extreme weather conditions.

Financial assets are the last livelihood asset investigated in the current study. Financial assets refer to access to monetary resources such as loan, credits, and savings in a bank or any other financial institutions (Siegel & Alwang, 1999). It also involves access to available banking services (Maiti, 2017). Maiti (2017) argues that a better financial status of an individual can serve as a backbone to reduce the severity of the impact of climate change and variability. The field survey into the financial assets from the three study sites revealed that most community members did not have money in a savings account or any bank account. The community relies heavily on government social grant. Respondents also do not have money or qualify for bank loans to acquire irrigation equipment that can help enhance their farming. Possession of financial assets determines the worth of an individual. However, this is not the case from the study sites. Poverty in all the three communities are very high and this can affect their crop production. The findings presented on the asset-based framework and climate change influences helped to address the third objective formulated for the study which is to study the literature on the asset-based framework with the objective of adapting the concept to the current areas of study. Employing the asset-based framework has helped to close the knowledge gap identified for the study and advanced the applicability of the framework in a South African context.

Based on the above discussions, a framework of social and other types of risk management for rural areas are proposed. The proposed framework offer

valuable risk management interventions that can be incorporated into policy formulation to minimize CC effects prior to crises, during crises, and after crises. The framework also provides a possible task team to address the crisis. Basically, before crisis (e.g. drought, heatwaves, flood, soil erosion) it is prudent to engage the community and educate them on CC and adaptation strategies. The building of dams can assist minimize drought. Farmers can also be encouraged to practice contour ploughing to prevent soil erosion. Although various tasks teams can be engaged, government institutions through the local government (e.g. department of agriculture, forestry and fisheries, public works) should be tasked with this responsibility. Community leaders should also be empowered (e.g. through education and providing the necessary resources) to assist the community. Non-governmental organisations should also be engaged to steer the program of community engagement and education on CC.

During crises (e.g. damage to crops, destruction of houses, low crop yield, hunger, death of livestock, soil infertility) there should be available response teams to offer relief to affected communities, individuals and households. Supply of fertilisers and irrigation facilities can be provided to affected people. A task team of community leaders, local government (e.g. department of agriculture, forestry, and fisheries, department of public works). NGO's, community co-operative organisations, government assistance, and donor support should also be engaged to offer relief to those affected.

In the aftermath (post) crises (e.g. hunger, soil infertility, rebuilding after crises) sold mechanisms such as building of projects and programmes, provision of finance should drive policy formulation at government level. A holistic assessment of the loss and strategies to avert future occurrence should be embarked upon to curb the situation. Community leaders, local government (e.g. department of agriculture, forestry and fisheries, department of public works), NGO's, community co-operative organisations, government assistance, and the donor should be engaged in the policy formulation and its implementation. This framework will serve as a foundation for the recommendation in Chapter 7.

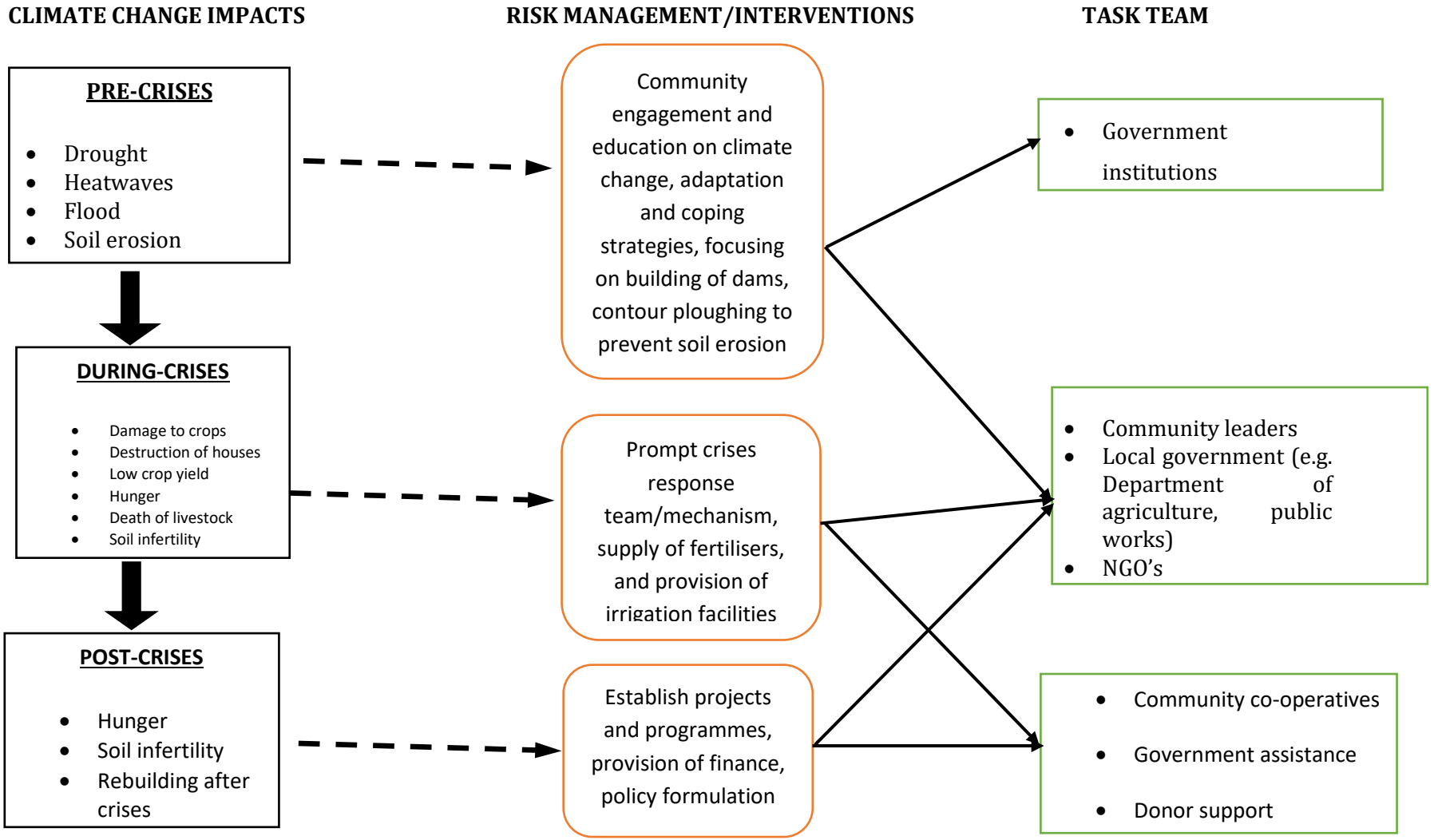


Figure 7.1: Proposed framework of social and other types of risk management in rural areas
Source: Own Construction

6.5 CONCLUDING REMARKS

From the discussions in this chapter, it is clear that rural households are severely affected by climate change. The study identified that most of the rural households from the rural communities visited were poor. They rely heavily on government social grant for their living. It was also discovered that the communities experience continuous drought, especially during the summer season. Drought, in particular, has affected the communities in many ways such as less harvesting of crops, damage to crops, and death of livestock. The situation has caused many farmers and the youth to view farming as not an attractive occupation.

The study also found that households embark on different adaptation and coping strategies to mitigate the impact of climate change. The key adaptation strategies practiced by farmers include introduction of new crop varieties, planting of shorter cycle crop varieties, and in some cases, farmers stopped cultivating some crop varieties. Furthermore, the three most commonly coping strategies that the communities prioritise are relying on less preferred or less expensive foods. This is followed by reducing the number of meals eaten in a day. Lastly, households rely on government grants.

Finally, the risks associated with livelihood assets were discussed. Six livelihood assets namely agriculture, natural, physical, human, social, and financial assets were provided. The findings in this study demands an urgent intervention from civil society, non-governmental organisations, and the government. In the final chapter of this study, conclusions and recommendations are provided. This will also include a framework of social and other risk management strategies for rural communities to address climate change related impacts.

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATIONS

7.1 INTRODUCTION

This chapter will focus on synthesising the entire study and highlight the most important findings that emerged from the thesis regarding how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security. The chapter is divided into four sections. The first section is the introduction part of the chapter. The second section provides an overview of the motivation for the current study. Thereafter, the key findings emerged from the study are provided. Next, the recommendations resulting from the empirical findings are provided. The recommendations section will include a framework for social and other types of risk management with a focus on rural areas in South Africa. This will be followed by the contributions of the study. The final section will suggest areas for future research.

7.2 RECAP ON THE MOTIVATION FOR THE CURRENT STUDY

This study examined how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security. Three rural communities namely Mgugwana, Manaleni, and Ndayini in the PSJ Local Municipality served as the focus area of the investigation. CC has been identified as an emerging stressor of extreme weather conditions (Connolly-Boutin & Smit, 2016). It has been vividly predicted that the continuous emission of greenhouse gases into the atmosphere impact on people.

In the South Saharan Africa, rural dwellers are severely affected by the impact of CC and climate variability. Turpie and Visser (2013) for example observed that CC significantly impact on rural livelihoods and the economy at large. Some homes have been destroyed leaving many people homeless, livestock and animals have died, agricultural production has been destroyed due to extreme weather conditions. South Africa is not an exception to the impact of climate change. Floods and droughts have been reported as extreme weather conditions affecting

most communities (Turpie & Visser, 2013). Precisely, severe drought has been documented in many parts of the country. Available data also suggest that by 2050 and beyond there will be significant warming over the South African interior (LTAS, 2013). Projections of climate conditions in South Africa reveals many uncertainties such as extreme warmer or too much rainfall (e.g. flooding) (LTAS, 2013).

Although it is widely acknowledged that CC has become a global issue, there is little empirical evidence on the impact that the rural poor have experienced, and how the rural poor respond and adapt to ensure food security. Bohle et al., (1994) for example argue that it is no more an option to determine the current vulnerability of households in order to draw lessons to cope with future CC. The three communities identified for the study have experienced severe CC ranging from severe drought to severe flooding which negatively impacts on the rural poor. Despite efforts made by rural farmers and rural households on adaptation and coping strategies, these communities still experience continued food shortages. Given the impact of climate change and the fact that many households have failed to produce sufficient food to feed their households, there is huge poverty in the three study sites. To the best of my knowledge, no research focusing on the three study sites could be located in the literature.

In light of the above discussions, this study focusing on Mgugwana, Manaleni, and Ndayini rural communities of PSJ Local Municipality sought to make theoretical and methodological contributions regarding how climate change affects the rural poor, and how the rural poor respond and adapt to rural food security.

7.3 KEY FINDINGS

Findings from the study revealed that summer is the season that CC becomes a serious problem for most rural households. Particularly this period is between December to February. Participants pinpointed that the weather experienced during this season was dominated by drought, heatwaves, and less often flood. A significant number of respondents from Mgugwana (92.9%), Manaleni (97.4%), and from Ndayini (96.4%) confirmed that CC affect food security. The

participants were of the view that the negative impact of drought has affected their food production. Many rural farmers from Mgugwana, Manaleni, and Ndayini, as evidenced in Chapter five, expressed strong views that the drought situation in the area has resulted in the death of their livestock, damaged their crops, resulted in less food to harvest, exposed most households to hunger, and rendered some farmers with no interest in farming. These views must be seen as a serious concern to the government to incorporate the plight of the rural poor in national policy formulation.

The study further revealed that a significant number of respondents from the three study sites have changed their farming practices in order to respond to extreme weather conditions. Farmers in all the three study sites have introduced new crop varieties, changed to shorter cycle crop varieties, and stopped cultivating some crop varieties. However, it became known from the study that these adaptation strategies did not help the communities to address the shortage of food experienced during CC. It seems that there are several factors affecting their ability to precisely deal with the impact of CC. For example, most respondents had no irrigation facilities that they could use to draw water from the nearby river for their farms. Considering the farmer's low income as revealed in Chapter 5, it was argued that rural communities should be assisted to build structures and infrastructure such as dams that will contribute to long term solutions to manage extreme weather events.

It also emerged from the study that farmers have utilised different coping strategies to help them minimise the adverse impact of CC in the area. In particular, households consumed food that was not their preferred option and which did not cost a lot of money to buy, some borrowed food or depended on friends or relatives for help, some also went as far as purchased food on credit whiles others consumed the seeds meant for future season planting. Some farmers also sold their assets such as cattle, sheep, and goat to obtain income to buy food for the household. A significant number of participants also reduced the size of food at mealtimes and the number of intake of meals in a day. Government social grants were seen as an option for most households (see Table 5.12) to cope with the effect of CC. Unfortunately, respondents believed that the coping and

adaptation strategies practiced have not yielded ample results to ensure food security as most households are still living in severe poverty.

Findings from the study suggest that households' natural and agricultural assets suffered devastating consequences due to CC. Respondents argued that CC especially drought rendered their soil unproductive thereby contributing to low crop yield. Their livestock production was also severely affected. Hunger became significant in many households. Furthermore, it became evident that the only river that the community depend on as a source of drinking water and sometimes obtain fish from as a source of food became dried up. In addition, the households surveyed voiced their anger that heavy rainfall in 2014 destroyed their houses and the roof causing a severe burden on their livelihood. These events, unfortunately, are a clear indication that CC affects the natural assets of the households.

The focus group discussion showed that households' physical assets were also impacted by CC. Most survey responses shared a common view that heavy rainfall in the past year destroyed their road and bridge. The participants in the study declared that their untarred road is the only means that facilitate their movements from the place of abode to the city centres. The road and the bridge also help them to go to their farms. The respondents also pointed out that most of their animals used for ploughing their land for farming had died due to drought resulting in dryness of the grass and river to feed on.

The participants in the focus group discussion unanimously claimed that CC affect human assets. Unemployment, school dropout, hunger, poor health, and high crime rate were key risk factors attributed to human assets. These are serious findings that require an urgent solution. Although the government has incorporated policies in an effort to reduce unemployment from different angles, this study has also confirmed that CC change influence negatively on the employment rate in the country. The participants claimed that because of drought, they could not cultivate the land and some farmers have stopped farming. The youth are not interested in farming because of the impact of drought

on the farms. It can be argued that school dropout contributes to unemployment which subsequently influences the high crime rate in the area.

In an effort to build solid social assets and networks, most community members have formed community associations where they help each other in the event of CC effects. Women, in particular, have formed groups where they contribute a small amount of money on a monthly basis. These monies are kept and used in the last month of the year to buy groceries and other foodstuffs. The members in these associations share equally the food they have purchased from the contributions. This form of practice enables the community to lessen the food scarcity problem in the area, especially during the December holidays. Household neighbours also rely on each other for help during extreme weather events.

Another important factor that the community voiced their concern was their financial assets. The participants argued that they do not have money in a savings account, they have no monthly income except the social grant received from the government. Many participants suggested for example that, no financial institution is willing to offer loans or credit to them to purchase irrigation equipment for their farms. These constraints may have contributed to those farmers who have abandoned cultivating the land for food. Lack of financial support for rural farmers may also limit their productivity level to feed the entire families and even strive for surpluses in order to obtain extra income.

7.4 RECOMMENDATIONS

In light of the above research findings, it is argued that CC significantly impact on the livelihood of the rural people especially in their effort to obtain food security. It is against this background that the following recommendations are made.

i. The government through the department of public works, department of agriculture and fisheries should provide rural communities and rural farmers with regular engagement and education that will sensitise them on possible CC events in the future. This education should focus on the management of drought, heatwaves, flood, and soil erosion.

ii. The government should have a policy that will focus on building dams for rural farmers. The dam will serve as a reservoir of water for rural farmers to use in order to irrigate their crops. This can improve their crop yield and ensure food security.

iii. Renewed management of adaptation and coping strategies such as education on indigenous knowledge strategies (IKS) should be discussed and implemented with the communities. It is recommended that the ministry of agriculture and fisheries should take the lead in this initiative.

iv. Rural farmers should be encouraged to include contour ploughing in their farmers to curb soil erosion during extreme weather events such as heavy rainfall or flooding.

v. The government should set up a task team to offer immediate relief remedy to communities affected by climate change. It is recommended that the government should partner with community leaders and non-governmental organisations to ensure that this task team acts swiftly when the need arises. The task team should be equipped with the necessary resources such as fertilisers, irrigation equipment, food parcels, temporal shelters, and medical assistance to assist affected communities.

vi. There must be a deliberate effort by the PSJ local municipality to establish programmes or projects that will support rural gardening and rural agriculture especially for the rural poor.

vii. There must also be an effort from PSJ local municipality and the national government to support rural poor farmers to obtain finance to acquire equipment for irrigation purposes in their farms.

viii. The local authorities in consultation with the national government and donor agencies should formulate a long term policy on post CC crises management for rural poor communities.

7.5 CONTRIBUTIONS OF THE STUDY

This study has demonstrated an understanding of how rural households and farmers adapt and cope with CC. As emphasised in Chapter one, little research exists focusing on vulnerability and adaptation strategies used by rural

households to respond to CC in the Eastern Cape in South Africa. The main new contribution of this study is the primary data obtained from real-world which provides valuable insights into how the rural poor are vulnerable to CC and how they strive for achieving resilience during extreme CC events. Furthermore, by employing the asset-based adaptation framework in assessing the vulnerability and adaptation of rural households to CC, this study has contributed to expanding knowledge-based information, applicability, and reliability of the framework in a South African context. The findings and recommendations thus add to the existing body of knowledge on climate change, adaptation and coping strategies, and assets based framework. The recommendations provided will also benefit the society especially the rural poor in the sense that government can utilise the findings to improve their livelihood. The proposed framework (see Figure 6.4) can serve as a holistic building block on which government, society and other stakeholders (e.g. NGO's) can use to mitigate the potential impact of CC.

7.6 FUTURE RESEARCH FOCUS

It is acknowledged that studies on the impact of CC have been done in many parts of the world. However, evidence-based research on vulnerability and adaptation of rural households livelihoods to climate change using the asset- based framework in South Africa is still under-researched. This study has attempted to provide useful evidence to assist the government and other stakeholders to develop policies in order to assist rural poor communities to overcome CC effects. Whiles, there are recommendations offered in this study, other possible areas of research still have to be done which include:

i. This study focused on only three rural communities in the PSJ local municipality in the Eastern Cape of South Africa. There should be similar studies focusing on other rural communities in the Eastern Cape or South Africa at large.
ii. There is also little empirical evidence on the impact of CC in urban areas especially using the assets-based framework in South Africa. This calls for urgent research in this sector.

iii. To provide a dual purpose of comparison, a comparative study on urban and rural households farmers adaptation strategies to climate change can also be initiated.

iv. There is a lack of literature on the role of institutions i.e policies, rules, regulations, norms and values that condition human agency on climate change. Contextualisation of these fields could enhance the understanding of proactive ways to curb climate change.

v. Finally, as recommended by previous studies, knowledge on the relationship between CC, food security, nutrition, and environmental impacts are still limited and calls for urgent research.

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APPENDIX A

ETHICAL CLEARANCE CERTIFICATE

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Amoah

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H17/10/01**
PROJECT TITLE	Vulnerability and adaptation of rural households livelihoods to climate change in the Eastern Cape, South Africa: Perspectives on the asset based adaptation framework
INVESTIGATOR(S)	Mrs L Amoah
SCHOOL/DEPARTMENT	Geography, Archaeology and Environmental Science/
DATE CONSIDERED	20 October 2017
DECISION OF THE COMMITTEE	Approved
EXPIRY DATE	17 December 2020

DATE 18 December 2017 **CHAIRPERSON** J. Knight
(Professor J Knight)

cc: Supervisor : Professor D Simatele

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

Signature

22 / 12 / 2017
Date

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

APPENDIX B

PARTICIPANTS INFORMATION SHEET

THIS IS MEANT FOR HOUSEHOLD HEADS

INVESTIGATOR: Laura Novienyo Abla AMOAH (PhD Student)

TITLE OF RESEARCH: Vulnerability and Adaptation of rural households' livelihoods to climate change in the Eastern Cape, South Africa: Perspectives on the asset based adaptation Framework.

INSTITITION: University of the Witwatersrand; School of Geography, Archaeology and Environmental Studies.

STUDY INVESTIGATOR'S No: +27 12 306 7415

INTRODUCTION

Good day Sir/Madam,

My name is Laura Novienyo Abla AMOAH, a PhD student in the School of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg, South Africa. I am conducting a study to investigate Vulnerability and Adaptation of rural households' livelihoods to climate change in the Eastern Cape, South Africa: Perspectives on the asset based adaptation Framework.I would like to invite you to participate in completing this questionnaire based on the above study strictly for academic purposes.

This questionnaire will require 30 minutes of your time. Before agreeing to participate, it is important that you read and understand the purpose of the study. Participation in this study is totally voluntary, there are no risks involved in participating and no payment or fee will be paid to the participants. You are under no obligation to take part in this study. You are free to skip any question and withdraw from the study at any stage and this will not be held against you. If you decide to take part in this study, you will be invited to sign a consent form confirming that you understand and accept to be part of the study. You will also be given a copy of the information sheet to keep. The data obtained will be kept confidential and will be stored in a password computer used by the researcher alone and only use strictly for academic purposes. Your name or any identifying characteristics will not be available to anyone, other than me and my supervisor, at any point. Participation in these study may help to contribute in improving on ways in uplifting sustainable growth and development in the Post Saint John's rural area.

The proposal have been considered and approved by the Faculty of Science, University of the Witwatersrand. The data collected from this research will be used for academic purposes

only. They will be compiled into a PhD thesis through two publications in scientific journals and the final thesis submitted to the Faculty of Science, University of the Witwatersrand. Any information that may identify you or any references made in this study will not be disclosed. The results would be accessed through the University website and Wits library archives open to all registered students and staff of the University.

ADDITIONAL CONTACT DETAILS

For any information regarding the research or the implication of your participation, please do not hesitate to contact the HREC (Non-medical) secretariat or my supervisor on:

HREC (NON-MED) SECRETARIAT

Ms Shaun Schoeman

Phone No: +27 0117171408

Shaun.Schoeman@wits.ac.za

SUPERVISOR'S CONTACT

Professor. Danny Simatele

Phone No: +20117176515 E-mail:

EmailDanny.Simatele@wits.ac.za

CONSENT FORM

THIS IS MEANT FOR HOUSEHOLD HEADS

I hereby confirm that I have been well informed by study investigator Mrs. Laura Novienyo Abla AMOAH about the nature, conduct, benefits and risks of the study. I have also received, read and understood the participant information sheet regarding the study. I am aware that the results of the study will be anonymously processed and may, at any stage without prejudice withdraw my consent and participation in the study. There will be no audio visual recordings. I have had sufficient opportunity to ask questions and therefore, I declare that I am/more than 18 years of age and prepared to voluntarily participate in the study.

PARTICIPANT' S

Signature ----------Date----------

STUDY INVESTIGATOR

LAURA NOVIENYO ABLA AMOAH

Signature ----------Date----------

PARTICIPANTS INFORMATION SHEET

THIS IS MEANT FOR THE COMMUNITY LEADER

INVESTIGATOR: Laura Novienyo Abla AMOAH (PhD Student)

TITLE OF RESEARCH: Vulnerability and Adaptation of rural households' livelihoods to climate change in the Eastern Cape, South Africa: Perspectives on the asset based adaptation Framework.

INSTITITION: University of the Witwatersrand; School of Geography, Archaeology and Environmental Studies.

STUDY INVESTIGATOR'S No: +27 12 306 7415

INTRODUCTION

Good day Sir/Madam,

My name is Laura Novienyo Abla AMOAH, a PhD student in the School of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg, South Africa. I am conducting a study to investigate Vulnerability and Adaptation of rural households' livelihoods to climate change in the Eastern Cape, South Africa: Perspectives on the asset based adaptation Framework. I would like to invite you to participate in completing this questionnaire based on the above study strictly for academic purposes.

This questionnaire will require 30 minutes of your time. Before agreeing to participate, it is important that you read and understand the purpose of the study. Participation in this study is totally voluntary, there are no risks involved in participating and no payment or fee will be paid to the participants. You are under no obligation to take part in this study. You are free to skip any question and withdraw from the study at any stage and this will not be held against you. If you decide to take part in this study, you will be invited to sign a consent form confirming that you understand and accept to be part of the study. You will also be given a copy of the information sheet to keep. The data obtained will be kept confidential and will be stored in a password computer used by the researcher alone and only use strictly for academic purposes. Your name or any identifying characteristics will not be available to anyone, other than me and my supervisor, at any point. Participation in these study may help to contribute in improving on ways in uplifting sustainable growth and development in the Port Saint John's rural area.

The proposal have been considered and approved by the Faculty of Science, University of the Witwatersrand. The data collected from this research will be used for academic purposes only. They will be compiled into a PhD thesis through two publications in scientific journals and the final thesis submitted to the Faculty of Science, University of the Witwatersrand. Any information that may identify you or any references made in this study will not be disclosed.

The results would be accessed through the University website and Wits library archives open to all registered students and staff of the University.

ADDITIONAL CONTACT DETAILS

For any information regarding the research or the implication of your participation, please do not hesitate to contact the HREC (Non-medical) secretariat or my supervisor on:

HREC (NON-MED) SECRETARIAT	**SUPERVISOR'S CONTACT**
Ms Shaun Schoeman	Professor. Danny Simatele
Phone No: +27 0117171408	Phone No: +27 0117176515
E-mail: Shaun.Schoeman@wits.ac.za	Email: Danny.Simatele@wits.ac.za

CONSENT FORM

THIS IS MEANT FOR COMMUNITY LEADER

I hereby confirm that I have been well informed by study investigator Mrs Laura Novienyo Abla AMOAH about the nature, conduct, benefits and risks of the study. I have also received, read and understood the participant information sheet regarding the study. I am aware that the results of the study will be anonymously processed and may, at any stage without prejudice withdraw my consent and participation in the study. There will be no audio visual recordings. I have had sufficient opportunity to ask questions and therefore, I declare that I am/more than 18 years of age and prepared to voluntarily participate in the study.

COMMUNITY LEADER

Signature ----------Date----------

STUDY INVESTIGATOR

LAURA NOVIENYO ABLA AMOAH

Signature ----------Date----------

PARTICIPANTS INFORMATION SHEET

THIS IS MEANT FOR HOUSEHOLDS (SEMI-STRUCTURED INTERVIEW)

INVESTIGATOR: Laura Novienyo Abla AMOAH (PhD Student)

TITLE OF RESEARCH: Vulnerability and Adaptation of rural households' livelihoods to climate change in the Eastern Cape, South Africa: Perspectives on the asset based adaptation Framework.

INSTITITION: University of the Witwatersrand; School of Geography, Archaeology and Environmental Studies.

STUDY INVESTIGATOR'S No: +27 12 306 7415

INTRODUCTION

Good day Sir/Madam,

My name is Laura Novienyo Abla AMOAH, a PhD student in the School of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg, South Africa. I am conducting a study to investigate Vulnerability and Adaptation of rural households' livelihoods to climate change in the Eastern Cape, South Africa: Perspectives on the asset based adaptation Framework.I would like to invite you to participate in completing this interview based on the above study strictly for academic purposes.

This interview exercise will require 25 minutes of your time. Before agreeing to participate, it is important that you read and understand the purpose of the study. Participation in this interview is totally voluntary, there are no risks involved in participating and no payment or fee will be paid to the participants. You are under no obligation to take part in this interview. You are free to skip any question and withdraw from the interview at any stage and this will not be held against you. If you decide to take part in this interview, you will be invited to sign a consent form confirming that you understand and accept to be part of the study. You will also be given a copy of the information sheet to keep. This interview will be conducted in your household/place or in a location of your choice. The text transcript of the interview may, with specific consent from you, be kept in a password computer accessed only by the researcher and destroyed five years after the completion of the study. The consent form is specifically designed for this purpose; also, if you do not agree, it will be destroyed five years after the publication of the thesis. You are also free to use English or the Local dialect in your responses, and the questions will be put to you in one of these languages of your choice.

Your name or any identifying characteristics will not be available to anyone, other than me and my supervisor, at any point. Participation in these interview may help to contribute in improving on ways in uplifting sustainable growth and development in the Port Saint John's rural area. The proposal have been considered and approved by the Faculty of Science, University of the Witwatersrand. The data collected from this research will be used for

academic purposes only. They will be compiled into a PhD thesis through two publications in scientific journals and the final thesis submitted to the Faculty of Science, University of the Witwatersrand. Any information that may identify you or any references made in this study will not be disclosed. The results would be accessed through the University website and Wits library archives open to all registered students and staff of the University.

ADDITIONAL CONTACT DETAILS

For any information regarding the research or the implication of your participation, please do not hesitate to contact the HREC (Non-medical) secretariat or my supervisor on:

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Phone No: +27 0117171408	Phone No: +27 0117176515
E-mail: Shaun.Schoeman@wits.ac.za	Email: Danny.Simatele@wits.ac.za

CONSENT FORM

THIS IS MEANT FOR HOUSEHOLDS (SEMI-STRUCTURED INTERVIEW)

I hereby confirm that I have been well informed by study investigator Mrs Laura Novienyo Abla AMOAH about the nature, conduct, benefits and risks of the interview. I have also received, read and understood the participant information sheet regarding the interview. I am aware that the results of the study will be anonymously processed and may, at any stage without prejudice withdraw my consent and participation in the study. There will be an audio visual recordings. I have had sufficient opportunity to ask questions and therefore, I declare that I am/more than 18 years of age and prepared to voluntarily participate in the interview.

INTERVIEWEE

Signature ----------Date----------

STUDY INVESTIGATOR

LAURA NOVIENYO ABLA AMOAH

Signature ----------Date----------

PARTICIPANTS INFORMATION SHEET

THIS IS MEANT FOR FOCUS GROUP DISCUSSIONS

INVESTIGATOR: Laura Novienyo Abla AMOAH (PhD Student)

TITLE OF RESEARCH: Vulnerability and Adaptation of rural households' livelihoods to climate change in the Eastern Cape, South Africa: Perspectives on the asset based adaptation Framework.

INSTITITION: University of the Witwatersrand; School of Geography, Archaeology and Environmental Studies.

STUDY INVESTIGATOR'S No: +27 12 306 7415

INTRODUCTION

Good day Sir/Madam,

My name is Laura Novienyo Abla AMOAH, a PhD student in the School of Geography, Archaeology and Environmental Studies at the University of the Witwatersrand, Johannesburg, South Africa. I am conducting a study to investigate Vulnerability and Adaptation of rural households' livelihoods to climate change in the Eastern Cape, South Africa: Perspectives on the asset based adaptation Framework.I would like to invite you to participate in the focus group discussions based on the above study strictly for academic purposes.

This discussion will require 30 minutes of your time. Before agreeing to participate, it is important that you read and understand the purpose of the discussion. Participation in this discussion is totally voluntary, there are no risks involved in participating and no payment or fee will be paid to the participants. You are under no obligation to take part in this discussions. You are free to skip any question and withdraw from the discussions at any stage and this will not be held against you. If you decide to take part in this discussion, you will be invited to sign a consent form confirming that you understand and accept to be part of the discussions. You will also be given a copy of the information sheet to keep. The data obtained will be kept confidential and will be stored in a password computer used by the researcher alone and only use strictly for academic purposes. Your name or any identifying characteristics will not be used for reporting at any point. Participation in these discussions may help to contribute in improving on ways in uplifting sustainable growth and development in the Port Saint John's rural area.

The proposal have been considered and approved by the Faculty of Science, University of the Witwatersrand. The data collected from this research will be used for academic purposes only. They will be compiled into a PhD thesis through two publications in scientific journals and the final thesis submitted to the Faculty of Science, University of the Witwatersrand. Any information that may identify you or any references made in this study will not be disclosed.

The results would be accessed through the University website and Wits library archives open to all registered students and staff of the University.

ADDITIONAL CONTACT DETAILS

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E-mail: Shaun.Schoeman@wits.ac.za	Email: Danny.Simatele@wits.ac.za

CONSENT FORM

THIS IS MEANT FOR FOCUS GROUP DISCUSSIONS

I hereby confirm that I have been well informed by study investigator Mrs. Laura Novienyo Abla AMOAH about the nature, conduct, benefits and risks of the focus group discussions. I have also received, read and understood the participant information sheet regarding the discussions. I am aware that the results of the study will be anonymously processed and may, at any stage without prejudice withdraw my consent and participation in the discussions. There will be no audio visual recordings. I have had sufficient opportunity to ask questions and therefore, I declare that I am/more than 18 years of age and prepared to voluntarily participate in the discussions.

PARTICIPANT' S

Signature ----------Date----------

STUDY INVESTIGATOR

LAURA NOVIENYO ABLA AMOAH

Signature ----------Date----------

APPENDIX C

QUESTIONNAIRE

1. DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

Personal Information:

1.1.	What is your gender?	Male	Female
		1	2

1.2	Age of members of the household	Between 0 – 15 years of age	Between 16 – 65 years of age	Above 65 years of age:
		1	2	3

1.3	Education level of the respondent	Primary School	Secondary School	College/University	No Education	Other (Please specify)
		1	2	3	4	5

1.4	How many are you in your family (i.e. number of people in the household)?	Male	Female	Total
		1	2	3

1.5	What is your occupation?	Farming	Non-farming
		1	2

.

2: SOCIO-ECONOMIC ISSUES, SOCIAL CAPITAL AND LIVELIHOODS

2.1. What are the main sources of income in your household?

Source of Income	Tick
Formal Employment	1
Own business	2
Other(specify)	3

2.2. Does your household receive any

Yes=1	No=2

remittances?

2.2.1. If yes, tick in the following box.

Amount (Month)	Tick
<R500	1
R501-R1000	2
R1001-R1500	3
>R1500	4

2.3. Respondent's agricultural activities details

2.3.1. Have you cultivated the land last

Yes=1	No=2

year?

2.3. 2.What is/are the major agricultural production you do depending on?

Agricultural production	Tick	Example of crops /livestock
A. Crop Farming	1	
B. Livestock keeping	2	
C. Agro-pastoralists	3	
D. Others specify	4	

2.3.3.	Do you produce your crops just for food crops, cash, or both?	Food	Cash	Both
		1	2	3

2.4. How is your experience on climate change since you were young/since you started farming for the last 10-15 years?

n	Experience	Tick		How
		Yes=1	No=2	
1	More heavy rains			
2	Getting rain later than normal			
3	Planting date change applying to most crops			
4	Temperature of the area increasing			
5	Temperature of the area decreasing			
6	Decrease in recurrence of floods			
7	Increase in recurrence of droughts			
8	Increase in number of pests or rodents compared to previous years			
9	Other (specify) …… ……			

2.5. How have you experienced the changes in climate impact(s) in your farm/ location?

Impact	Tick	How?
A. Floods	1	
B. Drought	2	
C. Others (specify)…….	3	

2.6. Are there any other factors that influence food security (i.e. landscape changes) in addition to impacts of climate change?

Yes	No
1	2

2.7. If yes, list ……..

3. INFORMATION ON EXISTING ADAPTATION STRATEGIES TO CLIMATE CHANGE AND MOTIVATING FACTOR

3.1	Have you changed any of your farming practices in order to adjust to the changes in climate?	Yes	No
		1	2

3.2. What are the changes that you have made in response to changing climate with associated motivating factors?

S/n	Adaptation Strategies	Yes=1	No=2	Possible motivating Factors					
				Drought 1	Rainfall variability 2	Less rainfall 3	Pest Invasion due to Climate change 4	Heavy rain or Flooding 5	Increased temperature 6
1	Introduce new crop varieties								
2	Shift to higher yielding crop varieties								
3	Shift to shorter cycle crop varieties								
4	Shift to drought resistant crop varieties								
5	Stop cultivating some crop varieties								
6	Intensify irrigation								
7	Others								

3.3. Does climate change influence food insecurity in your household?

Yes=1	No=2

3.4. Which of the coping strategies did you use in your household to adopt?

S/n	Strategy	Specify		
		Yes=1	**No=2**	**How**
1	**Dietary Change Coping Strategies**			
	Rely on less preferred and less expensive foods?			
2	**Increase Short -Term Household Food Availability**			
	Borrow food, or rely on help from a friend or relative			
	Purchase food on credit?			
	Gather wild food, hunt, or harvest immature crops?			
	Consume seed stock held for next season?			
	Sale of assets to gain income for buying food?			
3	**Decrease Numbers of People**			
	Send children to eat with neighbours?			
	Send household members to beg?			
4	**Rationing Strategies**			
	Limit portion size at mealtimes?			
	Restrict consumption by adults in order for small children to eat?			
	Reserve more food for certain members/groups in the household.			
	Ration the money you have and buy prepared food?			
	Reduce number of meals eaten in a day?			
	Skip entire days without eating?			
5	**Economic reasons**			
6	Shift to crops that command good market prices			
7	Diversify household income sources			
8	**In case of total failure of coping strategy**			
	Total dependence on external food aid?			
9	Government grants			
10	Other (Specify)			

3.5. Among the coping and adaptation strategies mentioned above, what are the three most used on your farm/household?

i) ……

ii) ……

iii) ……

3.6. How did you got to know about food security coping and adaptation options?

S/n	Source	Tick
1	The radio	1
2	TV	2
3	Newspapers	3
4	Family Members or Neighbours	4
5	Community Meetings	5
6	Agriculture Extension Officers	6
7	Researchers	7
8	Traditional and cultural knowledge	8
9	Other sources of knowledge (Specify)	9

4: EXPERIENCE WITH ADAPTATION STRATEGIES TO CLIMATE CHANGE INFLUENCED BY FOOD INSECURITY.

4.1. In your opinion(s), do you think applying the adaptation strategies to climate change and variability in your farm/household is helpful?

Yes=1	No=2

4.2. Has the adaptation strategies to climate change influenced the agricultural production at your farm/households?

Yes=1	No=2

4.3. Did the adaptation strategies to climate change help you to attain food security?

Yes=1	No=2

4.4. Capacity on adaptive strategies to climate change influenced by food insecurity.

4.4.1. Are the adaptation strategies to climate change cost effective? If yes or no, how?

Yes=1	No=2

……

4.4.2. How is your capacity in using the adaptation strategies to climate change?

……
……

4.4.3. Limitations on adaptive strategies to climate change /influenced by food insecurity.

4.4.3.1. In applying the adaptation strategies to climate change in your farm, what are the limitations that you're facing?

……
……

4.4.3.2. How do these limitations affect the application of adaptation strategies to climate change in your farm/households?

……
……

4.4.3.3. How do you overcome or manage the mentioned limitations in applying the adaptation strategies to climate change?

……
……

4.4.3.4. What do you think you can do in the future to be able to adapt to the changes if they persist?

……
……

THANK YOU FOR YOUR TIME

INTERVIEW GUIDE

THIS IS MEANT FOR THE FOCUS GROUPS

1. What are the main available water resources for the community households' livelihoods?

2. How does climate change affect food production on the local people's livelihood?

3. What are the main effects of climate change on the community livelihood?

4. What strategies do you adopt to help your household in terms of drought and/ or too much flooding on low productivity?

5. How are you affected by climate risk events and threats based on the assets stated below?

i) Agricultural production (clue: crop production and livestock production)

ii) Natural assets (clue: agricultural land, water sources and grazing land)

iii) Physical assets (clue:

iv) Human assets (clue: health, access to extension services and education)

v) Social assets (clue:

vi) Financial assets

THANK YOU FOR YOUR COOPERATION AND TIME

APPENDIX D: LIST OF COMMUNITIES IN PSJ MUNICIPALITY

PORT ST JOHNS
• MUNICIPALITY •
OUR HERITAGE OUR PEOPLE
Erf 257 · Main Street
Port St Johns · 5120

LIST OF VILLAGES FALLING UNDER PORT ST JOHNS MUNICIPALITY

Ward	Villages	Councillor	Contacts
1	1. Mpotshotsho	Nomsa Vava	078 383 8553
	2. Tsweleni		
	3. Rhebu		
	4. Mncwetsha		
	5. Farm		
	6. Lutatweni		
	7. Vithini		
	8. Masameni		
	9. Ntlangwini		
	10. Phahlakazi		

	11. Lugongqozo		
	12. Nocuze		
	13. Nyakeni		
	14. Nqutyana		
	15. Gogogo		
	16. Maqebevu		
	17. Mangweni		
	18. Nkonkoni		
	19. Lufifini		
	20. Khwethu		
2	1. Lugasweni	Lubabalo Ndamase	082 564 0090
	2. Mtalala Left		
	3. Masameni		
	4. Mvelelo		
	5. Magcakini		
	6. Sihlanjeni		
	7. Njela		

	8. Madakeni		
	9. Ngcanda		
	10. Mawotsheni		
	11. Noduva		
	12. Nkwilini		
3	1. Buzongoma	Zolile Maqina	082 564 5230
	2. Buto		
	3. Mahlathini		
	4. Mbenengeni		
	5. Bhungeni		
	6. Lundini		
	7. Mfadaleni		
	8. Mtondeza		
	9. Mancu		
	10. Ludalasi		
4	1. Mthalala-Right	Zamile Totwana	073 540 2644
	2. Hlamvana		

	3. Bolani			
	4. Tombo			
	5. Mgxabakazi			
	6. Nkonxeni			
	7. Getto			
	8. Rhela			
	9. Mafusini			
	10. Gade			
	11. Mngazana			
	12. Mabhulwini			
5	1. Cwebeni	Thembisa Msongelwa		060 440 3132
	2. Caguba			
	3. Vukandlule			
	4. Dumasi			
	5. Sicamberi			
	6. Maheng			

6.	1. Mpantu	Zwelivumile Mhlabeni	082 564 1721
	2. Town		
	3. 2nd Beach		
	4. Isilaka		
	5. Green's Farm		
	6. Mtumbane		
	7. Isinuka and Farms		
7	1. Mantusini	Fikile Jama	060 617 4289
	2. Dangwana		
	3. Ntsimbini		
	4. Ngqwaleni		
	5. Butulo		
	6. Mrhuleni		
	7. Mvume Springs		
8	1. Mgqwarhume	Bulelwa Mjakuja	076 562 1508
	2. Rhawutini		

3. Machibi																			
	4. Ziphondo																		
		5. Mevana																	
			6. Siphusiphu																
				7. Gangatha															
					8. Tyeni														
						9. Buje													
							10. Ngwemnyama												
								11. Mhlotsheni											
									12. Ntlanjane										
										13. Siqhozameni									
											14. Lutatweni								
												15. Ntsimbini							
													16. Tshakude						
														17. Mgceni					
															18. Matshadala				
																19. Madamini			
																	20. Ngcose		

9	1. Swazini	Knowledge Mkhuseli Fono	082 564 0101
	2. Magombeni		
	3. Qhaka		
	4. Sigovu		
	5. Bizana		
	6. Mkhanzini		
10	1. Gabelana	Mthuthuzeli Veni	079 874 3172
	2. Luphoko		
	3. Bolani		
	4. Sizilo		
	5. Khaleni		
	6. Dedeni (Mthweni)		
	7. Noqhekwana		
	8. Mswakazi		
	9. Magoba (Sikhulu)		

11	1. Mthambala	Masixole Hobo	060 691 2430
	2. Gemvale		
	3. Dakane (Nonjonjo)		
	4. Buchele		
	5. Mathane		
	6. Ntshamathe		
	7. Xhaka		
12	1. Gqubeni	Zalisile Mtiki	082 799 0135
	2. Mpophomeni		
	3. Lusibeni		
	4. Mgugwana		
	5. Ndayini		
	6. Sandlulube		
	7. Ntafufu		
	8. Nomvalo		

13	1. Ndwalane	Maqashiso Zweni	082 564 0212
	2. Kwa-Zulu		
	3. Nyazi		
	4. Kwa-Msikwa		
	5. Kwa-Zweni		
	6. Mpoza		
	7. Manaleni		
	8. Dukulweni		
	9. Nkweza		
	10. Mbokazi		
14	1. Mzintlava A	Simthembile Scotho	060 6856 165/073 2704 386
	2. Mzintlava B		
	3. Sobaba		
	4. Maphindela		
15	1. Mdlankala	Gcinumzi Tshotho	079 896 1111

	2. Luqhoqhweni		
	3. Goqwana		
	4. Komani		
	5. Gcobani		
	6. Sandlulube		
16	1. Mvume Springs	Sivuyile Mavimbela	078 680 3395
	2. Mbabalane		
	3. Selwane		
	4. Qukuswayo		
	5. Ngxongweni		
	6. Maplotini		
	7. Qhoboshendlini		
	8. Ngcose		
	9. Lupapasi		
17	1. Bukuqweni	Dalton Zwelonakele	072 674 5663/063 6655 618
	2. Mkhuzaza		

	3. Mkhumbeni		
	4. Mnqezu		
	5. Ndayini		
	6. Sijungqwini		
	7. Phephu		
	8. Bhakeleni		
18	1. Lutshaya	Xolile Moni	082 459 6008
	2. Mboziseni		
	3. Mlaza		
	4. Ndlelengana		
	5. Bele		
	6. Gqwesa		
	7. Mbambeni		
	8. Ngcoya		
	9. Ngqikiza		
	10. Tyeni		
	11. Gujwini (Tshantshala)		

19	1. Mamvenyana	Xolile Vimba	082 840 7656
	2. Jamberi A		
	3. Jamberi B		
	4. Sihlitho		
	5. Ntlenga		
	6. Meyiwa		
	7. Mazizini		
20	1. Jamberi C	Nomfuneko Soga	081 009 4983
	2. Mthimde		
	3. Dumezweni		
	4. Luzuphu		
	5. Sunrise		
	6. Jabavu		
	7. Sitshayelo		